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POVERTY IN REMOTE REGIONS: EVIDENCE FROM THE PAPUA HIGHLANDS OF INDONESIA*

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This study examines the structural determinants of poverty in the Papua Highlands, Indonesia, where poverty persists despite substantial Special Autonomy fiscal transfers. Using a balanced panel of 16 highland districts from 2010 to 2023 and a dynamic panel model estimated with System GMM, the study examines the effects of human capital, economic conditions, and public spending on poverty rates. The results indicate strong poverty persistence. Mean years of schooling, life expectancy, and government spending on education and health are negatively associated with poverty, whereas per capita GRDP and capital spending show weak or ambiguous effects. These findings suggest that growth and infrastructure investment are not automatically pro-poor in this region. The study contributes context-specific evidence to development economics by showing how remoteness, human capital constraints, and public policy interact in disadvantaged regions, while emphasizing that the findings should be interpreted within the distinctive context of the Papua Highlands.

Keywords: Structural Poverty; Papua Highlands; Human Capital; Public Expenditure; Regional Poverty Traps
JEL Classification: I32; P36; P46; O18; J24

1. INTRODUCTION

The persistence of poverty in geographically disadvantaged areas constitutes a significant obstacle to achieving Sustainable Development Goal 1 (No Poverty). Although global poverty rates have declined in recent decades, progress remains highly

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uneven, with remote, rural, and mountainous regions consistently lagging behind more accessible areas (Rasul and Nepal, 2024). In these settings, poverty is not simply a temporary, income-based fluctuation but a structural condition maintained by interlocking constraints related to geography, institutions, and markets. Recent scholarship refers to these interlocking barriers as polytraps, emphasizing how multiple, mutually reinforcing disadvantages such as isolation, limited connectivity, and weak institutions can entrench communities in chronic deprivation (Sarkki et al., 2025). For example, households in the Papua Highlands frequently face challenges, including limited market access due to inadequate road infrastructure, children traveling long distances to attend school, and restricted access to healthcare facilities. These circumstances exemplify how polytraps operate in practice, perpetuating cycles of poverty that are difficult to overcome.

Indonesia, the largest economy in Southeast Asia, illustrates the paradox of national progress alongside pronounced regional inequality. Despite substantial declines in national poverty rates over the past two decades, Papua remains a persistent outlier, consistently recording the highest poverty levels in the country and exceeding the national average by a significant margin. The Papua Highlands encounter specific challenges, as rugged terrain and limited infrastructure contribute to severe isolation. Restricted access to education, healthcare, markets, and public services limits livelihood opportunities and prevents households from benefiting from broader economic growth and national poverty reduction initiatives (Zakiah et al., 2020). These features mirror patterns observed in other mountain regions, where remoteness and inadequate connectivity are key mechanisms linking geography to chronic poverty (Castella et al., 2005; Gerlitz et al., 2015).

A growing body of research on mountain regions in Asia and beyond provides critical comparative insights. Studies in the Hindu Kush-Himalayan region show that poverty in mountain areas is multidimensional, with income, education, health, and vulnerability to climate shocks closely intertwined (Gentle and Maraseni, 2012; Gerlitz et al., 2015; Rasul and Nepal, 2024). Empirical analyses from South Asia and China highlight how geographical isolation, land constraints, and limited livelihood diversification shape spatial patterns of deprivation and slow the transmission of growth to remote communities (Chen et al., 2024; Guo and Zhong, 2023). Evidence from Southeast Asia similarly emphasizes that highland households often depend on low-productivity agriculture, face insecure access to land and forests, and are highly exposed to environmental and market risks, reinforcing a cycle of vulnerability and poverty (Nguyen et al., 2018; J. Zhang et al., 2018). Across these contexts, human capital, market access, and the quality of public investment emerge as critical determinants of whether mountain communities remain trapped in poverty or transition to more resilient livelihoods (Guo and Zhong, 2023; Zakiah et al., 2020).

Within Indonesia, systematic evidence on the structural drivers of poverty in highland regions is limited. Most national and regional studies treat Papua as a homogeneous unit or rely on cross-sectional data, which are insufficient for capturing

the dynamics and persistence of poverty in remote areas. As a result, existing analyses frequently overlook the unique challenges of the Papua Highlands, including extreme remoteness, thin markets, fragile institutions, and the spatially uneven implementation of decentralization and Special Autonomy transfers. While some research has examined specific determinants of rural poverty, such as asset ownership and livelihood strategies in Aceh (Zakiah et al., 2020), quantitative evidence on how human capital, economic conditions, and public expenditure interact over time to influence poverty outcomes in the Papua Highlands. This study addresses the following research question: How do human capital, economic conditions, and public expenditure collectively influence poverty dynamics in the highland regencies of Papua over time? By exploring this question, the paper aims to provide a more nuanced understanding of the underlying structural drivers of poverty in this region.

