

Analysis of Factors Affecting the Number of Poor People in Central Sulawesi

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ABSTRACT: Poverty is a persistent challenge constraining regional development in Central Sulawesi. Therefore, this study intends to analyze the main determinants affecting the number of poor people in the cities and districts of Central Sulawesi from 2015 to 2024. The analysis was conducted using three econometric approaches, namely Panel Data Regression, Geographically Weighted Panel Regression (GWPR), and Vector Error Correction Model (VECM). The results showed that REM (Random Effect Model) was the most appropriate specification, suggesting life expectancy and gross regional domestic product (GRDP) per capita have a significant and negative effect on poverty. GWPR model captured spatial heterogeneity more effectively, demonstrating that the impact of GRDP and education varies across regions. Meanwhile, VECM results confirmed both short-run and long-run relationships among variables, indicating that economic, educational, and health factors jointly influence poverty reduction. These results emphasize the urgency of economic growth, human capital development, and employment opportunities in reducing poverty sustainably across Central Sulawesi. In conclusion, policymakers should design targeted interventions in poverty alleviation across Central Sulawesi.

KEYWORDS: Central Sulawesi, Geographically Weighted Panel Regression, Panel Data Regression, Poverty, Vector Error Correction Model

1. INTRODUCTION

Development is transformative process targeted at improving the social system toward a more advanced and sustainable condition. The concept of sustainable development underscores significant multidimensional poverty reduction and improvement in quality of life (Todaro & Smith, 2020). However, development often encounters complex challenges in practice, one of which is poverty.

According to Statistics Indonesia (BPS, 2024), Central Sulawesi Province is characterized by a fluctuating poverty situation, but has shown a downward trend in recent times. More specifically, the number of poor people reached 398.73 thousand in 2020, or 12.92% of the total population, and by 2024, there was a decline to 379.76 thousand, or 11.04%. Although the poverty rate has decreased, the value remains above the target set in the Regional Medium-Term Development Plan 2021–2026, which aimed for a reduction to 7.65% by 2024. The average annual decline in the poverty rate has also been relatively slow, estimated at 0.12% per year.

From 2020 to 2024, Central Sulawesi remained to have the second-highest poverty rate on Sulawesi Island (BPS, 2024). This condition places a considerable burden on both local government and regional economic development, specifically when compared with other provinces. The high poverty rate across the province is largely shaped by the disparities among the districts and cities. Poverty is not only a financial issue but also reflects multidimensional deprivation such as poor health, limited education, exposure to vulnerability, inability to exercise autonomy, and lack of access to decision-making power.

BPS recorded wide disparities in poverty levels among districts in Central Sulawesi. In 2024, Parigi Moutong had the highest number of poor people (74.68 thousand), while Banggai Laut had the fewest (11.16 thousand). This persistent inter-district inequality indicates that poverty remains a structural issue across the province. The ability of local governments to use and optimize available resources becomes essential to reduce poverty levels. In general, regional economic development fundamentally depends on local resource utilization, where economic potential serves as the foundation for regional development (Armida & Murniningtyas, 2018).

Urban areas, such as Palu City, tend to have lower poverty levels compared to rural regions, including Parigi Moutong and Donggala (BPS, 2024). The concentration of economic activities and educational institutions in urban centers contributes to lower

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poverty incidence, as these factors create better employment opportunities and improved access to essential services that enhance living standards.

Health plays a crucial role as an investment in improving productivity and the quality of human resources. It is generally considered a foundation for raising living standards. Health status directly influences well-being and is closely associated with poverty, which can be observed through indicators such as life expectancy (Adhitya, Parabawa, & Kencana, 2022). Between 2020 and 2024, Palu City recorded the highest life expectancy, followed by Poso District, due to the concentration of healthcare and educational facilities. Conversely, Parigi Moutong and Banggai Laut were reported to have lower life expectancy rates (BPS, 2024). Education is equally crucial in the effort to reduce poverty, as reflected by the average length of schooling. Thahir, Semmaila, and Arfah (2021) reported that one major cause of poverty is the low quality of human capital due to limited education. Higher educational attainment enhances the capacity of individuals to secure better employment and income, thereby reducing poverty. The typical duration of schooling is a crucial measure of educational success and indicates the total years individuals spend in formal education. According to BPS (2024), from 2020 to 2024, Palu City and Poso District consistently recorded the highest average years of schooling, while Parigi Moutong and Donggala recorded the lowest. This educational disparity significantly influences poverty levels, as regions with lower schooling averages face limited job opportunities. Todaro in Hasanah & Priyadi (2021) also mentioned that education is a key determinant of income and economic mobility.

