

## EMPLATE EKOBIS

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### **Pengaruh Inflasi, Pertumbuhan Petani, Luas Lahan, Dan Curah Hujan Terhadap Produksi Kopi Sumatera Selatan**

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#### **Abstrak**

- **Tujuan:** Penelitian ini bertujuan menganalisis pengaruh inflasi, pertumbuhan petani, luas lahan, dan curah hujan terhadap produksi kopi Provinsi Sumatera Selatan dalam jangka pendek dan panjang.
- **Desain/metodologi/pendekatan:** Penelitian menggunakan pendekatan kuantitatif dengan metode ARDL. Data yang digunakan berupa triwulanan periode 2013–2024.
- **Temuan:** Hasil penelitian menunjukkan bahwa inflasi berpengaruh signifikan terhadap produksi kopi dengan dampak negatif dalam jangka panjang dan pengaruh yang berfluktuasi dalam jangka pendek. Pertumbuhan jumlah petani tidak berpengaruh signifikan baik dalam jangka pendek maupun panjang. Luas lahan berpengaruh signifikan dalam jangka pendek namun tidak dalam jangka panjang, menunjukkan bahwa perluasan lahan tanpa peningkatan kualitas belum menjadi penentu produksi. Curah hujan berpengaruh signifikan, dengan dampak negatif jangka pendek akibat hujan berlebih dan dampak positif jangka panjang ketika kondisi hujan relatif stabil. Secara simultan, seluruh variabel berpengaruh signifikan terhadap produksi kopi.
- **Batasan penelitian/dampak:** Penelitian terbatas pada penggunaan data sekunder dan variabel makro sehingga belum mencakup faktor mikro seperti teknologi budidaya, kualitas bibit, dan manajemen kebun. Penelitian selanjutnya disarankan menambahkan variabel teknis.
- **Implikasi praktis:** Hasil penelitian menjadi dasar bagi pemerintah daerah dalam merumuskan kebijakan pengembangan kopi, khususnya optimalisasi lahan dan strategi adaptasi terhadap risiko iklim. Bagi petani, temuan ini menekankan pentingnya pengelolaan lahan produktif dan kesiapan menghadapi variabilitas iklim.
- **Keaslian/nilai:** Penelitian ini mengintegrasikan faktor ekonomi dan iklim secara simultan dalam analisis produksi kopi tingkat provinsi menggunakan pendekatan ARDL.
- **Jenis makalah:** Makalah penelitian

**Kata Kunci:** Produksi kopi, Inflasi, Pertumbuhan petani, Luas lahan, Curah hujan.

### **Abstract**

- **Purpose:** This study aims to analyze the effects of inflation, farmer growth, land area, and rainfall on coffee production in South Sumatra Province in the short and long term.
- **Design/methodology/approach:** The study used a quantitative approach with the ARDL method. The data used were quarterly for the period 2013–2024.
- **Findings:** The results show that inflation has a significant effect on coffee production, with a negative impact in the long term and a fluctuating effect in the short term. Farmer growth has no significant effect in either the short or long term. Land area has a significant effect in the short term but not in the long term, indicating that land expansion without improving quality is not yet a determinant of production. Rainfall has a significant effect, with a negative short-term impact due to excessive rainfall and a positive long-term impact when rainfall conditions are relatively stable. Simultaneously, all variables have a significant effect on coffee production.
- **Research limitations/impact:** This study is limited to the use of secondary data and macro variables, thus not including micro factors such as cultivation technology, seedling quality, and plantation management. Future research is recommended to add technical variables.
- **Practical implications:** The research results serve as a basis for local governments in formulating coffee development policies, particularly land optimization and adaptation strategies to climate risks. For farmers, these findings emphasize the importance of productive land management and preparedness for climate variability.
- **Originality/value:** This research simultaneously integrates economic and climate factors in a provincial-level coffee production analysis using the ARDL approach.
- **Paper type:** Research paper.

