

Poverty Persistence and Human Development: District-Level Evidence from Aceh

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ABSTRACT

Purpose – This study examines whether poverty exhibits persistent characteristics and whether human development is associated with lower poverty after accounting for historical poverty conditions in Aceh, Indonesia.

Design/methodology/approach – The analysis uses balanced panel data from 23 districts and municipalities in Aceh during 2012–2023. Static and dynamic fixed-effects models are estimated, followed by robustness checks using dynamic two-way fixed effects and a lagged-HDI specification.

Finding/Results – The baseline dynamic fixed-effects model provides consistent evidence of poverty persistence, with a lagged poverty coefficient of 0.6288. HDI is negatively associated with poverty in the baseline models. However, after year fixed effects and lagged HDI are introduced, the HDI coefficients remain negative but are no longer statistically significant. These results indicate that the evidence for poverty persistence is more robust than the evidence for a contemporaneous HDI effect.

Originality/Value – The study integrates human development and poverty persistence within a district-level framework, showing that sustainable poverty reduction in Aceh requires attention to both human capability formation and the historical persistence of deprivation.

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1. Introduction

Poverty remains one of the most persistent challenges in economic development. Although many developing countries have experienced substantial economic growth and improvements in social welfare, poverty continues to affect a significant proportion of the population. Beyond the issue of insufficient income, poverty is closely associated with limited access to education, healthcare, productive resources, and economic opportunities (Alkire & Foster, 2011; Klasen, 2008; Ravallion, 2011). These limitations reduce individual capabilities and hinder long-term development outcomes. Consequently, poverty reduction remains a central objective of development policy and constitutes the primary target of the first Sustainable Development Goal (SDG 1), which aims to eradicate poverty in all its forms (United Nations, 2015).

Indonesia has made considerable progress in reducing poverty during the last two decades. Nevertheless, the pace of poverty reduction varies substantially across regions. While some provinces have successfully reduced poverty to relatively low levels, others continue to experience persistent poverty despite sustained economic growth and government intervention. Such disparities suggest that poverty is influenced not only by current economic conditions but also by structural and institutional factors operating at the regional level (Hill et al., 2008; Ravallion & Wodon, 1999; Suryahadi et al., 2009; World Bank, 2022).

Aceh represents an important case for understanding regional poverty dynamics in Indonesia. Since the implementation of special autonomy policies, the province has received substantial fiscal transfers intended to accelerate development, improve public services, and enhance community welfare (Lewis, 2017). These resources were expected to strengthen human development and facilitate poverty reduction. However, despite continuous development efforts, poverty remains a major socioeconomic challenge in the province. Compared with many other provinces in Sumatra, Aceh continues to record relatively high poverty rates, raising concerns regarding the effectiveness of existing poverty reduction strategies.

Table 1 presents the average poverty rate across districts and municipalities in Aceh during the period 2012–2023.

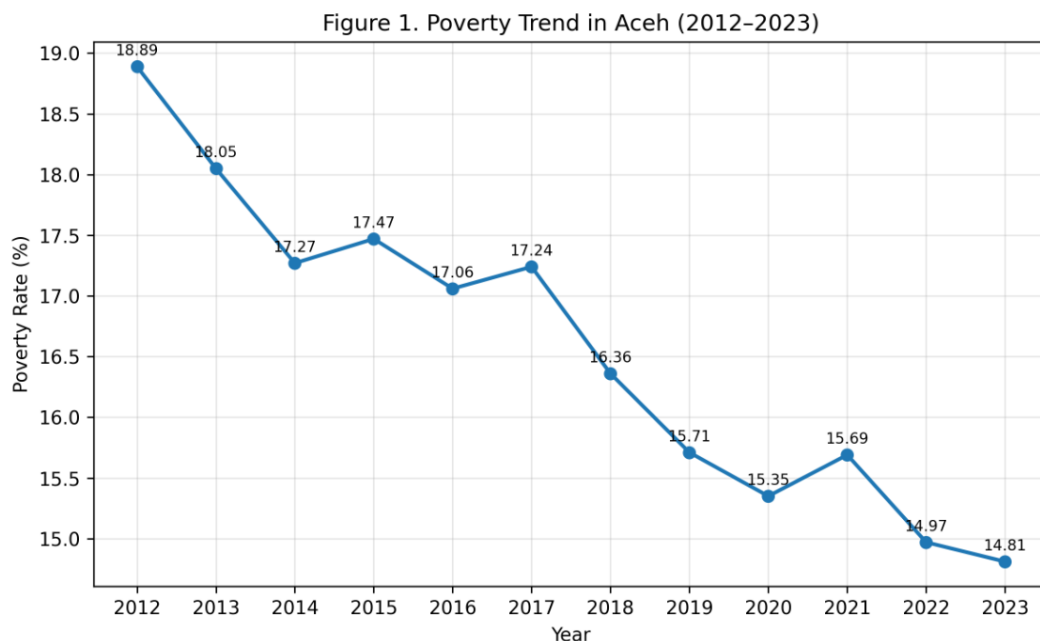
Table 1. Average Poverty Rate in Aceh, 2012–2023

Year	Poverty Rate (%)
2012	18.89
2013	18.05
2014	17.27
2015	17.47
2016	17.06
2017	17.24
2018	16.36
2019	15.71
2020	15.35
2021	15.69
2022	14.97
2023	14.81

Source: Authors' calculation based on Statistics Indonesia (BPS) district-level data.

As shown in Table 1, poverty in Aceh generally declined from 18.89 percent in 2012 to 14.81 percent in 2023. The downward trend indicates that poverty reduction efforts have generated positive outcomes. However, the decline has been relatively gradual, with several periods showing only modest improvements and even temporary increases. For example, the poverty rate increased from 17.27 percent in 2014 to 17.47 percent in 2015 and again from 15.35 percent in 2020 to 15.69 percent in 2021. These fluctuations suggest that poverty reduction is neither automatic nor linear. More importantly, the persistence of relatively high poverty levels despite continuous development efforts raises the possibility that poverty may exhibit a dynamic and self-reinforcing character (Dartanto & Nurkholis, 2013; Fields et al., 2003).

Figure 1. Poverty Trend in Aceh (2012–2023)



Note: Figure 1 illustrates the evolution of poverty in Aceh between 2012 and 2023. The poverty rate declined from 18.89 percent in 2012 to 14.81 percent in 2023, indicating substantial progress in poverty reduction. Nevertheless, the decline was not entirely linear. Temporary increases occurred in 2015 and 2021, suggesting that poverty remains vulnerable to economic and social shocks. Despite the overall downward trend, Aceh continues to exhibit poverty rates above the national average, indicating that structural challenges remain.

The notion that poverty can persist over time has received increasing attention in development economics. Rather than being viewed solely as a temporary condition resulting from short-term economic shocks, poverty is increasingly understood as a dynamic phenomenon in which past deprivation influences current welfare outcomes (Bane & Ellwood, 1986; Baulch & Hoddinott, 2000; Stevens, 1999). This perspective is closely associated with Myrdal's (1957) theory of circular and cumulative causation, which argues that economic and social disadvantages tend to reinforce one another through cumulative processes. Limited access to education, poor health conditions, and restricted economic opportunities reduce productivity and income-generating capacity, thereby increasing the likelihood that poverty continues over time.

