Caspian Journal of Environmental Sciences
Online ISSN: 1735-3866
Print ISSN: 1735-3033

Analyzing the determinant of the Profit of citronella oil in Blangjerango District, Gayo Lues Regency, Indonesia

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ABSTRACT
Developing citronella oil processing in rural areas is a strategic step in spurring regional economic growth and increasing farmers' income and employment opportunities. Fluctuations in input and output prices reduce the income of citronella oil farmers. This study analyzes the factors that influence the profit level of the citronella oil business in Blangjerango district of Gayo Lues Regency, Indonesia. The population in this study was 742 citronella farmers in this regency. Samples were taken using simple random sampling from 60 respondents. Data were analyzed using a multiple linear regression model with the Ordinary Least Square (OLS) method. The results showed that partially and simultaneously, the amount of production, labor costs, the price of citronella leaves, and the output price of citronella oil significantly affect citronella oil profit at the 95% confidence level.

Keywords: Citronella oil, Profit, Multiple regression analysis.
Article type: Research Article.

INTRODUCTION
The people of Gayo Lues Regency are trying to boost their economy in the agricultural sector, that is, farming citronella oil. This essential oil raw material has become a favorite in this area. The topographic conditions of the Gayo Lues Regency area are very suitable for citronella plants, which can also function to prevent soil erosion due to rainwater. Citronella is one of the leading commodities of the Gayo Lues community. The Gayo Lues Regency Government has been promoting citronella cultivation in recent years to improve the welfare of local farmers. Eleven districts in this regency generally have citronella cultivation businesses, including Blangjerango District (Statistics Indonesia 2020). One of the plants that produces essential oil is lemongrass (Camas-Reyes *et al*. 2022; Kamaruddin *et al*. 2022; Sarah *et al*. 2023). Lemongrass plants are classified into *Cymbopogon citratus* (the West Indian lemongrass, or simply, lemongrass) *C. nardus* (the citronella grass; Barrahi *et al.* 2020; Pooja *et al*. 2023; Yadav *et al*. 2023). This study worked on citronella. The parts harvested from citronella are the leaves and stems. Distilled citronella leaves produce fragrant essential oil, known as citronella oil, while the stems are harvested to make new seeds. Citronella oil has various benefits as a raw material for products in various industries, including being used as a bio additive for fuel oil. Citronella oil is also beneficial for health and beauty and is a raw material for making fragrance products such as perfume, soap, and lotion. Citronella waste can even also be utilized; the liquid waste can be used as raw material for carbolic acid and anti-mosquito spray, while the solid waste as animal feed. Citronella oil can also be a botanical pesticide to control plant pests and diseases (Nabila & Nurmalina 2019). Citronella is a herbal plant widely cultivated in Indonesia, especially in the Blangjerango District in Gayo Lues Regency. This plant has many benefits, especially the oil content in citronella. Essential oils are volatile compounds generally in liquid form obtained from plant parts, roots, bark, stems, leaves, fruit, seeds, or flowers by distillation. The results of distilling the leaves and stems of citronella produce essential

oil, which, in the world of trade, is known as citronella oil. The main compounds that make up citronella oil are citronellal, citronellol, and geraniol (Mulyati *et al*. 2017). Developing citronella plants and managing essential oils has very high positive values, contributing to agricultural development and improving the community's economy. Developing citronella oil processing in rural areas is a strategy to spur regional economic growth and increase employment opportunities, added values, competitiveness, and farmers' income (Sebayar 2011). Farmer income is a measure of the income received by farmers from their farming business. Farming income can be determined by calculating the difference between receipts and expenses. Farmers' income is an important indicator since it is the main source of meeting their daily needs (Nurlina *et al.* 2019). Price fluctuations cause a decrease in income for citronella oil farmers. Researchers are interested in these income differences. The difference in the yield of lemongrass oil obtained creates a difference in the income that will also be received. The problem of this study is to analyze the factors that influence the income of citronella farming in Blangjerango District in Gayo Lues Regency.

MATERIAL AND METHODS

Population and sample

The population in this study were the 161 citronella farmers in the Sekuelen Village of Blangjerango District of Gayo Lues Regency. The samples were taken using the Slovin formula with a sampling error rate of 10%, with 62 citronella oil processing farmers as the respondents.

