

DOES ECONOMIC GROWTH REDUCE POVERTY UNDER INCOMPLETE STRUCTURAL TRANSFORMATION? PANEL DATA EVIDENCE FROM CENTRAL JAVA, 2015-2025

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Abstract

Poverty remains a major development challenge in Central Java despite sustained regional economic growth. This study examines the effects of Gross Regional Domestic Product (GRDP), Mean Years of Schooling (MYS), paddy productivity, and the open unemployment rate on poverty across 35 regencies and cities in Central Java during 2015–2025. Using a balanced panel dataset of 385 observations, the study employs a Fixed Effect Model with White cross-section robust standard errors to address heteroskedasticity. The results indicate that GRDP has a significant negative effect on poverty, suggesting that regional economic growth remains an important driver of poverty reduction. In contrast, Mean Years of Schooling has a significant positive effect on poverty, indicating that improvements in educational attainment have not been accompanied by sufficient productive employment opportunities capable of translating human capital accumulation into welfare gains. Meanwhile, paddy productivity and the open unemployment rate do not have a statistically significant effect on poverty. These findings suggest that economic growth remains effective in reducing poverty even under conditions of incomplete structural transformation. However, improvements in education, agricultural productivity, and labor market conditions alone may not automatically generate measurable poverty reduction without complementary structural support. This study contributes to the literature on regional poverty by providing evidence from Central Java regarding the effectiveness of economic growth and related socioeconomic factors in reducing poverty under conditions of uneven structural transformation.

Keywords: poverty, economic growth, mean years of schooling, paddy productivity, Central Java

INTRODUCTION

Economic growth is widely regarded as an important driver of poverty reduction. According to Todaro and Smith (2011), increased economic growth expands productive capacity, raises household income, and improves access to basic needs through greater labor absorption and purchasing power. This perspective is consistent with Sen's (1999) capability approach, which emphasizes the importance of expanding individuals' opportunities and living standards as part of the development process. Poverty reduction also remains the primary objective of Sustainable Development Goal 1 (SDG 1), which aims to eradicate poverty in all its forms everywhere through inclusive and sustainable development. However, the relationship between growth and poverty reduction is not always automatic. Lewis (1954) explains that in economies where structural transformation remains incomplete, surplus labor often remains concentrated in low-productivity traditional sectors such as agriculture rather than transitioning into modern high-productivity

sectors. As a result, economic expansion may increase aggregate output while poverty persists due to the unequal distribution of the benefits of growth (Ali & Suliman, 2026; Suparman, 2022).

Central Java reflects this pattern of growth without proportional poverty reduction. Despite being part of Java Island, which contributed 56.94% of Indonesia's GDP in the second quarter of 2025, the province consistently recorded one of the highest poverty rates on the island between 2015 and 2025. By 2025, Central Java's poverty rate reached 9.48%, exceeding the national average of 8.25% (Statistics Indonesia, 2026). This condition is partly associated with a sectoral imbalance between output and labor absorption. In 2025, the manufacturing sector contributed 33.39% to GRDP while employing only 20.98% of the workforce, whereas the agricultural sector absorbed 26.01% of workers despite contributing only 13.07% to regional output (Statistics Indonesia, 2026). This pattern reflects the incomplete structural transformation described by Lewis (1954), in which surplus labor remains concentrated in low-productivity sectors with limited income growth (Imai et al., 2019). The condition is further worsened by the dominance of smallholder farmers, with approximately 83% of farmers in Central Java operating on landholdings smaller than 0.5 hectares whether owned or rented (Statistics Indonesia, 2023). These conditions suggest that economic growth alone may not be sufficient to reduce poverty when structural transformation fails to shift labor from low-productivity sectors into more productive economic activities.

Previous studies have shown mixed findings regarding the relationship between economic growth and poverty reduction. Several studies show that economic growth can reduce poverty through increased income opportunities and labor absorption (Falah & Rahmawati, 2024; Maryam et al., 2024). Other studies suggest that the poverty-reducing effect of growth is not always consistent, particularly in regions where labor absorption remains limited and a large share of the workforce is concentrated in low-productivity agricultural sectors, causing the benefits of economic expansion to be unevenly distributed across households (Agussalim et al., 2024; Nalle, 2026; Suparman, 2022). Furthermore, studies examining the role of structural transformation in the relationship between economic growth and poverty reduction also report differing findings. Erumban and de Vries (2024) find that in Asian developing countries and Sub-Saharan Africa, economic growth consistently reduces poverty even when structural transformation remains incomplete, particularly when growth is supported by agricultural productivity improvement. Meanwhile, Ardiansyah et al. (2020) find that in Indonesia, economic growth under unbalanced structural transformation reduces poverty only in the short term, but fails to do so and even worsens poverty in the long term due to widening inequality. These findings indicate that the poverty-reducing effect of economic growth may depend not only on output expansion, but also on the extent to which structural transformation improves labor productivity and employment absorption across sectors.