The literature on poverty traps provides a complementary explanation for the persistence of poverty. Carter and Barrett (2006) argue that households with limited productive assets

frequently face structural constraints that restrict their ability to accumulate capital and improve their welfare. Under such conditions, poverty becomes path dependent, meaning that historical deprivation continues to influence future outcomes. Empirical evidence from developing countries indicates that past poverty conditions often remain strong predictors of current poverty levels, suggesting that poverty possesses a significant temporal dimension (Barrett et al., 2006; Jalan & Ravallion, 2000; Kraay & McKenzie, 2014; Lybbert et al., 2004).

Among the various factors associated with poverty reduction, human development occupies a central position in both development theory and public policy. The concept of human development emphasizes the expansion of individual capabilities through improvements in education, health, and standards of living. Human Capital Theory suggests that investments in human capital enhance productivity, increase earning potential, and improve welfare outcomes (Becker, 1993). Individuals with better education and health are generally more productive, more competitive in labor markets, and better equipped to respond to economic challenges (Hanushek & Woessmann, 2008; Pritchett & Summers, 1996; Weil, 2007). Consequently, improvements in human development are expected to reduce poverty by expanding economic opportunities and strengthening income-generating capacity.

A substantial body of empirical research supports the argument that human development contributes to poverty reduction. Improvements in education and health have been consistently associated with lower poverty rates and higher welfare outcomes across developing economies (Anand & Sen, 2000; Gupta et al., 2002; Psacharopoulos & Patrinos, 2018; Ranis et al., 2000; Suri et al., 2011; Tilak, 2002). In Indonesia, previous studies generally report a negative relationship between the Human Development Index (HDI) and poverty. Regions with higher levels of human development tend to experience lower poverty rates due to better educational attainment, improved health outcomes, and enhanced labor productivity.

Despite the growing body of literature, most existing studies examine poverty using static analytical frameworks that focus on contemporaneous relationships between development indicators and poverty outcomes. Such approaches provide valuable insights but often overlook the dynamic nature of poverty. When poverty persistence is ignored, the estimated impact of human development may not fully capture the mechanisms through which poverty evolves over time. Consequently, understanding poverty requires an analytical framework that considers both current development conditions and the influence of historical poverty.

Empirical evidence on poverty persistence at the district level remains relatively limited, particularly in the context of Aceh. Most previous studies have focused on identifying the determinants of poverty without explicitly considering whether poverty exhibits persistent characteristics. As a result, important questions remain unanswered regarding the extent to which current poverty is influenced by past poverty conditions and whether human development remains negatively associated with poverty after accounting for historical deprivation.

Unlike previous studies that primarily examine the static relationship between human development and poverty, this study explicitly incorporates poverty persistence into the analytical framework. By combining static and dynamic fixed-effects panel models using district-level data from Aceh, the study examines whether human development remains

negatively associated with poverty after accounting for historical poverty conditions. This approach provides a more comprehensive understanding of regional poverty dynamics.

Despite the growing literature on poverty and human development, an important empirical gap remains. Existing studies in Indonesia predominantly examine the relationship between human development and poverty using static analytical frameworks that focus on contemporaneous effects. At the same time, studies investigating poverty persistence generally emphasize intertemporal poverty dynamics without explicitly incorporating human development as a central explanatory factor. Consequently, limited evidence exists regarding whether improvements in human development remain effective after accounting for the persistence of poverty over time. Addressing this gap is important for understanding the extent to which poverty reduction is driven by current development achievements or constrained by historical deprivation.

This study seeks to address these issues by examining the relationship between poverty persistence and human development across districts and municipalities in Aceh. The analysis utilizes balanced panel data covering 23 districts and municipalities during the period 2012–2023 and employs static and dynamic fixed-effects models to investigate the determinants of poverty. By incorporating lagged poverty into the empirical framework, the study captures the temporal dimension of poverty that has received limited attention in previous research. The analysis also evaluates whether human development continues to play a significant role in poverty reduction after controlling for district-specific heterogeneity and poverty persistence.

The study is expected to enrich the literature on poverty dynamics by providing district-level evidence from a region that continues to face substantial poverty challenges despite extensive development interventions. A better understanding of the interaction between poverty persistence and human development may assist policymakers in designing more effective strategies aimed not only at reducing poverty in the short term but also at preventing the reproduction of poverty across time.

2. Literature Review & Hypothesis Development

2.1. Poverty Persistence

Poverty has increasingly been recognized as a dynamic phenomenon rather than a temporary condition associated solely with current income deprivation. Contemporary development literature suggests that poverty often exhibits persistence, whereby past poverty conditions continue to influence present and future welfare outcomes (Hulme & Shepherd, 2003; McKay & Lawson, 2003). In such circumstances, individuals, households, and regions experiencing poverty encounter structural barriers that limit their ability to improve living conditions, creating a cycle that is difficult to break.

The theoretical foundation of poverty persistence can be traced to the theory of circular and cumulative causation developed by Myrdal (1957). According to this theory, economic and social disadvantages tend to reinforce one another through cumulative processes. Low income limits access to education, healthcare, and productive assets, which subsequently reduces productivity and earning capacity. The resulting decline in economic opportunities further exacerbates poverty, creating a self-reinforcing mechanism that perpetuates deprivation over time. From this perspective, poverty is not merely a consequence of current economic

conditions but also a result of historical disadvantages that continue to shape development outcomes.

The concept of poverty persistence is closely related to the literature on poverty traps. Carter and Barrett (2006) argue that households with limited productive assets may remain trapped below critical asset thresholds, preventing them from accumulating the resources necessary to escape poverty. Such conditions generate path dependence, whereby historical deprivation significantly influences future welfare trajectories. Poverty therefore becomes a dynamic process characterized by persistence rather than a short-term socioeconomic phenomenon (Krishna, 2004; Sen, 2003; Woolard & Klasen, 2005).

Empirical evidence supports the existence of persistent poverty across various contexts. Jalan and Ravallion (2000), using household panel data from rural China, found that chronic poverty constitutes a substantial component of overall poverty and tends to persist across time. Similar findings have been reported in developing countries, where poverty often exhibits intertemporal dependence due to limited human capital accumulation, inadequate infrastructure, and restricted access to economic opportunities (Bigsten et al., 2003; Carter & Barrett, 2006; Dang et al., 2014; Dercon & Krishnan, 2000; Ward, 2016). These findings suggest that understanding poverty requires attention not only to its determinants but also to its dynamic nature.

The notion of poverty persistence has important implications for development policy. If poverty exhibits strong persistence, short-term interventions may be insufficient to achieve sustainable poverty reduction. Instead, policymakers must address the structural conditions that allow poverty to reproduce itself across time. Consequently, examining poverty persistence provides a more comprehensive understanding of poverty dynamics and the effectiveness of poverty reduction strategies.