Data analysis

The following *Double-Log* multiple linear regression equation was used to see the effect of total production, labor cost, citronella leaf price, and citronella oil output price on the citronella income:

$$Log\ (Y) = c + a_1\ Log\ (X_1) + a_2\ Log\ (X_2) + a_3\ Log\ (X_3) + a_4\ Log\ (X_4) + et$$

Whereas:

Y : citronella oil income (in IDR)
X_1 : Total Production (in kilogram)
X_2 : labor cost (in IDR/man-day)
X_3 : citronella leaf price (in IDR/kilogram)
X_4 : citronella oil output price (in IDR/kilogram)

The data were processed using the Eviews12 app.

Coefficient of determination

The coefficient of determination (R^2) aims to see whether the independent variable provides sufficient meaning in explaining the dependent variable. In other words, the amount of variation occurs in the independent variable can explain the dependent variable (Gujaraii 2013).

Simultaneous test (F-statistic Test)

The F-test looks at the significance of all independent variables in influencing the dependent variable. The overall sample regression test (overall test) aims to determine whether the regression coefficient is simultaneously significant.

Partial test (T-statistic test)

The T-test aims to determine whether the regression coefficient is partially significant.

Classical assumption deviation test

Normality test

This test detects whether the residual is normally distributed by comparing the Jarque Bera (JB) value with the X_2 table, i.e., if the Jarque Bera (JB) probability is > 0.05, the residual is normally distributed; if the Jarque Bera (JB) probability is < 0.05, the residual is not normally distributed.

Serial correlation test

The autocorrelation test uses the serial Correlation LM Test, where the obs*R-squared probability value in the model is greater than the real level (α = 5%). On the other hand, if the obs*R-squared probability value in the model is smaller than the real level (α = 5%) used, it can be concluded that the equation model has an autocorrelation symptom.

Heteroscedasticity test

The heteroscedasticity test examines whether there is an inequality of residual variance in a regression model from one observation to another. Detecting heteroscedasticity symptoms is by comparing the obs*R-Squared probability value with the specified significance level (α = 5%).

Multicollinearity test

The multicollinearity test aims to examine whether the regression model has a strong correlation between the independent variables. This test is to see double collinearity (multicollinearity), which can be seen from a tolerance value of less than 10.

Linearity test

This test is used to see whether the model built has a linear relationship. The model formed in linear regression should be based on theoretical studies that the relationship between the independent variable and the dependent variable is linear. The linearity test is used to confirm whether the linear properties between two variables identified theoretically correspond with existing observation results. This linearity test uses the Ramsey Test (Widarjono 2013).

RESULTS AND DISCUSSION

Total production development

The development of total production in citronella oil farming can be described in Fig. 1.

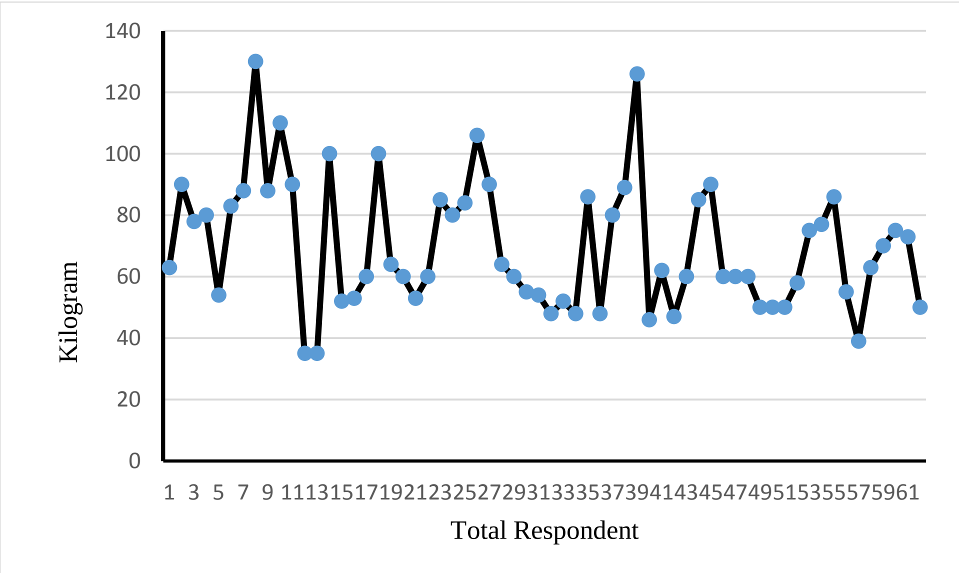

Fig. 1. Total production development.