**Keywords:** Coffee production, Inflation, Farmer growth, Land area, Rainfall.

## Introduction

Coffee is a strategic plantation commodity in Indonesia, contributing significantly to rural livelihoods and regional economic development. In South Sumatra, coffee production supports thousands of smallholder farmers, yet its output has fluctuated over time due to the interaction of economic pressures and environmental conditions. Rising inflation affects farmers production costs and labor allocation decisions, while structural factors such as the number of farmers and land availability interact with climatic variability particularly rainfall to shape production performance. At the national level, regional differences in agricultural performance are closely related to variations in socioeconomic conditions and environmental exposure, which jointly determine regional vulnerability and production capacity in Indonesia (Juliannisa et al., 2025). This indicates that agricultural output, including plantation commodities such as coffee, is shaped by the interaction between economic pressures and climatic conditions across regions.

Previous studies show that climatic factors, especially rainfall, play a crucial role in determining coffee productivity. Excessive rainfall has been found to reduce yields by increasing disease incidence and disrupting flowering cycles (Gao et al., 2020). On the other hand, economic factors such as inflation influence farmers capacity to purchase inputs and maintain cultivation intensity, often leading to lower output when cost pressures persist (Iaroshenko et al., 2020). Research on land expansion also indicates that increasing cultivated area does not automatically raise production, as productivity depends heavily on land quality, technology, and farm management (Al Zarliani, 2023). Besides being influenced by macroeconomic and climate factors, the sustainability of coffee production is also greatly determined by the feasibility of the business at the farmer level. A feasibility study of Arabica coffee farming shows that despite its high economic potential, farmers still face various production cost constraints and business risks that influence production and land management decisions (Khatimah et al., 2023).

To address this gap, this study analyzes the effects of inflation, farmer growth, land area, and rainfall on coffee production in South Sumatra using the Autoregressive Distributed Lag (ARDL) approach, which allows for the examination of both short-run dynamics and long-run relationships (Pesaran et al., 2001). The study aims to answer two main questions: (1) how do these variables affect coffee production in the short and long run? and (2) do they jointly exert a significant influence on production dynamics? The objective of this research is to assess the short-term and long-term impacts of economic and climatic factors on coffee production in South Sumatra during the period 2013–2024. The scope is limited to this province and relies on quarterly time-series data from official secondary sources. The significance of this study lies in its contribution to the literature by integrating macroeconomic and environmental determinants within a dynamic econometric framework and the Agricultural Household Model, providing empirical evidence on how farmers respond to price pressures and climate variability. From a policy perspective, the findings offer important insights for designing strategies to stabilize production, enhance farmers resilience to inflationary shocks, and improve adaptation to climate risks.

## Literature review and hypothesis development

Coffee production is influenced by a complex interaction between economic, structural, and climatic factors, particularly in regions dominated by smallholder farming systems such as South Sumatra. Within the framework of the Agricultural Household Model (AHM), production decisions are shaped not only by technical considerations but also by household responses to price signals, labor allocation, and environmental risks. Inflation plays a crucial role in agricultural production by affecting farmers' real income and input affordability. Rising inflation increases the cost of fertilizers, pesticides, labor, and transportation, which often leads to reduced cultivation intensity and lower output (Iaroshenko et al., 2020). Several empirical studies show that inflation tends to have a negative effect on agricultural production in the long run, as persistent cost pressures limit farmers' capacity to sustain productivity (Silvia et al., 2025). However, short-run effects are often mixed due to adjustment mechanisms, where farmers rely on previously purchased inputs or temporarily alter production strategies.

The number of farmers is commonly associated with labor availability in agriculture. Classical production theory suggests that an increase in labor should raise output, yet empirical evidence in coffee farming shows inconsistent results. (Al Zarliani, 2023) finds that increasing the number of farmers does not necessarily improve productivity when land quality, capital, and technology remain unchanged. Similar findings indicate that labor expansion without complementary inputs may even reduce efficiency due to land fragmentation and diminishing returns. These results align with the AHM perspective that labor alone is insufficient to drive production growth. Land expansion has long been considered a key driver of agricultural output. However, recent studies argue that quality matters more than quantity. (Tegegn et al., 2024) demonstrate that land size has only a marginal effect on coffee production compared to technical inputs such as fertilizer use and farm management practices. In the short run, newly expanded land often shows low productivity due to immature plants and poor soil conditions, while long-run impacts depend heavily on farmers' capacity to manage the land efficiently.