2.2. Human Development and Poverty

Human development occupies a central position in development economics because it emphasizes the expansion of human capabilities rather than focusing exclusively on economic growth. The human development approach, introduced by the United Nations Development Programme (UNDP), defines development as a process of enlarging people's choices through improvements in health, education, and living standards (UNDP, 2024).

The theoretical basis linking human development and poverty reduction is provided by Human Capital Theory. Becker (1993) argues that investments in education, health, and skills enhance productivity and increase individuals' earning potential. Better education improves knowledge and competencies, while improved health increases labor productivity and participation in economic activities. As a result, human capital accumulation strengthens individuals' capacity to generate income and improve their welfare (Strauss & Thomas, 1998).

The Human Development Index (HDI) serves as one of the most widely used indicators for measuring human development. The index combines three fundamental dimensions: longevity and health, educational attainment, and standard of living (Klugman et al., 2011; Noorbakhsh, 1998; Sagar & Najam, 1998). Improvements in HDI reflect broader improvements in human capabilities and are expected to contribute to poverty reduction through enhanced productivity, higher incomes, and greater access to economic opportunities.

From a policy perspective, human development is frequently regarded as one of the most sustainable mechanisms for reducing poverty. Unlike short-term assistance programs, investments in education and health generate long-lasting benefits that improve individual capabilities and strengthen economic resilience. Consequently, improvements in human development are expected to reduce both the incidence and persistence of poverty (Dollar & Kraay, 2002; Fosu, 2017).

2.3. Empirical Evidence and Research Gap

The relationship between human development and poverty has attracted considerable attention in empirical research. Numerous studies report that improvements in education, health, and living standards contribute significantly to poverty reduction. Ranis et al. (2000) demonstrate that human development and economic growth reinforce one another, creating conditions that improve welfare outcomes and reduce poverty. Similarly, Tilak (2002) emphasizes that investments in education constitute one of the most effective long-term strategies for alleviating poverty.

Studies conducted in Indonesia generally produce similar findings. Regions characterized by higher levels of human development tend to experience lower poverty rates due to improvements in labor productivity, educational attainment, and access to economic opportunities. Nevertheless, most of these studies rely on cross-sectional or static panel approaches that focus primarily on the contemporaneous relationship between HDI and poverty.

Recent empirical evidence from Indonesia continues to highlight the importance of human development in poverty reduction. Using provincial panel data, several studies have reported that improvements in the Human Development Index (HDI) are associated with lower poverty levels, suggesting that investments in education, health, and living standards remain important drivers of welfare improvement (Arianto & Cahyono, 2025; Pratamasyari et al. 2025). Nevertheless, the magnitude and significance of these effects vary across regions and model specifications, indicating that poverty is shaped by multiple socioeconomic factors beyond human development alone.

Emerging studies have also emphasized the role of regional heterogeneity in explaining poverty outcomes. Empirical evidence from Indonesia consistently indicates that improvements in human development contribute to poverty reduction through enhanced productivity, better educational attainment, and improved economic opportunities. Using provincial data from Indonesia, Wiranatakusuma and Primambudi (2021) found that the Human Development Index exerts a significant negative effect on poverty, highlighting the importance of investments in human capital and social protection programs in improving welfare outcomes. These findings imply that poverty reduction strategies cannot rely solely on aggregate improvements in development indicators but must also consider local socioeconomic characteristics.

At the same time, recent research on poverty dynamics has drawn attention to the persistence of deprivation across time. Studies examining poverty transitions and intergenerational poverty in Indonesia indicate that past poverty conditions continue to influence current welfare outcomes, suggesting that poverty often exhibits path-dependent characteristics (Pakpahan et al., 2009; Tantiara et al., 2024). Similar evidence has been reported in the

international literature, where persistent poverty significantly increases the likelihood of future deprivation even after controlling for socioeconomic differences (Carter & Barrett, 2006; Jalan & Ravallion, 2000). These findings reinforce the importance of incorporating dynamic dimensions into poverty analysis.

At the same time, another strand of literature highlights the importance of poverty persistence. Research on poverty traps and chronic poverty indicates that historical poverty conditions often remain significant determinants of current poverty outcomes (Jalan & Ravallion, 2000; Carter & Barrett, 2006). Despite these insights, studies examining poverty persistence and human development within a unified analytical framework remain relatively limited, particularly at the district level in Indonesia.

The existing literature therefore reveals an important gap. Studies on human development generally focus on how HDI influences poverty but often ignore the dynamic nature of poverty. Conversely, studies on poverty persistence emphasize the intertemporal dimension of poverty but rarely incorporate human development as a central explanatory factor. As a result, there remains limited empirical evidence regarding whether human development remains negatively associated with poverty after accounting for historical deprivation.

Table 2 summarizes selected studies relevant to the relationship between poverty persistence and human development.

Table 2. Summary of Previous Studies and Research Gap

Authors	Context	Method	Main Findings	Gap
Myrdal (1957)	Developing countries	Theoretical	Poverty persists through cumulative causation	No empirical validation
Jalan & Ravallion (2000)	China	Panel data	Chronic poverty exhibits persistence	HDI not examined
Carter & Barrett (2006)	Developing countries	Asset-based framework	Poverty traps create persistent deprivation	Regional heterogeneity not explored
Tantriana et al. (2024)	Indonesia	Synthetic panel	COVID-19 increased poverty persistence	Human development not included
Arianto & Cahyono (2025)	Indonesia	Fixed Effect Model	HDI reduces poverty, unemployment increases poverty	Static panel
Wiranatakusuma & Primambudi (2021)	Indonesia	Panel Analysis	Poverty affected by structural socio-economic factors	No dynamic analysis

Authors	Context	Method	Main Findings	Gap
Pakpahan et al. (2009)	Indonesia	Panel data	Poverty persists across generations	Human development excluded
This Study	Aceh	Static & Dynamic Fixed Effects	HDI and poverty persistence jointly explain poverty	Integrates both perspectives

Source: Compiled by the authors.

Table 2 demonstrates that the literature on poverty and human development has developed along two closely related but largely separate research streams. The first stream emphasizes the role of human development in alleviating poverty through improvements in education, health, and living standards. The second stream focuses on poverty persistence, highlighting how historical deprivation influences current poverty outcomes. Despite their common objective of explaining poverty dynamics, these perspectives are rarely integrated within a single empirical framework.

Recent empirical studies consistently report that improvements in human development contribute to poverty reduction in Indonesia (Arianto & Cahyono, 2025; Pratamasyari et al. 2025). However, most of this evidence is derived from static panel models that examine only the contemporaneous relationship between human development and poverty. As a result, limited attention has been given to whether the poverty-reducing effect of human development remains robust once the persistence of poverty over time is explicitly considered.

This limitation is particularly relevant in Aceh, where poverty levels remain relatively high despite continuous improvements in human development indicators and substantial development interventions. Persistent poverty may indicate that current poverty conditions are influenced not only by present socioeconomic circumstances but also by historical deprivation. Ignoring this dynamic dimension could therefore lead to an incomplete understanding of poverty reduction processes.