The total citronella oil production development from several respondents tends to fluctuate. However, respondents produce 70-kilogram citronella oil per processing on average each week.

Labor cost development

The development of labor costs in citronella oil farming can be described in Fig. 2.

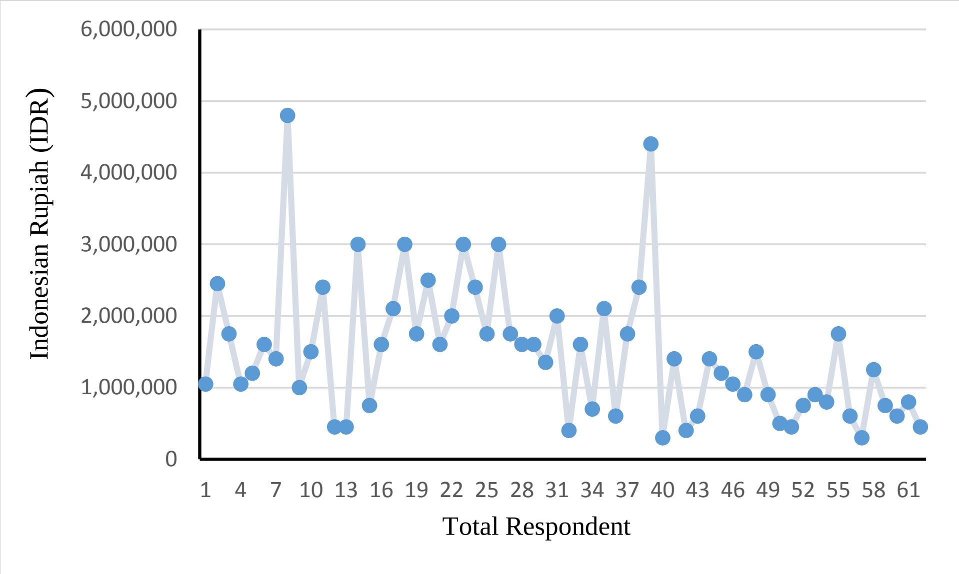

Fig. 2. Labor cost development.

The labor cost development of producing citronella oil from several respondents tends to fluctuate. However, the average labor cost is IDR 1,473,385 per citronella oil processing.

Citronella oil leaf price development

The development of the price of citronella leaves in citronella oil farming can be described in Fig. 3.

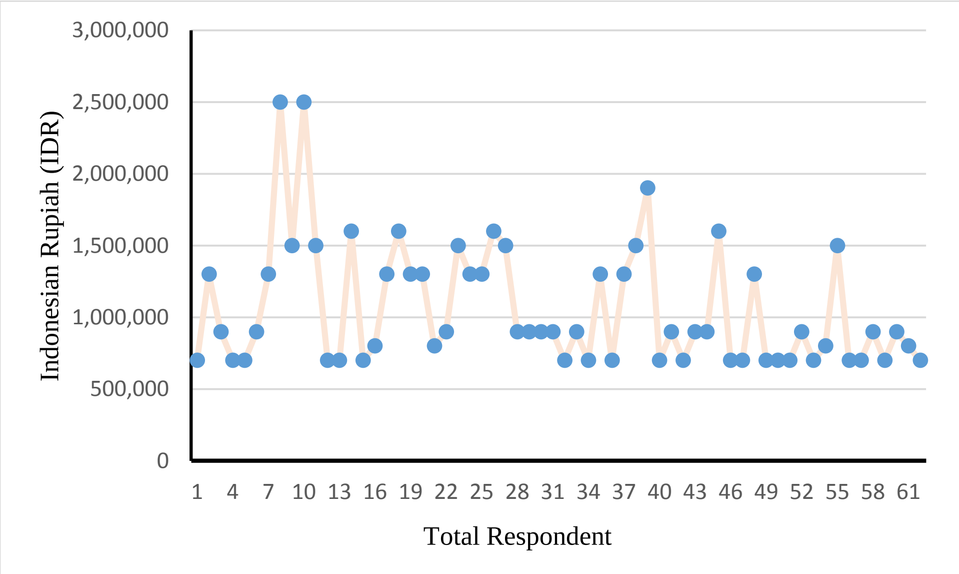

Fig. 3. Citronella oil leaf price development.

