

INFLATION, EDUCATION, LABOR FORCE PARTICIPATION, AND POVERTY IN NORTH SUMATRA: EVIDENCE FROM 2005-2024

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Abstract

This study examines how inflation, education, and labor force participation influenced the poverty rate in North Sumatra Province during 2005-2024. Annual secondary data were obtained from Statistics of North Sumatra. Education was represented by the school participation rate for the 16-18 age group, while labor market involvement was measured by the labor force participation rate. Multiple linear regression was estimated with EViews 13 after testing residual normality, multicollinearity, serial correlation, and heteroskedasticity. Inflation had a positive and statistically significant coefficient ($\beta = 0.112683$; $p = 0.0458$). Education had a negative and significant coefficient ($\beta = -0.273439$; $p < 0.001$), and labor force participation also had a negative and significant coefficient ($\beta = -0.299388$; $p = 0.0234$). The model was jointly significant ($F = 28.09907$; $p < 0.001$) and explained 81.06% of the adjusted variation in poverty. The findings indicate that poverty reduction requires coordinated price stabilization, stronger upper-secondary participation, and expansion of productive employment opportunities.

Keywords: education; inflation; labor force participation; North Sumatra; poverty

INTRODUCTION

Poverty remains a central development problem because it reflects more than insufficient income. It also indicates restricted access to food, housing, education, health services, and opportunities to participate productively in the economy. Statistics Indonesia applies a basic-needs approach and classifies people as poor when their average per capita expenditure falls below the poverty line (BPS, 2023). This condition matters for regional development because persistent poverty can limit human-capital formation, weaken labor productivity, and reproduce deprivation across generations. North Sumatra presents an important case. The province has substantial agricultural, plantation, industrial, and trade potential, yet poverty has not disappeared and has responded unevenly to economic shocks. The coexistence of a diversified economic base and continuing poverty raises a policy question about which macroeconomic and social factors are most closely associated with changes in household welfare.

The long-run pattern shows meaningful progress but also repeated interruptions. The poverty rate declined from 14.68% in 2005 to 7.99% in 2024, although it rose to 15.66% in 2006, increased again in 2015, and moved upward from 8.75% in 2020 to 9.01% in 2021 during the continuing effects of the COVID-19 pandemic. Afterward, poverty fell to 8.42% in 2022, 8.15% in 2023, and 7.99% in 2024. These movements suggest that poverty responds to more than aggregate growth alone. Changes in consumer prices, access to education, and the capacity of the labor market to absorb working-age residents can influence whether households maintain or lose the resources required to meet basic needs.

Inflation is one potential mechanism. A sustained increase in the general price level reduces real purchasing power when nominal income does not adjust at the same pace. The effect is especially important for low-income households because a large share of their expenditure is directed to food, energy, transportation, and other essentials. North Sumatra experienced pronounced inflation volatility during the study period, including 22.41% in 2005, 10.72% in 2008, 10.18% in 2013, and 6.12% in 2022. Yet the annual relationship was not mechanically uniform. In 2021, inflation fell to 1.71% while poverty rose to 9.01%, largely in a context of pandemic-related income and employment losses. In 2022, inflation increased sharply while poverty declined during economic recovery. Such episodes show why a multivariate model is necessary: the poverty effect of inflation must be evaluated while education and labor-force participation are held constant.

Education is a second mechanism because it shapes the knowledge and skills required for productive employment. The study measures education using the school participation rate for residents aged 16-18, corresponding to upper-secondary education. This indicator increased from 65.77% in 2005 to 78.59% in 2024 and reached 79.25% in 2023. Higher participation may reduce future poverty by improving employability and earnings capacity, but the effect can take time to appear. For example, school participation increased in 2021 while poverty also rose, reflecting the fact that enrollment does not immediately offset a severe macroeconomic shock. In 2024, school participation declined slightly while poverty continued to fall, suggesting that contemporaneous poverty also depends on labor-market recovery, social protection, and price conditions.

Labor force participation is the third mechanism. The labor force participation rate (LFPR) indicates the proportion of working-age residents who are employed or actively seeking work. In principle, broader participation can increase household income and regional output. However, a high LFPR does not automatically guarantee poverty reduction if available jobs are informal, unstable, or poorly paid. North Sumatra's LFPR fluctuated between 65.99% and 72.09% during 2005-2024. It fell to 68.67% in 2020 as economic activity contracted, then recovered gradually to 71.36% in 2024. The quality of labor absorption therefore matters alongside the number of people entering the labor market.

