

Reducing Regional Poverty Gaps Through Optimized Local Government Spending

By:

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ABSTRACT: This study aims to analyze the relationship between local government expenditure allocation and poverty reduction and map the time needed to fade the disparity between the dichotomy of regions. The methods used statistical approaches and mathematical models, both linear and non-linear, to project the time of inequality fading by observing all districts and cities in Banten Province during the period 2005-2024. The study also examines the differences in spending patterns between North and South Banten in the context of fiscal decentralization. Key results show that spending on these functions has a strong negative correlation with poverty rates, while predictive models show optimistic and pessimistic scenarios in the fading of inequality. This study concludes that optimizing local government spending can significantly accelerate the reduction of poverty gaps. The contribution of this research provides a theoretical and practical basis for more effective fiscal policies in supporting inclusive and sustainable development.

Keywords: Fiscal Decentralization, Regional Disparity, Subnational Public Expenditure, Sustainable Development Goals, Welfare Disparities.

ABSTRAK: Penelitian ini bertujuan untuk menganalisis hubungan antara alokasi belanja pemerintah daerah dan pengurangan kemiskinan serta memetakan waktu yang dibutuhkan untuk memudahkan dikotomi antar wilayah. Metode yang digunakan adalah pendekatan statistik dan model matematis, baik linier maupun non-linier, untuk memroyeksikan waktu pemudaran ketimpangan dengan mengamati seluruh kabupaten dan kota di Provinsi Banten selama periode 2005-2024. Studi ini juga mengkaji perbedaan pola belanja antara wilayah Banten Utara dan Selatan dalam konteks desentralisasi fiskal. Hasil utama menunjukkan bahwa pengeluaran untuk fungsi-fungsi ini memiliki korelasi negatif yang kuat dengan tingkat kemiskinan, sementara model prediktif menunjukkan skenario optimis dan pesimis dalam memudarnya ketimpangan. Penelitian ini menyimpulkan bahwa optimalisasi belanja pemerintah daerah dapat secara signifikan mempercepat pengurangan kesenjangan kemiskinan. Kontribusi penelitian ini memberikan landasan teoritis dan praktis untuk kebijakan fiskal yang lebih efektif dalam mendukung pembangunan yang inklusif dan berkelanjutan.

Kata Kunci: Desentralisasi Fiskal, Ketimpangan Wilayah, Belanja Publik Tingkat Daerah, Tujuan Pembangunan Berkelanjutan, Kesenjangan Kesejahteraan.

INTRODUCTION

Poverty and income inequality remain major global challenges despite ongoing economic growth and policy interventions. The United Nations Sustainable Development Goals (SDGs) emphasize the need to eradicate extreme poverty (SDG 1) and reduce income inequality (SDG 10). However, disparities persist due to unequal economic structures, fiscal imbalances, and ineffective public policies (Cano-hila, 2022; Halkos & Aslanidis, 2023; Filho et al., 2021).

Realizing inclusive and sustainable development, as called for in the Sustainable Development Goals (SDGs), faces higher poverty gaps between regions and in the world (Cano-hila, 2022; Halkos & Aslanidis, 2023; Filho et al., 2021; Wei et al., 2023). The poverty gap can be classified into developed and developing countries. For example, Nae et al. (2024) use indicators of a 'social crisis' by ranking countries based on life expectancy and other risks to health and access to social services. Their findings reveal persistent disparities in living standards across and within regions. These disparities contribute to ongoing poverty and inequality in many parts of Europe, posing a threat to the European Union's broader ambition of achieving convergence and cohesion. Likewise, in developing world regions such as Sub-Saharan Africa, progress toward poverty reduction has been slow, while income inequality is high, thus impeding SDG achievement (Fofana et al., 2023). Similarly, in Indonesia, Az Zakiyyah et al. (2023) found that low HDI and rising unemployment significantly contributed to poverty levels, emphasizing the multidimensional nature of the problem.

In developed economies, such as the United States and the European Union, regional disparities between urban and rural areas remain pronounced. Economic hubs attract more investment and government spending, while peripheral regions lag (Nae et al., 2024). Poverty alleviation in emerging regions, such as Sub-Saharan Africa and Southeast Asia, has progressed slowly, with fiscal decentralization producing inconsistent outcomes. (Fofana et al., 2023). The COVID-19 epidemic intensified these discrepancies, disproportionately impacting low-income and underdeveloped areas, hence rendering fiscal interventions essential for economic recovery. Indonesia has comparable patterns of regional disparity, especially between industrialized metropolitan centers and impoverished rural areas. Banten Province exemplifies this duality, with North Banten flourishing economically, while South Banten grapples with poverty and little public investment.

This regional divide is not unique to Banten but reflects broader challenges faced in Eastern Indonesia. Tamba et al. (2024) show that while village and health funds significantly reduce poverty in Eastern provinces, education funding has limited impact. These findings highlight the need for region-specific fiscal strategies, as the effectiveness of public spending is shaped by local institutional and socio-economic conditions.

Numerous studies have investigated the impact of fiscal decentralization on poverty alleviation, yet substantial gaps persist. The majority of the study concentrates on industrialized nations, where decentralization transpires within a stable economic context, resulting in scant empirical information regarding the functioning of fiscal decentralization in emerging areas characterized by significant inequality and fragile governance (Kyriacou & Roca-Sagalés, 2019). Additionally, previous studies on Indonesia (Muhammad et al., 2019) have not specifically examined the impact of government spending functions (education, health, social protection, and public services) on poverty reduction at the regional level, making it difficult to identify which areas of expenditure are most effective. A significant deficiency is the absence of mathematical modeling to forecast the timetable for reducing inequality, as current research does not offer a quantitative estimation of when poverty disparities may diminish under various fiscal policy scenarios. This paper fills these gaps by providing empirical validation, predictive modeling, and policy-oriented insights to improve the efficacy of fiscal decentralization in mitigating regional inequality.

Understanding how local government spending can accelerate the dilution of poverty gaps is crucial in supporting equitable and sustainable development. Although the role of local government spending in reducing poverty has been widely recognized, there are still limitations in understanding the extent to which different budget allocations in certain functions can effectively address inequalities

between regions. In Banten Province, significant inequality between North and South Banten shows the need for a more in-depth analysis of the influence of fiscal decentralization on regional disparities. Based on a comprehensive mathematical model approach, there is no accurate time mapping of when this poverty inequality will fade. Another gap is the lack of empirical evidence explaining how spending allocation strategies can be optimized to accelerate the fading of such inequality in some scenarios. This creates a need for research that can bridge these gaps to support more inclusive development policies.