The citronella leaf price development in one-time production process from several respondents tends to fluctuate. However, the average value of citronella leaves is IDR 1,061,290 per sack, or an average of around 50 kg.

Citronella oil output price development

The development of the output price of citronella oil can be described in Fig. 4.

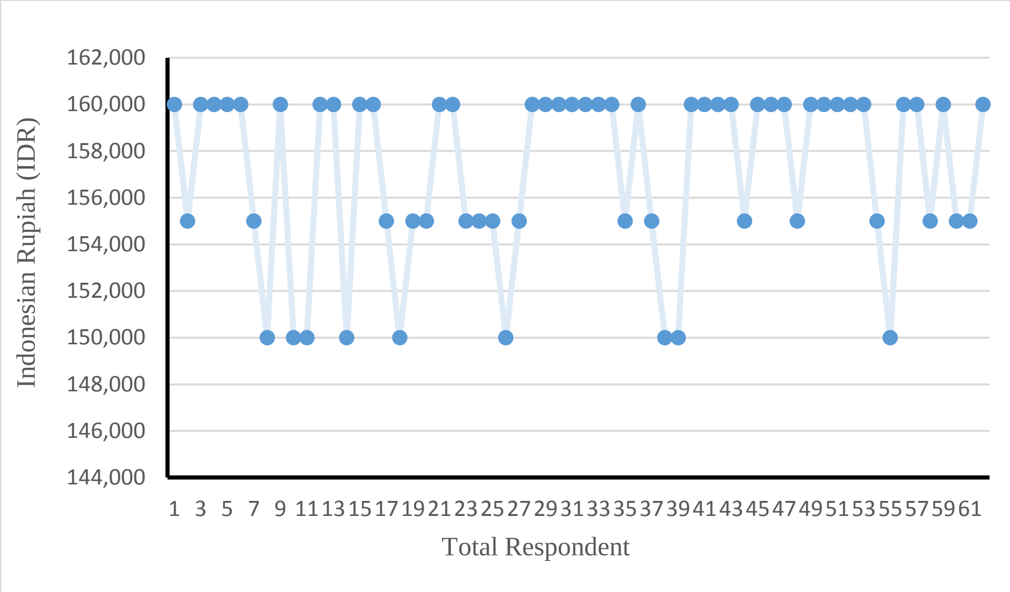

Fig. 4. Citronella oil output price development.

The citronella oil output price development from several respondents tends to fluctuate. However, the average price of citronella oil is IDR 157,170 per kilogram.

Citronella oil income development

The development of farmers' citronella oil income can be described in Fig. 5.

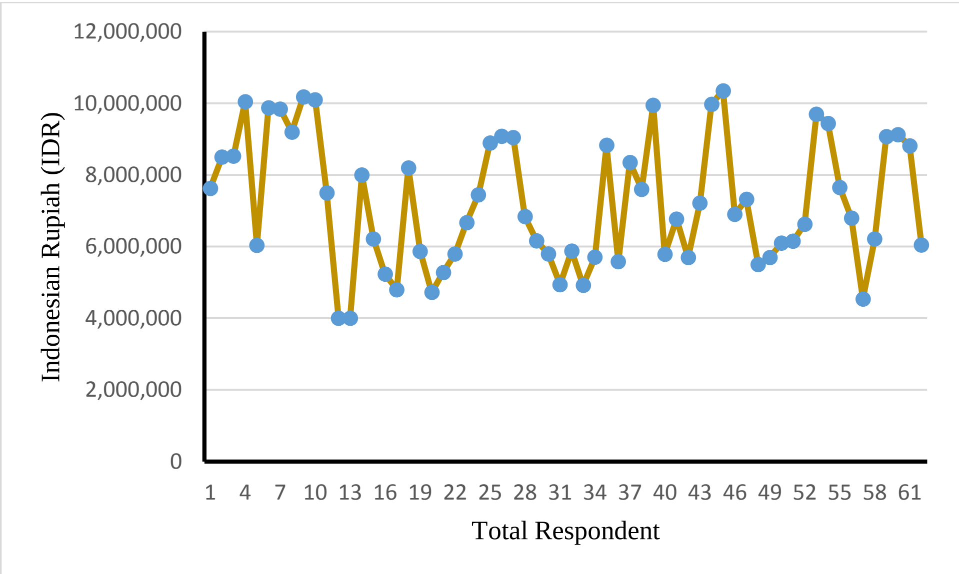

Fig. 5. Citronella oil income development.