Unemployment is considered another crucial factor affecting poverty in Central Sulawesi. Open unemployment refers to the proportion of the labor force actively in search but unable to obtain employment. Despite having a relatively high education level, Palu City consistently recorded the highest open unemployment rate (TPT) between 2020 and 2024. The rate declined from 8.38% in 2020 to 5.63% in 2024 (BPS, 2024). Across districts, there is a paradox of “educated unemployment,” where regions with higher schooling averages experience higher unemployment rates. This phenomenon may be attributed to a mismatch between the skills of educated workers and available job opportunities, leading to an excess supply of educated labor (BPS, 2024).

As stated by Balasubramanian, Burchi, and Malerba (2023), a society is considered to have a decent standard of living when it can independently fulfill basic needs. On the other hand, when individuals fail to meet these needs, poverty persists. Economists and policymakers often use GRDP (Gross Regional Domestic Product) per capita as a proxy for measuring welfare levels. Data from BPS (2024) showed that Morowali District had the highest GRDP per capita, followed by North Morowali, while Banggai Islands had the lowest in Central Sulawesi. Christiani and Nainupu (2021) also emphasized that GRDP per capita is a more accurate indicator of economic growth compared to total GRDP, as it better reflects the welfare of local populations.

The complex interaction of factors such as health, education, unemployment, and regional economic performance underscores the need for an in-depth analysis of the simultaneous and partial effects on poverty across districts and cities in Central Sulawesi. This study incorporated both spatial and temporal dimensions, acknowledging variations in regional characteristics and resource potential. By examining the determinants of poverty in Central Sulawesi, the result provides valuable insights for policymakers to design targeted and evidence-based poverty alleviation strategies. It also contributes to the ongoing academic discourse on regional poverty reduction by integrating economic, social, and spatial perspectives.

2. LITERATURE REVIEW

Poverty is defined as a low standard of living characterized by a lack of financial and material resources (Hardianto, 2021). It is widely recognized as an undesirable condition that generates various socio-economic problems, namely deteriorating health, unemployment, and declining human resource quality (Istyawan, 2025). The capability approach introduced by Amartya Sen conceptualizes poverty not merely as a lack of income but a deprivation of fundamental human capabilities to lead a valuable life. These capabilities comprise access to education, healthcare, decent employment, and a sustainable environment. Variables such as mean years of schooling, life expectancy, and GRDP per-capita are dimensions of human capability that determine opportunities to escape poverty. As stated in a previous study, improving the quality of education, health, employment, and access to basic services is an essential instrument for poverty alleviation (Lundahl, Rauhut, & Hatti, 2021).

Based on the Theory of Human Capital, health and education are long-term investments that improve labor productivity. The average years of schooling (RLS) reflects the quality of education, while UHH (life expectancy) functions as an indicator for health. An increase in these two indicators strengthens the competitiveness of the labor force and contributes to poverty reduction. A previous study by Firdaus, Dawood, and Abrar (2021) found that education significantly reduced poverty levels in Indonesia during the 2016–2020 period. The correlation between education and poverty is particularly strong, as education gives people the skills and knowledge necessary for economic advancement (Hasanah, Syaparuddin, & Rosmeli, 2021). Life expectancy, which reflects a higher quality of life and better health conditions, is also associated with lower poverty levels (Niastuti & Setyowati, 2024).

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Unemployment serves as a key indicator of labor market conditions. In general, higher unemployment rates typically lead to an increase in poverty due to income loss and inadequate social protection (Pradipta & Dewi, 2020). Therefore, TPT is considered a critical factor influencing poverty. The informal sector plays a strategic role in improving the income of low-wage workers and reducing poverty by increasing earnings above the poverty threshold.