To address this gap, the present study integrates human development and poverty persistence within a district-level panel framework covering 23 districts and municipalities in Aceh. By combining static and dynamic fixed-effects estimators, the analysis evaluates whether human development remains negatively associated with poverty after accounting for historical poverty conditions. This approach provides a more comprehensive understanding of poverty dynamics and offers new evidence on district-level poverty persistence in Aceh.

2.4. Hypothesis Development

The literature reviewed above suggests that poverty possesses a dynamic character. Theories of cumulative causation and poverty traps argue that historical deprivation may continue to influence current welfare outcomes through self-reinforcing mechanisms. Empirical evidence from developing countries further indicates that poverty frequently exhibits persistence across time. Therefore, the following hypothesis is proposed:

H1: Poverty persistence exists across districts and municipalities in Aceh.

Human Capital Theory suggests that improvements in education, health, and living standards enhance productivity and income-generating capacity, thereby reducing poverty. Previous empirical studies generally support the proposition that human development contributes significantly to poverty reduction. Consequently, higher levels of human development are expected to be associated with lower poverty rates. Therefore, the following hypothesis is formulated:

H2: Human development is negatively associated with poverty across districts and municipalities in Aceh.

3. Methodology

3.1. Research Design

This study adopts a quantitative research design to examine the relationship between poverty persistence and human development across districts and municipalities in Aceh, Indonesia. The analysis is intended to investigate whether poverty exhibits persistent characteristics over time and whether human development is associated with lower poverty after controlling for district-specific heterogeneity.

A panel data approach is employed because it combines cross-sectional and time-series dimensions, allowing the analysis to capture both spatial and temporal variations. Compared with purely cross-sectional or time-series methods, panel data analysis provides greater variability, increases the degrees of freedom, reduces multicollinearity among explanatory variables, and allows researchers to control for unobservable characteristics that remain constant over time (Baltagi, 2021; Wooldridge, 2019).

The empirical analysis is conducted using both static and dynamic panel data specifications. The static model evaluates the direct relationship between human development and poverty, while the dynamic model incorporates lagged poverty to capture poverty persistence. This dual-model strategy enables a more comprehensive understanding of poverty dynamics and provides an additional robustness check for the estimated effects of human development.

3.2. Data and Sources

The study utilizes balanced panel data covering 23 districts and municipalities in Aceh Province during the period 2012–2023. The observation period was selected based on data availability and consistency across districts.

All data were obtained from official publications of Statistics Indonesia (Badan Pusat Statistik—BPS). The primary variables include district-level poverty rates and the Human Development Index (HDI). Following data cleaning, validation, and consistency checks, the final dataset consisted of 276 observations for the static model. The dynamic specification produced 253 observations because the first observation for each district was lost during the construction of the lagged poverty variable. The two robustness specifications also use 253 observations to maintain comparability with the baseline dynamic model.

The district-level perspective was chosen because substantial disparities in poverty and development conditions exist among regions in Aceh. Consequently, district-level analysis is expected to provide a more detailed understanding of poverty dynamics than provincial-level analysis.

3.3. Variable Measurement

This study employs one dependent variable, one independent variable, and one lagged variable used exclusively in the dynamic specification.

Table 3. Variable Definitions and Measurements

Table 3. Variable Definitions and Measurements

<i>Variable</i>	<i>Symbol</i>	<i>Measurement</i>	<i>Unit</i>	<i>Source</i>
Poverty Rate	(POV_{it})	Percentage of population living below the poverty line in district (i) during year (t)	Percent (%)	BPS
Human Development Index	(HDI_{it})	Composite index measuring health, education, and standard of living in district (i) during year (t)	Index (0–100)	BPS
Lagged Poverty Rate	$(POV_{i,t-1})$	Poverty rate in district (i) in the previous year	Percent (%)	Author's calculation
Lagged Human Development Index	$(HDI_{i,t-1})$	Human Development Index in district (i) in the previous year	Index (0–100)	Author's calculation

Source: Compiled by the authors.

The poverty rate is used as the dependent variable because it represents the most widely accepted indicator of socioeconomic deprivation. Human development is measured using the Human Development Index (HDI), which captures multidimensional aspects of development, including health, education, and standard of living. The lagged poverty variable is introduced in the dynamic model to evaluate the extent to which previous poverty conditions influence current poverty outcomes.

3.4. Model Specification

The empirical analysis estimates two baseline specifications and two robustness specifications. The baseline models consist of a static fixed-effects model and a dynamic fixed-effects model. The robustness checks extend the dynamic specification by adding year fixed effects and by replacing contemporaneous HDI with lagged HDI.

Static Fixed Effects Model

The first specification examines the effect of human development on poverty:

$$POV_{it} = \beta_0 + \beta_1 HDI_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where:

POV_{it} denotes the poverty rate in district i during year t;

HDI_{it} represents the Human Development Index;

μ_i captures district-specific effects that are constant over time;

ε_{it} denotes the idiosyncratic error term.

The coefficient β_1 is expected to be negative, indicating that higher levels of human development are associated with lower poverty rates.

Dynamic Fixed-Effects Specification

To capture the temporal dimension of poverty, a dynamic specification is estimated by including lagged poverty:

$$POV_{it} = \beta_0 + \alpha POV_{i,t-1} + \beta_1 HDI_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

where:

$POV_{i,t-1}$ represents the lagged poverty rate;

α measures the degree of poverty persistence.

A positive and statistically significant coefficient for α indicates that poverty in the previous period influences poverty in the current period, suggesting the existence of poverty persistence. In other words, districts and municipalities that experience relatively high poverty levels in one period tend to maintain higher poverty rates in subsequent periods. The inclusion of the lagged dependent variable therefore enables the analysis to capture the dynamic nature of poverty and to assess whether current poverty outcomes are shaped by historical deprivation.

To account for the possibility that current poverty conditions are influenced by past poverty experiences, the analysis incorporates a dynamic fixed-effects specification that includes a lagged dependent variable. This specification should be interpreted as a dynamic extension of the conventional Fixed Effects model rather than a Generalized Method of Moments (GMM) estimator. Because the lagged dependent variable may be correlated with the transformed error term, the dynamic estimates are interpreted as suggestive evidence of poverty persistence rather than definitive causal estimates.

Robustness Specifications

Two additional robustness checks are estimated. First, the dynamic model is re-estimated by adding year fixed effects to control for common shocks affecting all districts in the same year, including national policy changes, macroeconomic conditions, and the COVID-19 period.

$$POV_{it} = \alpha POV_{i,t-1} + \beta_1 HDI_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

Second, a lagged-HDI specification is estimated by replacing contemporaneous HDI with prior-year HDI while retaining district and year fixed effects. This specification reduces simultaneity concerns because human development is measured before the observed poverty outcome.

$$POV_{it} = \alpha POV_{i,t-1} + \beta_1 HDI_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{it} \quad (4)$$

In Equations (3) and (4), λ_t denotes year fixed effects. These robustness checks are used to assess whether the baseline results remain stable after accounting for common temporal shocks and alternative timing of human development.