This study analyzes the effect of Gross Regional Domestic Product, Mean Years of Schooling, paddy productivity, and open unemployment rate on poverty across 35 regencies and cities in Central Java during 2015–2025. Unlike previous studies that primarily examine economic growth as a quantitative indicator of regional output, this study evaluates whether economic expansion is accompanied by inclusive structural transformation. The inclusion of paddy productivity also reflects the continuing importance of the agricultural sector, which absorbs a substantial share of the workforce in Central Java. Economic growth is positioned as the central driver, while education, labor market conditions, and agricultural productivity are examined as channels through which growth may influence poverty reduction.

The novelty of this study lies in examining economic growth not only in terms of output expansion, but also in terms of its effectiveness in reducing poverty under conditions of persistent labor concentration in low-productivity sectors. The study further contributes to the development economics literature by examining whether economic growth remains effective in reducing poverty when structural transformation remains unbalanced across sectors. Practically, the findings are

expected to provide policy insights regarding the importance of labor absorption and structural transformation in regional poverty reduction strategies.

LITERATURE REVIEW AND HYPOTHESIS FORMULATION

Economic Growth

Regional economic growth is theoretically expected to reduce poverty through multiple transmission channels. Todaro and Smith (2011) argue that economic growth reduces poverty by broadening labor absorption, raising household income, and improving purchasing power among lower-income groups. (Sen, 1999) extends this by emphasizing that growth reduces poverty only when it expands the substantive freedoms individuals need to participate in economic life, including access to productive employment and basic services. Together, these frameworks establish that poverty reduction depends not merely on the magnitude of output growth but also on whether economic expansion effectively translates into labor absorption, income improvement, and broader household welfare gains. (Lewis, 1954) introduces the dual-sector framework, arguing that in economies where structural transformation remains incomplete, surplus labor stays concentrated in low-productivity traditional sectors, and output expansion may therefore increase aggregate regional income while leaving household welfare among agricultural workers largely unchanged. This structural condition shapes the empirical relationship between GRDP and poverty in ways that existing studies have documented with mixed results.

Empirical evidence on the relationship between GRDP and poverty across regions in Indonesia shows mixed findings. Studies using regional panel data in Indonesia generally confirm that higher GRDP reduces poverty through expanded labor absorption and improved household purchasing power (Falah & Rahmawati, 2024; Machmud & Sidharta, 2023; Maryam et al., 2024). However, this poverty-reducing effect weakens considerably when economic expansion is concentrated in sectors with limited employment linkages. Suparman (2022) finds that in Indonesian provinces where income inequality persists, GRDP growth coincides with rising rather than falling poverty, as gains are captured disproportionately by higher-income groups rather than distributed through labor markets to poor households. Ardiansyah et al. (2020) further demonstrate that in Indonesia, growth under unbalanced structural transformation reduces poverty only in the short term but worsens it in the long term as distributional inequality widens. The economic structure of Central Java reflects this condition of incomplete structural transformation, placing the province in a context where the poverty-reducing effect of GRDP may be conditional rather than automatic. The first hypothesis is therefore formulated as follows:

H1: GRDP at constant prices has a significant negative effect on the poverty rate in Central Java.

Mean Years of Schooling (MYS)

The effectiveness of human capital in reducing poverty depends on whether educational attainment translates into productive labor market participation. Becker (1964) argues that education is a productive investment that enhances individual skills, raises labor productivity, and expands access to higher-paying employment, forming the theoretical basis for expecting Mean Years of Schooling to reduce poverty. (Sen, 1999) complements this by viewing education as a core human capability that expands individuals' economic and social opportunities, resulting in greater capacity to engage in productive economic activities and escape poverty. When average education levels remain low, the workforce's ability to adopt productive technologies becomes constrained and access to formal employment remains limited, conditions associated with higher poverty rates (Effendy, 2017).