Previous research reports mixed findings. Inflation has been found to increase poverty in several studies, while other research identifies weak or insignificant relationships. Education generally shows a poverty-reducing effect, but its significance varies with the indicator, period, and unit of analysis. Evidence on labor force participation is similarly inconsistent because an increase in labor supply can reduce poverty when workers obtain productive jobs, but may have little effect when employment quality remains low. Many earlier studies also examine these variables separately, use panel data across districts or provinces, or focus on shorter periods. The present study integrates inflation, upper-secondary school participation, and labor force participation in one annual model for North Sumatra over 2005-2024, a period that covers pre-pandemic conditions, the pandemic shock, and post-pandemic recovery.

Accordingly, this study aims to estimate the partial and simultaneous effects of inflation, education, and labor force participation on the poverty rate in North Sumatra. Its contribution is threefold. First, it provides a two-decade time-series view of poverty dynamics. Second, it connects macroeconomic price stability with human-capital access and labor-market participation in one empirical specification. Third, it translates the results into coordinated regional policy priorities rather than treating poverty as the outcome of a single sector.

LITERATURE REVIEW

Poverty and the Development Trap

Poverty can be understood as the inability of individuals or households to satisfy minimum food and non-food needs. The basic-needs approach used by BPS emphasizes consumption expenditure and identifies the share of residents below the poverty line. This measure is particularly relevant for regional policy because it captures the immediate capacity of households to secure essential goods and services. Poverty nevertheless has a dynamic dimension. Nurkse's vicious-circle theory argues that low income restricts saving, investment, nutrition, and education; these constraints lower productivity and reproduce low income (Nurkse, 1953). The theory therefore links macroeconomic pressures, human-capital limitations, and labor-market outcomes in a mutually reinforcing process.

The vicious circle can operate through several channels in North Sumatra. Price increases can reduce real consumption and force vulnerable households below the poverty line. Limited schooling can constrain skills, occupational mobility, and long-term earnings. Weak labor absorption can leave working-age residents unemployed or concentrated in low-productivity activities. These channels justify an integrated empirical model in which inflation, school participation, and labor-force participation jointly explain variation in the poverty rate.

Inflation and Poverty

Inflation is a sustained and broad increase in the prices of goods and services. From a Keynesian perspective, demand-pull inflation can emerge when aggregate demand exceeds productive capacity, while cost-push inflation results from higher input, energy, wage, or distribution costs. Both forms can affect poverty, but the transmission differs. Demand-led inflation may accompany economic expansion and employment growth, whereas cost-push inflation can raise living costs while simultaneously constraining production. The distributional impact depends on whether household income and employment improve enough to compensate for higher prices. For poor and near-poor households, the dominant short-run channel is a decline in real purchasing power. These households allocate a high proportion of income to necessities and possess limited savings with which to smooth consumption. Persistent

increases in food, transport, housing, or energy prices therefore reduce the quantity and quality of goods they can purchase. Inflation may also lift the nominal poverty line because the cost of the basic-needs basket increases. When wages and social transfers adjust slowly, households that were previously just above the threshold may become statistically and materially poor. Empirical studies in Indonesia often support a positive relationship between inflation and poverty (Faisal & Ichsan, 2020; Nasution et al., 2023; Simanungkalit, 2023). Muttaqin and Anwar (2023) also found a positive short-run inflation effect, although their long-run result was not significant. By contrast, Murobbi and Usman (2021) and Susanto and Pangesti (2020) reported different or insignificant effects, indicating that context, model specification, and the source of inflation matter.

The North Sumatra data similarly show that inflation and poverty can move in different directions in individual years. Such divergence does not invalidate the purchasing-power mechanism; rather, it indicates that recovery, employment, transfers, and base effects may counteract or dominate price pressures in a given period. After controlling for education and labor-force participation, the expected net coefficient remains positive. Thus, H1 states that inflation has a positive and significant effect on the poverty rate in North Sumatra.