This research is important because the disparity between regions, especially in North Banten and South Banten, can obstruct equitable and sustainable development in Banten Province. As poverty inequality is highly multidimensional, covering various economic, social, and political levels, it is also important to gain insight into the types of inequality patterns and contributing factors. Also, projections on when these inequities will be eradicated signal that we need to chart some bold moves vs. possible life urgent mortgage more to the battle. The finding is also a reminder of how local government money is being spent and a warning against wasting local government resources if we want to drive down poverty locally.

This study provides a model based on the time needed to decrease regional poverty inequality significantly. This study also shows that local government spending allocated by economic functions (education, health, social protection, economy, housing, and public services) was significantly related to poverty levels. Furthermore, the study discusses the significance of data-based planning in helping the government distribute its budget.

Poverty is a multidimensional problem that can be seen in several aspects. One is an inequality between the rich and the poor, which Gini's index can measure. This study also seeks to find the correlation between local government spending on some functions, such as education, health, social protection, and public services and the area's poverty level. From such findings, this study can provide evidence-based recommendations to foster a more effective policy in accelerating the elimination of poverty inequality and improving the community's welfare evenly in Banten Province.

This study is anchored in Fiscal Decentralization Theory, which postulates that shifting fiscal authority to local governments improves resource allocation efficiency and public service delivery (Oates, 1972). However, decentralization outcomes vary based on governance structures, fiscal capacity, and institutional quality. Several studies have examined the effects of fiscal decentralization on poverty reduction with mixed findings. Kyriacou & Roca-Sagalés (Kyriacou & Roca-Sagalés, 2019) found that fiscal decentralization improves education outcomes but has inconsistent effects on health services, while Djiogap et al. (2024) demonstrated that in Cameroon, decentralization enhanced school infrastructure but failed to guarantee healthcare improvements due to governance inefficiencies. Similarly, Sun & Andrews (2023) showed that in China, enhanced local economic autonomy resulted in elevated bureaucratic expenditures, diminishing the efficacy of poverty alleviation initiatives. The effect of local government expenditure on poverty is contingent upon spending priorities, with research indicating that investments in education and health are significantly correlated with poverty alleviation (Muhammad et al., 2019), social protection programs are effective when well-targeted (Fonayet et al., 2020), and public service efficiency plays a crucial role in minimizing regional inequality (Dick-Sagoe, 2020). Nonetheless, the quality of governance is a critical determinant, as inadequately managed fiscal decentralization can exacerbate inequality, especially when local governments lack transparency and accountability measures (Kim et al., 2022). These findings underscore the necessity for efficient administration, strategic expenditure, and data-informed planning to guarantee that fiscal decentralization results in concrete poverty alleviation benefits.

Inclusive finance significantly contributes to the mitigation of rural poverty by enhancing income, employment, health, and living conditions. Nonetheless, its benefits vary based on group disparities such as levels of poverty and education, indicating the necessity for targeted financial inclusion measures. (L. Wang et al., 2022). The regional poverty gap continues to pose a substantial obstacle to inclusive and sustainable development. The issue is complex, requiring solutions involving economic development, ecological preservation, and social justice. Addressing these gaps through region-specific strategies, integrated policy frameworks, and targeted interventions ensures that no region is left behind in pursuing the SDGs.

In fiscal decentralization, local governments deliberately reduce disparities by managing expenditure through prioritized functions such as education, health, and the economy. Wealthier regions are predicted to experience the most significant effects of fiscal decentralization, as local governments typically have superior fiscal capacity and institutional quality (Sun & Andrews, 2023). In Cameroon, it was shown that decentralization helped educational infrastructure, but it had mixed results for healthcare and emphasized the need for local governance to ensure effective and non-corrupt management (Djiogap et al., 2024). Health expenditures can be decentralized either directly or indirectly, which can, at times, weigh against health (balance costs) due to externalities and lost economies of scale (particularly in smaller localities) (Kyriacou & Roca-Sagalés, 2024). Moreover, the rise in local bureaucrats' expenditures in China typically implies reduced budget allocations towards public goods such as healthcare (Qian & Zhang, 2017).

Decentralized education spending generally increases the perceived quality of public services (Kyriacou & Roca-Sagalés, 2019). Fiscal decentralization in Cameroon improved educational facilities such as additional classrooms and desks per pupil (Djiogap et al., 2024). Organizational infrastructure of government and strong structures are also important in the effective delivery to ensure that resources are used effectively and equitably (Mbedzi & Gondo, 2010).

They can enhance efficiency at the local government level, and responsiveness to local demands may stimulate economic growth and reduce regional inequities (Ananda et al., 2016). Moreover, the phenomenon of fiscal decentralization in Vietnam results in a reduction in public expenditure and the scale of government (Thanh & Canh, 2019). The beneficial effects of fiscal decentralization on economic growth depend on the financial capacity and governance quality of local governments. In Ethiopia, local governments frequently lack sufficient financial resources, resulting in inefficient public service delivery (Mesfin & Teka, 2023).

Decentralization can enhance the efficiency and accountability of government, particularly when local governments possess revenue streams (Kim et al., 2022). The magnitude of benefits fluctuates based on factors such as economic growth levels and the quality of local government (Alonso & Andrews, 2019; Di Novi et al., 2019). Fiscal decentralization serves as a mechanism to mitigate intra-regional disparities, while its effects on inter-regional inequality remain equivocal and are significantly influenced by the level of local economic growth (Di Novi et al., 2019).

Realizing the full potential benefits of fiscal decentralization necessitates the enhancement of local government institutions, more openness, and the promotion of accountability (Dick-Sagoe, 2020). Local governments must possess sufficient autonomy to handle resources, accompanied by supervision systems to prevent mismanagement and guarantee equitable resource distribution (Djiogap et al., 2024; Mbedzi & Gondo, 2010). While fiscal decentralization may lead to increased inequalities, targeted expenditures on education, health, and economic development help minimize the disparities likely to emerge when devolving and/or delegating responsibility. However, as with much else, its effectiveness is determined by competent local governance, levels of economic development, and the efficient and equitable management of resources.