Empirical evidence generally supports a negative relationship between MYS and poverty, although its effectiveness varies across regional contexts. Faritz and Soejoto (2020) find that MYS has a significant negative effect on poverty across all 35 regencies and cities in Central Java, while Yusuf and Hayati (2024) confirm that human capital improvements reduce poverty among districts

consistently recording poverty rates above the provincial average. However, this relationship is conditioned by labor market absorption capacity. (W. & Masjkur, 2020) demonstrate that higher educational attainment may not reduce poverty effectively when workforce qualifications are mismatched with available employment opportunities in low-productivity sectors. Rambe et al. (2024) further show that education contributes more effectively to poverty reduction when regional economic growth generates sufficient demand for educated workers. Under conditions of incomplete structural transformation, where employment remains concentrated in agriculture and informal activities, improvements in MYS may therefore not fully translate into welfare gains due to the limited absorption of educated labor. The second hypothesis is formulated as follows:
H2: Mean Years of Schooling has a significant negative effect on the poverty rate in Central Java.

Paddy Productivity

Paddy productivity represents a potential channel through which the agricultural sector can increase household income and reduce poverty in Central Java, where paddy farming remains a dominant agricultural activity and many rural households depend on farm output as a primary source of income (Lubis et al., 2024). Agricultural productivity reflects the efficiency of input utilization in generating agricultural output (Soekartawi, 2003), meaning that higher paddy productivity increases output per harvested hectare and strengthens farm income, thereby improving the ability of agricultural households to meet basic needs and reduce vulnerability to poverty. However, agricultural activities in Central Java are dominated by smallholder farmers who often face limited access to capital, technology, and institutional support (Supanggih & Widodo, 2013, as cited in Novindra & Arifah, 2024). Under these conditions, increases in productivity may not always translate into substantial welfare improvements for farming households.

Empirical evidence on the relationship between paddy productivity and poverty shows mixed findings. Kharisma (2020) finds that land productivity significantly reduces rural poverty in Indonesia, suggesting that improvements in agricultural output can generate meaningful income gains for farming households. However, Nalle (2026) finds that rice productivity does not significantly affect poverty, attributing this to structural barriers such as limited access to agricultural inputs and weak market institutions that prevent productivity gains from reaching poor households. Farida and Widodo (2024) similarly find no significant effect, while also showing that poverty itself constrains agricultural productivity, suggesting that the relationship between poverty and agricultural productivity works in both directions. These mixed findings indicate that the effect of paddy productivity on poverty may vary depending on the structural conditions faced by agricultural households. The third hypothesis is formulated as follows:

H3: Paddy productivity has a significant negative effect on the poverty rate in Central Java.

Unemployment

Unemployment represents another channel through which poverty may emerge and deepen in Central Java. In this study, unemployment is measured using the Open Unemployment Rate (TPT), which captures the percentage of the labor force that is unemployed, actively seeking work, and available to work (Statistics Indonesia, 2021). TPT is selected because it is consistently available across all 35 regencies and cities in Central Java during 2015–2025 and directly reflects the formal dimension of labor market distress that suppresses household income. Becker (1964) argues that individual productivity and employability are determined by the level of human capital, including education, skills, and health. Individuals with limited human capital are less competitive in the labor market and more vulnerable to prolonged unemployment, weakening their capacity to generate income and increasing poverty risk (Doppelt, 2019). When households lose a stable source of income, their ability to meet basic needs and invest in education and health becomes constrained, further reducing future economic opportunities and deepening poverty over time (Dahliah, 2023).

Empirical evidence supports a positive relationship between unemployment and poverty, though its magnitude varies across contexts. Yacoub and Restiatun (2024) find that unemployment significantly increases rural poverty through income loss and skill depreciation, indicating that unemployed individuals face a higher risk of falling below the poverty line. Chen and Tan (2022) further demonstrate that the relationship is asymmetric, where rising unemployment worsens poverty more severely than falling unemployment alleviates it, suggesting that the damage from job loss is not fully reversed by subsequent employment recovery. The fourth hypothesis is formulated as follows:

H4: Open unemployment rate has a significant positive effect on the poverty rate in Central Java.

RESEARCH METHODS

This study employs a quantitative approach using balanced panel data covering 35 regencies and cities in Central Java Province during 2015–2025, resulting in 385 observations. Panel data estimation enables simultaneous control of cross-sectional heterogeneity across regencies and temporal variation within individual units, which is particularly important in a structurally diverse province where poverty dynamics differ substantially between predominantly agrarian regencies and more urbanized areas.

