ANALYSIS OF ECONOMIES OF SCALE AND PRODUCTION FACTORS EFFICIENCY OF CITRUS FARMING IN KERTA VILLAGE GIANYAR REGENCY

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Abstract

Agriculture has an important role as one of the economic sector that supports economic development in developing countries, including Indonesia. However, the agricultural system in Indonesia has not yet reached its optimal point. Due to this phenomenon, this study aims to analyze the simultaneous and partial influence of production factors input on citrus production, and to analyze the economies of scale and economic efficiency of production factors in citrus farming. This study used primary data that obtained from interviews with citrus farmers in Kerta Village Gianyar Regency. The sample was determined using nonprobability sampling with purposive sampling. The sample size was determined with Slovin formula, yielding a sample of 91 citrus farmers. The data analysis technique used was multiple linear regression based on the Cobb-Douglas production function. The results of this study indicate that land area, capital, and labor simultaneously had a significant influence on citrus production. Partially, the land area, capital, and labor had a positive and significant influence on citrus production. The economies of scale in citrus farming were in an increasing return to scale condition. The economic efficiency of the production factors utilization such as land area, capital, and labor in citrus farming was not yet efficient.

Keywords: *Economies of Scale, Efficiency, Land Area, Capital, Labor*

INTRODUCTION

Economic development is a process of increasing the real per capita income of a country's population in the long term. Economic development aims to enhance economic growth. Economic growth can also be defined as the process of increasing a country's production capacity, which is reflected in the rise of national income. Agriculture has an important role in developing countries as one of the economic sectors that serves as a source of income for workers (Nguyen et al., 2015). The agricultural sector provides employment opportunities for people in need of work (Ginting & Andari, 2021). Indonesia is an agrarian country, as its economic development is heavily influenced by the agricultural sector. The agricultural sector itself is one of the dominant sectors that serves as the main source of income for the population and plays an important role in Indonesia, as the majority of its population works in agriculture (Yusuf & Sumner, 2015). This means that Indonesia relies on the agricultural sector as a pillar of development and as a source of livelihood for its people.

The agricultural sector has a very important role in meeting human needs, both in terms of food supply and its contribution to the economy (Chau & Ahamed, 2022). The agricultural sector has a significant contribution to Gross Regional Domestic Product and is the main livelihood for most of Indonesia's population (Anggreani et al., 2023). Indonesia has a land area of about 1,9 million km^2, most of which is highly suitable for agriculture. Its diverse geographical and climatic conditions offer great potential for agriculture and food production. The agricultural sector not only serves as a livelihood for the people but also holds great potential to boost Indonesia's economy. Agricultural productivity is closely related to the level of national and regional economic development and thus requires special attention (Zhang et al., 2021). Nevertheless, agriculture in Indonesia has not yet reached its optimal point and needs improvement and revitalization to increase productivity and competitiveness in this sector.

Indonesia's agriculture is tropical in nature, as most of its regions are located in the tropics and are directly influenced by the equator. Indonesia has a humid tropical climate and fertile soil, resulting in a wide variety of fruit types. There are approximately 329 types of fruits, both native to Indonesia and introduced from other countries (Nurnatasya & Titisari, 2023). Several reasons underpin the importance of agriculture in Indonesia, including its diverse resource potential, significant contribution to national income, and the large number of people who depend on this sector, making it a foundation for economic growth. The agricultural sector, which encompasses socio-economic components, is expected to drive economic development in rural areas.

The agricultural sector consists of several sub-sectors, including food crops, plantations, livestock, fisheries, and forestry. One approach to managing this sector is through agricultural business or agribusiness (Soekartawi, 1993:30). The horticulture sub-sector consists of commodities such as fruits, vegetables, ornamental plants, and medicinal plants. The sub-sector that focuses on meeting public needs includes food crops within the horticulture category. Horticultural land can be used to cultivate vegetables such as chili, tomatoes, cucumbers, green beans, corn, while horticultural fruits include oranges, mangoes, coconuts, salak, and others (Langit & Ayuningsasi, 2019). One of the leading commodities that has long been cultivated in Indonesia is citrus. Citrus commodities grow and develop in various regions, each with specific characteristics. Citrus is one of the most important horticultural crops for citrus-producing countries, as it is one of the most widely traded commodities globally.

