

THE EFFECT OF ECONOMIC GROWTH, POPULATION, HUMAN DEVELOPMENT INDEX (HDI), AND POVERTY ON INCOME INEQUALITY IN NORTH SUMATRA



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ABSTRACT

This study examines the impact of economic growth, population size, Human Development Index (HDI), and poverty on income inequality in the provinces of Sumatera Utara from 2014 to 2023. The research employs a quantitative approach using panel data regression analysis, incorporating both time-series and cross-sectional data from 33 districts/cities across the region. The findings reveal that economic growth has a significant negative effect on income inequality, indicating that higher economic growth leads to a more equitable income distribution. Conversely, population growth and poverty are found to exacerbate income inequality, with a higher population and increased poverty levels contributing to greater disparities in income across the province. Furthermore, the study finds that improvements in HDI correlate with lower income inequality, as higher educational attainment, healthcare access, and living standards contribute to increased productivity and more balanced income distribution. This research underscores the importance of inclusive economic growth and targeted poverty reduction strategies to mitigate income inequality in Sumatera Utara. The results suggest that addressing the underlying factors of population growth and poverty could significantly enhance the economic equity in the region.

Keywords : Economic Growth, Population Size, Human Development Index (HDI), Poverty, and Income Inequality

INTRODUCTION

Income inequality remains a fundamental problem faced by many developing countries, including Indonesia (Meiriza et al., 2024). Although Indonesia has recorded positive Gross Domestic Product (GDP) growth over the past two decades, the distribution of development outcomes remains highly uneven. Despite positive economic growth, certain groups in society have not enjoyed commensurate benefits. (Pardita et al., 2024) This income inequality is in stark contrast to national development goals, which prioritize not only economic growth but also equity, poverty reduction, and improved welfare for all segments of society. This phenomenon of inequality is even more striking when looking at regional disparities within Indonesia, both between the western and eastern regions and between provinces (Hendri & Iswandi, 2022).

At the provincial level, North Sumatra is one of the regions facing complex income inequality dynamics. The province has a diverse economic structure ranging from industry, trade, services, agriculture, to mining, which makes equitable distribution of development outcomes a challenge in itself (Salsabila & Azhar, 2023). Major cities such as Medan, Binjai, and Pematangsiantar enjoy faster economic and infrastructure development, while several districts in mountainous and island areas such as West Nias, Pakpak Bharat, and Humbang Hasundutan still lag behind in terms of human resource quality and access to basic services. This uneven development between regions has resulted in sharp income disparities between districts/cities.

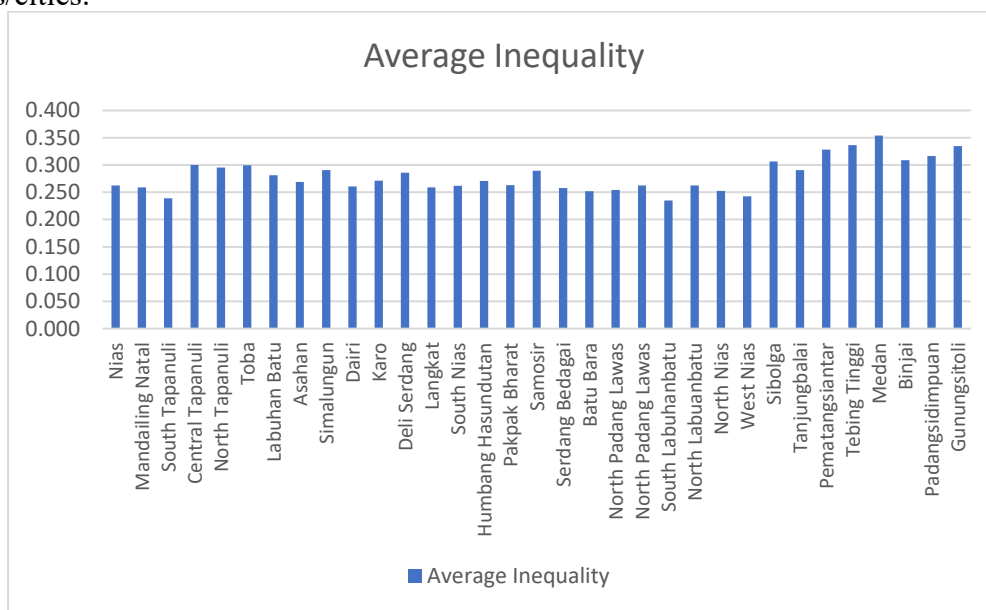


Figure 1.
Average Number of Poor People in North Sumatra Province 2014-2023
 Source: Central Statistics Agency (2025)

The data shows that in North Sumatra, income inequality between districts/cities follows a clear pattern. For example, Medan City experienced the largest increase in income inequality during the 2014–2023 period, while South Labuhanbatu District actually experienced a decline. This phenomenon illustrates that the factors causing income inequality in each region are not uniform, but are influenced by various local variables such as the level of urbanization, the quality of the workforce, and access to developing modern sectors.