The trickle-down effect theory assumes that economic growth will eventually benefit lower-income groups. However, structuralist perspectives emphasized that growth does not automatically reduce poverty due to unequal income distribution. Therefore, GRDP per capita becomes an essential indicator to assess the extent to which economic growth contributes to poverty reduction. Saputri, Setyonugroho, and Hartono (2024) reported that economic growth accompanied by equitable access leads to poverty reduction at the household level.

Empirical studies have provided strong support for the relationships among these variables and poverty. Firdaus, Dawood, and Abrar (2021) confirmed that education and health play a significant role in alleviating poverty in Indonesia. Similarly, Saputri, Setyonugroho, and Hartono (2024) mentioned that inclusive economic growth promotes poverty reduction, although the effects depend on the accessibility and distribution of resources. According to theoretical and empirical insights, this study integrates the capability approach as the primary framework, supported by human capital, economic growth, and structuralist theories. The integration offers a comprehensive analytical foundation for examining how life expectancy, average years of schooling, TPT, and GRDP per capita affect poverty across cities and districts in Central Sulawesi.

The reviewed theories and empirical results underscore the need to examine poverty determinants with greater attention to spatial and temporal variations. Most previous studies have analyzed poverty determinants at the national or provincial level using conventional panel data methods (Pradipta & Dewi, 2020; Firdaus et al., 2021). However, limited attention has been paid to the spatial heterogeneity of poverty determinants across districts in Central Sulawesi using the Geographically Weighted Panel Regression (GWPR) approach. Therefore, this study aims to integrate panel data, GWPR, and VECM models to comprehensively capture both spatial and dynamic aspects of poverty determinants.

3. STUDY METHODS

Secondary data used in the form of panel data, comprising cross-sectional observations from 12 regencies and 1 city in Central Sulawesi Province, combined with time-series data covering the period from 2015 to 2024. Data processing was conducted using EViews 13, R Studio, and Microsoft Excel. Moreover, a quantitative approach was used, including secondary data collected from the BPS (Central Bureau of Statistics) to analyze the determinants of poverty across regencies and cities in Central Sulawesi. This approach allows for a comprehensive analysis that captures both temporal and spatial variations in the selected variables. The independent variables, including UHH, RLS, TPT, and GRDP per capita were chosen due to theoretical considerations and empirical evidence indicating a connection to poverty levels.

Three analytical models were utilized to analyze the influence of the variables on the number of poor people, namely the Panel Data Regression, Geographically Weighted Panel Regression (GWPR) model, and Vector Error Correction Model (VECM). The random effects approach was applied to ensure more robust and reliable parameter estimation.

The combination of Panel Data Regression, GWPR, and VECM was used to ensure a comprehensive examination of poverty determinants. The panel regression provides a global estimation of the relationships among variables, GWPR captures spatial heterogeneity across regencies and municipalities, and VECM identifies both short-run and long-run dynamics. This integrated approach enables a stronger understanding of the spatial-temporal factors influencing poverty in Central Sulawesi.

The general panel regression model can be specified as follows:

Ln JPM_{it} = β₀ + β₁UHH_{it} + β₂RLS_{it} + β₃TPT_{it} + β₅Ln PDRBpk_{it} + e_{it}

GWPR model is formulated as:

Ln JPM_{it} = β₀(μ_{it}, θ_{it}) + β₁(μ_{it}, θ_{it})UHH_{it} + β₂(μ_{it}, θ_{it})RLS_{it} + β₃(μ_{it}, θ_{it})TPT_{it} + β₅(μ_{it}, θ_{it})Ln PDRBpk_{it} + e_{it}

Where:

Symbol	Description
JPM	: Number of poor people
UHH	: Life expectancy
RLS	: Average years of schooling
TPT	: Open unemployment rate
PDRBpk	: Gross Regional Domestic Product per capita
β ₀	: Constant
β ₁ β ₂ β ₃ β ₄ β ₅ β ₆	: Regression coefficients

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Symbol	Description
e	Error term
i	Regency/City
t	Year
(μ_{it}, θ_{it})	Geographic coordinates (latitude and longitude)

4. RESULTS AND DISCUSSION

The selection of the most appropriate model to examine the aspects affecting the total of poverty in the regencies/municipalities of Central Sulawesi Province was carried out through a sequence of tests, namely Chow, Hausman, and Lagrange Multiplier. Chow test showed a rejection of H_0 with a p value of 0.000, which is less than the 5% significance level ($\alpha = 0.05$). This suggests that FEM (Fixed Effect Model) is more appropriate than CEM (Common Effect Model). Hausman test failed to reject H_0 with a p-value of 0.7588, which is greater than α , suggesting REM (Random Effect Model) is more suitable than FEM. Lagrange Multiplier test rejected H_0 with a p-value of 0.000, smaller than α , implying that REM is preferable to CEM. Based on the three tests, REM is the most suitable model to apply. These findings align with the studies carried out by Hermawan, Sukmawaty, and Lestia (2022) as well as Hidayati, Fransiska, and Agwil (2023).