Table 1
Citrus Production in Bali Province by Regency/City (Tons) 2019-2024

Kabupaten/Kota	Produksi Buah Jeruk (Ton)					
	2019	**2020**	**2021**	**2022**	**2023**	**2024**
Kab. Jembrana	91	138	97	116	154	242
Kab. Tabanan	207	123	1.340	429	2.700	6.638
Kab. Badung	2.660	3.217	3.307	2.659	1.861	1.362
Kab. Gianyar	**174.509**	**351.295**	**126.101**	**39.654**	**45.237**	**25.974**
Kab. Klungkung	77	42	313	91	3	19
Kab. Bangli	168.476	131.587	104.528	87.011	73.063	83.799
Kab. Karangasem	368	420	386	418	433	442
Kab. Buleleng	3.382	3.560	5.521	4.657	7.686	4.867
Kota Denpasar	5	11	23	36	28	43
Provinsi Bali	**349.775**	**490.393**	**241.617**	**135.071**	**131.165**	**123.386**

Source: Central Bureau of Statistics Bali Province, 2025

Table 1 shows that over a six year period of citrus production fluctuations, two districts had the highest citrus production compared to other. Gianyar was one of the largest contributors to citrus production, competing with Bangli, while Denpasar had the lowest production. Gianyar Regency has an area of 36,800 ha and has 1,254 ha of citrus farmland. Gianyar Regency is one of the potential citrus growing areas in Bali. This is due to environmental conditions (climate and temperature). The types of citruses grown and cultivated in Gianyar are Siam Kintamani, Selayar, Madu, Valencia, and Keprok Brastagi (Supartha et al., 2015:4).

Despite Gianyar's citrus production showing an advantage in terms of quantity, Gianyar's citrus commodities are still less known in the market compared to Bangli's citrus commodities, better known as Kintamani citrus. Kintamani citrus has a strong local identity and has been widely known for a long time (Yosafat et al., 2019). This shows that the economies of scale and efficiency of citrus farming in Gianyar have not yet reached optimal conditions. The economies of scale are not yet optimal due to relatively high production costs per unit that are not balanced with production yields, as well as the inefficient use of production factors in farming (Dewi & Saskara, 2023). Because of this, farmers are struggle to achieve competitive selling prices and reach wider markets. Consequently, the high potential production volume has not been able to provide maximum economic benefits for citrus farmers in Gianyar.

Gianyar Regency has fluctuations and a decreasing trend in production in recent years. This decrease was caused by fluctuations in citrus prices due to production exceeding market demand, commonly referred as oversupply. Milonda et al. (2023) stated that several factors can trigger a decrease in production, one of which is price fluctuations. The significant price drop during the harvest season occurs due to supply exceeding market demand (oversupply). This situation reduces financial incentives for farmers, ultimately affecting overall production levels in the next planting season period (Marwanti et al., 2023).

Table 2
Citrus Production in Gianyar Regency by District (Tons) 2021-2024

Kecamatan	Produksi Buah Jeruk (Ton)			
	2021	2022	2023	2024
Sukawati	140	140	115	45
Blahbatuh	21	4	32	43
Gianyar	5	27	21	30
Tampaksiring	1.245	204	1.432	3.261
Ubud	2	1	1	1
Tegallalang	7.328	989	4.596	719
Payangan	**117.360**	**38.289**	**39.040**	**21.875**
Kabupaten Gianyar	**126.101**	**39.654**	**45.237**	**25.974**

Source: Central Bureau of Statistics Gianyar Regency, 2025

According to Table 2, shows that the highest number of citrus production is in Payangan, Tegallalang, and Tampaksiring. It is known that Payangan District is the largest producer of citrus in Gianyar Regency, but the amount of citrus production in Payangan District has fluctuated and tended to decreased in recent years. Production fluctuations can occur due to changes in the utilization of production factors. Align with the study by Ragita & Saskara (2022), which states that agricultural commodities are produced from a combination of several production factors, such as land, labor, and capital in farm business. Budiasa et al. (2024) state that the combination of production factors input greatly determines the amount of production output, so that the optimal allocation of production factors can provide benefits. Farmers tend not to use resources at the optimal level due to the lack of information they have (Mehta et al., 2024).