The dependent variable is the poverty headcount ratio (P0), defined as the percentage of the population with average per capita monthly expenditure below the poverty line established by Statistics Indonesia (2026). Independent variables include paddy productivity measured in quintals per hectare, Mean Years of Schooling (RLS) measured in years for the population aged 25 and above, the open unemployment rate (TPT) measured as a percentage of the labor force, and Gross Regional Domestic Product (GRDP) at constant prices. GRDP is transformed into natural logarithmic form to normalize its distribution and reduce scale heterogeneity relative to the other variables. All data were obtained from official Statistics Indonesia publications at the provincial and regency/city level. Data processing and estimation were conducted using EViews 10. The regression model is specified as follows:

$$Povr_{it} = \alpha + \beta_1 \ln GRDP_{it} + \beta_2 RLS_{it} + \beta_3 PP_{it} + \beta_4 TPT_{it} + \varepsilon_{it} \dots \dots \dots (1)$$

where Povr is the poverty headcount ratio, α is the intercept term, $\ln GRDP$ is the natural logarithm of GRDP at constant prices, RLS is Mean Years of Schooling, PP is paddy productivity, TPT is the open unemployment rate, i denotes the cross-sectional unit, t denotes the time period, and ε is the error term.

Model selection followed a sequential specification testing procedure. The Chow test was first applied to compare the Common Effect Model (CEM) and the Fixed Effect Model (FEM) by evaluating whether unit-specific effects improve the estimation over a pooled model. If the Chow test rejects the CEM in favor of the FEM, the Hausman test is subsequently applied to determine whether the FEM or the Random Effect Model (REM) produces more consistent estimates by testing for correlation between unit-specific effects and the independent variables. If the Hausman test fails to reject the REM, the Lagrange Multiplier test is applied to choose between the CEM and the REM by evaluating the significance of individual-specific variance components. The model selected through this procedure is then used as the basis for all subsequent estimation and hypothesis testing.

Following model selection, classical assumption tests are conducted to ensure the reliability of the estimates. Multicollinearity is assessed using the pairwise correlation matrix, where a correlation coefficient exceeding 0.8 between any two independent variables indicates a serious multicollinearity problem (Gujarati, 2003). Heteroskedasticity is examined using the Glejser test, where a p-value below 0.05 indicates the presence of non-constant error variance. If heteroskedasticity is detected, White cross-section standard errors and covariance with degrees-

of-freedom correction are applied to produce robust estimates. The normality test is not conducted because with 385 observations the Central Limit Theorem ensures asymptotic normality of the estimators (Gujarati, 2003), and the autocorrelation test is not separately conducted because the selected panel estimation procedure and robust standard errors are expected to mitigate potential serial correlation problems in the error term.

Hypothesis testing is conducted through three procedures. The coefficient of determination (R^2) and Adjusted R^2 are reported to measure the proportion of variation in the poverty rate explained by the independent variables. The F-test evaluates whether all independent variables jointly have a significant effect on the poverty rate at the 5% significance level. The t-test assesses the partial effect of each independent variable on the poverty rate, where a p-value below 0.05 indicates a statistically significant effect in the hypothesized direction.

RESULTS AND DISCUSSION

Research Area Overview

During the period 2015 to 2025, the poverty rate in Central Java Province showed a declining trend, falling from 13.58% in 2015 to 10.80% in 2019 before rising temporarily to 11.79% in 2021 due to the Covid-19 pandemic, then resuming its decline to reach 9.48% in 2025. Although the poverty rate declined over time, Central Java's poverty rate continued to exceed the national average of 8.25% in 2025, indicating that the pace of reduction has not been sufficient to close the gap with national development targets. Poverty distribution across the province's 35 regencies and cities is also highly uneven. In 2015, poverty rates ranged from 4.97% in Kota Semarang to 21.45% in Wonosobo, and while the gap narrowed by 2025, the disparity remained with rates ranging from 3.80% in Kota Semarang to 14.15% in Brebes (Statistics Indonesia, 2026).

The variation in poverty rates is partly shaped by differences in employment structure across regencies and cities in Central Java. Agriculture, forestry, and fisheries constitute the largest source of employment in Central Java. However, the employment structure varies across regencies and cities. Grobogan, for instance, recorded 38.78% of its workforce in the agricultural sector in 2025. In contrast, Kudus recorded 44.56% of its workforce in manufacturing driven by tobacco processing industries, while Kota Semarang recorded 67.22% in the service sector, reflecting its role as the provincial capital with an urban-dominated economy. These differences illustrate the diverse economic characteristics of regencies and cities in Central Java, ranging from agrarian-dependent areas to manufacturing-based and service-oriented urban economies.