Table 1. Estimation Results of Random Effect Model (REM) – Panel Regression

Variable	Coefficient	Standard Error	t-Statistic	p-value	
C	12,5647	0,50687	24,78876	0,0000	***
UHH	-0,0237	0,00887	-2,67028	0,0086	**
RLS	-0,0175	0,02425	-0,72314	0,4709	
TPT	0,0027	0,00504	0,53518	0,5935	
PDRBpk	-0,0573	0,02213	-2,58852	0,0108	**
R-Squared: 0,404467		F-statistic	: 21,22397		
		P-value	: 0,0000		
Notes	:	*** significant at 1%, ** significant at 5%, * significant at 10%			
Source	:	Author's calculation, 2025			

$$\ln JPM_{it} = 12,56 - 0,02 UHH_{it} - 0,18 RLS_{it} + 0,003 TPT_{it} + 0,06 \ln PDRBpk_{it} + e_{it}$$

$$(24,79)^{***} \quad (-2,67)^{**} \quad (-0,72)^{ns} \quad (0,54) \quad (-2,59)^{**}$$

Partially, the variables of UHH and PDRB per capita had significant and negative effects on level of poverty, with coefficients of -0.0237 and -0.0573 , respectively, at the 5% significance level. Hermawan, Sukmawaty, and Lestia (2022) also found that increasing life expectancy can reduce poverty levels in South Kalimantan Province. Similarly, Azriyansyah (2022) reported that an increase in PDRB per capita significantly contributes to reducing poverty in Central Java. This suggests that improvements in health and economic growth effectively reduce poverty.

RLS variable shows a negative direction, implying that the higher the education levels, the lower the poverty. However, the effect was statistically insignificant, indicating that the contribution of education to poverty reduction is not optimal. This result is consistent with Hidayati, Fransiska, and Agwil (2023), who found that education significantly affects poverty in South Sumatra. TPT variable had a positive but insignificant coefficient, implying that an increase in unemployment tends to raise poverty, though not sufficiently strong to be significant. Previous studies also suggested that unemployment influences poverty levels, though the degree of significance varies (Kasus et al., 2022; Hermawan, Sukmawaty, and Lestia, 2022).

The estimation results show that R-squared score of 0.404467 shows that 40% of the variation in poverty levels could be accounted for by the independent variables, while the remaining 60% is influenced by other factors outside the model. The F-test was significant at the 1% level, indicating that the independent variables jointly affect poverty levels in Central Sulawesi regencies/municipalities during 2015–2024. In general, the regression model is considered feasible for further spatial modeling using GWPR (Azkiya, Angraini, & Anisa, 2024; Kartika, Sufri, & Kholijah, 2020; Ninda, Dinayanti, & Berliana, 2022).

The Breusch–Pagan cross-section test yielded a p value of 0.0000 (>0.05), leading to the rejection of H_0 at the 5% level. This indicates the presence of spatial heterogeneity in the panel regression model. The result confirms that the characteristics of poverty across regencies/municipalities in Central Sulawesi from 2015–2024 demonstrate spatial dependence, consistent with

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Ninda, Dinayanti, & Berliana (2022). To address this issue, a local modeling approach considering spatial diversity, namely GWPR, was applied.

Table 2. Kernel Function Selection

Model Kernal	CV	AIC	R-Square
Adaptive Bisquare	0,1257	-557,7708	0,7497
Adaptive Gaussian	0,1239	-553,3923	0,7223
Adaptive Exponential	0,1204	-559,4871	0,7384

Source: Author's calculation, 2025

Table 2 shows that the best GWPR model uses Adaptive Exponential kernel, characterized by the lowest AIC and CV values along with the highest R-squared.