Sukirno (2016) adds that economic growth refers to an increase in the number of goods and services produced in a country, which is often measured by growth in GRDP (Gross Regional Domestic Product) (Yuniarti et al., 2020). In North Sumatra Province, for example, fluctuations in the rate of economic growth between districts/cities show a clear gap. Padang

Lawas District recorded the highest GRDP growth in the 2014-2023 period at 4.98%, while Batu Bara District experienced a significant decline of 3.58%. This decline has led to a sharp increase in income inequality in the region.

(Harahap et al., 2020) This phenomenon is in line with the inverted U hypothesis proposed by Simon Kuznets, which states that in the early stages of per capita income growth, income distribution tends to worsen. However, after reaching a certain level, income distribution will become more equitable. In reality, income inequality in Indonesia, especially in North Sumatra, shows an alarming pattern, with an uneven rate of economic growth (Rozaini et al., 2024).

In addition, population size also plays an important role in income inequality. Medan, as the largest city in North Sumatra, has a population of more than 2 million. On the other hand, Pakpak Bharat district has the smallest population, which is around 49,345 people. This inequality becomes even more apparent when observing the number of poor people in who are concentrated in large cities with higher living costs, such as Medan. Data shows that Medan also has the largest number of poor people, which is around 19,408 people in the 2014-2023 period.

(Sinaga & Zalukhu, 2022) Poverty, which is the result of income inequality, further exacerbates socioeconomic conditions in disadvantaged areas. Barber (2015) argues that poverty worsens income inequality, causing poor areas to become even more impoverished. The Human Development Index (HDI) is also an important indicator that influences income inequality. A lower HDI in districts such as West Nias (61.02%) compared to Medan City (80.57%) illustrates the difference in the quality of human resources (HR), which greatly affects the productivity and income of the community.

REVIEW OF LITERATURE

(Untari et al., 2019) Income inequality is a phenomenon in which the distribution of income in society is uneven, causing a significant gap between high- and low-income groups. According to Todaro (2011), this inequality can be measured using tools such as the Gini index, which describes the level of inequality in income distribution. (Yasir et al., 2024) adds that this inequality worsens with the growth of capitalism, where capital accumulation is faster than economic growth, exacerbating the gap between the rich and the poor. (Alamanda, 2021) In addition, Aimon (2015) explains that income inequality arises from differences in ownership of factors of production, whereby groups with more capital will earn greater incomes. Income inequality can be reduced through a progressive taxation system and subsidies for low-income groups (Gustiara & Syahri, 2020).

Types of income inequality consist of individual income distribution and functional income distribution. Individual distribution measures inequality based on individual groups, while functional distribution focuses on factors of production such as labor and capital. Measures of inequality include the quintile and decile approaches, the Lorenz curve, and the Gini coefficient, which measures how evenly income is distributed. (Arham et al., 2020) This inequality can be caused by factors such as high population growth, inflation, uneven development between regions, and investment in capital-intensive projects that benefit certain groups.

(Woyanti, 2023) Economic growth, measured by an increase in the number of goods and services produced, plays an important role in driving a country's economic progress. However, while economic growth is important, income distribution must also be taken into account. According to economic growth theory, as explained by Smith and others, economic growth is influenced by factors of production such as capital, labor, and technology. In addition, technology plays an important role in increasing productivity and reducing

dependence on labor. In this case, uneven economic growth can exacerbate income inequality, especially in less developed regions (Rozali et al., 2022).

Population size also plays an important role in income inequality. According to Kuncoro (2013), a large population without adequate quality can be a burden on development. Conversely, if the population is well managed and supported by good human resources, then population size can be an asset for development. Poverty, which occurs as a result of low income, is also closely related to income inequality. Poverty can be caused by various factors, including low quality of human resources, limited access to education and employment, and unequal distribution of income. To reduce poverty, development of the agricultural sector, investment in human resources, and the active role of non-governmental organizations (NGOs) are essential.