Because the empirical analysis focuses on a parsimonious specification, multicollinearity is not expected to pose a serious concern. The static model includes only one explanatory variable, namely the Human Development Index (HDI), while the dynamic specification incorporates HDI together with lagged poverty. The correlation matrix indicates that the association between the explanatory variables remains below levels commonly associated with severe

multicollinearity. Consequently, the estimated coefficients can be interpreted with a reasonable degree of confidence.

3.5. Model Selection Procedure

Selecting the appropriate panel data estimator is essential to ensure unbiased and efficient parameter estimates. Therefore, two specification tests were conducted.

Poolability Test

The poolability test was performed to determine whether Pooled Ordinary Least Squares (Pooled OLS) was appropriate. The null hypothesis states that pooled estimation is sufficient and that no district-specific effects exist.

The empirical results produced an F-statistic of 4.386 with a probability value below 0.001. Consequently, the null hypothesis was rejected, indicating the presence of significant district-specific effects. This result suggests that Pooled OLS is inappropriate for the dataset.

Hausman Test

After rejecting Pooled OLS, the Hausman specification test was conducted to determine whether Fixed Effects or Random Effects estimation should be employed.

The null hypothesis states that the Random Effects estimator is consistent and efficient. The Hausman test generated a statistic of 38.000 with a p-value below 0.001, leading to rejection of the null hypothesis. Therefore, the Fixed Effects estimator was selected as the preferred model.

The results of the model selection tests are summarized in Table 4.

Table 4. Panel Model Selection Results

Test	Statistic	p-value	Decision
Poolability Test	4.386	0.000	Reject Pooled OLS
Hausman Test	38.000	0.000	Fixed Effects Preferred

Source: Author's calculations.

The results indicate that district-specific characteristics significantly influence poverty outcomes and must therefore be controlled through Fixed Effects estimation.

3.6. Analytical Procedure

The empirical analysis was conducted in several stages.

The first stage involved descriptive statistical analysis to summarize the distribution and characteristics of the variables. The second stage examined the bivariate relationship between poverty and human development using Pearson correlation analysis. The third stage estimated the static fixed-effects model to evaluate the association between human development and poverty. The fourth stage estimated the dynamic fixed-effects model by incorporating lagged poverty to assess poverty persistence. The fifth stage conducted robustness checks using dynamic two-way fixed effects and the lagged-HDI specification.

Finally, model selection procedures were conducted to identify the most appropriate panel estimator. The reported regression estimates use district-clustered robust standard errors to

account for heteroskedasticity and within-district error correlation, thereby improving the reliability of statistical inference.

All statistical analyses were performed using Python. Data management and descriptive analyses were conducted using the pandas package, while econometric estimation was performed using statsmodels and linearmodels.

3.7. Methodological Considerations

The dynamic specification adopted in this study incorporates a lagged dependent variable within a fixed-effects framework to capture poverty persistence. While this approach is commonly employed in applied development research, the inclusion of lagged dependent variables in fixed-effects models may introduce dynamic panel bias, often referred to as Nickell bias (Nickell, 1981). The potential bias tends to decline as the time dimension increases and is generally less severe when the primary objective is to identify persistence patterns rather than obtain structural causal estimates.

Accordingly, the findings related to poverty persistence should be interpreted as evidence of dynamic dependence rather than definitive causal effects. The robustness checks with year fixed effects and lagged HDI are used to assess the stability of the baseline estimates, but they do not fully eliminate potential endogeneity. Future research may extend the present analysis by employing dynamic panel estimators such as the Arellano-Bond Generalized Method of Moments (GMM) or System GMM, which are specifically designed to address endogeneity concerns associated with lagged dependent variables.

4. Result and Discussion

4.1. Descriptive Statistics

Descriptive statistics provide an overview of the characteristics and distribution of the variables used in the analysis. Table 5 presents the summary statistics for the poverty rate and the Human Development Index (HDI) across districts and municipalities in Aceh during the period 2012–2023.

Table 5. Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
Poverty (%)	276	16.573	3.803	6.900	24.500
HDI	276	70.021	5.085	59.760	88.320

Source: Author's calculations.

Table 5 shows that the average poverty rate across districts and municipalities in Aceh was 16.57 percent during the study period. The minimum poverty rate was 6.90 percent, while the maximum reached 24.50 percent. The relatively wide range indicates substantial variation in poverty conditions across districts. Such variation suggests that local socioeconomic characteristics continue to play an important role in shaping poverty outcomes.

The Human Development Index averaged 70.02 points, indicating a moderate level of human development. However, HDI values varied considerably among districts, ranging from 59.76 to 88.32. These differences reflect disparities in educational attainment, health outcomes, and living standards across the province.

Overall, the descriptive statistics indicate that both poverty and human development exhibit substantial regional variation, supporting the suitability of panel data analysis for investigating their relationship.

4.2. Correlation Analysis

Before estimating the regression models, Pearson correlation analysis was conducted to examine the bivariate relationship between poverty and human development.

Table 6. Correlation Matrix

Variable	Poverty	HDI
Poverty	1.000	
HDI	-0.626***	1.000

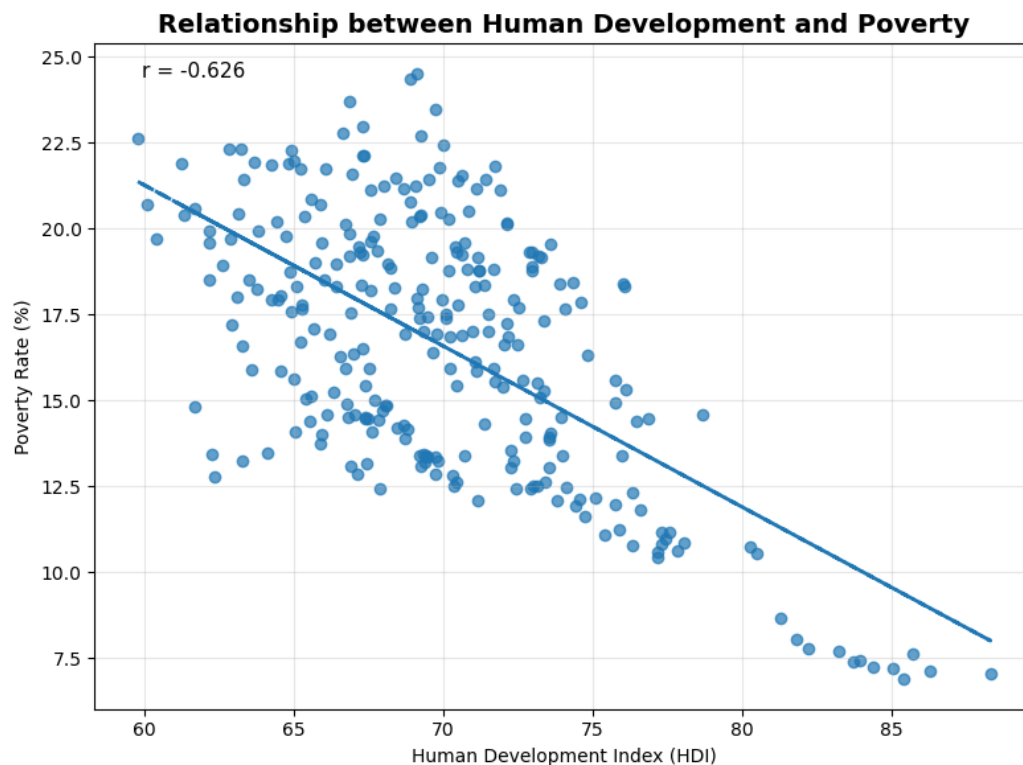
*** $p < 0.01$

Source: Author's calculations.