Rainfall is one of the most critical climatic determinants of coffee production. While adequate rainfall supports flowering and fruit development, excessive rainfall increases the risk of pests and diseases, leading to yield losses. (Gao et al., 2020) and (Beilby, 2020) show that irregular and extreme rainfall patterns significantly reduce coffee yields through disrupted phenological cycles and increased fungal infections. Empirical studies further reveal that rainfall tends to have lagged effects, influencing production in subsequent periods rather than immediately, highlighting the importance of dynamic analysis. Although numerous studies examine the determinants of coffee production, three major gaps remain. First, most research focuses on either economic or climatic factors separately, with limited integration of both dimensions in a single model. Second, many studies rely on static methods, which fail to capture the dynamic adjustments in agricultural production. Third, empirical evidence specific to South Sumatra remains scarce, particularly using time-series approaches that distinguish between short-run and long-run effects. This study addresses these gaps by employing a

dynamic ARDL framework to integrate inflation, farmer growth, land area, and rainfall in explaining coffee production.

Based on production theory, the Agricultural Household Model, and previous empirical findings, this study views coffee production as the result of the interaction between economic, structural, and climatic factors. Inflation is expected to affect production through rising input costs and declining farmers purchasing power, which may reduce output, particularly in the long run. Growth in the number of farmers is assumed to increase production capacity; however, without adequate improvements in technology and land quality, its impact is likely to be limited. Land area has the potential to raise output, but its effectiveness depends largely on productivity and farm management practices. Meanwhile, rainfall, as a key climatic factor, influences the coffee growth cycle, where excessive rainfall tends to have a negative effect on production, while stable rainfall supports higher yields. Therefore, this study hypothesizes that inflation, farmer growth, land area, and rainfall have a significant effect on coffee production in South Sumatra, both individually and simultaneously, in the short run and the long run.

### **Research Method**

This study employs a quantitative explanatory research design with a causal approach to examine the effects of inflation, farmer growth, land area, and rainfall on coffee production in South Sumatra. The analysis uses secondary time-series data from 2013 to 2024, converted into quarterly observations, obtained from Badan Pusat Statistik (BPS), Dinas Perkebunan Provinsi Sumatera Selatan, and Badan Meteorologi, Klimatologi, dan Geofisika (BMKG). The variables include coffee production (tons), inflation rate (%), farmer growth (%), land area (hectares), and rainfall (mm), all measured using official statistics to ensure reliability and validity. The study applies the Autoregressive Distributed Lag (ARDL) approach because it accommodates variables integrated at different orders, I(0) and I(1) (Pesaran et al., 2001). The general model is specified as:

$$\Delta Y_t = \alpha + \sum_{i=1}^p \beta_1 \Delta X_{t-i} + \sum_{i=0}^q \beta_2 \Delta Z_{t-i} + \lambda (Y_{t-1} - \theta_0 - \theta_1 X_{t-1} - \theta_2 Z_{t-1}) + \epsilon_t$$

The analytical procedure includes unit root testing using ADF and PP tests, optimal lag selection based on the Akaike Information Criterion (AIC), bounds testing for cointegration, estimation of both short-run and long-run relationships, and the Error Correction Model (ECM) to capture the speed of adjustment toward long-run equilibrium. Model adequacy is assessed through the F-test and goodness-of-fit measures ( $R^2$  and Adjusted  $R^2$ ). As the study relies solely on publicly available secondary data, ethical standards are maintained through transparency, objectivity, and the protection of confidentiality.

## Result and discussion

This study begins with descriptive statistical analysis to provide an overview of the characteristics of the variables used in the model. Descriptive statistics such as mean, minimum, maximum, and standard deviation are employed to capture the central tendency and variability of the data. These statistics help identify the general distribution pattern of each variable and serve as an initial diagnostic before conducting time-series econometric analysis.