(Fitriady et al., 2022)The Human Development Index (HDI) is an indicator used to measure the success of human development, which includes health, education, and decent living standards. The HDI can describe the overall quality of life, which in turn affects income inequality. According to the UNDP (1995), human development focuses not only on economic improvement, but also on expanding people's life choices. Human development must take into account productivity, equity, sustainability, and community empowerment. High income inequality is associated with low levels of well-being, while extreme poverty exacerbates income inequality, creating greater social and economic instability.

RESEARCH METHOD

This study examines the effect of economic growth, population, human development index (HDI), and poverty on income inequality in North Sumatra Province during the period 2014-2023. This study uses a quantitative method with one dependent variable (income inequality) and four independent variables (economic growth, population, HDI, and poverty). The data used is panel data, which includes annual data from 33 districts/cities in North Sumatra, which is a combination of cross-section and time series data.

The data used in this study is secondary data obtained from various sources, including the Central Statistics Agency (BPS), the official website of the North Sumatra Provincial Government, and other relevant literature. The variables analyzed were income inequality (using the Gini index as a measure), economic growth (measured by per capita GRDP), population, HDI, and poverty (measured by per capita expenditure).

Data collection methods were conducted through literature and documentation studies, gathering information from books, journals, and official reports related to the research object. Data collection focused on the period from 2014 to 2023 and involved cross-sectional data from 33 districts/cities in North Sumatra.

This study uses panel data regression with Eviews 12 software to analyze the relationship between independent and dependent variables. Several regression models used for estimation are the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Model testing was conducted using the Chow test, Hausman test, and Lagrange Multiplier test to determine the most appropriate regression model. In addition, classical assumption tests such as normality, multicollinearity, heteroscedasticity, and autocorrelation tests were also conducted to ensure that the regression model was unbiased (Purba et al., 2024).

To test the hypothesis, a t-test (partial test) was used to see the significant effect of each independent variable on income inequality, and an F-test (simultaneous test) was used to see the combined effect of all independent variables on the dependent variable. The coefficient of determination (R^2) was used to measure how much of the variation in income inequality could be explained by the independent variables in the model (Naufal & Fikriah, 2023).

RESULTS AND DISCUSSION

This study examines the effect of economic growth, population, Human Development Index (HDI), and poverty on income inequality in North Sumatra Province during the period 2014-2023. North Sumatra, as one of the provinces with the largest economic contribution in western Indonesia, has a fairly high level of income inequality, especially between the developed city of Medan and remote districts such as West Nias and Pakpak Bharat. Differences in economic growth rates between districts/cities cause greater inequality, with areas that have adequate infrastructure, such as Medan, experiencing faster growth than areas with limited infrastructure.

In addition, the high population in large cities such as Medan and Deli Serdang adds pressure on the provision of basic services, while areas with smaller populations struggle to develop their economic potential. The sharp differences in HDI also contribute to income inequality, where large cities with high HDI have better access to education and health care. Conversely, districts with low HDI face limitations in human resources and low productivity, exacerbating income inequality.

(Maurilla et al., 2023)Poverty remains an important issue, especially in remote areas with limited access to employment, education, and health services. This study uses a quantitative approach with panel data regression analysis of 33 districts/cities in North Sumatra, using secondary data from the Central Statistics Agency (BPS). The use of panel data allows for a more comprehensive and accurate analysis of the influence of socioeconomic factors on income inequality. The results of this study are expected to provide an overview of the factors causing inequality and policy recommendations to reduce economic disparities in the province.

Chow Test

(Nindien et al., 2024)The Chow test aims to determine the best model between the Common Effect approach and the Fixed Effect approach to be used for panel data regression. The basis for decision-making in the Chow test is seen from the cross-section F probability value in the following table:

Table 1.
Chow Test Results

| Effect Test | Statistic | Probability |
|-----------------|-----------|-------------|
| Cross-section F | 14.008757 | 0.0000 |

Source: Research data (2025)

Based on Table 1 above, it can be seen that the value of the cross-section F probability is $0.0000 < 0.05$, so H_0 is rejected, and the regression model selected is the Fixed Effect Model (FEM).

Hausman Test

(Rizky et al., 2024)The Hausman test is conducted to compare the Fixed Effect Model and the Random Effect Model with the aim of determining which model should be used. The basis for decision-making in the Hausman test is seen from the random cross-section probability value in the following table:

Table 2.
Hausman Test Results

| Effect Test | Statistic | Probability |
|----------------------|-----------|-------------|
| Cross-section Random | 61.309094 | 0.0139 |

Source: Research data (2025)

Based on Table 2 above, it can be seen that the cross-section random probability value is $0.0000 < 0.05$, so the regression model chosen is the Fixed Effect Model (FEM).