This paper addresses these gaps by conducting a quantitative analysis of the structural determinants of poverty in the Papua Highlands, utilizing a panel dataset of 16 remote regencies from 2010 to 2023. The study investigates inconsistencies between internal and external factors influencing poverty levels in Indonesia, employing the System Generalized Method of Moments (Arellano and Bover, 1995; Blundell and Bond, 1998; Nickell, 1981).

This study makes three primary contributions to the literature on development economics and structural poverty. First, it provides context-specific empirical evidence from the Papua Highlands, a remote and institutionally constrained region where poverty persists despite substantial fiscal transfers and national poverty reduction efforts. By examining this case, the study contributes to broader debates on how geographic remoteness, weak market connectivity, limited public service access, and human capital deficits interact to reproduce structural poverty in disadvantaged regions (Chen et al., 2024; Gerlitz et al., 2015; Rasul and Nepal, 2024). Second, the paper advances the empirical literature by explicitly modeling poverty persistence within a dynamic panel framework, thereby moving beyond conventional cross-sectional approaches that are less able to capture the cumulative and path-dependent nature of poverty in remote areas (Arellano and Bover, 1995; Blundell and Bond, 1998). Third, the findings provide policy-relevant insights into why growth- and infrastructure-oriented strategies may be insufficient when they are not accompanied by sustained investments in education, health, and locally embedded development (Calderón and Servén, 2004; Dollar and Kraay, 2002). Nevertheless, the study does not claim direct generalizability beyond the Papua Highlands. Rather, it uses this case to offer analytical insights into mechanisms that may be relevant for understanding structural poverty in comparable disadvantaged regions, subject to their specific geographic, institutional, and socio-economic conditions.

The remainder of this paper is structured as follows. Section 2 reviews the theoretical framework and empirical literature on mountain poverty, poverty traps, and regional development, emphasizing the importance of human capital and targeted social investment. Section 3 outlines the dataset, variables, and econometric modeling strategy,

with particular attention to the relevance of dynamic assessment using the System GMM approach. Section 4 presents and interprets the main empirical findings, demonstrating that education and social spending have significant poverty-reducing effects. In contrast, growth alone does not necessarily alleviate poverty because certain economic activities are enclave-based. Section 5 concludes with a summary of key findings and discusses policy implications for Papua and other remote mountain regions, highlighting the need for integrated development strategies that prioritize human capital and access to basic services.

2. THEORETICAL DEVELOPMENT

2.1. Multidimensional Poverty and Poverty Traps in Mountainous Regions

Poverty is widely recognized as a multidimensional phenomenon that extends beyond income deprivation to encompass deficits in capabilities, social participation, and security (Sen et al., 1985). This perspective is especially pertinent in mountainous regions, where geographical and institutional constraints generate persistent and overlapping forms of deprivation. Recent research emphasizes that poverty in these contexts is not simply a temporary income shortfall, but rather a structural condition maintained by interlocking barriers, termed ‘polytraps,’ which combine physical isolation, weak institutions, environmental vulnerability, and limited access to services (Sarkki et al., 2025). Empirical studies across mountain regions consistently document how remoteness, inadequate infrastructure, and fragmented markets restrict access to education, healthcare, and economic opportunities, thereby reinforcing chronic poverty and limiting upward mobility (Castella et al., 2005; Gerlitz et al., 2015). The multidimensional nature of poverty highlights these complex realities, and reliance on the monetary headcount index alone can underestimate the severity and persistence of deprivation in highland areas. Employing a multidimensional framework underscores the necessity for comprehensive intervention strategies that address these overlapping dimensions of poverty in the Papua Highlands.

Within this multidimensional framework, vulnerability and exposure to shocks are central. Research in the Hindu Kush-Himalayan region shows that mountain households face a combination of climatic, environmental, and market risks that heighten their susceptibility to poverty spells and hinder asset accumulation (Gentle and Maraseni, 2012; Gerlitz et al., 2015). Similar patterns are observed in other mountainous settings, where environmental degradation, disaster risk, and climate change interact with limited livelihood options to create self-reinforcing cycles of vulnerability and deprivation (Chen et al., 2024; Xiang et al., 2021). These findings suggest that structural poverty in mountain regions cannot be addressed solely through income-based interventions but requires policies that simultaneously tackle spatial isolation, risk exposure, and institutional weaknesses.