Education and Poverty

Human capital theory treats education as an investment that raises knowledge, skills, productivity, and potential earnings (Becker, 1993). Schooling can reduce poverty directly by improving access to better-paid employment and indirectly by strengthening adaptability, health awareness, financial decision-making, and intergenerational mobility. The effect is especially relevant at the upper-secondary level because this stage prepares young people either to enter the labor market with foundational competencies or to continue to tertiary education.

The present study uses the school participation rate for ages 16-18 rather than average years of schooling or literacy. This indicator measures the proportion of the relevant age group that remains enrolled in formal education. A higher rate implies broader access and lower dropout at the transition to upper-secondary schooling. It does not, however, directly measure learning quality, completion, or the relevance of acquired skills. Consequently, the poverty effect may emerge gradually and may depend on whether local labor demand rewards the education obtained.

Most empirical evidence supports a poverty-reducing role for education. Akhir et al. (2019) found that education negatively and significantly affected poverty in West Sumatra. Athadena (2021) and Isroviyah (2022) reached similar conclusions in different Indonesian settings, while Susanto and Pangesti (2019) emphasized education as a pathway to higher productivity and income. Other studies, however, report insignificant or even positive estimates depending on the education proxy and period (Aliyah et al., 2025; Serly et al., 2025). These differences reinforce the need to examine North Sumatra directly. On theoretical grounds, H2 states that education, represented by upper-secondary school participation, has a negative and significant effect on poverty.

Labor Force Participation and Poverty

Labor-market theory links household welfare to the interaction of labor supply, labor demand, wages, and employment opportunities. Marshall's framework emphasizes that wages are shaped by the relationship between the demand for labor from firms and the supply of labor from households (Marshall, 1890). If labor supply expands without corresponding demand, wages may remain low and unemployment may rise. If expanding participation is accompanied by productive job creation, however, more households gain earned income and poverty should decline.

The LFPR measures the proportion of the working-age population that is employed or actively looking for work. It is therefore broader than the employment rate and should be interpreted carefully. An increase can reflect more people obtaining work, but it can also reflect discouraged or financially pressured household members entering job search. The poverty outcome depends on employment quality, hours worked, productivity, and remuneration. This distinction is important in economies where informal work absorbs a large share of labor but may provide unstable earnings.

Evidence from Indonesia is mixed. Mirah et al. (2020) described labor-force participation as an important development driver. Muttaqin and Anwar (2023) found a negative and significant relationship between LFPR and poverty, while Matondang et al. (2024) reported a similar result for North Sumatra. Other studies found a negative but insignificant effect, including Nurhaila and Anwar (2024), Serly et al. (2025), and Lestari et al. (2025). The differences are consistent with variation in employment structure and wage quality. The expected relationship in this study remains negative because broader participation, when supported by available work, increases the probability that households receive labor income. H3 therefore states that LFPR has a negative and significant effect on poverty.

Integrated Framework and Joint Hypothesis

Inflation, education, and labor-force participation represent complementary dimensions of poverty. Inflation captures pressure on the cost of living; education reflects access to a key form of human-capital investment; and LFPR reflects engagement with the labor market. Their effects can also interact in practice. Education may improve the capacity of workers to enter higher-productivity jobs, but inflation can erode the real value of the resulting earnings. A high LFPR may support poverty reduction, but its effectiveness depends on the availability of work and on the purchasing power of wages. An integrated model can therefore provide a more complete explanation than separate bivariate analyses. Based on this framework, H4 states that inflation, education, and labor-force participation jointly have a statistically significant effect on the poverty rate in North Sumatra. The estimated signs are expected to be positive for inflation and negative for education and LFPR.

METHOD

This research used a quantitative explanatory design based on annual time-series data for North Sumatra Province from 2005 to 2024. The unit of observation was the province-year, producing 20 observations for each variable. All data were secondary data obtained from Statistics of North Sumatra. Documentary and computerized searches were used to compile the series; no questionnaire or respondent sampling was required.

The dependent variable was the poverty rate, measured as the percentage of residents whose per capita expenditure was below the poverty line. Inflation was measured by the annual change in the consumer price index. Education was proxied by the school participation rate for the 16-18 age group, representing upper-secondary participation. Labor-market involvement was measured by the labor force participation rate among residents aged 15 years and older. All variables were expressed in percentages, which makes the regression coefficients interpretable as percentage-point changes, conditional on the other regressors.