Classical Assumption Test
Normality Test

The normality test aims to assess whether the distribution of data on a variable is normally distributed. This test is important in regression testing to ensure that the regression model has a normal distribution, which is an important requirement in testing the significance of regression coefficients. A good regression model has a normal or near-normal distribution, making it valid for statistical testing. Normality testing can be performed using the Jarque-Bera test, where a significance result > 0.05 indicates that the residual is normally distributed. Based on the results, the Jarque-Bera value of 0.795420, which is greater than 0.05, indicates that the data is normally distributed.

Table 3.
Normality Test Results

| Variable | Probability | Significance Level | Description |
|----------|-------------|--------------------|----------------------|
| RESIDUAL | 0.094 | 0.05 | Normally distributed |

Source: Research data (2025)

In accordance with the basic concept of statistical testing in the Jarque Bera test, data is said to be normally distributed if the probability value is greater than 0.05. From Table 3 above, it can be seen that the probability value of 0.094 is greater than 0.05, meaning that the data in this study is normally distributed.

Multicollinearity Test

Multicollinearity testing is used to determine the existence of correlations between independent variables in a regression model. If there is a correlation, then multicollinearity will arise. Multicollinearity occurs when there is a linear relationship between independent variables, which does not occur in simple regression (Winarno, 2017). In this study, the multicollinearity test showed a probability value > 0.08 , which means that there was no multicollinearity in the regression model. The following are the results of the multicollinearity test data processing.

Table 4.
Multicollinearity Test Results

| | X1 | X2 | X3 | X4 |
|----|--------|--------|--------|--------|
| X1 | 1,0000 | 0,2216 | 0,2013 | 0,7011 |
| X2 | 0,2216 | 1,0000 | 0,3986 | 0,8010 |
| X3 | 0,2013 | 0,3986 | 1,0000 | 0,2124 |
| X4 | 0,7011 | 0,8010 | 0,2124 | 1,0000 |

Source: Research data (2025)

Based on the correlation values in Table 4, it can be seen that the relationship between independent variables has a correlation value that is not close to 1, indicating a weak relationship. However, the correlation between Population Size and Poverty is close to 1. A high correlation (generally above 0.80) indicates the potential for multicollinearity in the regression model.

Heteroscedasticity Test

The heteroscedasticity test aims to test whether there is a difference in variance from one observation to another in the regression model. If the variance of the residuals from one observation to another is constant, it is called homoscedasticity, and if it is different, it is called heteroscedasticity. If the probability is > 0.05 , there is no heteroscedasticity, whereas if the probability is < 0.05 , there is heteroscedasticity.

Table 5.
Heteroscedasticity Test Results

| Variable | Probability | Level α | Description |
|-----------------|-------------|----------------|-----------------------------------|
| Economic Growth | 0.0935 | 0.05 | No signs of heteroscedasticity |
| Population | 0.1395 | 0.05 | No evidence of heteroscedasticity |
| HDI | 0.1097 | 0.05 | No evidence of heteroscedasticity |
| Poverty | 0.2336 | 0.05 | No evidence of heteroscedasticity |

Source: Research data (2025)

From Table 5, it can be seen that all independent variables, namely Economic Growth, Population, HDI, and Poverty, have a probability value > 0.05 . Thus, it can be concluded that the assumption of non-heteroscedasticity is fulfilled, or in other words, homoscedasticity.

Autocorrelation Test

The autocorrelation test is performed by looking at the Durbin-Watson (DW) value. To test for autocorrelation, the calculated DW is compared with the acceptance or rejection criteria determined based on the dL and dU values, which depend on the number of independent variables (k) and the number of samples (n). The basis for decision-making in the autocorrelation test is that if $(4 - dU) > DW > dU$, then there is no autocorrelation. The following are the results of the autocorrelation test data processing.

Table 6.
Autocorrelation Test Results

| DU Value | DW Value | 4-DU Value |
|----------|----------|------------|
| 2,1900 | 1,8669 | 1,8100 |

Source: Research data (2025)

In accordance with the basic concept of autocorrelation testing decision making, data is said to not contain autocorrelation if the DU value $< DW < 4-DU$. From Table 6, it can be seen that the DU and DW values are 2.1900 and 1.8689. Therefore, according to the condition $2.1900 > 1.8669 > 1.8100$, it means that the data in this study does not contain autocorrelation.