Past studies have indicated that the optimum budget allocation to these functions significantly correlates with declining poverty rates. Investment in goods, services, and capital availed by the government has been noted to lower poverty significantly. However, the effectiveness of these expenditures can be tempered by the unemployment rate since increased unemployment weakens the poverty reduction impact (Amri et al., 2024). Evidence shows that social expenditures, especially those planned at the exclusions of the social sector and child/family level towards those at risk of poverty, improve social indicators, specifically in the state of poverty within the European Union (EU) now. The efficiency of these outlays differs greatly depending on the country, as some countries can achieve considerable poverty reduction with relatively low levels of social expenditure (Miežiene & Krutuliene, 2019; Fonayet et al., 2020).

Investments in health and education are essential. For instance, higher budgetary allocations to education and health in Indonesia have resulted in more than a thirty-hour decline in poverty (Muhammad et al., 2019). Likewise, counterfactually — in the Southern United States, increased educational funding in high-poverty counties is associated with decreasing poverty in those counties and neighboring counties (Jung et al., 2015). In China, public spending, particularly on health services,

has effectively lowered poverty in poorer countries. However, there is not vast immediacy in education spending with the extended return cycle (Wang et al., 2023).

The social expenditure efficiency in poverty reduction is heterogeneous. In the European Union, countries with more efficient social spending, especially in family/children and spending in health care, obtain lower poverty rates (Fonayet et al., 2020). Cash transfer programs (CTPs) reduce poverty effectively, provided occupancy rules are built appropriately to reach the correct benefactor. Efficient targeting and allocation can meaningfully increase the impact of these programs (Zheng et al., 2022).

Models like the quadratic model have been designed to distribute the budget efficiently and fairly. Such models intend to reduce deviations from optimal allocations and have been used in multiple settings, including universities and public organizations (Sinuany-Stern, 2014). However, investing in particular sectors such as health, education, and social protection can dramatically lower poverty rates. Maximizing the impact of poverty reduction programs requires focusing on the efficiency of expenditure (what is produced with the investment) and beneficiary targeting (who can benefit from the investment). The success of different budget allocations can differ depending on local situations like local unemployment levels or regional poverty rates. In conclusion, these results suggest that poverty rates can be decreased when budget allocations are strategic and specific.

METHODS

This study employs a quantitative research approach to examine the relationship between local government expenditure allocation and poverty inequality in Banten Province, Indonesia. The selection of correlation analysis rather than a regression model is based on the research objective: to measure the strength and direction of associations between government spending categories and poverty levels rather than establishing a predictive or causal relationship. Given that fiscal policies and poverty trends are shaped by intricate socio-economic and external factors beyond just government expenditure, a regression model may inadequately represent the complexities that surround poverty alleviation. Correlation analysis offers a more explicit statistical assessment of whether heightened expenditure in particular budgetary sectors (education, health, social protection, and public services) corresponds with reduced poverty rates across areas.

The choice to employ correlation analysis is substantiated by prior research that has examined the relationship between fiscal decentralization and poverty through correlation, as opposed to regression models, in scenarios where several external variables hinder direct causal inference (Djiogap et al., 2024; Kyriacou & Roca-Sagalés, 2019). Comparable methodologies have been utilized in regional inequality research to assess the efficacy of local government expenditure distributions in subnational fiscal administration (Sun & Andrews, 2023). Additionally, past research on Indonesia (Muhammad et al., 2019) has explored local government budget allocations and poverty reduction using correlation analysis, reinforcing its suitability for this study. This study employs mathematical models to forecast the timeline for reducing inequality, utilizing a correlation approach that facilitates a more rigorous interpretation of the statistical relationship between fiscal decentralization and poverty disparities while mitigating overfitting due to uncontrolled external variables in regression models.

The object of observation in this study is all districts and cities in Banten Province, which consists of 8 (eight) administrative regions, namely Tangerang City, South Tangerang City, Serang City, Tangerang Regency, Serang Regency, Lebak Regency, Pandeglang Regency, and Cilegon City. Data were observed from 2005 to 2024 to provide an overview of the poverty inequality trend between Banten Province regions.

This study uses secondary data from various official sources, such as the Central Statistics Agency (BPS) and the Directorate General of Fiscal Balance of the Ministry of Finance of the Republic of Indonesia (DJPK Kemenkeu-RI). The data includes poverty rates and local government expenditure allocations based on specific functions (education, health, social protection, and others). The research process includes a few key steps: gathering data from trustworthy sources, checking and confirming the data to make sure it's accurate and consistent, and then using math techniques to look at trends, relationships, and forecasts. This data provides a solid basis for empirical analysis and projected fading inequality time between Banten Province regions.

To analyze the pattern and trend of the poverty gap between regions in Banten Province, a coefficient of variation consisting of two indicators was used, namely the standard deviation and the Williamson index. Analysis of the coefficient of variation, the standard deviation, measures how widely values are dispersed from the average value (the mean). Standard deviation uses the following formula:

$$\text{Standard Deviation} = \sqrt{\frac{\sum (x - \bar{x})^2}{(n - 1)}}$$

Where x is the poverty level, and n is the sample size.

The Williamson index to assess the inter-regional gap as follows:

$$CV_w = \frac{\sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2 \frac{P_i}{P}}}{\bar{Y}}$$

Where, CV_w = weighted coefficient of variation; n = number of regions; Y_i = poverty level of its region; \bar{Y} = average of poverty level; P_i = population of its region; and P = total population.

A linear trendline indicates a consistent increase or decrease at a uniform rate. A linear trendline employs this equation to determine the least squares fit for a line:

$$y = b + mx + \varepsilon$$

Where y is the poverty level, b is the intercept, m is the slope, x is the time period, and ε is the error term.

Logarithmic trendlines illustrate an optimal curved fit. This trendline is applicable when the pace of data change accelerates or decelerates rapidly before stabilizing. A logarithmic trendline can incorporate both negative and positive numbers. A logarithmic trendline employs this equation to determine the least squares fit over data points:

$$y = b + c \ln x + \varepsilon$$

Where y is the poverty level, b and c are the intercepts, \ln is the natural logarithm function, x is the time period, and ε is the error term.