Table 1. Research Data Description

Variabel	Satuan	Minimum	Maximum	Mean
coffee production	Ton	110.400	209.470	174.349
inflation	%	1,53	6,40	3,82
farmer growth	%	-2,669	2,370	0,0565
land area	Ha	249.290	267.380	255.554
rainfall	Mm	1.668,30	3.490,30	2.643,07

Source: Results of Eviews 12 data processing

The table shows that coffee production in South Sumatra fluctuated during the observation period, indicating instability in output that reflects changing economic and climatic conditions. Similar production volatility in Indonesian coffee farming has also been reported by (Septiani & Kawuryan, 2021) and (Candra & Irmeilyana, 2024). The variation in inflation illustrates differences in production cost pressures faced by farmers, consistent with findings by (Omobolanle, 2021) and (Saraswati & Rastini, 2020), while the dispersion in rainfall data indicates the presence of climate variability that potentially affects crop performance (Sarvina et al., 2021). Meanwhile, the distribution of farmer growth and land area suggests that structural changes in agriculture occur gradually rather than uniformly over time (Widyawati et al., 2024).

### Stationarity Test (Unit Root Test)

Prior to estimating the ARDL model, unit root tests are conducted to examine the stationarity properties of the variables. This step is essential to ensure that none of the variables are integrated of order two,  $I(2)$ , as ARDL methodology is only applicable for variables integrated of order zero,  $I(0)$ , or order one,  $I(1)$ .

Table 2. Stationarity Test Results at Level  $I(0)$

Variabel	Prob.
Produksi Kopi	0.7964
Inflasi	0.2228

<b>Variabel</b>	<b>Prob.</b>
Pertumbuhan Petani	0.0366
Luas Lahan	0.8788
Curah Hujam	0.5091

*Source: Results of Eviews 12 data processing for 2025*

Table 3. Stationarity Test Results at First Difference Level I(1)

<b>Variabel</b>	<b>Prob.</b>
<b>Produksi Kopi</b>	0.0037
<b>Inflasi</b>	0.0000
<b>Luas Lahan</b>	0.0114
<b>Curah Hujam</b>	0.0000

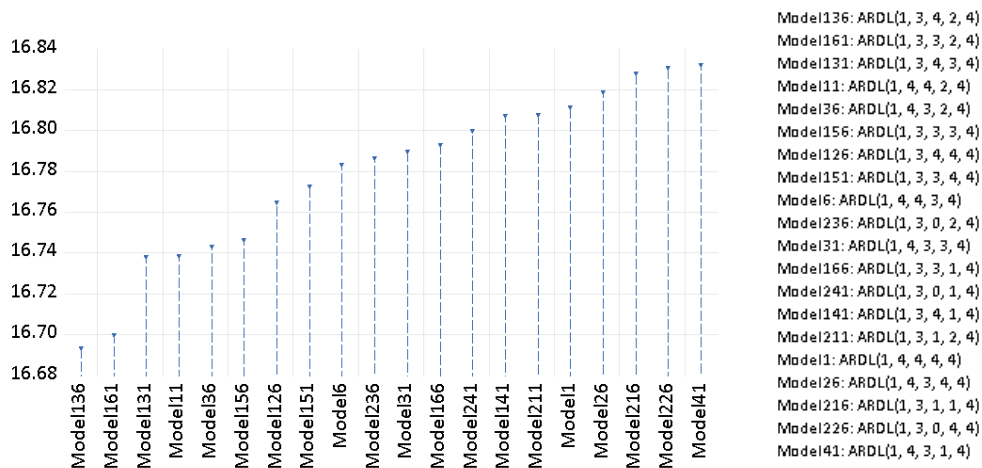
*Source: Results of Eviews 12 data processing for 2025*

The Augmented Dickey–Fuller (ADF) test results reveal that some variables are stationary at level, while others become stationary after first differencing. This mixed order of integration justifies the use of the ARDL approach, as it allows for the combination of I(0) and I(1) variables within a single model.

### **Lag Length Selection**

After confirming stationarity, the next step involves selecting the optimal lag length for the ARDL model. The selection is based on several information criteria, namely Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan–Quinn Criterion (HQ). Among these, AIC is used as the primary criterion due to its effectiveness in capturing dynamic relationships in relatively small samples.

Figure 1. Akaike Information Criteria (AIC) graph



Source: Results of Eviews 12 data processing for 2025

The Akaike Information Criterion (AIC) graph shows the top 20 ARDL models with the lowest AIC values. The model with the smallest AIC value is considered the most optimal. Based on the results, Model 136 ranks first and is therefore selected as the best-performing model. This model adopts the ARDL (1, 3, 4, 2, 4) specification, indicating one lag for coffee production, three lags for inflation, four lags for farmer growth, two lags for land area, and four lags for rainfall.