The results reveal a negative correlation of -0.626 between poverty and HDI. This coefficient indicates a relatively strong inverse relationship, suggesting that districts with higher levels of human development tend to experience lower poverty rates.

The finding is consistent with Human Capital Theory, which argues that improvements in education, health, and living standards enhance productivity and increase income-generating capacity (Becker, 1993). However, correlation analysis does not establish causality. Therefore, panel regression models are estimated to obtain more reliable evidence regarding the relationship between human development and poverty.

Figure 2. Relationship between Human Development and Poverty



Note: Figure 2 shows a clear negative association between HDI and poverty across districts and municipalities. Regions with higher levels of human development generally experience lower poverty rates. The pattern provides preliminary support for the regression results reported in subsequent sections.

4.3. Model Selection Results

Selecting the appropriate panel estimator is crucial to ensure reliable results. Accordingly, poolability and Hausman tests were performed.

Table 7. Model Selection Results

Test	Statistic	p-value	Decision
Poolability Test	4.386	0.000	Reject Pooled OLS
Hausman Test	38.000	0.000	Fixed Effects Preferred

Source: Author's calculations.

The poolability test rejects the null hypothesis that pooled estimation is sufficient, indicating the presence of district-specific effects. Subsequently, the Hausman test rejects the null hypothesis that Random Effects estimation is consistent and efficient. The test produced a Hausman statistic of 38.000 with a p-value below 0.001, indicating that the Fixed Effects estimator is preferred because the individual effects are correlated with the explanatory variables. Therefore, the Fixed Effects Model is selected as the most appropriate estimator for this study.

These results imply that unobserved district-specific characteristics significantly influence poverty outcomes and should be controlled in the estimation process.

4.4. Static Fixed Effects Estimation

The first model examines the direct effect of human development on poverty without accounting for poverty persistence.

Table 8. Static Fixed Effects Results

Variable	Coefficient	Std. Error	t-statistic	p-value
HDI	-0.5374	0.0596	-9.023	0.000
R ² (Within)	0.6506			
F-statistic	299.80			0.000

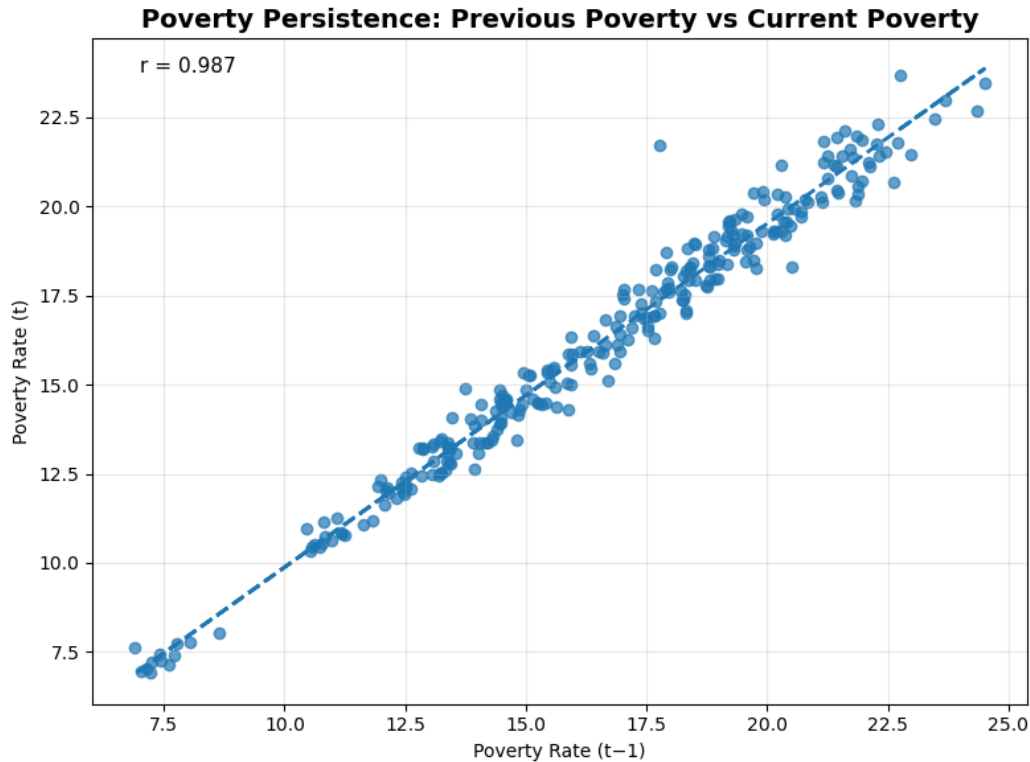
Source: Author's calculations.

The coefficient of HDI is negative and highly significant. The results indicate that a one-point increase in HDI is associated with a reduction of approximately 0.54 percentage points in the poverty rate.

The magnitude of the coefficient suggests that improvements in education, health, and living standards play a substantial role in reducing poverty across districts in Aceh. The findings are consistent with previous studies emphasizing the importance of human capital accumulation for poverty reduction (Ranis et al., 2000; Tilak, 2002).

The within R^2 value of 0.651 indicates that approximately 65 percent of the variation in poverty within districts can be explained by changes in HDI.

Figure 3. Poverty Persistence



Note: Figure 3 illustrates the relationship between poverty in the previous period and current poverty levels. The strong positive relationship suggests that districts experiencing higher poverty in the past tend to maintain higher poverty levels in subsequent periods. This pattern provides visual evidence of poverty persistence, which is formally tested through the dynamic fixed-effects model.

4.5. Dynamic Fixed Effects Estimation

The second model incorporates lagged poverty to capture poverty persistence.

Table 9. Results of the Dynamic Fixed-Effects Specification

Variable	Coefficient	Std. Error	t-statistic	p-value
Poverty Lag	0.6288	0.0432	14.549	0.000
HDI	-0.1549	0.0257	-6.027	0.000
R^2 (Within)	0.8261			
F-statistic	587.04			0.000

Source: Author's calculations.