An exponential trendline depicts a curving line when data values increase or decrease at consistently accelerating rates. An exponential trendline cannot be generated if the data includes zero or negative values. An exponential trendline employs this equation to determine the least squares fit over data points:

$$y = ce^{bx} + \varepsilon$$

Where y is the poverty level, c and b are intercepts, e is the base of the natural logarithm, x is the time period, and ε is the error term.

A power trendline displays a curved line, which is advantageous for data sets that compare measurements increasing at a specified pace. The acceleration of a race automobile at one-second intervals. A power trendline cannot be generated if the data includes zero or negative values. A power trendline employs this equation to determine the least squares fit via data points:

$$y = cx^b + \varepsilon$$

Where y is the poverty level, c and b are intercepts, x is the time period, and ε is the error term.

To enhance a forecast, whether moving average, exponential smoothing, or an alternative method, it is essential to compute and assess MAD, MSE, RMSE, and MAPE. The Mean Absolute Deviation (MAD) is calculated by summing the absolute differences between the actual values and the forecasts and then dividing by the total number of observations. MAD is equivalent to MAE, denoting absolute inaccuracy. Mean square error (MSE) is arguably the most prevalent error statistic. It imposes more significant penalties for larger errors, as squaring larger values exerts a more substantial influence than squaring smaller values. The Mean Squared Error (MSE) is the quotient of the sum of squared errors and the total number of observations. The Root Mean Square Error (RMSE) is the square root of the Mean Squared Error (MSE). RMSE converts MSE back to the native units of the real data. The Mean Absolute Percentage Error (MAPE) is the mean of absolute errors divided by the actual observed values. MAPE should be eschewed in datasets containing zeros or near-zero values.

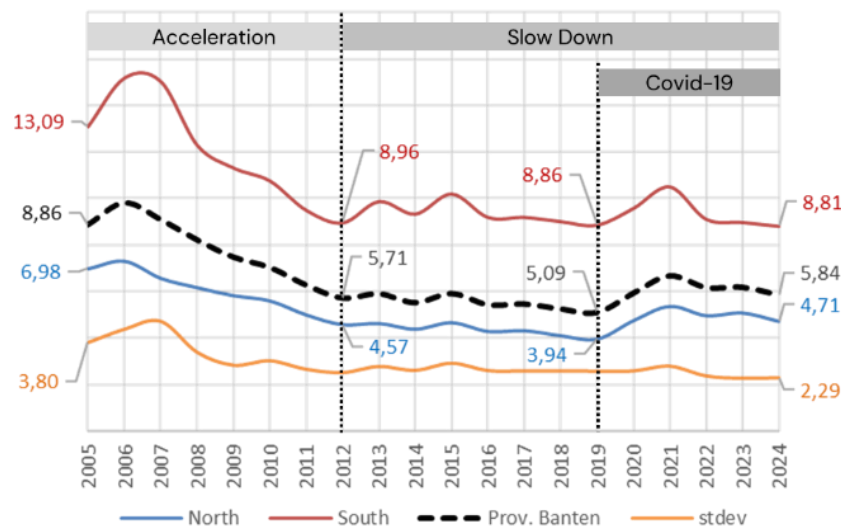
The correlation coefficient is employed to analyze the relationship between regional expenditure factors and poverty levels. A correlation coefficient approaching +1 or -1 signifies a positive (+1) or negative (-1) correlation between the two variables' value sets. A positive correlation indicates a directional relationship, meaning that if the value in one variable is high, then the value in the other variable is also high. A negative correlation indicates the opposite direction of the relationship, meaning that if the value in one variable is high, then the value in the other variable is low. A correlation coefficient that is close to 0 indicates no or weak correlation. The equation for the correlation coefficient is:

$$r(x, y) = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

Variable x is regional spending according to the function of the number of poor people, and y is the poverty rate.

RESULTS AND DISCUSSIONS

The Northern region of Indonesia, which is more developed than the southern region, especially Banten Province, is one of the important issues that must be pursued to ensure equitable welfare at the regional level. As illustrated in Figure 1, South Banten's poverty rate is always higher than North Banten's, and the average of Banten Province ranges from 2005 to 2024. Poverty reduction remained during the "Acceleration" period (2005–2012). The rate of decline slowed, so this led to the "Slow Down" period (2013–2019) affected by the Covid-19 pandemic (2020–2024) in South Banten alone.



Source: Central Bureau of Statistics, processed by author, 2024

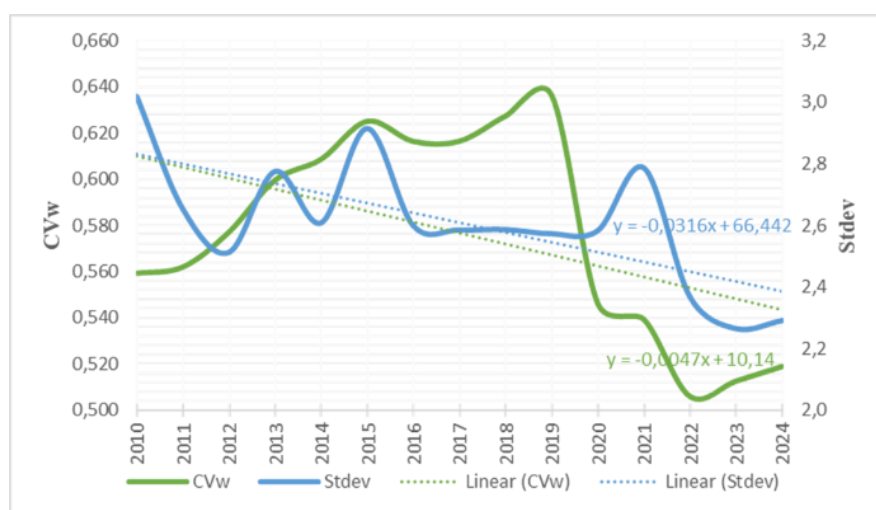
Figure 1. Poverty Rate (%) North and South Banten, Period 2005-2024

Inequality between regions is still evident, although standard deviations show a downward trend reflecting a gradual reduction in inequality. However, North Banten remains at a much lower poverty level than South Banten, reflecting significant socio-economic disparities. This underscores the importance of implementing more substantial and focused policy interventions in South Banten to accelerate the reduction of inequality, particularly due to the pandemic's impact on vulnerable regions. A fair development strategy is needed to ensure equitable welfare throughout Banten Province.