Table 3. Estimated GWPR Coefficients by Regency/Municipality in Central Sulawesi

Regency/ Municipality	Coefficient and Prob					R ²
	C	UHH	RLS	TPT	PDRBpk	
Banggai	1,74e-17	0,001 0,906	-0,175 0,000	0,015 0,008	0,009 0,605	0,825
Banggai Kepulauan	-9,79e-16	-0,008 0,490	-0,182 0,000	0,026 0,002	0,024 0,323	0,845
Banggai Laut	-1,10e-15	0,014 0,211	-0,137 0,000	0,020 0,002	0,004 0,817	0,798
Buol	-3,45e-16	-0,028 0,001	0,029 0,339	0,001 0,981	-0,087 0,000	0,617
Donggala	3,87e-16	-0,031 0,033	0,047 0,095	-0,002 0,772	-0,170 0,097	0,604
Morowali	1,22e-16	-0,026 0,002	-0,034 0,094	0,010 0,032	-0,037 0,031	0,783
Morowali Utara	7,37e-17	-0,031 0,006	-0,005 0,847	0,006 0,242	-0,058 0,003	0,783
Parigi Moutong	5,18e-16	-0,014 0,259	-0,014 0,597	0,001 0,833	-0,140 0,026	0,637
Poso	2,77e-16	-0,023 0,010	-0,004 0,858	0,002 0,560	-0,069 0,001	0,706
Sigi	-2,80e-16	-0,026 0,009	0,036 0,141	-0,015 0,018	-0,148 0,001	0,597
Tojo Una-Una	-4,60e-17	-0,018 0,039	-0,040 0,048	0,004 0,327	-0,051 0,005	0,743
Toli-Toli	-6,38e-16	-0,029 0,001	0,047 0,042	-0,004 0,416	-0,110 0,000	0,528
Palu	6,27e-16	-0,025 0,106	0,023 0,436	0,017 0,063	0,006 0,964	0,543

Source: Author's calculation, 2025

Table 3 shows that the effects of independent variables on poverty differ by location. Some variables show negative effects on poverty, while others demonstrate positive effects depending on regional characteristics. GWPR analysis confirmed spatial variation across regencies/municipalities, with each having distinct parameter values. In general, the independent variables significantly affect poverty levels in Central Sulawesi.

For instance, the model estimated for Palu City is as follows:

$$\text{Ln JPM}_{it} = 12,56 - 0,02 \text{ UHH}_{it} - 0,18 \text{ RLS}_{it} + 0,003 \text{ TPT}_{it} + 0,06 \text{ LnPDRBpk}_{it} + e_{it}$$

(24,79)*** (- 2,67)** (- 0,72) (0,54) (- 2,59)**

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Table 4. Short- and Long-Run Estimation of VECM (Panel Data)

Variable	Coefficient	Standard Error	t-statistik t-tabel(1,979)	Sig.
ECT (JMP)	-0,241868	0,12142	1,99192	**
Δ JPM(-1)	-0,618846	0,15847	3,90514	**
Δ JPM(-2)	-0,334913	0,16048	2,08693	**
Δ UHH(-2)	-0,087246	0,02186	3,99049	**
Δ UHH(-3)	0,055965	0,02619	2,13672	**
Δ TPT(-1)	0,035537	0,01406	2,52810	**
Δ TPT(-3)	0,014387	0,00687	2,09475	**
R-Squared: 0,7964		F-statistic: 11,73541		**
AIC: -3,66				
ECT (TPT)	-15,14709	2,04933	-7,39124	**
Δ JPM(-1)	15,81339	2,67455	5,91254	**
Δ JPM(-2)	10,53571	2,70850	3,88987	**
Δ JPM(-3)	6,793848	2,74435	2,47557	**
Δ UHH(-2)	1,136999	0,36900	3,08132	**
Δ TPT(-1)	0,802621	0,23724	3,38315	**
Δ TPT(-2)	0,445630	0,17217	2,58831	**
Δ TPT(-3)	0,350439	0,11592	3,02317	**
Δ PDRB(-1)	-3,327579	1,36882	2,43098	**
R-Squared: 0,8447		F-statistic: 16,32014		**
AIC: 1,99				

Notes : ** significant at 5%

Source : Author's calculation, 2025

VECM estimation results show a long-run relationship among poverty, UHH, RLS, TPT, and PDRB per capita. The negative and significant ECT coefficient (-0.241868) confirms an error-correction mechanism, indicating a speed of adjustment toward long-run equilibrium of 24.18% per period. Changes in poverty levels in the first and second lags negatively and significantly affect current poverty levels. This implies that increases in past poverty tend to correlate with a decrease in the poverty levels.