### Cointegration Test (Bounds Test)

To investigate the existence of a long-run relationship among the variables, the ARDL Bounds Test for cointegration is applied. The null hypothesis assumes no long-run relationship, while the alternative hypothesis suggests the presence of cointegration.

Table 4. Cointegration Test Results

F-Statistic	I(1) Signif.			
	1%	2.5%	5%	10%
4.8200214	4.37	3.87	3.49	3.09

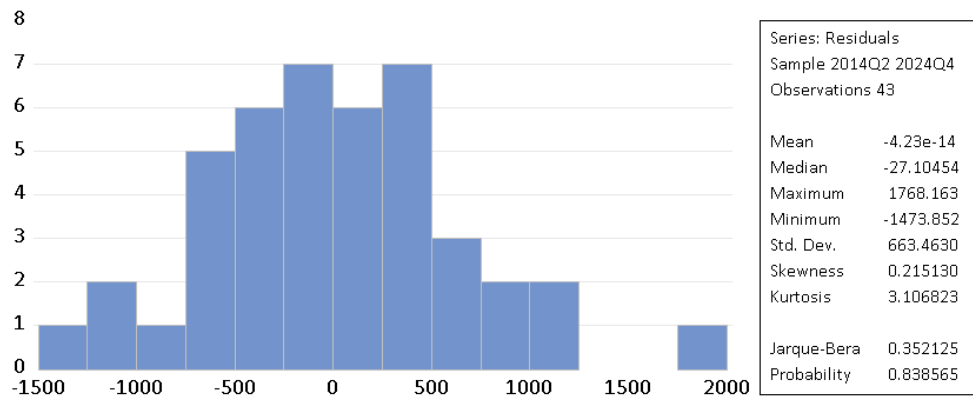
Source: Results of Eviews 12 data processing for 2025

The ARDL cointegration test is conducted to examine the existence of a long-run relationship between the dependent and independent variables using the Bounds Testing approach. The results show that the F-statistic value of 4.82 exceeds the upper critical bound I(1) at the 5% significance level (3.49). Therefore, the null hypothesis of no cointegration is rejected, indicating the presence of a long-run equilibrium relationship between coffee production and inflation, farmer growth, land area, and rainfall during the study period.

## Normality Test

The normality test is conducted using the Jarque–Bera statistic to ensure that the residuals of the ARDL model are normally distributed.

Figure 2. Normality Test Results



Source: Results of Eviews 12 data processing for 2025

The results show a Jarque–Bera value of 0.35 with a probability of 0.84, exceeding the 5% significance level. Therefore, the null hypothesis of normally distributed residuals cannot be rejected, indicating that the ARDL model satisfies the normality assumption.

## Multicollinearity Test

The multicollinearity test is conducted to examine the presence of strong correlations among independent variables, which may lead to unstable coefficient estimates and biased interpretations. This study employs the Variance Inflation Factor (VIF) as an indicator, where a model is considered free from multicollinearity if the centered VIF values are below the threshold of 10.

Table 5. Multicollinearity Test Results

Variabel	Coefficient Variance	Uncentered VIF	Centered VIF
D(Jumlah_Produksi)	0.010408	1.662971	1.570752
D(Inflasi)	35244.50	1.812127	1.783906
Pertumbuhan_Jumlah_Petani	818699.8	4.828706	4.772598
D(Luas_Lahan)	0.083213	2.209708	2.159843
D(Curah_Hujan)	0.454212	3.995148	3.994839

Source: Results of Eviews 12 data processing for 2025

The results show that all independent variables have centered VIF values below 10, indicating the absence of multicollinearity in the model. Specifically, the centered VIF values are 1.57 for coffee production, 1.78 for inflation, 4.77 for farmer growth, 2.16 for land area, and 3.99 for rainfall. These findings suggest that the estimated ARDL model is not affected by multicollinearity and the coefficients can be reliably interpreted.

### Heteroscedasticity Test

The heteroskedasticity test is conducted to examine whether the variance of the residuals in the ARDL model is constant. This study employs the Breusch–Pagan–Godfrey test, where the model is considered free from heteroskedasticity if the probability value of the Chi-square statistic exceeds the 5% significance level.