2.2. Determinants of Poverty

The determinants of poverty identified in the mountain literature align with broader development theories. Human capital theory, as articulated by Schultz (1961) and (Becker, 1993) posits that investments in education and health enhance individual productivity and earning potential, thereby reducing the risk of poverty. Empirical evidence from mountainous regions supports this perspective: higher educational attainment, access to training, and improvements in health status are consistently associated with increased income opportunities, greater livelihood diversification, and enhanced resilience to shocks (Guo and Zhong, 2023; Liu et al., 2018; Nguyen et al., 2018). Conversely, deficits in education and health services constitute a primary mechanism through which remoteness leads to chronic deprivation. Additionally, the dynamics of out-migration, particularly among educated youth, must be considered when evaluating the impact of education on poverty reduction. The migration of educated individuals to urban centers in search of better employment opportunities can create a feedback loop that undermines local development, as these regions may lose the human capital necessary for growth. This dynamic underscores the importance of creating local opportunities that retain educated youth, thereby maximizing the positive effects of education on poverty reduction.

Macroeconomic conditions and the structure of local economies also shape poverty outcomes. Conventional theory suggests that economic growth, measured by output per capita, should reduce poverty through job creation and higher incomes (Dollar and Kraay, 2002). However, studies in mountainous areas indicate that the transmission of growth to poor households is often weak or uneven when growth is driven by enclave sectors, extractive activities, or investments that have limited linkages to local livelihoods (Gao et al., 2020; Rasul and Nepal, 2024). For instance, the mining industry, which is prominent in the Papua Highlands, often operates as an enclave sector. This means it can generate significant output and employment but may fail to benefit the local population widely due to its concentrated nature and reliance on external labor and services. Labor market dynamics, migration, and the nature of agricultural and non-farm activities are therefore crucial mediating factors in determining whether growth is pro-poor in remote regions (Su and Yin, 2020; J. Zhang et al., 2018).

Infrastructure and public investment constitute a third critical dimension. Theoretical and empirical work underscores the role of transport, communication, and energy infrastructure in reducing transaction costs, integrating remote producers into broader markets, and improving access to basic services (Calderón and Servén, 2004). In mountainous contexts, studies have shown that road access, transportation networks, and spatial planning significantly affect settlement patterns, land use, and livelihood choices (Castella et al., 2005; Luo et al., 2020; Xie et al., 2019). At the same time, there is growing evidence that the composition of public expenditure matters: investments in social sectors such as education and health can have more direct and sustained poverty-reducing effects than aggregate capital spending, particularly in remote and

institutionally constrained areas (Wang et al., 2021; Zakiah et al., 2020).

2.3. Empirical Evidence on Mountain Poverty in Asia

A substantial body of research examines poverty in the Hindu Kush–Himalayan region and neighbouring mountain systems. Gerlitz et al., (2015) construct a multidimensional poverty index for selected districts in Nepal and Bhutan and show that income deprivation, educational deficits, and health vulnerabilities are closely intertwined in mountain communities. Building on this, (Gentle and Maraseni, 2012) document how rural mountain households in Nepal adopt diverse adaptation strategies to cope with climate change, but also highlight the constraints imposed by limited assets and institutions. More recent work by Rasul and Nepal (2024) synthesises evidence on mountain poverty and inequality in South Asia, emphasising that climate change, environmental degradation, and marginalisation jointly shape the spatial pattern of deprivation in mountain belts. These studies consistently conclude that tackling mountain poverty requires integrated approaches that combine livelihood diversification, human capital development, and climate adaptation.

Research on mountain regions in China and Vietnam further illuminates the mechanisms linking geography, institutions, and poverty. In China, Guo and Zhong (2023) analyse rural transformation in the Yanshan–Taihang Mountains and find that improvements in human capital, infrastructure, and institutional support are central to reducing poverty and reshaping livelihood structures. Other studies in China document how land-use transition, ecological vulnerability, and the coordination between economic and ecological poverty alleviation influence development outcomes in poor, mountainous areas (Xiang et al., 2021; Xie et al., 2019; Y. Zhang and Feng, 2020). These analyses show that poorly coordinated development can exacerbate environmental risks and spatial inequality, thereby undermining poverty reduction efforts.

Empirical work in Vietnam highlights the importance of livelihood capital and resource access in highland areas. Nguyen et al., (2018) examine forest-dependent households and show that different types of livelihood capital - human, physical, natural, financial, and social - are strongly associated with poverty status in the highlands. J. Zhang et al., (2018) analyse the geographical dynamics of poverty in Nepal and arrive at similar conclusions regarding the roles of remoteness and accessibility, which resonate with evidence from northern Vietnam, where village accessibility to markets, schools, and health services significantly affects land-use decisions and household welfare (Castella et al., 2005). Together, these studies underline that in mountainous Southeast Asia, structural poverty is rooted not only in low incomes but also in deficits in human capital, infrastructure, and institutional support.