The coefficient of lagged poverty is positive and statistically significant at the one-percent level. The estimated coefficient of 0.6288 indicates that poverty in the previous period remains an important determinant of current poverty conditions. This finding provides consistent evidence of poverty persistence across districts and municipalities in Aceh, suggesting that regions experiencing higher poverty levels in the past are more likely to maintain higher

poverty levels in subsequent periods. However, because the estimated coefficient remains below one, the results do not support the existence of an absolute poverty trap.

In the baseline dynamic fixed-effects model, human development continues to exhibit a negative and statistically significant association with poverty after controlling for poverty persistence. The estimated coefficient indicates that a one-point increase in the Human Development Index (HDI) is associated with a reduction of approximately 0.15 percentage points in the poverty rate. Although this coefficient is smaller than that observed in the static fixed-effects model, it suggests that the relationship between human development and poverty remains relevant after accounting for historical poverty conditions.

Table 10. Comparison of Static and Dynamic Fixed-Effects Specifications

Variable	Static FE	Dynamic FE
HDI	-0.5374***	-0.1549***
Poverty Lag	–	0.6288***
R ² Within	0.6506	0.8261

Table 10 compares the results obtained from the static and dynamic fixed-effects specifications. The coefficient of HDI remains negative and statistically significant across the two baseline models. However, the magnitude of the HDI coefficient declines substantially after the inclusion of lagged poverty, suggesting that part of the observed relationship between human development and poverty is connected to longer-term poverty dynamics. At the same time, the positive and statistically significant coefficient of lagged poverty provides consistent evidence of poverty persistence across districts and municipalities in Aceh.

Although the baseline results are informative, they do not fully account for common year shocks that may affect all districts simultaneously. Therefore, additional robustness checks are conducted by estimating a dynamic two-way fixed-effects model and a lagged-HDI specification. These checks are reported in Table 11 and are used to evaluate whether the baseline findings remain stable after controlling for year-specific shocks and alternative timing of human development.

4.6. Robustness Checks

Table 11 presents two robustness checks. The first model adds year fixed effects to the dynamic specification, while the second model uses lagged HDI and includes both district and year fixed effects. Both models are estimated on the same dynamic sample of 253 observations.

Table 11. Robustness Check Results

Variable	Dynamic TWFE	Lagged HDI TWFE
Poverty Lag	0.6935*** (0.0449)	0.6930*** (0.0443)
HDI	-0.0565 (0.0823)	–
Lagged HDI	–	-0.0554 (0.0738)

District fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	253	253
R-squared	0.9902	0.9902

*Note: District-clustered robust standard errors are reported in parentheses. *** $p < 0.01$. TWFE denotes two-way fixed effects.*

The robustness results confirm that poverty persistence remains statistically stable after controlling for common year shocks. In both robustness models, the coefficient of lagged poverty is positive, close to 0.69, and statistically significant at the one-percent level. This pattern supports the interpretation that current poverty outcomes in Aceh are strongly linked to previous poverty conditions.

By contrast, the HDI coefficients remain negative but are not statistically significant after year fixed effects are introduced. In the dynamic TWFE model, the contemporaneous HDI coefficient is -0.0565. In the lagged-HDI model, the prior-year HDI coefficient is -0.0554. These findings indicate that the negative HDI-poverty relationship observed in the baseline models is less robust once common temporal shocks are controlled. Therefore, the most stable empirical conclusion concerns poverty persistence, while the HDI results should be interpreted as indicative association rather than definitive causal evidence.

4.7. Discussion

The findings provide consistent evidence that poverty in Aceh exhibits persistent characteristics. The significance of the lagged poverty coefficient indicates that poverty cannot be understood solely as a contemporaneous outcome of current socioeconomic conditions. Rather, current poverty levels are partly shaped by historical deprivation, supporting the theoretical arguments advanced by Myrdal (1957) and the poverty trap literature developed by Carter and Barrett (2006).

The existence of poverty persistence implies that poverty reduction is likely to be a gradual process. Households and communities that have experienced long-term deprivation often face structural barriers, including limited educational attainment, inadequate healthcare access, weak labor market participation, and restricted access to productive assets. These conditions constrain their ability to benefit fully from development opportunities and contribute to the reproduction of poverty over time.

The baseline results also suggest that human development is negatively associated with poverty. Consistent with Human Capital Theory Becker, (1993), improvements in education, health, and living standards may enhance productivity and expand economic opportunities. However, the robustness checks show that the HDI coefficient becomes statistically insignificant after year fixed effects are included. This pattern suggests that the HDI-poverty relationship should be interpreted cautiously as an association rather than definitive evidence of a direct causal effect.

An important insight emerges from the comparison between the static and dynamic models. The estimated coefficient of HDI declines from -0.537 in the static specification to -0.155 in the dynamic model. This reduction suggests that part of the observed relationship between human development and poverty operates through longer-term processes associated with poverty persistence. The robustness checks further indicate that this relationship is sensitive to common year shocks. Thus, human development remains policy-relevant, but the estimated statistical association should be interpreted cautiously.

From a policy perspective, the findings imply that poverty reduction strategies should extend beyond short-term income support programs. Improving education, healthcare, and living standards remains important, but the robustness results indicate that poverty persistence is the more stable empirical pattern in the data. Efforts to reduce poverty must therefore address the structural mechanisms that allow deprivation to persist over time, including unequal access to productive assets, employment opportunities, and basic public services.

5. Conclusion and Suggestion

5.1. Conclusion

This study examined the relationship between poverty persistence and human development across 23 districts and municipalities in Aceh during the period 2012–2023. Using static and dynamic fixed-effects panel models, the analysis sought to determine whether poverty exhibits persistent characteristics and whether human development is associated with lower poverty.

The findings provide consistent evidence that poverty in Aceh exhibits significant persistence. The positive and statistically significant coefficient of lagged poverty indicates that current poverty conditions are strongly influenced by poverty levels in the previous period. This result suggests that poverty is not merely a short-term socioeconomic phenomenon but rather a dynamic process in which historical deprivation continues to affect present welfare outcomes.

The baseline results indicate that human development is negatively associated with poverty. In the static and dynamic fixed-effects specifications, the Human Development Index (HDI) has a negative and statistically significant coefficient. However, the additional robustness checks show that the HDI coefficient becomes statistically insignificant after year fixed effects and lagged HDI are introduced. Therefore, the evidence for the HDI-poverty relationship should be interpreted as suggestive rather than conclusive.

A comparison between the static and dynamic models reveals that the magnitude of the HDI coefficient declines after poverty persistence is incorporated into the analysis. The robustness checks further show that the HDI association is sensitive to the inclusion of year fixed effects. This finding suggests that part of the relationship between human development and poverty may operate through broader time-specific conditions and longer-term processes associated with historical deprivation.

Overall, the findings indicate that poverty reduction in Aceh requires policies that combine sustained human development with stronger interventions targeting the structural persistence of poverty. The most robust empirical evidence from this study concerns poverty persistence across districts and municipalities.

5.2. Theoretical Implications

The findings contribute to the literature on poverty dynamics by providing empirical evidence that supports both Human Capital Theory and the theory of circular and cumulative causation.