The citronella oil income development from several respondents tends to fluctuate. However, the average citronella oil respondents' income is IDR 7,238,300 in one processing.

Normality test

The normality test is the significance test of the influence of the independent variable on the dependent variable through the t-test, and it will only be valid if the residual obtained has a normal distribution. The following is the normality test results.

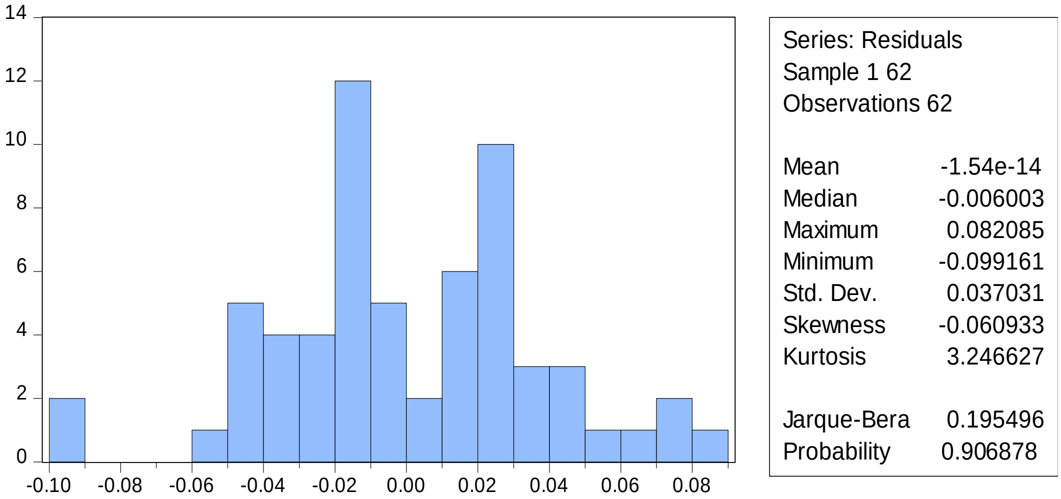

Fig. 6. Normality test results.

The test results show that if the probability value of the Jarque Bera test is greater than alpha 5% or 0.906 > 0.05, then the null hypothesis is accepted, meaning the residuals are normally distributed.

Serial Correlation/Autocorrelation Test

Autocorrelation occurs when errors or residuals from several periods are correlated. The following is the serial correlation test results.

Table 1. Serial correlation/autocorrelation test results. Breusch-Godfrey Serial Correlation LM Test.

F-statistic	**1.205379**	**Prob. F (2.55)**	**0.3074**
Obs*R-squared	2.603468	Prob. Chi-Square (2)	0.2721

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 1 62
Included observations: 62
Pre-sample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.492029	4.789077	-0.102740	0.9185
LOG(X_1)	-0.000640	0.030703	-0.020841	0.9834
LOG(X_2)	9.59E-05	0.012241	0.007833	0.9938
LOG(X_3)	0.002797	0.030246	0.092487	0.9266
LOG(X_4)	0.038014	0.379346	0.100210	0.9205
RESID (-1)	-0.015175	0.139706	-0.108618	0.9139
RESID (-2)	-0.207847	0.134253	-1.548178	0.1273

R-squared	0.041991	Mean dependent var	-1.54E-14
Adjusted R-squared	-0.062519	S.D. dependent var	0.037031
S.E. of regression	0.038171	Akaike info criterion	-3.587498
Sum squared resid	0.080135	Schwarz criterion	-3.347338
Log likelihood	118.2124	Hannan-Quinn criter.	-3.493205
F-statistic	0.401793	Durbin-Watson stat	1.960317
Prob(F-statistic)	0.874692		

The test results show that if the prob. value of F-statistic is greater than the alpha level of 5%, where the prob. value is 0.307 > 0.05, then the null hypothesis is accepted, meaning there is no autocorrelation.

Heteroscedasticity Test

Heteroscedasticity occurs when the error or residual does not have a constant variance throughout the data value, and it will affect the test value statistically at a 5% confidence interval. The following is the results of the heteroscedasticity test.

Table 2. Heteroscedasticity test results. Heteroskedasticity Test: Breusch-Pagan-Godfrey.