Table 6. Heteroscedasticity Test Results

<b>Prob. Chi-Square</b>	0.1626
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*Source: Results of Eviews 12 data processing for 2025*

The test results indicate a Chi-square probability value of 0.16, which is greater than 0.05. Therefore, the null hypothesis of homoskedasticity cannot be rejected, suggesting that the ARDL model satisfies the assumption of constant error variance and is free from heteroskedasticity.

### Autocorrelation Test

The autocorrelation test is conducted to examine whether the residuals are correlated across time, which may lead to inefficient coefficient estimates. This study applies the Breusch–Godfrey Serial Correlation LM test, where the model is considered free from autocorrelation if the Chi-square probability value exceeds the 5% significance level.

Table 7. Autocorrelation Test Results

<b>Prob. Chi-Square</b>	0.3928
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*Source: Results of Eviews 12 data processing for 2025*

The results show a Chi-square probability value of 0.39, which is greater than 0.05. Therefore, the null hypothesis of no serial correlation cannot be rejected, indicating that the ARDL model is free from autocorrelation and satisfies the assumption of error independence.

### Short-Term ARDL Model

The short-run ARDL model is estimated to examine the immediate effects of changes in independent variables on coffee production and to capture short-run dynamics through the Error Correction Model (ECM). The inclusion of the error

correction term (ECT) allows for assessing the speed of adjustment toward long-run equilibrium, where a negative and statistically significant ECT indicates a stable convergence process.

Table 8. Short-Term ARDL Model Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Inflasi)	-389.3737	132.5339	-2.937918	0.0072
D(Inflasi(-1))	171.1221	159.6776	1.071672	0.2945
D(Inflasi(-2))	584.2724	121.3712	4.813928	0.0001
D(Pertumbuhan_Jumlah_Petani)	1224.133	685.0725	1.786866	0.0866
D(Pertumbuhan_Jumlah_Petani(-1))	490.3364	682.2542	0.718701	0.4793
D(Pertumbuhan_Jumlah_Petani(-2))	-2316.624	749.4099	-3.091264	0.005
D(Pertumbuhan_Jumlah_Petani(-3))	963.9294	642.1967	1.500988	0.1464
D(Luas_Lahan)	-0.525152	0.226493	-2.318622	0.0293
D(Luas_Lahan(-1))	0.534879	0.203816	2.62432	0.0149
D(Curah_Hujan)	-0.527392	0.48565	-1.085951	0.2883
D(Curah_Hujan(-1))	-8.761493	1.414997	-6.191883	0.0000
D(Curah_Hujan(-2))	-6.197092	1.012267	-6.121993	0.0000
D(Curah_Hujan(-3))	-3.618976	0.627813	-5.764421	0.0000
Cointeq(-1)*	-0.377512	0.063861	-5.911442	0.0000

Source: Results of Eviews 12 data processing for 2025

The estimation results reveal that inflation has a significant short-run effect on coffee production, with mixed impacts across different lag periods. Current inflation negatively affects production, while inflation lagged by two periods shows a positive and significant effect, indicating a time-dependent response. Farmer growth is largely insignificant in the short run, except at the second lag where it exerts a significant negative impact, suggesting adjustment inefficiencies among new farmers. Land area exhibits a lagged effect, where current expansion reduces production, while expansion in the previous period positively contributes to output, reflecting delayed productivity gains. Rainfall consistently shows a significant negative impact across multiple lag periods, implying that excessive rainfall in preceding quarters adversely affects coffee production. The error correction term is negative and statistically significant, confirming

the validity of the ARDL model. The ECT coefficient indicates that approximately 37.8% of short-run deviations from long-run equilibrium are corrected in the following quarter, suggesting a moderate speed of adjustment toward long-run stability.

### Long-Term ARDL Model

The long-run ARDL model is estimated after confirming the existence of cointegration among variables using the Bounds Testing approach. This model captures the stable long-term relationship between coffee production and its determinants, allowing the estimation of long-run coefficients that reflect persistent economic and climatic effects.