Model Selection

Test	Statistic	d.f.	Prob.	Decision
Chow Test	1037.288	34	0.0000	FEM selected over CEM
Hausman Test	118.188	4	0.0000	FEM selected over REM

The Chow test indicated that the Fixed Effect Model was preferred to the Common Effect Model, as evidenced by a probability value of 0.0000. The Hausman test further supported the use of the Fixed Effect Model over the Random Effect Model, with a probability value of 0.0000. Based on these results, the Fixed Effect Model was used for the estimation.

Classical Assumption Tests

Multicollinearity

Variable	LN_GRDP	RLS	PP	TPT
LN_GRDP	1.000000	0.097477	0.136318	0.137391
RLS	0.097477	1.000000	0.168900	-0.009935
PP	0.136318	0.168900	1.000000	-0.097853
TPT	0.137391	-0.009935	-0.097853	1.000000

All pairwise correlation coefficients among the independent variables remain below the 0.8 threshold, with the highest correlation coefficient of only 0.169 observed between RLS and PP. These results indicate that multicollinearity does not constitute a serious problem in the model.

Heteroskedasticity

The Glejser test detected the presence of heteroskedasticity in the model, as indicated by the TPT variable with a probability value of 0.0000, below the 0.05 significance threshold. To address this issue, the model was re-estimated using White cross-section standard errors and covariance with degrees-of-freedom correction, producing robust standard errors that remain valid in the presence of heteroskedasticity without altering the coefficient estimates.

Regression Result

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	109.4645	6.687968	16.36738	0.0000
LN_GRDP	-10.68788	0.737828	-14.48560	0.0000
RLS	1.034578	0.310792	3.328844	0.0010
PP	0.009430	0.017071	0.552377	0.5810
TPT	0.000583	0.087139	0.006686	0.9947

R-squared	0.966725
Adjusted R-squared	0.963071
F-statistic	264.5337
Prob (F-statistic)	0.000000

Note: Estimation uses Fixed Effect Model with White cross-section standard errors and covariance (d.f. corrected)

The estimated coefficients indicate that a 1% increase in GRDP is associated with a reduction of approximately 0.107 percentage points in the poverty rate, *ceteris paribus*. Meanwhile, an additional year of Mean Years of Schooling is associated with an increase of approximately 1.035 percentage points in the poverty rate. Paddy productivity and the open unemployment rate have positive coefficients; however, both variables are statistically insignificant and therefore should not be interpreted as meaningful determinants of poverty in Central Java.

Coefficient of Determination and F-Test

The model explains 96.67% of the variation in poverty rates across regencies and cities in Central Java, as indicated by an R-squared value of 0.967. The Adjusted R-squared value of 0.963 further suggests that the model retains strong explanatory power after accounting for the number of explanatory variables included in the estimation. The F-statistic of 264.533 with a probability value of 0.0000 indicates that the independent variables jointly have a statistically significant effect on poverty. Therefore, the model is considered statistically valid for explaining poverty variation across regencies and cities in Central Java.

Effect of GRDP on Poverty

GRDP at constant prices has a significant negative effect on the poverty rate in Central Java, supporting H1. This finding is consistent with Falah and Rahmawati (2024) and Maryam et al. (2024), who find that higher regional output reduces poverty through expanded labor absorption and improved household purchasing power. While the dual-sector framework of Lewis (1954) suggests that poverty reduction depends on the successful transfer of surplus labor from low-productivity to high-productivity sectors, Erumban and de Vries (2024) show that economic growth can still reduce

poverty even under conditions of incomplete structural transformation, particularly when supported by agricultural productivity improvements and sectoral growth. This finding suggests that economic growth can still contribute to poverty reduction even when structural transformation remains incomplete.