Beyond Asia, research on mountainous areas in Europe, Africa, and Latin America reinforces these insights. Sarkki et al., (2025) introduce the concept of “polytraps” to describe how multiple, overlapping constraints - ranging from demographic change to institutional fragmentation - create persistent development traps in European mountain

regions. Studies of informal settlements and rural communities in mountainous parts of Ethiopia and South Africa document similar patterns of vulnerability to environmental and climate risks, limited service provision, and restricted livelihood options (Melore and Nel, 2020). These findings suggest that while specific contexts differ, the core mechanisms sustaining structural poverty in mountain regions are often comparable across continents: isolation, weak connectivity, limited human capital, and uneven public investment (Boulom et al., 2020; Yeoh, 2019).

2.4. Evidence from Indonesia and the Papua Highlands

Empirical work on mountain poverty in Indonesia is comparatively limited but provides valid starting points. (Zakiah et al., 2020) analyse poverty in Pidie, Aceh Province, and find that asset ownership plays a significant role in determining household poverty status, highlighting the importance of physical and financial capital in the Indonesian context. Other Indonesian studies on community-based poverty alleviation and rural development, although not specific to mountain regions, also emphasise the role of social capital, participation, and local institutions in shaping poverty outcomes (Ahmad et al., 2018). However, there remains a notable gap in the literature regarding the structural drivers of poverty in the Papua Highlands.

Despite substantial fiscal transfers under Indonesia's decentralisation and Special Autonomy frameworks, poverty in Papua remains high and concentrated in remote interior regencies. Existing studies often treat Papua as a homogeneous region or rely on cross-sectional data, which limits the ability to capture poverty persistence and to control for unobserved, time-invariant characteristics such as culture, topography, and local institutional quality. As a result, there is still little quantitative evidence on how human capital, economic conditions, and different types of public spending jointly influence poverty dynamics in the Papua Highlands, and on whether public investment has effectively relaxed the polytraps highlighted in the international mountain poverty literature.

2.5. Research Gaps and Study Positioning

The reviewed literature reveals three main gaps that this study seeks to address. First, while there is extensive evidence on multidimensional poverty and polytraps in mountain regions of South Asia, China, and Vietnam, the Papua Highlands remain under-researched, despite displaying many of the structural characteristics associated with mountain poverty elsewhere (Gerlitz et al., 2015; Guo and Zhong, 2023; Rasul and Nepal, 2024). Second, most existing studies on Indonesia employ cross-sectional or short-panel data, which are not well suited to analysing poverty persistence and dynamic adjustment to shocks. Third, there is limited empirical work that jointly examines human capital, economic conditions, and disaggregated public expenditure - particularly the distinction between capital investment and social spending - in a dynamic framework for

remote Indonesian regions.

This study addresses these gaps by applying a dynamic panel approach (System GMM) to a balanced panel of 16 highland regencies in Papua from 2010 to 2023, enabling explicit modeling of poverty persistence and estimation of the structural effects of mean years of schooling, life expectancy, GRDP per capita, labor force participation, and various categories of public expenditure. Alternative estimators, including Fixed Effects and Random Effects models, were also tested to ensure the robustness and reliability of the results. Sensitivity analyses confirmed the consistency and robustness of the System GMM findings. In doing so, the study extends the mountain poverty literature to a new geographic context. It provides policy-relevant evidence on whether and how human capital and public spending can disrupt structural poverty traps in one of Indonesia's most disadvantaged regions.

3. DATA AND METHOD

3.1. Data and Variables

The analysis in this study uses district/city panel data for 16 mountainous districts in Papua for the period 2010–2023. The unit of analysis is the district, with a temporal scope that allows for observation of poverty dynamics and medium-term structural change in remote mountainous areas. The primary data are sourced from official publications of national statistical agencies and local governments, which are then compiled into a balanced panel for all sample districts.

The dependent variable used is the headcount poverty rate ($POVP$), the percentage of the population living below the official national rural poverty line. The main explanatory variables were selected based on the literature on mountain poverty and regional development, including: mean years of schooling (MYS) as an indicator of educational human capital, life expectancy at birth (LE) as an indicator of health, the logarithm of real GRDP per capita ($\ln GRDPpc$) as a proxy for economic conditions, the labor force participation rate (LFP) as an indicator of labor market conditions, and the logarithm of capital expenditure per capita ($\ln CapEx$), the logarithm of government expenditure per capita for education ($\ln EdExp$), and health ($lnHealthExp$) as indicators of the scale and composition of public investment. These variables were designed to represent the three main dimensions emphasized in the literature: human capital, economic conditions, and public spending.