Changes in UHH demonstrate mixed effects across periods, with a negative effect in the second lag but positive in the third. This pattern suggests that improvements in public health have dynamic effects on poverty. Although higher life expectancy reduces poverty in the short run, it may increase economic pressure in the longer term, due to higher living and healthcare costs. Changes in TPT in the first and third lags show positive and significant effects on poverty, indicating that rising unemployment leads to higher poverty. R^2 value of 0.7964 and a significant F-statistic demonstrate strong explanatory power of the model for poverty dynamics in Central Sulawesi from 2015 to 2024.

The unemployment equation shows a long-run relationship with the other variables. The ECT coefficient of -15.14709 , which is significant at the 5% level, indicates a high adjustment speed toward long-run equilibrium. Changes in poverty in the first to third lags have significant and positive effects on unemployment, implying that higher past poverty levels tend to increase unemployment in subsequent periods. UHH variable in the second lag has a positive and significant effect on unemployment, indicating that improvements in public health potentially influence labor market dynamics through increased participation. PDRB per capita variable has a significant and negative effect on unemployment, suggesting that higher economic growth helps reduce unemployment levels.

VECM estimation results show a mutual relationship between poverty and unemployment. More importantly, unemployment serves as an intervening variable transmitting the effects of health (UHH), education (RLS), and economic growth (PDRB per capita) on poverty. Improvements in human capital and economic growth do not directly reduce poverty, but rather, part of the effect operates through labor market improvements. These results indicate the complex transmission mechanisms among regional economic variables, where community welfare is determined by structural interactions between health, education, employment opportunities, and income.

Table 5. Comparison of Global and GWPR Models

Model	RSS	AIC	R-Square
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REM	0,2147	-	0,4044
		820,7821	
VECM	0,0579	-	0.7964
		3,6612	
GWPR Model	0,0896	-	0,7383
		293,9880	

Source: Author's calculation, 2025

The model comparison shows that VECM model outperformed REM and GWPR, with the lowest RSS and highest R-squared value (79.64%). Meanwhile, REM and GWPR explained 40.44% and 73.83% of the dependent variable, respectively. REM had the smallest AIC, but VECM model demonstrated superior explanatory power and predictive accuracy.

REM estimation results show that UHH significantly and negatively impacts poverty, with a coefficient of -0.0237 (p-value 0.0086). This implies that a 1% increase in UHH reduces poverty by 0.0237%, provided other variables remain constant. Theoretically, improved public health enhances individuals ability to work productively, contributing to poverty reduction. Rambe et al. (2024) as well as Thahir, Semmaila, and Arfah (2021) found that better health indicators were negatively associated with poverty.

GWPR model shows that the effect of UHH on poverty was spatially uneven across regions. In regions such as Tojo Una-Una, Toli-Toli, Poso, North Morowali, Morowali, Sigi, Buol, and Donggala, UHH coefficient was negative and significant. This reinforces the REM results showing that public health plays a vital role in alleviating poverty. Pradipta and Dewi (2020) also stated that increasing the quality of life and community health contributes to poverty reduction. However, in several regions such as Banggai and Banggai Laut, UHH coefficient was positive but insignificant, indicating that higher life expectancy does not always immediately reduce poverty. The disparity in results may be due to factors such as labor productivity or unequal access to public services.

VECM model further added a dynamic perspective. In the short run, changes in UHH at lag-2 had a significant negative impact, while lag-3 had a significant positive effect on poverty. The pattern indicates a complex dynamic, where improvements in public health in the past 2 years appear to suppress poverty, but in the longer term, the effect may reverse. This could be associated with higher living and healthcare costs as UHH increases.