The negative association between HDI and poverty in the baseline models is consistent with Human Capital Theory Becker, (1993), which argues that investments in education and health improve productivity and income-generating capacity. Nevertheless, because the HDI coefficient becomes statistically insignificant in the robustness checks with year fixed effects, this theoretical implication should be interpreted with caution.

At the same time, the significance of lagged poverty supports Myrdal's (1957) argument that socioeconomic disadvantages tend to accumulate and reinforce one another over time. The evidence of poverty persistence indicates that poverty possesses a dynamic dimension that cannot be fully explained by contemporaneous socioeconomic conditions alone.

By integrating poverty persistence and human development within a single empirical framework, this study extends the existing literature beyond conventional static analyses and provides a more comprehensive understanding of regional poverty dynamics.

This finding suggests that analyses relying solely on static specifications may overstate the immediate relationship between human development and poverty reduction. Therefore, accounting for temporal dependence and common year shocks is essential for understanding regional poverty dynamics more accurately.

5.3. Policy Implications and Suggestions

The findings suggest that poverty reduction efforts in Aceh should be viewed as a long-term development agenda rather than a series of short-term interventions. The significant persistence of poverty indicates that current poverty conditions are partly shaped by historical deprivation. As a result, policies that focus solely on temporary assistance may have limited effectiveness if the structural factors underlying poverty remain unresolved. Sustainable poverty reduction therefore requires interventions that address the conditions allowing poverty to persist across time.

The empirical results indicate that human development remains relevant for poverty reduction policy, although the robustness checks suggest caution in interpreting its direct statistical effect. Strengthening educational quality, expanding access to healthcare services, and investing in human capital development are still important because these interventions can improve long-term capabilities and employment prospects. However, such policies should be combined with measures that directly address persistent poverty conditions.

Another important implication concerns regional disparities in poverty dynamics. The Fixed Effects estimation reveals that poverty is influenced by district-specific characteristics, suggesting that development challenges vary considerably across regions. This finding highlights the need for policy approaches that are responsive to local conditions rather than relying on uniform programs applied across all districts. Tailoring interventions to the specific socioeconomic circumstances of each locality may improve the effectiveness of poverty reduction initiatives.

Particular attention should also be directed toward groups and communities experiencing chronic or persistent poverty. Limited access to education, healthcare, productive assets, and labor market opportunities often constrains their ability to improve living conditions. Expanding opportunities in these areas may not only reduce current poverty but also weaken the mechanisms through which poverty is transmitted across generations. In this regard, policies that combine human development initiatives with targeted support for vulnerable populations are likely to generate more sustainable and inclusive development outcomes.

5.4. Research Novelty

The contribution of this study extends beyond the conventional examination of the relationship between human development and poverty. Existing studies in Indonesia have generally focused on estimating the contemporaneous effect of the Human Development Index (HDI) on poverty using cross-sectional or static panel approaches. While these studies consistently report that improvements in human development contribute to poverty reduction, they often overlook the possibility that current poverty conditions may be influenced by historical poverty experiences. Consequently, the dynamic nature of poverty remains insufficiently explored in the Indonesian context.

The first contribution of this study lies in its conceptual integration of human development and poverty persistence within a unified analytical framework. Previous studies have typically treated these two perspectives separately. Research on human development emphasizes the role of education, health, and living standards in improving welfare outcomes, whereas studies on poverty persistence focus on the intertemporal transmission of deprivation and the existence of poverty traps. By combining these perspectives, the present study provides a more comprehensive understanding of poverty dynamics and demonstrates that poverty reduction is influenced not only by current development achievements but also by historical poverty conditions.

A second contribution relates to the methodological approach employed in the analysis. In addition to estimating conventional static and dynamic fixed-effects models, this study adds two robustness checks: a dynamic two-way fixed-effects specification and a lagged-HDI specification. This design allows the analysis to examine poverty persistence while assessing whether the HDI-poverty relationship remains stable after controlling for common year shocks and alternative timing of human development.

The third contribution is empirical in nature. Evidence on poverty persistence at the district level remains relatively limited in Indonesia, particularly for Aceh Province. Using balanced panel data covering 23 districts and municipalities during 2012–2023, this study provides new empirical evidence that poverty in Aceh exhibits a clear dynamic component. The findings indicate that districts experiencing relatively high poverty levels in the past tend to maintain higher poverty rates in subsequent periods. At the same time, HDI is negatively associated with poverty in the baseline models, although this relationship becomes less robust after year fixed effects are included. These results provide a more nuanced district-level evidence base from Aceh than a purely static model would offer.

The results further suggest that investments in human development remain policy-relevant, although the empirical evidence is more consistent for poverty persistence than for a robust contemporaneous HDI effect. Therefore, policies aimed at improving education, health, and

living standards should be integrated with targeted interventions designed to weaken persistent deprivation.

Taken together, these contributions provide a more nuanced understanding of the relationship between human development and poverty by demonstrating that current poverty outcomes are shaped simultaneously by present development achievements and historical poverty conditions. The integration of these perspectives represents the principal novelty of the study and contributes to a more comprehensive explanation of poverty dynamics at the regional level.

6. Limitations and Future Research

Several limitations should be acknowledged when interpreting the findings of this study. Although the Human Development Index (HDI) provides a comprehensive measure of welfare by incorporating education, health, and living standards, poverty is inherently multidimensional and influenced by a broader set of socioeconomic factors. Variables such as economic growth, income inequality, unemployment, fiscal capacity, infrastructure availability, and institutional quality may also play important roles in shaping poverty dynamics. The exclusion of these factors means that the present analysis captures only part of the complex mechanisms underlying poverty.

Another limitation relates to the empirical approach adopted in the dynamic specification. The inclusion of a lagged dependent variable within a fixed-effects framework allows the analysis to identify the existence of poverty persistence; however, potential dynamic panel bias cannot be entirely ruled out. While the approach remains informative for examining intertemporal poverty dynamics, more advanced estimation techniques may provide more robust results. Future studies could employ dynamic panel estimators such as the Arellano–Bond Generalized Method of Moments (GMM) or System GMM to address potential endogeneity issues and strengthen causal inference (Arellano & Bond, 1991; Blundell & Bond, 1998; Roodman, 2009).

The geographical scope of the study also warrants consideration. The analysis is confined to districts and municipalities within Aceh Province, a region characterized by relatively high poverty levels and a unique institutional setting arising from its special autonomy status. These characteristics make Aceh an important context for investigating poverty persistence, yet they may also limit the direct applicability of the findings to other provinces with different economic structures, governance arrangements, and development trajectories.

Building on these limitations, future research may benefit from incorporating additional determinants of poverty, including economic, demographic, institutional, and fiscal variables. Expanding the analysis to other provinces or conducting comparative regional studies could provide valuable insights into whether the patterns observed in Aceh are consistent across different contexts. Furthermore, the application of more advanced dynamic panel techniques would help deepen understanding of the mechanisms through which poverty evolves and the extent to which development policies can effectively reduce persistent poverty over time.

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