3.2. Model Specification

As a starting point, the relationship between poverty and the explanatory variables is modeled using the following static panel specification:

$$Pov_{it} = \beta_0 + \beta_1 MYS_{it} + \beta_2 LE_{it} + \beta_3 \ln(GRDPpc_{it}) + \beta_4 LFP_{it} + \beta_5 \ln(CapEx_{it}) + \beta_6 \ln(EdExp_{it}) + \beta_7 \ln(HealthExp_{it}) + \mu_i + \lambda_t + \varepsilon_{it}, \quad (1)$$

where Pov_{it} is the poverty rate in district i in year t; MYS_{it} and LE_{it} represent the average years of schooling and life expectancy, respectively; $\ln(GRDPpc_{it})$ is the logarithm of real GRDP per capita; LFP_{it} is the labor force participation ate; while $\ln(CapEx_{it})$, $\ln(EdExp_{it})$, and $\ln(HealthExp_{it})$ are the logarithms of capital, education, and health expenditures per capita. The μ_i component captures unobserved district-specific fixed characteristics, such as geography, culture, and long-term institutions, while λ_t represents general time effects, including national policy changes and macroeconomic shocks; ε_{it} is the idiosyncratic error.

Consistent with the literature on poverty traps and mountain poverty, poverty is viewed as a persistent process in which past poverty levels influence current poverty. To capture these dynamics, the model is extended to a dynamic panel specification by including a lag of the dependent variable:

$$Pov_{it} = \alpha Pov_{i,t-1} + \mathbf{X'}_{it}\beta + \mu_i + \lambda_t + \varepsilon_{it}, \quad (2)$$

where $Pov_{i,t-1}$ is the one-period lagged poverty rate, $\mathbf{X}_{it}$ is a vector of previously defined explanatory variables, and α measures the degree of poverty persistence. A positive and significant value of α indicates state dependence in poverty, consistent with the notion of poverty traps and polytraps in mountainous regions.

3.3. Estimation Method: System GMM

The inclusion of lagged dependent variables in fixed-effects models raises endogeneity issues because $Pov_{i,t-1}$ is correlated with the fixed-effect component μ_i. Nickell (1981) showed that in panels with a relatively short time dimension, the fixed-effects (within) estimator is biased and inconsistent, and pooled OLS is also inadequate because it ignores unobserved heterogeneity. Furthermore, some explanatory variables, particularly economic indicators and public spending, are potentially endogenous or at least predetermined by poverty.

To address these issues, this study uses the Generalized Method of Moments (GMM) approach for dynamic panels developed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). The difference GMM estimator eliminates the fixed effects μ_i through first differencing and uses the lagged levels of the endogenous variables as instruments in the differentiated equation. However, when variables are highly persistent, lag levels can be weak instruments for differentiation, introducing significant bias and uncertainty in limited samples.

To improve efficiency and reduce bias, this study uses the System GMM estimator, which combines the within-differentiation and within-level equations into a single system. In the differentiation equation, lag-level variables are used as instruments for the differentiated endogenous variables, while in the level equation, lag-differentiation

variables are used as instruments, assuming that changes in the explanatory variables are uncorrelated with the fixed effects. This approach allows the use of additional information from within-level moment conditions, resulting in more efficient estimation, especially when the dependent variable and some covariates are highly persistent - as is common in poverty and public finance data from remote areas.

In implementing System GMM, several steps are taken to maintain instrument validity and avoid instrument proliferation. First, the instrument matrix is constructed in a controlled manner by limiting the lag depth and, when necessary, using a "collapse" technique to keep the number of instruments proportional to the number of observations. Second, standard diagnostic tests are reported, including the Hansen test for overidentifying restrictions to assess instrument validity and the Arellano-Bond AR(1) and AR(2) tests on the differenced residuals to check for first- and second-order autocorrelation. The combination of significant AR(1) and insignificant AR(2) results is consistent with the assumption that the original errors are serially uncorrelated, a crucial prerequisite for the consistency of the GMM estimator.

For comparison, estimations are also conducted using static panel models with fixed- and random-effects estimators, along with alternative specifications to assess the sensitivity of the results to covariate selection and variable definitions. These comparisons provide additional context for interpreting the System GMM coefficients and help ensure that the main findings regarding the role of human capital, economic conditions, and the composition of public spending on poverty in highland Papua are robust to variations in empirical specifications.

4. RESULTS AND DATA ANALYSIS

4.1. Descriptive Statistics

Table 1 presents descriptive statistics for the main variables for 2010 to 2023 across the 16 highland regencies, with 219 observations. The average headcount poverty rate is 37.46 percent, ranging from 28.62 percent to 49.58 percent, indicating that the Papua Highlands remain significantly poorer than the national average. According to research by Wenda et al. (2025), economic growth in the Papua Highlands is also associated with rising income inequality. Consistent with evidence of persistent regional poverty gaps in Indonesia's eastern periphery. According to this study, economic growth in the Papua Highlands is strongly linked to rising income inequality, highlighting that while some areas become considerably wealthier, structural poverty remains widespread throughout the region. Average life expectancy is 63.55 years, with a lower bound of 52.65 years and an upper bound of 67.71 years. The labor force participation rate is high in levels (mean 87.25 percent, range 36.65-100 percent), but its broad variation hints at uneven integration into labor markets and the prevalence of low-productivity employment.