In general, the three models provide complementary insights. REM confirms a significant average negative relationship, GWPR underscores spatial variations across regions, and VECM captures short-term fluctuations. Enhancing public health through equitable access to healthcare remains a key strategy for reducing poverty. However, policy interventions should account for local conditions and the long-term implications of health improvements.

REM estimation shows that RLS had a negative but statistically insignificant coefficient (-0.0175 ; p-value 0.4709). This implies that, on average, higher education levels are associated with lower poverty, but the effect is not sufficiently strong empirically at the aggregate level in Central Sulawesi. The result may be due to uneven educational quality, implying that additional years of schooling are not necessarily accompanied by improved skills or income.

GWPR results demonstrated in-depth spatial variation. In regions such as Buol, Donggala, Sigi, Toli-Toli, and Palu, RLS coefficient was positive, suggesting that higher schooling levels are correlated with increased poverty. This phenomenon may be related to a mismatch between education and available employment opportunities, where individuals with higher education struggle to find suitable jobs. Similarly, Surbakti, Muchtar, and Sihombing (2023; Jannah & Sari, 2023; Hasanah and Priyadi, 2021) reported a positive relationship between education and poverty. This unexpected relationship could be interpreted as an indication of *educated unemployment*, a condition in which individuals with higher education fail to be absorbed into the labor market (Arsani, Ario, and Ramadhan, 2020). Conversely, in most other regions, such as Banggai, Banggai Kepulauan, Banggai Laut, Morowali, North Morowali, Parigi Moutong, Poso, and Tojo Una-Una, RLS coefficient was negative, suggesting that education remains an important instrument for reducing poverty, although the level of significance varies.

VECM results showed both short- and long-run dynamics. In the long run, ECT component indicated the presence of equilibrium relationships, although RLS contribution was not significant. In the short run, the lag coefficients fluctuated with lag-1 being negative, lag-2 positive, and lag-3 negative, but all were insignificant. This emphasizes that education does not have an immediate effect on poverty reduction. It requires time and supporting policies such as improved labor quality, job access, and strengthening of productive sectors. In general, all three approaches show that education, as measured by RLS, has the potential to reduce poverty but remains weak without parallel efforts to improve education quality, align with labor market demands, and ensure equitable educational access across regions. These results also underscore the potential of educated unemployment, where higher educational attainment is not matched by adequate job creation (Arsani, Ario, & Ramadhan, 2020).

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REM results show that TPT has a positive but insignificant coefficient (0.0027; p-value 0.5935). This suggests that higher unemployment tends to increase the number of poor people. However, the effect is not sufficiently strong at the aggregate level in Central Sulawesi. Previous studies by Pradipta and Dewi (2020), Bandha, Moelyono, and Suparman (2022), and Fajriah (2021) also reported similar results. This is consistent with general expectations that higher unemployment rates contribute to rising poverty levels. The condition occurs because poverty in the region is influenced not only by open unemployment but also job informality, work quality, and income instability.

GWPR model provides a deeper spatial perspective. In regions such as Morowali, North Morowali, Poso, Sigi, and Tojo Una-Una, TPT coefficient was positive and significant, indicating that open unemployment contributes to worsening poverty. The dependence of the local economy on specific sectors causes weak labor markets to directly impact poverty levels. Conversely, regions such as Banggai, Donggala, and Toli-Toli showed negative or insignificant TPT coefficients, suggesting that people in those regions still have access to subsistence employment even when formally recorded as unemployed.

VECM estimation shows the dynamic relationship between unemployment and poverty in both the short and long run. In the short run, lag coefficients of TPT were positive and partly significant, including lag-1 (0.0355, significant), lag-2 (0.0196, near significant), and lag-3 (0.0143, significant). This indicates that an increase in unemployment in the previous one to three periods directly raises current poverty levels, reflecting the rapid labor market effects on community welfare. In the long run, the significant ECT value indicates a mechanism of adjustment toward a new equilibrium, where higher unemployment hinders poverty reduction unless accompanied by inclusive job creation.

The results strengthen the assumption that higher open unemployment may increase poverty levels, as the loss of main income sources leads to structural poverty, particularly in urban areas (Aginta et al., 2025). In general, all three models confirm that open unemployment is one of the factors worsening poverty in Central Sulawesi, although the influence is not uniform across regions. These results emphasize the importance of strategies for creating productive jobs, empowering the informal sector, and improving workforce skills to meet market demands.