Table 1. Operationalization of research variables

Variable	Symbol	Operational measure	Expected sign
Poverty rate	POV	Percentage of residents below the poverty line	Dependent
Inflation	INF	Annual consumer-price inflation (%)	+
Education	APS	School participation rate, ages 16-18 (%)	-
Labor force participation	LFPR	Labor force as a share of population aged 15+ (%)	-

Multiple linear regression was estimated using ordinary least squares in EViews 13. The empirical model was specified as follows:

$$POV_t = \beta_0 + \beta_1 INF_t + \beta_2 APS_t + \beta_3 LFPR_t + \varepsilon_t \quad (1)$$

In Equation (1), POV denotes the poverty rate, INF is inflation, APS is upper-secondary school participation, LFPR is labor-force participation, β_0 is the intercept, β_1 - β_3 are partial regression coefficients, and ε is the error term. Each coefficient measures the expected change in poverty associated with a one-percentage-point change in the relevant explanatory variable, assuming the other variables remain constant.

Model adequacy was assessed through four diagnostic procedures. The Jarque-Bera test evaluated residual normality. Centered variance inflation factors were used to identify multicollinearity, with values below 10 treated as acceptable. The Breusch-Godfrey LM test assessed serial correlation, and the White test assessed heteroskedasticity. Hypotheses were tested at the 5% significance level using partial t-tests and a simultaneous F-test. The adjusted coefficient of determination was used to summarize the proportion of poverty variation explained after accounting for the number of regressors.

RESULTS AND DISCUSSION

Development of the Study Variables

The poverty series shows a substantial long-term decline with several temporary reversals. Poverty increased from 14.68% in 2005 to 15.66% in 2006 following strong price pressure, then generally decreased through 2014. It rose to 10.53% in 2015 before returning to a downward trajectory. The pandemic period interrupted this progress: poverty moved from 8.75% in 2020 to 9.01% in 2021 as economic activity, employment, and household income were disrupted. The rate subsequently declined to 7.99% in 2024, the lowest value in the sample.

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Inflation was the most volatile variable. It reached 22.41% in 2005 and 10.72% in 2008, reflecting major energy and commodity-price pressures. Inflation was also high in 2013 and 2014 following fuel-price adjustments. It remained relatively moderate during 2015-2021 and then rose to 6.12% in 2022 before declining to 2.25% in 2023 and 2.12% in 2024. These fluctuations imply that the cost-of-living channel varied considerably across years.

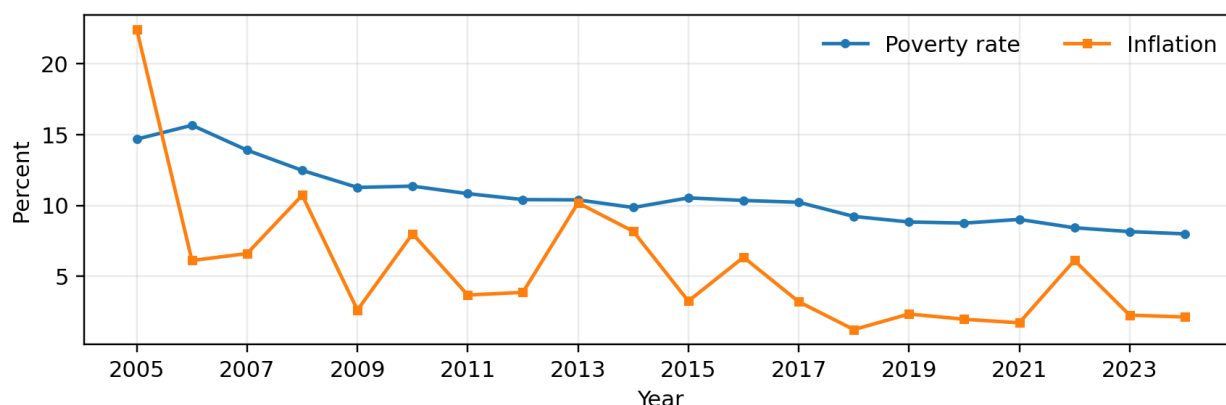


Figure 1. Poverty and inflation in North Sumatra, 2005-2024

Source: Statistics of North Sumatra, processed by the author (2026).