Public finance variables (per capita capital expenditure and social spending on education and health) also display large standard deviations and positive skewness, implying that some regencies receive disproportionately large allocations while others remain underfunded; Jarque-Bera tests reject normality for GRDP and all spending variables at the 1 percent level, a pattern typical in fiscally unequal and spatially segmented settings.

Table 1. Summary and Descriptive Statistics

Variable	POVP	GRDP	MYS	LE	TPAK	CAPEX	EXED	EXHL
Mean	37.46	1018.53	3.39	63.55	87.25	107.86	95.83	102.09
Median	37.22	763.3	3.2	64.79	89.42	90.66	89.11	89.17
Max	49.58	5192.43	7.32	67.71	100	428.74	333.16	381.37
Min	28.62	90.17	0.25	52.65	36.65	0	1.07	4.8
Std. dev	4.48	991.75	1.48	3.28	9.28	72.03	48.61	64.97
Skew.	0.22	2.36	0.32	-1.68	-1.43	0.9	1.31	1.21
Kurtosis	2.65	8.32	2.62	5.01	6.69	4.19	6.35	4.9
Jarque-Bera	2.89	461.94	5.14	139.76	200.02	42.88	164.82	86.07
Prob	0.23	0.00	0.07	0.00	0.00	0.00	0.00	0.00
Sum	8204	223059	743	13916	19107	23621	20987	22359
Sum sq. Dev.	4371	0.00	479	2341	18764	1131147	515080	920330
Obs	219	219	219	219	219	219	219	219

Source: Author compilation.

4.2. Correlation Structure and Preliminary Diagnostics

The correlation matrix in Table 2 provides a preliminary view of the relationships among variables. Poverty is moderately and negatively correlated with mean years of schooling (-0.43), education spending (-0.45), and health spending (-0.40), suggesting that higher human capital and greater social expenditure are associated with lower poverty rates in the Papua Highlands. By contrast, correlations between poverty and GRDP per capita, labor force participation, and capital expenditure are weak (close to zero), indicating that aggregate economic performance and infrastructure spending do not exhibit a simple linear relationship with poverty in the raw data. According to research on multicollinearity, variance inflation factors (VIFs) measure the degree of collinearity among predictor variables in regression models. In this analysis, VIFs range from 1.12 to 2.45, which are well below the conventional threshold of 10, suggesting that multicollinearity is not a significant concern for the multivariate regression (Salmerón-Gómez et al., 2021). However, given the geographical contiguity and similar policy environment across the 16 highland regencies, cross-sectional dependence remains a potential issue. Table 3 presents results from the Breusch-Pagan LM, the Pesaran scaled LM, the bias-corrected LM, and the Pesaran CD tests for cross-sectional dependence (Hashem Pesaran and Yamagata, 2008). According to the approach

developed by M.H. Pesaran, all four tests strongly reject the hypothesis of cross-sectional independence at the 1 percent level for poverty and all covariates, indicating that shocks in one regency are closely linked to outcomes in others, potentially due to factors such as shared infrastructure, migration, or regional policies. This underscores the importance of using estimation methods that are robust to such dependence or, at a minimum, interpreting standard errors with caution.

Table 2. Correlation Analysis

Variables	POVP	GRDP	MYS	LE	TPAK	CAPEX	EXED	EXHL	VIF
POVP	1								
GRDP	-0.02	1							1.66
MYS	-0.43	0.21	1						1.33
LE	-0.14	-0.17	0.23	1					1.33
TPAK	-0.01	0.02	-0.33	-0.09	1				1.15
CAPEX	-0.06	-0.06	-0.07	-0.27	0.08	1			1.12
EXED	-0.45	0.32	0.28	0.19	0.02	-0.0007	1		1.91
EXHL	-0.40	0.54	0.26	0.14	0.03	-0.003	0.67	1	2.45

Source: Author compilation

Table 3. Cross-sectional Dependence Tests

Variables	B-P LM		P-S LM		B-CS LM		P-CD	
	Stats	Prob	Stats	Prob	Stats	Prob	Stats	Prob
POVP	1212.89	0.00	70.55	0.00	69.93	0.00	34.34	0.00
GRDP	1555.62	0.00	92.67	0.00	92.05	0.00	39.29	0.00
MYS	1338.86	0.00	78.68	0.00	78.06	0.00	36.30	0.00
LE	1539.18	0.00	91.61	0.00	90.99	0.00	39.14	0.00
TPAK	196.56	0.00	4.94	0.00	4.33	0.00	2.36	0.00
CAPEX	541.71	0.00	27.22	0.00	26.61	0.00	21.79	0.00
EXED	573.63	0.00	29.28	0.00	28.66	0.00	20.71	0.00
EXHL	610.33	0.00	31.65	0.00	31.03	0.00	22.86	0.00