F-statistic	**2.041032**	**Prob. F(4,57)**	**0.1007**
Obs*R-squared	7.767709	Prob. Chi-Square(4)	0.1005
Scaled explained SS	7.374969	Prob. Chi-Square(4)	0.1174

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 1 62
Included observations: 62

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.095866	0.244038	-0.392830	0.6959
LOG (X_1)	-0.000363	0.001576	-0.230490	0.8185
LOG (X_2)	-9.22E-05	0.000627	-0.146946	0.8837
LOG (X_3)	0.002671	0.001560	1.711961	0.0923
LOG (X_4)	0.005278	0.019303	0.273435	0.7855

R-squared	0.125286	Mean dependent var	0.001349
Adjusted R-squared	0.063902	S.D. dependent var	0.002039
S.E. of regression	0.001972	Akaike info criterion	-9.541826
Sum squared resid	0.000222	Schwarz criterion	-9.370283
Log likelihood	300.7966	Hannan-Quinn criter.	-9.474474
F-statistic	2.041032	Durbin-Watson stat	2.210855
Prob(F-statistic)	0.100732		

The test results show that if the prob. of F-statistic is greater than the alpha level of 5%, where the prob. value is 0.100 > 0.05, then the null hypothesis is accepted, meaning the heteroscedasticity does not occur.

Multicollinearity Test

Multicollinearity is a condition where the independent or independent variables are strongly correlated. The following is the multicollinearity test results.

Table 3. Multicollinearity test results.

Variance Inflation Factors
Sample: 1 62

Included observations: 62

Variable	**Coefficient Variance**	**Uncentered VIF**	**Centered VIF**
C	22.46259	949020.1	NA
LOG(X1)	0.000937	702.3871	3.400199
LOG(X2)	0.000148	1232.527	2.686019
LOG(X3)	0.000918	7400.776	4.800177
LOG(X4)	0.140532	849975.8	3.291342

The test results show that the VIF values are all less than 10. This indicates that there is no multicollinearity problem in the model.

Linearity Test

The test results show that if the prob. value of F-statistic is greater than the alpha level of 5%, where the prob. value is 0.724 > 0.05, then the null hypothesis is accepted, meaning the model is linear. Furthermore, the results of multiple linear regression estimate regarding the determinants influencing the citronella income in the Gayo Lues Regency are shown in the table below. The coefficient of determination (R^2) is 0.9790. This shows that 97.90% of the variation in the citronella income variable can be explained by the total production, labor cost, citronella leaf price, and citronella oil output price; the remaining 2.10% is explained by other variables not included in the estimation model. The simultaneous test results are prob. (F), where prob. < 0.05 shows that the total production, labor cost, citronella leaf price, and citronella oil output price simultaneously significantly affect the citronella income at the 95% confidence level.

Table 4. Linearity Test Results

Ramsey RESET Test
Equation: UNTITLED
Omitted Variables: Squares of fitted values
Specification: LOG(Y) C LOG(X1) LOG(X2) LOG(X3) LOG(X4)

	Value	df	Probability
t-statistic	0.354776	56	0.7241
F-statistic	0.125866	(1, 56)	0.7241
Likelihood ratio	0.139195	1	0.7091

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.000188	1	0.000188
Restricted SSR	0.083647	57	0.001467
Unrestricted SSR	0.083460	56	0.001490

LR test summary:

	Value
Restricted LogL	116.8826
Unrestricted LogL	116.9522

Unrestricted Test Equation:
Dependent Variable: LOG(Y)
Method: Least Squares
Sample: 1 62
Included observations: 62

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.223755	55.85392	0.057718	0.9542
LOG(X1)	0.277128	3.164068	0.087586	0.9305
LOG(X2)	-0.034879	0.409718	-0.085129	0.9325
LOG(X3)	-0.044683	0.473540	-0.094359	0.9252
LOG(X4)	0.513372	6.069716	0.084579	0.9329
FITTED^2	0.025501	0.071880	0.354776	0.7241

R-squared	0.979077	Mean dependent var	15.76343
Adjusted R-squared	0.977209	S.D. dependent var	0.255716
S.E. of regression	0.038605	Akaike info criterion	-3.579103
Sum squared resid	0.083460	Schwarz criterion	-3.373251
Log likelihood	116.9522	Hannan-Quinn criter.	-3.498280
F-statistic	524.0897	Durbin-Watson stat	2.014265
Prob(F-statistic)	0.000000		