Kerta is one of the villages in Payangan that serves as a citrus production center. This is due to environmental conditions that are ideal for citrus cultivation and because most of the population work as citrus farmers, driving the local economy. Kerta Village has a total area of 1.442 hectares, with 573,52 hectares used for citrus farming. Citrus production in the village is influenced by several production factors, including land area, capital, and labor. The shrinking land area due to many trees entering non-productive age but not being rejuvenated immediately and limited access to capital has caused a decrease in citrus production in Kerta Village. However, the number of people working as citrus farmers in Kerta Village continues to increase each year. In 2019, there were 993 citrus farmers, and by 2025 this number had grown to 1.058. It indicates that the utilization of production factors is not yet optimal, resulting in a decrease in the total production of citrus in Kerta Village.

Based on the background described before, it can be concluded that this study was aims to analyze the economies of scale and efficiency in the use of production factors in citrus farming in Kerta Village Gianyar Regency. This research builds upon previous studies that analyzed economies of scale, efficiency, and the effect of production factors on output. The distinction of this study from previous research lies in the novelty of the data, the object, and the study location specifically citrus commodities in Kerta Village during the 2024 harvest season.

RESEARCH METHOD

This study employs a quantitative approach with an associative design to examine the effect of land area, capital, and labor on citrus production in Kerta Village, Payangan District, Gianyar Regency. The location was chosen based on the phenomenon of decrease in the total production of citrus in recent years, as well as the status of Kerta Village as the main citrus-producing center in the Payangan District. The data used include primary data obtained through observation and structured interviews with 91 citrus farmers, selected using purposive sampling based on specific criteria. The research variables consist of citrus production as the dependent variable (Y), and land area (X1), capital (X2), and labor (X3) as independent variables.

Data analysis was conducted using multiple linear regression in based on Cobb-Douglas production function, with a double-log approach to measure the elasticity of each production factor. Classical assumption tests such as normality, multicollinearity, and heteroscedasticity were carried out to ensure the validity of the regression model used. F-test was conducted to determine the simultaneous effect of all independent variables on citrus production, and a t-test to measure the partial effect of each variable. This model helps identify the economies of scale that are achieved through the sum of the regression coefficients. This study also measures the efficiency of production factor utilization through an economic efficiency approach. The calculations are comparing the value of the marginal physical product to the cost of each input, thereby determining whether the input allocation was optimal (Utama, 2016). Through this analysis, the research results are expected to provide practical contributions to enhancing the production and welfare of citrus farmers in Kerta Village in a sustainable manner.

RESULTS AND DISCUSSION

Descriptive Statistical Analysis

Table 3
Results of Descriptive Statistical Analysis

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Land Area (Are)	91	30	125	74,40	23,614
Capital (Rupiah)	91	8.500.000	37.400.000	19.934.862,64	6.970.640,099
Labor (Work Hour)	91	100	688	286,75	115,260
Production (Tons)	91	3,8	19,0	10,427	3,9703
Valid N (listwise)	91				

Source: Processed Primary Data, 2025

Table 3 shows that the number of observations in this study is 91 data entries. There is three independent variables in this study, such as land area (X1), capital (X2), and labor (X3), with one dependent variable, which is production (Y).

The production variable has a mean of 10,427, which indicates that the average citrus production in Kerta Village is 10,427 tons. The production variable has a minimum of 3,8 and a maximum of 19, indicating that citrus production in Kerta Village ranges from a minimum of 3,8 tons to a maximum of 19 tons.