Educational participation improved more steadily. The APS for ages 16-18 rose from 65.77% in 2005 to 78.59% in 2024, an increase of 12.82 percentage points. The strongest gains occurred after 2011, and the indicator reached a maximum of 79.25% in 2023. LFPR displayed a narrower but irregular pattern. It declined from 71.94% in 2005 to 66.90% in 2006, reached 72.09% in 2011, fell to 65.99% in 2016, and recovered to 71.36% in 2024. The contrast between the steady rise in school participation and the cyclical movement of LFPR illustrates that human-capital access and current labor-market engagement capture different dimensions of regional welfare.

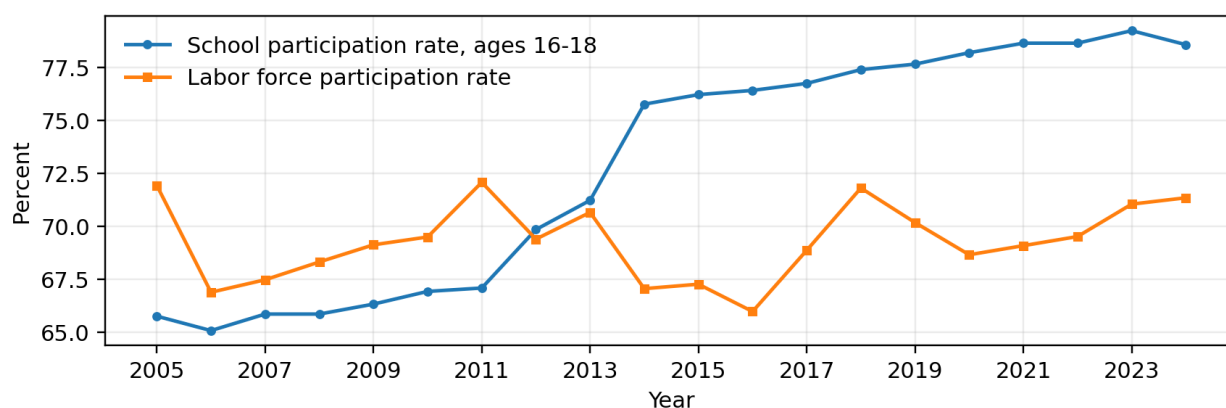


Figure 2. Education and labor force participation in North Sumatra, 2005-2024

Source: Statistics of North Sumatra, processed by the author (2026).

Table 2. Descriptive statistics, 2005-2024

Statistic	INF	APS	LFPR	POV
Mean	5.641500	72.88650	69.32150	10.61450
Maximum	22.41000	79.25000	72.09000	15.66000
Minimum	1.230000	65.09000	65.99000	7.990000
Standard deviation	4.881232	5.581691	1.804081	2.141341

Table 2 confirms that inflation had the greatest relative variation, with a standard deviation of 4.881232 around a mean of 5.641500. APS varied across a broader long-run range but followed an upward trend, whereas LFPR had the smallest standard deviation (1.804081), indicating comparatively limited dispersion. The mean poverty rate was 10.61450%, with a range from 7.99% to 15.66%.

Temporal Interpretation of the Observed Series

The annual paths in Figures 1 and 2 reinforce the need to separate short-run shocks from gradual structural change. The early part of the sample combined very high inflation with poverty that initially rose and then declined. Inflation reached 22.41% in 2005 and remained elevated in several later years, while poverty fell after 2006. This pattern is compatible with a positive conditional inflation coefficient because the regression evaluates the average relationship after education and labor-force participation are controlled. It also shows that public transfers, wage adjustments, agricultural income, and broader economic recovery can partially offset a price shock in particular years. Purchasing-power studies similarly emphasize that the welfare effect of inflation depends on the composition of household consumption and on whether nominal income keeps pace with essential prices (Angraeni et al., 2025; Artati et al., 2025).

The middle years of the sample show why education should be interpreted as a cumulative rather than instantaneous poverty mechanism. APS rose strongly from 69.86% in 2012 to 75.78% in 2014 and continued increasing thereafter, while poverty generally declined but did not move monotonically. School participation expands access to human-capital formation, yet the income return appears only when students remain in school, complete the relevant level, acquire usable competencies, and enter productive employment. Evidence for North Sumatra has connected educational access with lower poverty, while also showing that the indicator used and the period of observation can alter the estimated magnitude (Ritonga et al., 2024; Togatorop et al., 2024). The negative APS coefficient should therefore be read as a long-period association between wider upper-secondary participation and lower poverty, not as an immediate one-year treatment effect.