Judging from the coefficient of variation calculations, namely the Standard Deviation and the Williamson Index, it depicts a significant decrease in the value of variation, proving that there has been a significant process of reducing poverty inequality between districts and cities in Banten Province. Figure 2 shows the dynamics of the Williamson coefficient of variation (CVw) and standard deviation (Stdev) in measuring poverty inequality in Banten Province from 2010 to 2024. The CVw (green line) and Stdev (blue line) trends show a volatile pattern but are overall bearish, as seen in the linear trend line that is declining for both. This decrease reflects a gradual reduction in poverty inequality between regions. However, the 2020–2022 period showed a spike in inequality, which was most likely

influenced by the impact of the COVID-19 pandemic on the socio-economic conditions of the community. After 2022, the graph again shows a decline, indicating a slow recovery in inequality. It emphasizes that although poverty inequality in Banten Province shows a downward trend in the long term, external impacts such as the pandemic still pose significant challenges, so more adaptive and targeted policies are needed to ensure that inequality continues to decline sustainably.

As part of SDGs, regional income inequality continues to pose a cumbersome obstacle to inclusive and sustainable development (Cano-hila, 2022; Halkos & Aslanidis, 2023; Filho et al., 2021; Wei et al., 2023). Regional disparities plague both developed and developing regions, impeding social and economic cohesion. Persistent income gaps across EU member states are daunting realities, illustrating the challenges of convergence and cohesion objectives (Nae et al., 2024). According to one study by Fofana (Fofana et al., 2023), the only regions that are set to meet the SDGs are Structure, a well-developed area in the world; however, in developing regions, only groups with low levels of poverty will be able to meet SDGs, due to slow progress in poverty reduction and increasing income inequality in Sub-Saharan Africa. These examples demonstrate the pervasiveness of poverty across human geographies worldwide, highlighting the need for region-specific approaches to address inequities.



Source: Central Bureau of Statistics, processed by author, 2024
Figure 1. Poverty Rate (%) North and South Banten, Period 2005-2024

In fiscal decentralization, local governments are crucial for mitigating regional inequalities via pro-poor targeted spending for priority functions such as education, health, and economic development. The optimal allocation of public spending is significantly associated with a decrease in poverty level (Muhammad et al., 2019; Wang et al., 2023). In Indonesia, especially in Banten Province, there is a tremendous gap in socio-economic status between the northern and southern parts, being the most developed and the least developed, respectively. As depicted in Figure 1, the poverty of South Banten was continually higher than North Banten's and the provincial average from 2005–2024. The decline of poverty was far-reaching in the period 2005–2012, called “Acceleration,” when gains slowed down during 2013–2019 (“Slow Down”) but then interrupted by the Covid-19 pandemic in 2020–2024.

The coefficient of variation calculations, namely the Standard Deviation and Williamson Index (CVw), indicate a significant decrease in poverty inequality across districts and cities in Banten Province. The downward trend in CVw and Stdev confirms that regional inequality in poverty has been gradually reducing over time, aligning with Fiscal Decentralization Theory, which suggests that local government autonomy can improve economic development outcomes when well-managed (Oates, 1972). However, the data also highlight that the COVID-19 pandemic (2020–2022) caused a temporary spike in inequality, demonstrating that external shocks can disrupt progress, particularly in underdeveloped regions like South Banten. This pattern is consistent with previous findings on decentralization challenges in developing countries, where localized fiscal management can be

vulnerable to external crises due to weaker economic resilience and institutional capacity (Djiogap et al., 2024; Kyriacou & Roca-Sagalés, 2019).

The North-South gap in Banten closely resembles the disparity between Jakarta and West Java, with Jakarta receiving greater fiscal transfers and investment inflows compared to other regions in Indonesia. Conversely, peripheral regions contend with fiscal constraints and operational inefficiency (Muhammad et al., 2019). A comparable trend is observable in East Kalimantan, where urban-industrialized regions obtain greater infrastructure investment, resulting in rural districts experiencing slower poverty alleviation rates despite general economic advancement (Sun & Andrews, 2023). Globally, the findings correspond with regional disparities observed in Vietnam, where fiscal decentralization initially exacerbated the income gap before specific efforts mitigated poverty (Thanh & Canh, 2019). Conversely, China's experience with decentralization showed that as economic growth intensified in affluent provinces, impoverished rural regions continued to suffer from enduring underdevelopment due to disparities in fiscal ability across local governments (Qian & Zhang, 2017).