The land area variable has a mean of 74,40, meaning that the average land area for citrus farming in Kerta Village is 74,40 are. The land area variable has a minimum of 30 and a maximum of 125, indicating that the smallest citrus farm in Kerta Village covers 30 are and the largest covers 125 are.

The capital variable has a mean of IDR 19.934.862,64, which means that the average capital for citrus farming in Kerta Village is IDR 19.934.862,64. The capital variable has a minimum of 8.500.000 and a maximum of 37.400.000, indicating that the lowest capital invested in citrus farming in Kerta Village is IDR 8.500.000 and the highest is IDR 37.400.000.

The labor variable has a mean of 286,75, which means that the average labor input in citrus farming in Kerta Village is 286,75 working hours. The labor variable has a minimum of 100 and a maximum of 688, indicating that labor input ranges from 100 to 688 working hours.

Classical Assumption Test

1. Normality Test

Table 4
Normality Test Results
One-Sample Kolmogorov-Smirnov Test

		Unstandardized Residual
N		91
Normal Parameters[a,b]	Mean	0,0000000
	Standard Deviation	0,06531569
Most Extreme Differences	Absolute	0,069
	Positive	0,042
	Negative	-0,069
Test Statistics		0,069
Asymp. Sig. (2-tailed)[c]		0,200[d]

Source: Processed Primary Data, 2025

Based on Table 4, the significance value is 0,200, which is greater than 0,1. Since the Kolmogorov-Smirnov significance value exceeds 0,1, it can be concluded that the residuals are normally distributed or have passed the normality test.

2. Multicollinearity Test

Table 5
Multicollinearity Test Results

Variables	Tolerance	VIF	Information
Land Area (LnX1)	0,212	4,716	Multicollinearity Free
Capital (LnX2)	0,103	9,696	Multicollinearity Free
Labor (X3)	0,119	8,393	Multicollinearity Free

Source: Processed Primary Data, 2025

According to Table 5, shows that each variable's tolerance value is greater than 0,1 and the VIF value is less than 10, indicating that the regression model is free from multicollinearity.

3. Heteroscedasticity Test

Table 6
Heteroscedasticity Test Results

Model		Coefficients[a] Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	0,783	0,456		1.717	0,089
	Land Area (LnX1)	0,033	0,026	0,288	1.264	0,210
	Capital (LnX2)	-0,055	0,037	-0,489	-1.496	0,138
	Labor (LnX3)	0,010	0,030	0,102	0,334	0,739

a. Dependent Variable: Production (ABS_RES)

Source: Processed Primary Data, 2025

According to Table 6, the significance values of the variables such as land area (0,210), capital (0,138), and labor (0,739). These values are greater than 0,1, indicating that the independent variables have no effect on the absolute residuals. Therefore, the model is free from heteroscedasticity symptoms.

Multiple Linear Regression Analysis

Table 7
Results of Multiple Linear Regression Analysis

Model		Coefficients[a] Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-9,423	0,767		-12,279	0,000
	Land Area (LnX1)	0,298	0,044	0,258	6,693	0,000
	Capital (LnX2)	0,527	0,062	0,467	8,457	0,000
	Labor (LnX3)	0,285	0,050	0,295	5,732	0,000

a. Dependent Variable: Production (LnY)

Source: Processed Primary Data, 2025

According to multiple linear regression analysis results on Table 7, the regression equation formulated as follows.

$$\mathrm{Ln}\widehat{\mathrm{Y}} = -9{,}423 + 0{,}298\ \mathrm{LnX1} + 0{,}527\ \mathrm{LnX2} + 0{,}285\ \mathrm{LnX3}$$

The results of the multiple linear regression equation show the magnitude and direction of the effect of each independent variable on the dependent variable. Positive regression coefficient indicates a positive (direct) effect.

β_0 = -9,423. Economically, negative results has no meaning. Statistically, the constant value of -9,423 can be interpreted that assuming land area (X1), capital (X2), and labor (X3) were constant, the production will decreased.

β_1 = 0,298. If land area (X1) increased by one percent, it will cause the production to increased by 0,298, percent assuming other variables are constant.