LFPR moved differently from APS because it is more sensitive to the business cycle, household decisions, and the availability of work. Its fall to 65.99% in 2016 and decline to 68.67% in 2020 indicate that participation can weaken even when educational access is improving. During the recovery, LFPR rose to 71.36% in 2024 as economic activity and labor absorption improved. Indonesian studies nevertheless report heterogeneous LFPR coefficients because participation includes both workers and active job seekers, and because formal employment, informal work, hours, productivity, and wage quality differ across regions (Delviera & Amar, 2024; Desmawan et al., 2023). The negative estimate in this study is thus most plausible when additional labor-force participation is accompanied by actual employment and adequate remuneration.

The pandemic years provide the clearest illustration of joint determination. In 2021, poverty rose despite low inflation and higher APS, indicating that disrupted employment and household income outweighed favorable movements in other indicators. In 2022, poverty declined even though inflation increased to 6.12%, consistent with reopening, stronger activity, and social-protection support. Research on North Sumatra has documented the contribution of protection programs during the pandemic and the subsequent recovery of labor-market participation (Sinaga et al., 2022; Sipayung et al., 2026). These observations support an integrated interpretation in which inflation, education, and labor-market participation operate through different time horizons and can temporarily offset one another.

Because the analysis uses only 20 annual observations in a static OLS specification, the coefficients should be interpreted with appropriate caution. The diagnostic tests reported in the source study address residual normality, multicollinearity, serial correlation, and heteroskedasticity, but they do not by themselves establish causal identification or distinguish short-run from long-run dynamics. Future research should examine stationarity, structural breaks, and possible cointegration, especially because the sample includes major fuel-price adjustments and the COVID-19 shock. Even with these limitations, the model offers a transparent summary of how three policy-relevant indicators moved with poverty over two decades.

Model Diagnostic Tests

The diagnostic results indicate that the estimated model met the assumptions evaluated in the study. The residual Jarque-Bera probability was 0.425342, above 0.05, so residual normality was not rejected. Centered VIF values ranged from 1.015666 to 1.411149, far below the threshold of 10. The Breusch-Godfrey LM probability for Obs*R-squared was 0.0927, indicating no statistically significant serial correlation at the 5% level. The White-test probability was 0.2270, so the null hypothesis of homoskedasticity was not rejected.

Table 3. Summary of classical-assumption tests

Diagnostic	Test statistic / indicator	Probability / value	Decision
Normality	Jarque-Bera = 1.709725	0.425342	Residuals normally distributed
Multicollinearity	Centered VIF: 1.015666-1.411149	< 10	No problematic multicollinearity
Serial correlation	BG Obs*R ² = 4.757495	0.0927	No serial correlation at 5%
Heteroskedasticity	White Obs*R ² = 11.76268	0.2270	Homoskedasticity not rejected

Multiple Regression and Hypothesis Testing

Table 4 presents the estimated coefficients. All three explanatory variables were statistically significant at the 5% level and had the signs predicted by the conceptual framework. The estimated equation was $POV = 50.66278 + 0.112683 \text{ INF} - 0.273439 \text{ APS} - 0.299388 \text{ LFPR}$.

Table 4. Multiple linear regression results

Variable / statistic	Coefficient	Std. error	t-statistic	Probability	Inference
Constant	50.66278	8.633329	5.868279	0.0000	Significant
Inflation (INF)	0.112683	0.052035	2.165504	0.0458	Positive; H1 supported
Education (APS)	-0.273439	0.045446	-6.016826	0.0000	Negative; H2 supported
Labor force participation (LFPR)	-0.299388	0.119443	-2.506531	0.0234	Negative; H3 supported
R-squared	0.840474				
Adjusted R-squared	0.810563				
F-statistic (probability)	28.09907			0.000001	Jointly significant; H4 supported

The inflation coefficient of 0.112683 means that, holding APS and LFPR constant, a one-percentage-point increase in inflation was associated with a 0.112683-percentage-point increase in the poverty rate. The APS coefficient of -0.273439 indicates that a one-percentage-point rise in upper-secondary school participation was associated with a 0.273439-percentage-point decline in poverty, other variables held constant. The LFPR coefficient of -0.299388 indicates that a one-percentage-point increase in labor-force participation was associated with a 0.299388-percentage-point decline in poverty. The constant is a mathematical intercept and should not be interpreted as a realistic poverty prediction when all explanatory variables equal zero because those values lie outside the observed range.