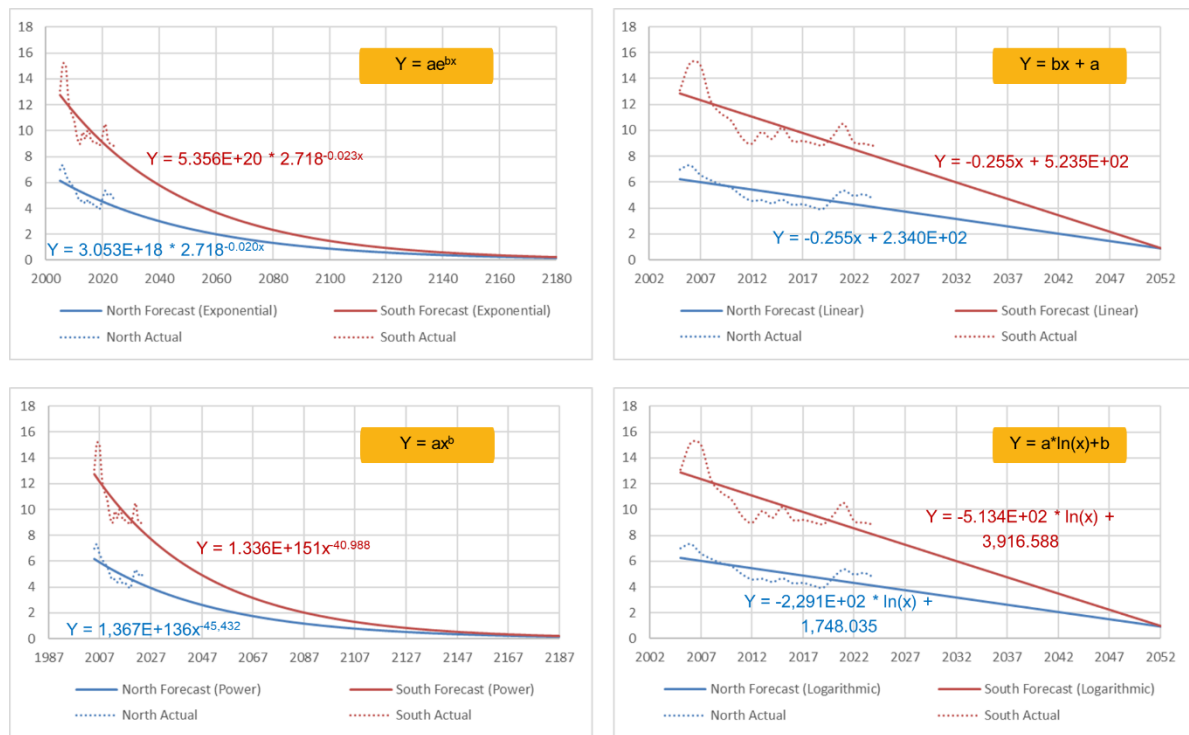
The forecasting accuracy of four mathematical models (Exponential, Linear, Logarithmic, and Power) to predict the poverty rate of North and South Banten using Table 1: MAPE, MAD, MSE, and RMSE. As shown in Table 9, North Banten gets its best accuracy for MAD and MSE with the Power model but also with the lowest MAPE (11.68), MAD (0.59), MSE (0.42), and RMSE (0.65), whilst the second best to Exponential model. In the South Banten region, both the Exponential and Power models provide nearly identical predictions, achieving the lowest MAPE (8.52 and 8.51), MAD (0.92), MSE (1.46), and RMSE (1.21). These results illustrate the importance of choosing region-specific forecasting models to maximize accuracy; while the Power model is a generation type in North Banten, both the Exponential and Power models perform quite well in South Banten. This distinction highlights the importance of developing context-specific strategies to address regional inequalities and enhance the effectiveness of poverty alleviation policies.

Table 1. Forecasting Model Accuracy Measurement

Accuracy Measure	North				South			
	Exponential	Linear	Logarithmic	Power	Exponential	Linear	Logarithmic	Power
MAPE	11,69	12,32	12,31	11,68	8,52	9,48	9,47	8,51
MAD	0,59	0,61	0,61	0,59	0,92	1,00	1,00	0,92
MSE	0,43	0,46	0,46	0,42	1,46	1,58	1,57	1,46
RMSE	0,65	0,68	0,68	0,65	1,21	1,26	1,25	1,21

Source: Central Bureau of Statistics (BPS) processed by author, 2024

Figure 3 shows the projected fading of poverty rates in North Banten (blue line) and South Banten (red line) based on four mathematical models: exponential, linear, power, and logarithmic. Linear and logarithmic models predict the fading of inequality between North and South Banten faster, with an estimate to be achieved in 2052. In contrast, the exponential and power models show a much longer fading time, i.e., up to the 22nd century (around 2180–2187). The graph also shows the actual data (dotted line) up to a specific point in time, which is used to validate the projected trend. The difference in outcomes between linear-logarithmic (optimistic) and exponential-power (pessimistic) models reflects a variety of scenarios that can occur depending on future social, economic, and government policy dynamics. Overall, this projection shows the importance of focused policy interventions to accelerate the elimination of inequality, especially in the South Banten region, where the poverty rate is much higher than that of North Banten.



Source: Central Bureau of Statistics (BPS) processed by author, 2024

Figure 3. Analysis of Trendline Forecasting of Poverty Gap Between North-South Banten

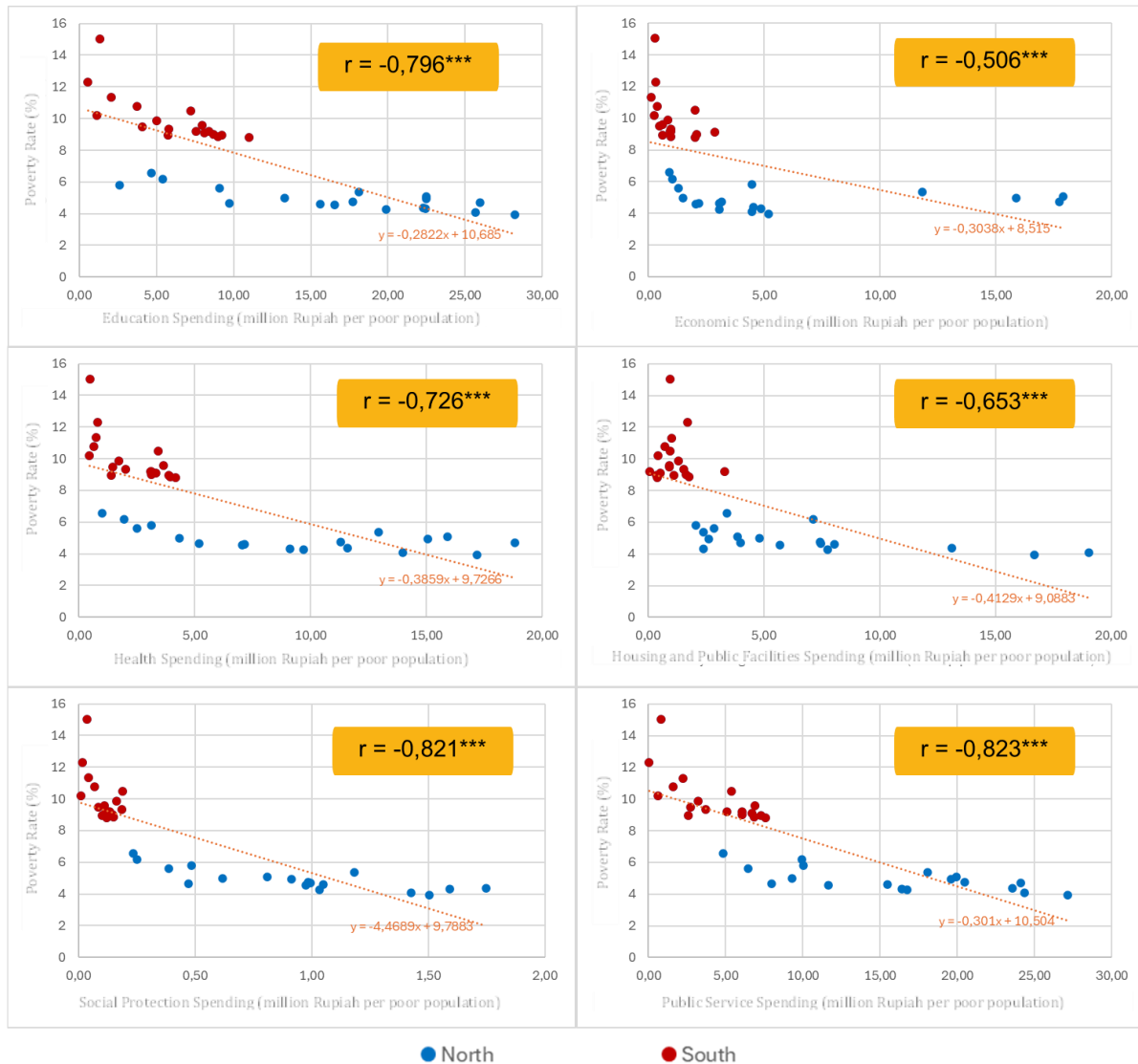
To address the question of when regional poverty disparities might dissipate, Figure 3 provides projections based on four mathematical models: exponential, linear, power, and logarithmic. Linear and logarithmic models offer optimistic scenarios, predicting equality between North and South Banten by 2052. In contrast, the exponential and power models paint a more pessimistic picture, with equality potentially delayed until the 22nd century. These differences highlight the dynamic nature of poverty reduction, influenced by economic, social, and policy factors. The importance of targeted policy interventions, particularly in South Banten, where poverty rates remain high, cannot be overstated. Effective governance and efficient resource allocation are essential to accelerate progress and ensure equity (Dick-Sagoe, 2020; Thanh & Canh, 2019).