β_2 = 0,527. If capital (X2) increased by one percent, it will cause the production to increased by 0,527, percent assuming other variables are constant.

β_3 = 0,285. If labor (X3) increased by one percent, it will cause the production to increased by 0,285, percent assuming other variables are constant.

Coefficient of Determination Test (R^2)

Table 8

Results of the Coefficient of Determination Test (R^2)

Model Summary

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	0,986[a]	0,973	0,972	0,06643

a. Predictors: (Constant), Labor (LnX3), Land Area (LnX1), Capital (LnX2)
b. Dependent Variable: Production (LnY)

Source: Processed Primary Data, 2025

Table 8 shows that the adjusted R^2 (adjusted coefficient of determination) is 0,972. It means that the variation in citrus production is significantly affected by the variables of land area, capital, and labor by 97,2 percent, while the remaining 2,8 percent is explained by other factors not included in the research model.

Simultaneous Regression Coefficient Test (F-Test)

Table 9

Results of the Simultaneous Regression Coefficient Test (F-Test)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13,631	3	4,544	1.029,562	0.000[b]
	Residual	0,384	87	0,004		
	Total	14,015	90			

a. Dependent Variable: Production (LnY)
b. Predictors: (Constant), Labor (LnX3), Land Area (LnX1), Capital (LnX2)

Source: Processed Primary Data, 2025

Table 9 indicates that F_{value} = 1.029,562 > F_{table} (3;87) = 2,15 with a significance of 0,000 which is less than α = 0,1, meaning that the model used in this study is feasible. It implies that H_0 is rejected, the production factors input such as land area, capital, and labor variables simultaneously have a significant effect on the production of citrus farming in Kerta Village.

Partial Regression Coefficient Test (t-Test)

The effect of the independent variables land area, capital, and labor on citrus production is tested using the t-Test. The testing criteria are as follows. If $t_{count} \leq t_{table}$ or the significance value > α, then H_0 is rejected and H_1 is accepted. If $t_{value} > t_{table}$ or the significance value ≤ α, then H_0 is accepted and H_1 is rejected.

Table 10

Results of the Partial Regression Coefficient Test (t-Test)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-9,423	0,767		-12,279	0,000
	Land Area (LnX1)	0,298	0,044	0,258	6,693	0,000
	Capital (LnX2)	0,527	0,062	0,467	8,457	0,000
	Labor (LnX3)	0,285	0,050	0,295	5,732	0,000

a. Dependent Variable: Production (LnY)

Source: Processed Primary Data, 2025

The results of testing the partial effect of each independent variable on the dependent variable can be explained as follows.

1. **The Influence of Land Area (X1) on Citrus Production (Y)**

According to Table 10, at $\alpha = 0.1$ with df = (n-k) = (91-4) = 87, the critical value t_{table} = 1.662. The probability value is 0.000 < 0.1 and t_{value} = 6,693 > t_{table} = 1,662. H_0 is rejected and H_1 is accepted. It can be concluded that land area has a positive and significant effect on citrus production in Kerta Village. The regression coefficient for land area is 0,298, meaning that an increase in land area by one percent will increase citrus production by 0,298 percent, assuming capital and labor remain constant. It indicate that farm production is affected by land size, larger land has greater production.

2. **The Influence of Capital (X2) on Citrus Production (Y)**

According to Table 10, α = 0,1 and df = 87, t_{table} = 1,662. The probability value is 0,000 < 0,1 and t_{value} = 8,457 > t_{table} = 1,662. H_0 is rejected and H_1 is accepted. It can be concluded that capital has a positive and significant effect on citrus production in Kerta Village. The regression coefficient for capital is 0,527, which implies that an increase in capital by one percent will increase citrus production by 0,527 percent, assuming land area and labor are constant. It means when sufficient capital is available, production activities can be conducted more optimally, thereby increasing output.