Table 9. Long-Term ARDL Model Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(Inflasi)	-2417.167	1085.455	-2.22687	0.0356
Pertumbuhan_Jumlah_Petani	951.4384	2165.918	0.439277	0.6644
D(Luas_Lahan)	0.020106	0.930776	0.021602	0.9829
D(Curah_Hujan)	30.0994	9.409827	3.19872	0.0039
C	360.1259	382.5645	0.941347	0.3559

*Source: Results of Eviews 12 data processing for 2025*

The long-run estimation results indicate that inflation has a negative and statistically significant effect on coffee production, implying that higher inflation reduces long-term output due to increased production costs. Rainfall exhibits a positive and highly significant impact, highlighting the crucial role of climatic conditions in sustaining coffee production over time. In contrast, farmer growth and land area are found to be statistically insignificant in the long run, suggesting that increases in labor participation and land expansion alone do not guarantee higher coffee output without improvements in productivity and land management. Overall, the long-run results emphasize the importance of macroeconomic stability and favorable climatic conditions in supporting sustainable coffee production.

### t-test (Partial)

The partial significance test (t-test) is applied to examine the individual effect of each independent variable on coffee production in both the short run and the long run. The test evaluates whether each coefficient is statistically significant at the 5% significance level based on its t-statistic and corresponding probability value.

Table 10. Short-Term t-Test Results

<b>Variable</b>	<b>t-Statistic</b>	<b>Prob.</b>
D(Inflasi)	-2.937918	0.0072
D(Inflasi(-1))	1.071672	0.2945
D(Inflasi(-2))	4.813928	0.0001
D(Pertumbuhan_Jumlah_Petani)	1.786866	0.0866
D(Pertumbuhan_Jumlah_Petani(-1))	0.718701	0.4793
D(Pertumbuhan_Jumlah_Petani(-2))	-3.091264	0.005
D(Pertumbuhan_Jumlah_Petani(-3))	1.500988	0.1464
D(Luas_Lahan)	-2.318622	0.0293
D(Luas_Lahan(-1))	2.62432	0.0149
D(Curah_Hujan)	-1.085951	0.2883
D(Curah_Hujan(-1))	-6.191883	0.0000
D(Curah_Hujan(-2))	-6.121993	0.0000
D(Curah_Hujan(-3))	-5.764421	0.0000
Cointeq(-1)*	-5.911442	0.0000

Source: Results of Eviews 12 data processing for 2025

The short-run results indicate that inflation significantly affects coffee production with varying effects across lag periods. Current inflation has a significant negative impact, while inflation lagged by two periods shows a significant positive effect. Farmer growth is largely insignificant in the short run, except at the second lag where it exerts a significant negative impact. Land area exhibits significant effects with opposite signs, where current land expansion reduces production, while land expansion in the previous period positively affects output, reflecting a delayed productivity effect. Rainfall shows a consistently significant and negative impact across multiple lag periods, indicating that excessive rainfall in preceding quarters adversely affects short-run coffee production. The error correction term is also statistically significant, confirming short-run adjustment toward long-run equilibrium.

Table 11. Long-Term t-Test Results

<b>Variable</b>	<b>t-Statistic</b>	<b>Prob.</b>
D(Inflasi)	-2.22687	0.0356
Pertumbuhan_Jumlah_Petani	0.439277	0.6644
D(Luas_Lahan)	0.021602	0.9829
D(Curah_Hujan)	3.19872	0.0039
C	0.941347	0.3559

Source: Results of Eviews 12 data processing for 2025

In the long run, inflation has a negative and statistically significant effect on coffee production, suggesting that persistent inflationary pressure reduces output through higher production costs. Rainfall exerts a positive and significant influence, highlighting the importance of favorable climatic conditions for long-term coffee productivity. In contrast, farmer growth and land area are statistically insignificant in the long run, indicating that increases in labor participation and land expansion alone do not generate sustained improvements in coffee production.

### Simultaneous F Test

The F-test is employed to examine whether all independent variables jointly have a statistically significant effect on coffee production. This test evaluates the null hypothesis that all slope coefficients are simultaneously equal to zero, with significance assessed at the 5% level.