All types of district and city government expenditures in Banten Province according to their functions, namely (a) the education function, (b) health functions, (c) social protection function, (d) economic functions, (e) housing functions, and public facilities; (f) the function of public services, strongly correlated negatively with poverty levels. This proves that areas with more significant expenditure according to these functions (North Banten) tend to have lower poverty levels or are more prosperous than areas with more minor expenditure according to these functions (South Banten).

The forecasting analysis, using four mathematical models (Linear, Logarithmic, Exponential, and Power), provides insights into the expected timeline for poverty disparity reduction. The Linear and Logarithmic models predict that inequality between North and South Banten will fade by 2052, assuming consistent policy interventions and sustained fiscal investments in public services. However, Exponential and Power models suggest that, without major changes in fiscal strategy, poverty disparities could persist until the 22nd century (2180–2187). These projections indicate the need for aggressive policy measures to accelerate poverty reduction, a point reinforced by similar findings in Sub-Saharan Africa, where slow fiscal adaptation has prolonged poverty cycles (Fofana et al., 2023). In contrast, European Union (EU) member states with strong regional convergence policies have successfully reduced income inequality faster, demonstrating the impact of well-managed fiscal decentralization on economic convergence (Nae et al., 2024).

Figure 4 shows a correlation analysis between regional expenditure based on six main functions (education, health, economy, housing, public facilities, social protection, and public services) and poverty rates across districts and cities in Banten Province for the period 2007-2024. The results showed that all expenditure functions had a significant negative correlation ($p < 0.01$) with poverty

levels, with public service functions ($r=-0.823$) and social protection ($r=-0.821$) showing the most substantial relationship. The functions of education ($r=-0.796$) and health ($r=-0.726$) also have significant influences, reflecting the importance of investment in these sectors for poverty alleviation. Housing and public facilities ($r=-0.653$) and economic functions ($r=-0.506$) showed weaker but significant correlations, indicating a more specific impact. Areas with more lavish spending on these functions, such as North Banten, tend to have lower poverty rates than areas with smaller allocations, such as South Banten. The results affirm that optimizing regional expenditure on priority functions is a crucial technique for facilitating successful poverty alleviation in Banten Province.



Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: Directorate General of Fiscal Balance of the Ministry of Finance of the Republic of Indonesia, processed by author, 2024

Figure 4. Correlation Analysis of Regional Expenditure and Poverty in All Regencies and Cities in Banten Province, Period 2007-2024

The robust negative connections between poverty rates and expenditure on specific important services (Figure 4) indicate that local government spending is a highly effective method for alleviating poverty. For example, public services and social protection expenditures exhibited the most significant correlations, suggesting that these effective transfers mitigate poverty. Likewise, the adverse correlations observed with spending on education and health underscore the imperative of investing in these two sectors of society. This aligns with Az Zakiyyah et al. (Az Zakiyyah et al., 2023), who found that provinces with higher HDI levels tended to have lower poverty rates, reinforcing the importance

of human capital investments in poverty alleviation. However, variations in spending effectiveness are not uncommon. Tamba et al. (Tamba et al., 2024) found that while village and health funds significantly reduced poverty in Eastern Indonesia, education funds showed no significant effect—highlighting that the impact of functional spending may differ across regions and sectors. These findings align with previous research, highlighting the significance of strategic spending in alleviating poverty (Kyriacou & Roca-Sagalés, 2019; Muhammad et al., 2019). Expenditures on economic development, housing, and infrastructure had diminished correlations, signifying greater context-dependent effects.

The correlation analysis between local government expenditure and poverty alleviation demonstrates a robust negative association, suggesting that more investment in essential social services is associated with reduced poverty rates. Public services ($r = -0.823$) and social protection ($r = -0.821$) have the strongest impact, confirming previous research that investment in administrative efficiency and social safety nets leads to tangible poverty reduction (Fonayet et al., 2020). Education ($r = -0.796$) and health ($r = -0.726$) also show significant effects, reinforcing the argument that human capital development is a crucial factor in breaking poverty cycles (Wang et al., 2023). However, spending on economic development ($r = -0.506$) and housing infrastructure ($r = -0.653$) exhibits weaker correlations, suggesting that these investments require complementary policies, such as job creation initiatives and housing affordability programs, to maximize their impact. These results parallel findings from Cameroon, where education and health decentralization yielded positive outcomes, but housing and economic spending required additional institutional support to be effective (Djiogap et al., 2024).