The F-statistic of 28.09907 with a probability of 0.000001 shows that the regressors were jointly significant. The R-squared value of 0.840474 indicates that 84.05% of the observed variation in poverty was associated with the variables included in the model. After adjustment for the number of predictors, the explanatory share was 81.06%. The remaining 18.94% reflects factors not represented in this specification, such as economic growth, unemployment, wage levels, inequality, social assistance, demographic change, and other shocks.

Effect of Inflation on Poverty

The positive and significant inflation coefficient supports H1 and is consistent with the purchasing-power channel. When consumer prices rise, households with fixed or slowly adjusting incomes can purchase fewer goods and services. This pressure is strongest for poor and vulnerable groups because essential consumption accounts for most of their budgets. Inflation can therefore increase both the depth of deprivation and the number of households falling below the poverty line. The result is consistent with Faisal and Ichsan (2020), Nasution et al. (2023), and Simanungkalit (2023), who identified a positive relationship between inflation and poverty in Indonesia. The magnitude should be read in the context of North Sumatra's inflation history. The province experienced exceptionally high inflation in 2005 and several later episodes associated with fuel, food, transport, and global commodity

pressures. These shocks can spread through distribution costs and the prices of basic necessities. The coefficient indicates that, after controlling for education and labor-force participation, higher inflation was associated with higher poverty over the full period. This does not imply that every annual increase in inflation raised poverty. The 2022 recovery is an important counterexample: inflation increased to 6.12% while poverty declined, likely because economic reopening, employment recovery, and social protection improved incomes enough to offset part of the price shock. The regression estimate captures the average conditional relationship across 20 years rather than a deterministic year-by-year rule.

The policy implication is that poverty reduction requires attention to the composition of inflation, not only the headline rate. Regional coordination between the provincial government, Bank Indonesia, and the Regional Inflation Control Team should prioritize food availability, interregional distribution, transport bottlenecks, market information, and targeted protection when administered prices change. Broad price controls can create distortions, but timely supply management and well-targeted transfers can protect real consumption among vulnerable households.

Effect of Education on Poverty

The negative and significant APS coefficient supports H2 and confirms the relevance of human-capital theory. Greater participation in upper-secondary education is associated with lower poverty because continued schooling expands knowledge, basic technical competence, and the probability of obtaining more productive employment. The estimate is also consistent with Akhir et al. (2019), Athadena (2021), Isroviyah (2022), and Susanto and Pangesti (2019), all of whom emphasize education as a mechanism for improving productivity and earnings.

The result is substantively important because the APS indicator rose by more than twelve percentage points during the study period. This expansion likely reflects wider access, education assistance, infrastructure improvement, and greater awareness of the value of remaining in school. Nevertheless, APS measures participation rather than completion or learning achievement. Its poverty-reducing effect will be stronger when students complete school, acquire relevant skills, and enter labor markets that reward those skills. A high enrollment rate without learning quality or transition to productive work may produce weaker income gains.

The short-run anomalies observed in 2021 and 2024 are therefore understandable. School participation can rise during a period when poverty also rises because the benefits of education are realized over time, while households may simultaneously face an acute income shock. Conversely, a slight decline in APS does not immediately increase poverty if employment, transfers, and economic conditions improve. The policy response should combine access with quality: scholarships for low-income students, dropout prevention, transportation or digital-access support in remote areas, stronger vocational and general secondary competencies, and collaboration with employers to align curricula with regional demand.

Effect of Labor Force Participation on Poverty

The negative and significant LFPR coefficient supports H3. When a larger share of the working-age population engages in employment or active job search, households have a greater opportunity to obtain labor income, and regional production capacity can expand. The finding agrees with Muttaqin and Anwar (2023) and Matondang et al. (2024), although it differs from studies reporting an insignificant effect (Lestari et al., 2025; Nurhaila & Anwar, 2024; Serly et al., 2025). The variation across studies likely reflects differences in geography, employment composition, and analytical method.