Effect of MYS on Poverty

Mean Years of Schooling has a significant positive effect on the poverty rate in Central Java, which contradicts the expected direction in H2. This result is consistent with Surbakti et al. (2023), who find that Mean Years of Schooling can have a direct positive effect on poverty, suggesting that increasing schooling duration without corresponding improvements in educational quality and practical skills may fail to alleviate poverty. The finding also aligns with W. and Masjkur (2020), who report that higher educational attainment is associated with lower labor absorption and emphasize the importance of strengthening the link between education and labor market needs. (Rambe et al., 2024) further suggest that education contributes to poverty reduction more effectively when economic growth generates productive employment opportunities capable of absorbing educated workers. One possible explanation for this finding is that improvements in educational attainment in Central Java have not been fully accompanied by the expansion of productive employment opportunities capable of utilizing higher levels of education. As a result, increases in Mean Years of Schooling may not immediately translate into welfare improvements or poverty reduction. This finding suggests that human capital accumulation alone may be insufficient to reduce poverty when labor market conditions limit the productive utilization of educated workers.

Effect of Paddy Productivity on Poverty

Paddy productivity does not have a significant effect on the poverty rate in Central Java, failing to support H3. This result is consistent with Nalle (2026) and Farida and Widodo (2024), who similarly find no significant effect of agricultural productivity on poverty. Their findings suggest that productivity improvements do not automatically translate into poverty reduction when structural constraints limit the transmission of agricultural gains into household welfare. In Central Java, where approximately 83% of farmers operate on landholdings smaller than 0.5 hectares, productivity gains may not be sufficient to generate substantial increases in household income among smallholder farmers. Limited land ownership, restricted access to capital and technology, and weak market integration may further constrain the ability of agricultural households to convert productivity improvements into welfare gains. This finding suggests that, in the context of smallholder-dominated agriculture, productivity improvements alone are insufficient to reduce poverty without complementary interventions addressing land fragmentation, access to productive resources, and market integration.

Effect of Open Unemployment Rate on Poverty

The open unemployment rate does not have a significant effect on the poverty rate in Central Java, failing to support H4. This finding suggests that variations in open unemployment are not a primary determinant of poverty differences across regencies and cities in Central Java during the study period. This result is consistent with Chen and Tan (2022), who show that the relationship between unemployment and poverty is context-dependent and may vary across economic conditions. Similar findings have been documented in the Indonesian context, where Rahmaningtyas and Adianita (2023) find that the open unemployment rate has no significant effect on poverty across 34 provinces in Indonesia, suggesting that unemployed individuals are not necessarily those with the lowest income. One possible explanation is that poverty in Central Java is driven more by underemployment and low productivity in the informal and agricultural sectors than by open unemployment, causing changes in the open unemployment rate to not necessarily translate into significant changes in poverty levels across regencies and cities.

CONCLUSION

This study examines the determinants of poverty across 35 regencies and cities in Central Java during the period 2015–2025 using a Fixed Effect Model with robust standard errors. The results show that GRDP at constant prices has a significant negative effect on poverty, indicating that regional economic growth remains an important driver of poverty reduction in Central Java. Mean Years of Schooling has a significant positive effect on poverty, contrary to the expected direction, suggesting that improvements in educational attainment have not been accompanied by sufficient productive employment opportunities capable of translating human capital accumulation into welfare gains. Meanwhile, paddy productivity and the open unemployment rate do not have a significant effect on poverty.

These findings imply that sustaining economic growth remains important for poverty reduction in Central Java. However, the positive coefficient of Mean Years of Schooling suggests that educational expansion alone may be insufficient to alleviate poverty without stronger linkages between education and labor market opportunities. The non-significant effect of paddy productivity indicates that productivity improvements may not automatically improve household welfare in regions dominated by smallholder agriculture. Similarly, the non-significant effect of the open unemployment rate suggests that poverty may be influenced by broader labor market conditions beyond open unemployment alone.

This study has several limitations. First, the analysis does not incorporate lag structures that may better capture the long-term effects of education and agricultural productivity on poverty. Second, the open unemployment rate may not fully reflect labor market conditions relevant to poverty, particularly in regions where informal employment remains substantial. Third, income inequality was not included in the model because district and city-level Gini Ratio data for Central Java were not consistently available throughout the study period, particularly for 2016–2020. Given that income distribution may influence the extent to which economic growth translates into poverty reduction, future studies are encouraged to incorporate inequality measures when more complete data become available. Finally, the study focuses on four explanatory variables and therefore does not capture all factors that may influence poverty across regencies and cities in Central Java. Future research is encouraged to employ dynamic panel models to examine the delayed effects of education and agricultural productivity on poverty. Further studies may also incorporate alternative labor market indicators, income inequality measures, and additional socioeconomic variables to provide a more comprehensive understanding of poverty dynamics at the regional level.

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