Hypothesis Testing

Partial Test (T-Test)

The t-test is used to test the partial significance of the model between independent variables and dependent variables. The following are the results of the t-test data processing:

Table 7.
T-Test Results

| Variable | Coef | Calculated T Value | Table T Value | Sig |
|-----------------|-----------|--------------------|---------------|--------|
| Economic Growth | -0.000656 | -2.740268 | 1.9745 | 0.0260 |
| Population | 9.32E-08 | 2.164962 | | 0.0312 |
| HDI | -0.005582 | -7.389210 | | 0.0000 |
| Poverty | 1.51E-07 | 2.200907 | | 0.0409 |

Source: Research data (2025)

In this study, several variables were converted into logarithmic form to reduce differences in scale between data and obtain more consistent analysis results. The application of logarithms also aimed to improve the distribution of data to be closer to normal and reduce the potential for heteroscedasticity in the regression model.

According to Gujarati (2017:195), panel data techniques combine cross-section and time series data. In panel data regression, the regression coefficients b_1, b_2, \dots, b_n have the following values:

1. If the coefficient value = 0, it means that the dependent variable is not influenced by the independent variable.
2. If the coefficient value is negative, there is an inverse relationship between the dependent and independent variables.
3. If the coefficient value is positive, there is a direct relationship between the dependent and independent variables.

From Table 7, the panel data regression equation can be written as follows:

$$Y = 0.636643 - 0.000656PE + 9.32E-08JP - 0.005582IPM + 1.51E-07$$

1. The above equation can be explained as follows: Economic Growth
 The analysis results show that Economic Growth has a negative and significant effect on Income Inequality. The coefficient value of -0.000656 indicates a negative effect. The t-test result (2.7403) > t table (1.9745) and the probability value (0.0260) < 0.05 indicate that this effect is significant.
2. Population
 The analysis results show that Population has a positive and significant effect on Income Inequality. The coefficient value of 9.32E-08 indicates a positive effect. The t-test (2.1650) > t table (1.9745) and probability (0.0312) < 0.05 indicate a significant effect.
3. HDI
 The analysis results show that HDI has a negative and significant effect on income inequality. The coefficient of -0.005582 indicates a negative effect. The t-test (7.3892) > t table (1.9745) and probability (0.0000) < 0.05 indicate a significant effect.
4. Poverty
 The analysis results show that Poverty has a positive and significant effect on Income Inequality. The coefficient of 1.51E-07 indicates a positive effect. The t-test (2.2009) > t table (1.9745) and probability (0.0409) < 0.05 indicate that this effect is significant.

Model Validity Test

Simultaneous Test (F Test)

To test this hypothesis, basic decision-making criteria were used. If the significance value is greater than 0.05, then Ho is accepted or Ha is rejected, which means that all independent variables do not collectively influence the dependent variable. Conversely, if the significance value is less than 0.05, then Ho is rejected or Ha is accepted, which means that all independent variables collectively influence the dependent variable. This test also compares the f table value and the f count value.

1. The test results show a table f value of 2.27. If the calculated f value is greater than the table f value, then the hypothesis is accepted. The F test results can be seen in the following table.

Table 8.
F Test Results

| -Calculated F Value | -Calculated F Value | Value Significance | Significance Level | Description |
|---------------------|---------------------|--------------------|--------------------|-------------|
| 15.65031 | 2.27 | 0.0000 | 0.05 | Influential |

Source: Research data (2025)

Based on Table 8 above, it is known that the calculated f value is greater than the table f value, which is 15.65031 > 2.27 at α = 5% and a significance value of 0.000 < 0.05. Thus, Ho is rejected, and Ha is accepted. This indicates that the variables of Economic Growth, Population, HDI, and Poverty simultaneously influence the variable of Income Inequality in North Sumatra.

Coefficient of Determination (R²)

The coefficient of determination or R² is the contribution of the independent variables to the dependent variable, or in other words, the coefficient of determination measures the extent to which the model is able to explain or describe the variation of the independent variables to the dependent variable. Its value ranges from 0 to 1. The closer it is to 0, the less effective the model is, or the more limited its ability to explain the variation in the dependent variable. Conversely, the closer it is to 1, the more effective the model is. The results of the coefficient of determination test can be seen in the following table:

Table 9.