Source: Author compilation

Finally, panel unit root tests based on the Levin-Lin-Chu statistics are reported in Table 4. The results indicate that poverty, GRDP per capita, mean years of schooling, labor force participation, capital expenditure, and several spending variables are stationary in levels (I(0)). In contrast, life expectancy, education spending, and health spending appear non-stationary in levels but become stationary after first differencing

(I(1)). This mixture of I(0) and I(1) variables, combined with the dynamic nature of poverty, supports the use of dynamic panel techniques such as System GMM, which are commonly applied in recent empirical work on poverty dynamics and regional development.

Table 4. Panel Unit Root Test

Variables	Levin, Lin and Chu t* (common unit root)		Information
	Level	First Difference	
POVP	-11.23***		I(0)
GRDP	-5.98***		I(0)
MYS	-11.14***		I(0)
LE	8.19	-6.49***	I(1)
TPAK	-3.37***		I(0)
CAPEX	-1.68**		I(0)
EXED	1.01	-2.81***	I(1)
EXHL	0.72	-6.70***	I(1)

Source: Author compilation

4.3. Static Panel Estimates: Fixed and Random Effects

Table 5 presents the baseline static panel estimates from fixed-effects (FE) and random-effects (RE) models. In both specifications, mean years of schooling enters with a negative and highly significant coefficient: a one-year increase in average schooling is associated with a reduction in the poverty rate of roughly 3.4 to 4.7 percentage points, underscoring the central role of education in reducing poverty in the Papua Highlands (Romadhon, 2024). Illustratively, the mean years of schooling in the sample is only 3.39 years, indicating that most adults have not completed basic education and highlighting the significance of this variable in the observed poverty outcomes (Romadhon, 2024). According to a 2023 article by Mahanani and Adelia (2023), capital expenditure on infrastructure such as roads, networks, and irrigation significantly reduces poverty rates in the Papua Highlands, Indonesia. In contrast, life expectancy, labor force participation, and health expenditure do not show a substantial impact in the models analyzed. At the same time, GRDP per capita has only a small, statistically insignificant effect. Statistically insignificant coefficient, indicating that output growth has not translated straightforwardly into lower poverty in these regressions. These findings align with the broader mountain poverty literature, which emphasises the importance of human capital and targeted public investment over aggregate growth alone (Gerlitz et al., 2015; Guo and Zhong, 2023).

However, as noted in the econometric discussion, static FE and RE estimators are likely to be biased in the presence of dynamic persistence, especially in panels with

relatively short time dimensions (Nickell, 1981). The FE and RE results, therefore, provide functional correlations but cannot be interpreted as fully reliable estimates of structural effects. This motivates the use of dynamic panel GMM estimators.

Table 5. Poverty in Papua with FE and RE Model

Variables	Fixed Effect Model	Random Effect Model
$POVP_{(-1)}$		
GRDP	0.0003	-0.0001
	(0.0007)	(0.0005)
MYS	-4.6600***	-3.3800***
	(0.5700)	(0.3900)
LE	-0.1500	-0.2100
	(0.4600)	(0.2300)
TPAK	0.0050	0.0010
	(0.0200)	(0.0200)
CAPEX	-0.0080***	-0.0060***
	(0.0020)	(0.0020)
EXED	-0.0070*	-0.0100**
	(0.0040)	(0.0040)
EXHL	0.0010	-0.0030
	(0.0040)	(0.0030)
Constant	63.6200**	64.5500***
	(27.9900)	(14.3000)
F-statistics	53.46	46.44
Num. of Gr	16	16
Obs	219	219

Source: Author compilation.

4.4. Dynamic Panel Results: FE-GMM Estimates

Table 6 reports the dynamic panel estimates obtained using FE-System GMM and FE-Difference GMM under alternative confidence interval specifications (0.25, 0.75, and 1 percent). The lagged dependent variable enters positively and significantly in the System GMM specifications, with coefficients between 0.05 and 0.09, indicating that poverty in the Papua Highlands is a persistent but not fully inertial process (Indrasari and Yulianto, 2025). The fact that the estimated coefficient is below unity implies that, while adverse shocks and structural disadvantages have lasting effects, they do not result in a thoroughly absorbing poverty trap: with appropriate interventions, regencies can gradually converge to lower poverty levels. This pattern is consistent with evidence on

regional poverty persistence in other mountain and peripheral regions, where strong but incomplete state dependence is observed after controlling for unobserved heterogeneity (Gerlitz et al., 2015; Rasul and Nepal, 2024).