Table 5. Multiple linear regression estimation results

Dependent Variable: LOG(Y)
Method: Least Squares
Sample: 1 62
Included observations: 62

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.51928	4.739471	-3.485470	0.0010
LOG (X_1)	1.399610	0.030615	45.71573	0.0000
LOG (X_2)	-0.180172	0.012184	-14.78752	0.0000
LOG (X_3)	-0.212334	0.030300	-7.007596	0.0000
LOG (X_4)	2.662586	0.374876	7.102585	0.0000
R-squared	0.979030	Mean dependent var		15.76343
Adjusted R-squared	0.977558	S.D. dependent var		0.255716
S.E. of regression	0.038308	Akaike info criterion		-3.609115

Sum squared resid	0.083647	Schwarz criterion	-3.437572
Log likelihood	116.8826	Hannan-Quinn criter.	-3.541763
F-statistic	665.2832	Durbin-Watson stat	2.003348
Prob(F-statistic)	0.000000		

Effect of total production on citronella income

Based on the results of multiple linear regression estimation in Table 5, the total production positively affects citronella income, where the regression coefficient value is 1.399, meaning every 1% increase in total production will elevate citronella income by 1.399%. Based on the prob. value test results, where the value prob. < 0.05, namely 0.000 < 0.05, then the total production significantly affects citronella income at the 95% confidence level. If the amount of citronella production increases, farmers will elevate inputs in the processing of citronella oil, and thus it will upraise citronella oil production, and ultimately will be able to increase citronella oil income. These results follow the research of Saleh *et al.* (2021); the variables of land area, production quantity, selling price, and farmer experience have a significant effect, and are positively related to the income of citronella farming in the Blangjerango District of Gayo Lues Regency.

Effect of labor cost on citronella income

Based on the results of multiple linear regression estimation in Table 5, the labor cost has a significant and negative effect on citronella income, where the regression coefficient value is -0.180, meaning every 1% increase in the labor cost will reduce citronella income by 0.180%. Based on the prob. value test, where the prob. value is <0.05, namely 0.000 <0.05, then the labor cost has a significant effect on citronella income at the 95% confidence level. If the labor cost increase, the production cost will also increase, thereby increasing the total production costs of citronella oil, and ultimately reducing citronella oil revenues. These results follow research by Jalil *et al.* (2021) that the labor variable negatively and significantly influences citronella production in Blangkala, Bukut, and Jabo Villages of the Terangun District of Gayo Lues Regency.

Effect of the citronella leaf price on the income

Based on the results of multiple linear regression estimation in Table 5, the citronella leaf price has a significant and negative effect on the income, where the regression coefficient value is -0.212, meaning every 1% increase in the citronella leaf price or raw materials for citronella oil will reduce the income, amounting to 0.212%. Based on the prob. value test results, where the prob. value is <0.05, namely 0.000 <0.05, then the citronella leaf price significantly affects the income at a 95% confidence level. If the citronella leaf or input prices elevate, it will reduce the income. These results follow research by Damanik (2016), which states that a citronella oil refining factory's maximum income or profit is significantly influenced by input price values, such as capital, land, factory, and building equipment at a confidence level of 95%.

Effect of Citronella Oil Output Price on the Income

Based on the results of multiple linear regression estimation in Table 5, the citronella oil output price has a significant and positive effect on citronella income, where the regression coefficient value is 2.662, meaning every 1% increase in the citronella oil output price will elevate the income by 2.662%. Based on the prob. value test results, where the prob. value is <0.05, namely 0.000 <0.05, the citronella oil output price significantly affects the income at a 95% confidence level. If the citronella oil output price increases, the farmers' total income will also elevate, thereby increasing the citronella oil income. These results follow research by Melasari (2019), which states that the citronella farmers' income has improved quite a lot due to the increase in the citronella oil output price. Furthermore, Handayani (2023) said that the citronella oil price or the output price simultaneously and partially affected the citronella oil farming income, significantly and positively.

CONCLUSION

The data analysis and the discussion above conclude that, partially and simultaneously, the total production, labor cost, citronella leaf price, and output price, all have a significant effect on the citronella oil farmers' income in the Blangjerango District of Gayo Lues Regency.

ACKNOWLEDGMENTS

Not applicable.

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