F Test Results

| Adjusted R-Square Value | Description |
|-------------------------|------------------------|
| 0.816559 | There is a correlation |

Source: Research data (2025)

Based on Table 9, the R-Square value obtained is 0.8166, indicating that the R² value is close to 1, meaning that the independent and dependent variables are correlated. This also explains that Income Inequality is influenced by Economic Growth, Population, HDI, and Poverty by 81.66%, while the remaining 18.34% is explained by other factors not included in the model estimation.

The Effect of Economic Growth on Income Inequality in North Sumatra

Research shows that economic growth in North Sumatra has a negative effect on income inequality, with economic improvement driving job creation and increased income, especially for low-income groups. These findings are in line with the Kuznets Hypothesis, which states that economic growth in its mature phase tends to improve income distribution. In addition, these results support Todaro & Smith's view that inclusive economic growth can reduce inequality. Previous studies have also shown that accelerated economic growth and increased regional GDP can reduce income inequality, especially in regions with diverse economic structures.

The Effect of Population Size on Income Inequality in North Sumatra

Research shows that population size has a positive effect on income inequality in North Sumatra, where the larger the population, the greater the inequality. This is due to the imbalance between population size and the region's ability to provide adequate employment and public facilities. These findings support the Population Pressure Theory and Malthusian theory, which state that rapid population growth without adequate economic growth can exacerbate income inequality. This study is also consistent with previous findings, such as those found by Didu et al. (2019) and Usman et al. (2018), which state that regions with large populations and low-quality human resources tend to experience greater inequality.

The Effect of the Human Development Index on Income Inequality in North Sumatra

Research shows that the Human Development Index (HDI) has a negative effect on income inequality, meaning that the higher the HDI in a region, the lower the income inequality. This shows that improving the quality of human resources through education, health, and better living standards can contribute to income equality. This finding is in line with the concept of human development from the UNDP (1990) and the thinking of Todaro & Smith (2015), which emphasizes that education and health are key to reducing inequality. This study is also consistent with the research by Tri (2017) and Gustiara & Syahri (2020), which found that an increase in HDI can reduce income inequality by increasing productivity and reducing unemployment.

The Effect of Poverty on Income Inequality in North Sumatra

Poverty has a positive effect on income inequality in North Sumatra; the higher the poverty rate, the greater the inequality. This is because the majority of the poor have very low

incomes, widening the gap between the rich and the poor. Poverty also limits access to education, health care, and employment, further exacerbating the uneven distribution of income. These findings are consistent with Barber's (2015) view that poverty and inequality reinforce each other () and Myrdal's (1957) theory that poor regions will continue to lag behind due to limited economic access. This study also supports the findings of Didu et al. (2019) and Siregar (2020), which show that high poverty exacerbates income inequality and slows economic development.

CONCLUSIONS

Based on the research findings, it can be concluded that economic growth has a negative impact on income inequality in North Sumatra. The higher the economic growth, the more likely it is that income inequality will decrease, as growth can increase productive economic activity, expand employment opportunities, and raise people's income, which contributes to a more equitable income distribution. On the other hand, population growth has a positive impact on income inequality, meaning that an increase in population, without being matched by job creation and improvements in human resources quality, will exacerbate income inequality. The Human Development Index (HDI) also has a negative effect on income inequality, where regions with higher HDI tend to have lower income inequality, reflecting that better education, healthcare, and living standards improve productivity and lead to a fairer income distribution. Meanwhile, poverty has a positive effect on income inequality because areas with high poverty levels tend to have greater inequality, as poverty limits access to education, healthcare, and economic opportunities, widening the income gap between social groups.

Suggestions

Suggestions for the provincial government of North Sumatra include continuing to promote inclusive economic growth by ensuring that productive sectors can optimally absorb local labor. Programs to empower small and medium enterprises (SMEs), increase investment in labor-intensive sectors, and ensure the equitable development of regions should be strengthened so that the benefits of economic growth can be felt by all levels of society. Additionally, the local government should increase the economic capacity and job creation in line with the population growth rate. Measures such as controlling population growth through family planning programs, improving education and workforce skills, and developing local-based industries are crucial to reduce the economic pressure caused by population growth and mitigate income inequality. The government is also advised to continue improving the quality of education, healthcare, and living standards. Enhancing HDI can be achieved by improving access to education, providing adequate healthcare facilities, and empowering local communities economically. Investments in human development are vital to increasing productivity and reducing income inequality across regions. Lastly, to reduce long-term income inequality, the government must strengthen poverty alleviation programs that are well-targeted, sustainable, and integrated, and expand access to education, healthcare, and economic opportunities for the poor.

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