REM results show that GDP per capita (PDRB) has a negative and significant effect on poverty, with a coefficient of -0.0573 (p-value 0.0108). In other words, an increase in GDP per capita will reduce poverty in Central Sulawesi. Theoretically, economic growth, reflected in rising GDP per capita, enhances purchasing power, expands employment opportunities, and improves income distribution, thereby reducing poverty. These results are consistent with Balasubramanian, Burchi, and Malerba (2023), who found that higher GDP per capita improves welfare and lowers poverty levels.

From a spatial perspective, GWPR results show more diverse patterns. Almost all districts show negative and mostly significant coefficients of GDP per capita, such as Buol (-0.087), Morowali (-0.037), North Morowali (-0.058), Poso (-0.069), Sigi (-0.148), and Tolitoli (-0.110). This demonstrates that economic growth in these areas truly contributes to poverty reduction. However, exceptions were found in Banggai (0.009) and Banggai Laut (0.004), where the coefficients were positive but insignificant, indicating that economic growth in these regions has not been inclusive. In other words, GDP growth remains concentrated in certain sectors such as extractive industries, which do not fully benefit the poor.

VECM results provide a long-term perspective. In the short run, most GDP per capita lag coefficients are negative but insignificant (lag-1: -0.0975 ; lag-2: -0.0280 ; lag-3: -0.0039). Although insignificant, the negative direction is consistent with the hypothesis that higher GDP per capita tends to reduce poverty. In the long run, the significant ECT term indicates that economic growth acts as a stabilizing factor capable of correcting imbalances toward lower poverty levels.

Across the three models, GDP per capita plays a central role in reducing poverty levels in Central Sulawesi. However, GWPR results emphasize the importance of *inclusive growth*, since in some regions, economic expansion has not reached poor populations. Therefore, regional development strategies should not merely aim to increase GDP per capita but also ensure that the benefits of growth are evenly distributed among all community groups.

The cross-sectional effects of the model demonstrate differences in poverty levels among districts and cities in Central Sulawesi. Banggai Laut had the lowest poverty rate, while Parigi Moutong had the highest. This spatial variation can be attributed to factors such as economic opportunities, service accessibility, and local economic structures. Based on the GWPR model estimation, the distribution of significant variables in each district/city of Central Sulawesi is presented in Table 6.

Table 6. Significance of Variables in GWPR Model

Grup	Variable Significance	Regency/Municipality
1	RLS	Donggala
2	PDRBpk	Parigi Moutong

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3	RLS and TPT	Banggai Banggai Laut Banggai Kepulauan
4	UHH and PDRBpk	Buol Morowali Utara Poso
5	UHH, RLS, and PDRBpk	Tojo Una-una Toli-toli
6	UHH, TPT, and PDRBpk	Morowali sigi

Source: Author's calculation, 2025

Table 6 shows the distribution of significant independent variables affecting poverty across six groups derived from GWPR model. The analysis demonstrates spatial variations in the influence of independent variables on poverty across districts and cities in Central Sulawesi Province. These results suggest that poverty reduction strategies should be spatially targeted, with consideration of the regional variations in economic and educational effects. Policymakers should design localized interventions focusing on human capital improvement and inclusive economic growth to achieve sustainable poverty alleviation.

5. CONCLUSION AND SUGGESTION

In conclusion, Parigi Moutong, Donggala, and Poso have the highest average number of poor people in Central Sulawesi. In general, poverty remains high, with significant inter-regional disparities. REM results show that UHH and per capita GRDP significantly reduce poverty, underscoring the importance of health and economic welfare. GWPR presents spatial variations in the influence of socio-economic indicators across districts, while VECM confirms valid long-term relationships and dynamic short-term effects. These results suggest that health improvements, economic growth, and employment opportunities are key drivers for poverty reduction in Central Sulawesi.

Poverty alleviation requires comprehensive attention from the government, private sector, and civil society. Priority policies should focus on equitable healthcare services, inclusive job creation, and human resource development. Strengthening the informal sector through easier licensing, financing, and training can enhance employment and local economic capacity. Education quality and access must also be improved to build adaptive and competitive human resources across the province. An integrated approach that considers local characteristics is essential to achieve sustainable poverty reduction.

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