Table 12. Simultaneous F-Test Results

<b>F-Statistic</b>	7.018572
<b>Prob (F-Statistic)</b>	0.000010

*Source: Results of Eviews 12 data processing for 2025*

The results show an F-statistic value of 7.02 with a probability of 0.00001, which is well below the 5% significance level. Therefore, the null hypothesis is rejected, indicating that inflation, farmer growth, land area, and rainfall jointly exert a significant effect on coffee production within the ARDL framework.

### R-squared and Adjusted R-Squared tests

The coefficient of determination ( $R^2$ ) and the adjusted  $R^2$  are used to assess the explanatory power of the ARDL model in capturing variations in coffee production. While  $R^2$  measures the proportion of variance explained by the model, the adjusted  $R^2$  accounts for the number of explanatory variables and provides a more reliable measure for models with multiple parameters.

Table 13. R-squared and Adjusted R-Squared Test Results

<b>R-Squared</b>	0.840356
<b>Adjusted R-Squared</b>	0.720623

*Source: Results of Eviews 12 data processing for 2025*

The results indicate an  $R^2$  value of 0.84, suggesting that approximately 84% of the variation in coffee production is explained by inflation, farmer growth, land area, and rainfall. The adjusted  $R^2$  value of 0.72 confirms that, after controlling for model complexity, the ARDL model retains strong explanatory power. These findings indicate

that the estimated model fits the data well and effectively captures the determinants of coffee production.

## Conclusions

This study examined the effects of inflation, farmer growth, land area, and rainfall on coffee production in South Sumatra using the Autoregressive Distributed Lag (ARDL) approach with quarterly data from 2013 to 2024. The findings provide important insights into how economic and climatic factors shape agricultural performance in a major coffee-producing region of Indonesia. The results indicate that inflation and farmer growth do not have a statistically significant effect on coffee production in either the short or long run. This suggests that changes in macroeconomic conditions and labor dynamics have not directly translated into variations in production levels during the observed period. This result is consistent with studies showing that labor expansion without technological and capital support does not automatically increase agricultural output (Saraswati & Rastini, 2020).

In contrast, land area shows a significant positive effect in the long run, confirming that land availability remains one of the decisive factors in sustaining and increasing coffee output. This finding aligns with evidence from (Widyawati et al., 2024), who emphasize that land resources continue to play a central role in determining coffee production capacity in Indonesia. Rainfall exhibits an inconsistent impact across time horizons, reflecting the complex and non-linear nature of climatic influences on coffee cultivation. Similar patterns have been reported by (Sarvina et al., 2021) and (Mbwambo et al., 2022), who highlight that excessive rainfall can disrupt flowering cycles and increase disease risks, while adequate rainfall supports long-term productivity. Simultaneously, all variables jointly have a significant effect on coffee production, highlighting the importance of considering economic, demographic, and environmental factors in an integrated framework. These findings address the research objectives and support the conclusion that structural factors, particularly land resources and climatic conditions, play a more dominant role than short-term economic fluctuations in determining coffee production in South Sumatra.

Despite these contributions, this study has several limitations that should be acknowledged. First, the analysis relies solely on secondary time-series data, which may not fully capture micro level conditions such as farm management practices, technology adoption, or access to credit. Second, the scope of variables is limited to four main factors, leaving out other potentially important determinants such as fertilizer use, irrigation systems, coffee prices, and government policy interventions, which have been shown to significantly affect agricultural performance in previous studies (Adeola & Ikpesu, 2020). Third, although the ARDL method is effective in identifying short and long run relationships, it does not explicitly model spatial differences across districts within South Sumatra, where production conditions may vary significantly (Candra & Irmeilyana, 2024). Future research is encouraged to build upon these findings in several ways. Subsequent studies could incorporate additional variables, including technological inputs, market prices, and institutional support, to provide a more comprehensive understanding of coffee production dynamics. Expanding the analysis to different regions

or comparing multiple provinces would also help to identify whether the observed patterns are specific to South Sumatra or applicable at a broader national level, as suggested by (Suryana et al., 2024) and (Haryono et al., 2024). Furthermore, employing alternative methodologies such as panel data models or mixed-method approaches that combine quantitative analysis with field surveys could enrich the empirical evidence and validate the robustness of the results. Through these avenues, future research can further advance knowledge on agricultural productivity and contribute to more effective policy formulation for sustainable coffee development in Indonesia.

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