The study fills important knowledge gaps by furnishing empirical evidence on the efficiency of local government expenditures in reducing regional inequalities in poverty. It validates the recent findings that excessive spending in the best-priority sectors can significantly alleviate the poverty rates experienced in the country/region under consideration, as well as observed in other contexts (Miežiene & Krutulienė, 2019; Zheng et al., 2022). Moreover, the study provides predictions on the timing of progress toward decreasing inequality in poverty, which will allow for a more evidence-based approach to crafting policy directed at this inequality. Although there is something to be said about how far the country has come, there are still challenges ahead that provide a unique opportunity to navigate these external shocks and make smarter choices regarding how resources are allocated to better combat existing diseases. Ultimately, the findings suggest that for Banten Province to attain just and sustainable development, the governance structures within local governments need to be improved, and transparency in budget allocation must be increased.

In line with this, the results of the empirical analysis carried out showed that there is a strong negative correlation between budget allocation to priority functions, including education, health, social protection, economy, and public services, and poverty levels; the lower the budget allocation, the higher the poverty levels. This, therefore, indicates that for those regions that spent more on economic growth and related functional expenditures in 2016, like North Banten, it is evident that the region has a lower poverty level than South Banten. Thus, this research addresses a call for studies examining whether and how regional expenditure management can help measurably overcome inequality between regions.

From a theoretical perspective, this study strengthens Fiscal Decentralization Theory, demonstrating that regional fiscal autonomy can contribute to poverty reduction, but only when budget allocations align with high-impact sectors such as education, health, and social protection. The findings also extend the work of Kyriacou & Roca-Sagalés (Kyriacou & Roca-Sagalés, 2019) by providing empirical evidence that decentralized public service investments can reduce poverty gaps over time. However, the data also challenge the assumption that fiscal decentralization automatically improves economic equity, highlighting that governance quality, policy responsiveness, and external factors play a crucial role in determining outcomes.

This research provides pragmatic advice for policymakers. Initially, South Banten needed a more focused fiscal intervention plan, encompassing increased allocations for education, health, and social security, emulating the model employed in Malaysia's regional development programs that effectively diminished poverty through localized social investments (Kim et al., 2022). Secondly, regional governments must improve policy responsiveness to economic shocks, as demonstrated in the EU, where adaptable fiscal frameworks alleviated income disparities during economic crises (Di Novi et al.,

2019). Finally, improving governance and transparency in budget allocation is critical, as evidenced by the success of Brazil's participatory budgeting models, which increased public spending efficiency and reduced corruption-related inefficiencies in social programs (Dick-Sagoe, 2020).

This study offers novel insights into the function of fiscal decentralization in alleviating regional poverty, with conclusions pertinent not only to Indonesia but also to other emerging nations encountering analogous socio-economic issues. This research enhances the discourse on inclusive and sustainable development by using statistical analysis, predictive modeling, and comparative regional insights, thereby underscoring the necessity for evidence-based policy decisions to attain long-term economic equality.

CONCLUSIONS

This study's findings affirm that fiscal decentralization is essential for diminishing regional poverty disparities, yet, its efficacy is significantly contingent upon governance quality, budget allocation efficiency, and local economic resilience. The examination of poverty patterns in Banten Province from 2005 to 2024 indicates that North Banten has continually reaped the advantages of more public investment in education, health, social protection, and public services, resulting in lower poverty levels relative to South Banten. However, the temporary spike in inequality during the COVID-19 pandemic demonstrates that external shocks can erode the progress of poverty reduction, particularly in regions with weaker fiscal capacity and economic infrastructure.

From a theoretical perspective, this study contributes to the understanding of Fiscal Decentralization Theory by showing that while decentralization can facilitate poverty reduction, it does not automatically lead to equitable regional development. The strong negative correlations between government spending and poverty levels highlight that education, health, and social protection investments have the most significant impact. However, the weaker effects of economic development and housing expenditures suggest that fiscal decentralization alone is insufficient; instead, it must be complemented by institutional reforms, governance improvements, and adaptive fiscal strategies. These findings provide empirical validation that decentralization outcomes depend on policy design, transparency, and local government capacity, reinforcing the need for targeted interventions to maximize the benefits of fiscal autonomy.

From a practical standpoint, this research provides policy recommendations for accelerating poverty reduction through strategic fiscal planning. First, local governments, particularly in South Banten, must increase targeted investments in human capital development, particularly in education, health, and social protection, as these sectors have shown the strongest impact on poverty alleviation. Second, regional policymakers must adopt more adaptive and responsive fiscal strategies to mitigate external shocks, as seen in the pandemic's disruption of poverty reduction trends. This can be achieved through contingency planning, improved social safety nets, and flexible budget allocations that can be restructured during economic crises. Third, governance reforms must be prioritized to enhance the efficiency of fiscal decentralization, including greater transparency in budget allocation, strengthened institutional oversight, and community participation in decision-making. Without these structural improvements, fiscal decentralization risks perpetuating inequality rather than reducing it.

This study also provides a long-term perspective on poverty reduction timelines, demonstrating that under optimistic scenarios (linear and logarithmic models), regional poverty gaps in Banten could be eliminated by 2052. However, under less favorable conditions (exponential and power models), inequality could persist until the 22nd century, emphasizing the critical role of government intervention in shaping development trajectories. These findings are relevant not only for Indonesia but also for other developing countries, where regional disparities continue to hinder inclusive economic growth. Future research should explore how governance quality, economic diversification, and intergovernmental fiscal transfers can further enhance the effectiveness of fiscal decentralization in reducing poverty inequality.

In conclusion, this study underscores the importance of evidence-based fiscal policies in addressing regional disparities, reinforcing that targeted government spending, strong governance, and adaptive policy frameworks are essential to achieving equitable and sustainable development.

Policymakers must take proactive steps to optimize fiscal decentralization mechanisms, ensuring that no region is left behind in the pursuit of economic and social progress.

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