North Sumatra's experience underscores that participation alone is insufficient. LFPR fell during the pandemic and recovered as economic activity normalized, but a person counted in the labor force may be unemployed, underemployed, or employed informally at low wages. The estimated negative coefficient should therefore be interpreted as the average effect of broader economic engagement within the observed provincial structure. Poverty reduction will be more durable when additional participants enter stable, productive, and adequately paid work.

Labor policy should consequently focus on both quantity and quality. Competency-based training, certification, apprenticeship, employment-matching services, job fairs, and support for entrepreneurship can improve access to work. Sector strategies in agriculture, agro-processing, logistics, tourism, trade, and manufacturing should raise productivity and connect small enterprises to markets. Particular attention is needed for young people transitioning from school, women facing care constraints, and rural workers with limited access to formal opportunities.

Joint Effects, Policy Integration, and Study Limitations

The significant F-test supports H4 and shows that poverty in North Sumatra is better understood through a combined economic and social framework. Price stability protects the real value of income, education strengthens future earning capacity, and productive labor-force participation converts human capability into current household resources. Treating these areas separately can reduce policy effectiveness. For example, expanding education without sufficient job creation may delay income gains, while creating jobs during high food inflation may still leave real household consumption under pressure.

An integrated poverty strategy should therefore coordinate three policy layers. The first is short-run protection through inflation control, food-supply management, and targeted assistance during price shocks. The second is medium- and long-run human-capital development through inclusive upper-secondary participation, learning quality, and skill relevance. The third is labor-demand development through investment, enterprise upgrading, employment services, and productivity improvement. Bappeda can use a common monitoring framework that links poverty indicators with food inflation, school participation and completion, job placement, wage quality, and formalization.

The model also has limitations. It uses only 20 annual observations and a static linear specification, so it does not distinguish short-run from long-run effects or explicitly model structural breaks. The provincial aggregate can conceal differences across districts, urban and rural areas, gender, and income groups. APS captures school participation but not learning outcomes, while LFPR captures labor-market entry but not employment quality. The adjusted R-squared should not be interpreted as proof that the included variables are the only causes of poverty. Future research can add unemployment, wages, economic growth, inequality, the human development index, social assistance, and sectoral employment, and can apply ARDL, error-correction, structural-break, or district-level panel methods. Table 5 translates the empirical findings into a coordinated policy framework. The actions are not substitutes for one another: short-run protection should preserve purchasing power, while education and labor-market measures strengthen the capacity of households to earn sustainable income.

Table 5. Integrated policy implications of the findings

Policy area	Immediate priority	Structural priority	Suggested monitoring
Price stability	Secure food supply and distribution; protect vulnerable households during shocks	Strengthen logistics, storage, market information, and interregional supply coordination	Food inflation, availability, real household consumption
Upper-secondary education	Prevent dropout and target assistance to low-income students	Improve learning quality, digital access, career guidance, and skill relevance	APS, completion, dropout, transition to work or tertiary study
Labor market	Employment matching, job fairs, and rapid competency support	Expand productive sectors, certification, apprenticeship, formalization, and entrepreneurship	LFPR, employment, wages, productivity, formal-job share
Integrated governance	Coordinate inflation, education, labor, and social-protection responses	Use a shared poverty-monitoring dashboard and place-based programs	Poverty rate, depth of poverty, district and rural-urban gaps

CONCLUSION

This study analyzed annual data for North Sumatra from 2005 to 2024 and found that inflation, education, and labor-force participation were all statistically related to poverty in the directions predicted by theory. Inflation had a positive and significant effect: a one-percentage-point increase was associated with a 0.112683-percentage-point rise in poverty, holding the other variables constant. Upper-secondary school participation had a negative and significant effect, with a coefficient of -0.273439. LFPR also had a negative and significant effect, with a coefficient of -0.299388. Together, the three variables were jointly significant and explained 81.06% of adjusted variation in the poverty rate.

The findings indicate that poverty reduction cannot rely on one policy instrument. North Sumatra needs stable prices for basic necessities, sustained participation and quality at the upper-secondary level, and labor-market policies that create productive and adequately paid work. Coordination among the provincial government, Bank

Indonesia, the Regional Inflation Control Team, education authorities, labor agencies, Bappeda, and local businesses is essential. The results also support targeted monitoring of vulnerable households during price shocks and stronger links between schooling, skills, and regional employment demand.

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