3. **The Influence of Labor (X3) on Citrus Production (Y)**

According to Table 10, at α = 0,1 with df = 87, t_{table} = 1,662. The probability value is 0,000 < 0,1 and t_{value} = 5,732 > t_{table} = 1,662. H_0 is rejected and H_1 is accepted. This means that labor has a positive and significant effect on citrus production in Kerta Village. The regression coefficient for labor is 0,285, meaning that an increase of one percent will increase citrus production by 0,285 percent, assuming land area and capital are constant. This results imply that increasing the number of laborers can lead to higher production. Labor as agricultural input has an essential role in enhancing productivity.

Analysis of Economies of Scale

Economies of scale refer to what occurs when all inputs proportionally changed or how output increases when all inputs are doubled proportionally. In a regression with Cobb-Douglas production function, β_i represents the regression coefficient of each input variable. The economies of scale is determined by summing the regression coefficients of all input variables. The economies of scale of the citrus farming in Kerta Village Gianyar Regency can formulated as follows.

$$\Sigma\beta_i = \beta_1 + \beta_2 + \beta_3$$

$$\Sigma\beta_i = 0{,}298 + 0{,}527 + 0{,}285 = 1{,}11 > 1$$

Based on the sum of the regression coefficients of the production factors, know that value of citurs farming economis of scale is 1,11. It indicates that the citrus farming business in Kerta Village is operating on increasing returns to scale. It can be identified from the total regression coefficients of the production factors, which exceeds one. It means when all inputs are increased proportionally, the growth of citrus production will be greater than the rate of input usage growth. To achieve the expected production growth, citrus farmers should optimize input use and also gradually increase the scale of production to optimize cost efficiency.

Analysis of the Economic Efficiency of Production Factors Utilization

To calculate the efficiency value of land area (X1), capital (X2), and labor (X3) utilization in citrus farming in Kerta Village, the following formula is used.

$Ef_{x1} = 0{,}298 \frac{10{,}4 \times 5.000.000}{74{,}4 \times 75.000} = 2{,}78$ (Not Yet Efficient)

$Ef_{x2} = 0{,}527 \frac{10{,}4 \times 5.000.000}{19.934.900 \times 0{,}12} = 11{,}45$ (Not Yet Efficient)

$Ef_{x3} = 0{,}285 \frac{10{,}4 \times 5.000.000}{286{,}7 \times 12.000} = 4{,}31$ (Not Yet Efficient)

Based on the above economic efficiency tests, it show that the utilization of production factors such as land area, capital, and labor is not yet efficient. It can be seen from the efficiency values of all three production factors, each exceeding one. This suggests that the utilization of land area, capital, and labor is not economically efficient and therefore must be increased to optimize production. To achieve greater efficiency in production factor utilization, citrus farmers in Kerta Village should optimize the utilization of production factors input to achieve more effective agricultural practices. Farmers need to manage resources optimally and keep up with the changing market conditions. Therefore, strategic intervention is needed through education, training, and access to technological innovations so that farmers can adapt and improve the efficiency of their farming practices.

CONCLUSION

1) Land area, capital, and labor simultaneously have a significant effect on citrus production in Kerta Village Gianyar Regency.
2) Land area, capital, and labor partially have a positive and significant effect on citrus production in Kerta Village Gianyar Regency.
3) The economies of scale of the citurs farming in Kerta Village Gianyar Regency is in a increasing return to scale condition. It means that every additional input of production factors will result a greater increase output than the input change.
4) The economic efficiency of the utilization of production factors land area, capital, and labor in citrus farming in Kerta Village Gianyar Regency is in a not yet efficient condition. Effiency value of each production factor is greater than one, so that the use of production factors such as land area, capital, and labor needs to be increased.

SUGGESTIONS

Based on the research results, it is suggested that the government should pay more attention to the welfare of farmers through policies or strategies of efficient farm management in order to increase farmer production. Farmers are suggested to gradually increase the scale of production so that they can optimally utilise cost efficiency. In addition, farmers are advised to prepare plans for each planting season that consider the integration of the three production factors and optimize the utilization of production factors inputs. Furthermore, it is necessary to maintain financial records and harvest records in order to evaluate the efficiency of production factors utilization.

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