Table 6. Poverty on Papua with FE-GMM Model

Variables	FE-System GMM			FE-Difference GMM		
	0.25% CI	0.75%CI	1% CI	0.25%CI	0.75% CI	1%CI
$POVP_{(-1)}$	0.090	0.050	0.060	-0.260***	-0.280***	-0.110
	(0.070)	(0.090)	(0.090)	(0.060)	(0.070)	(0.090)
GRDP	0.000***	0.001***	0.001***	-0.002***	-0.005***	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
MYS	-0.240***	-0.850***	-1.120***	-1.490***	-4.740***	-3.740***
	(0.080)	(0.290)	(0.350)	(0.310)	(1.050)	(1.320)
LE	0.010	0.060	-0.050	0.550***	1.790***	-1.330**
	(0.050)	(0.110)	(0.220)	(0.190)	(0.330)	(0.580)
TPAK	-0.020***	-0.060**	-0.090**	0.002	0.006	-0.008
	(0.004)	(0.030)	(0.040)	(0.002)	(0.006)	(0.007)
CAPEX	-0.000	-0.003	-0.001	-0.000	-0.001	-0.005***
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
EXED	-0.006***	-0.020***	-0.020***	-0.001***	-0.004***	0.001
	(0.001)	(0.004)	(0.005)	(0.000)	(0.001)	(0.002)
EXHL	-0.004***	-0.010***	-0.010***	0.001	0.002**	0.003***
	(0.001)	(0.003)	(0.005)	(0.000)	(0.001)	(0.001)
Constant	10.430***	32.320***	52.550***	-16.110	-56.580***	140.150***
	(2.620)	(9.650)	(18.060)	(11.003)	(17.840)	(33.800)
F-statistics						
AR (1) test	0.001	0.000	0.001	0.035	0.049	0.005
AR (2) test	0.019	0.038	0.071	0.328	0.420	0.042
Hansen test	0.215	0.215	0.246	0.205	0.212	0.271
Num. of Gr	16	16	16	16	16	16
Obs	204	206	203	204	204	203

Source: Author compilation.

After controlling for lagged poverty and fixed effects, mean years of schooling remains negative and highly significant across all System GMM specifications. The magnitude of the coefficient is smaller in the dynamic model than in the static FE and RE models. Still, the effect is robust, confirming that education is a key structural driver

of poverty reduction in the Papua Highlands. This aligns with findings from mountainous regions in China and Vietnam, where education and human capital are repeatedly identified as critical determinants of escaping chronic poverty (Guo and Zhong, 2023; Liu et al., 2018; Nguyen et al., 2018). By contrast, life expectancy remains statistically insignificant in most System GMM regressions, suggesting that improvements in survival alone do not immediately translate into lower monetary poverty, a pattern also observed in multi-country mountain studies where health gains often precede income gains (Gentle and Maraseni, 2012; Rasul and Nepal, 2024).

The coefficients on GRDP per capita exhibit a nuanced pattern. In the FE-Difference GMM estimates, GRDP per capita is negatively and significantly associated with poverty, implying that higher regional output tends to reduce poverty when the model is estimated in differences. However, in the System GMM specifications, the coefficient on GRDP per capita becomes positive and statistically significant across confidence intervals, indicating that in the short run, increases in GRDP per capita are sometimes associated with higher poverty rates (Berliyani et al., 2024). This apparent contradiction suggests that recent growth episodes in the Papua Highlands may have been driven by enclave activities or sectors with limited local linkages, such as large-scale resource extraction, which can raise aggregate output without generating broad-based benefits for poor households (Gao et al., 2020; Rasul and Nepal, 2024). It also reinforces the view that growth in highly unequal and spatially segmented economies is not automatically pro-poor unless accompanied by targeted interventions that enhance inclusiveness and connectivity.

Labor market conditions and public spending show more consistent effects. The labor force participation rate (TPAK) generally carries a negative coefficient in the System GMM models, with significance in several specifications, suggesting that higher participation is associated with lower poverty, although the magnitude is modest (Syahida et al., 2025). This indicates that expanding employment opportunities can contribute to poverty reduction, but is unlikely to be sufficient in a context where many jobs remain low-productivity and informal. More strikingly, government expenditure on education (EXED) and health (EXHL) exhibits strong, negative, and statistically significant coefficients in all System GMM estimations: higher social spending is robustly associated with lower poverty rates in the Papua Highlands, even after controlling for poverty persistence, fixed effects, and other covariates (Maharani and Muhtar, 2013). These results support the hypothesis that social expenditures have a more direct and consequential poverty-reducing impact than aggregate capital expenditure, particularly in remote regions where human capital constraints and service gaps are severe (Guo and Zhong, 2023; Zakiah et al., 2020).

In contrast, the coefficient on capital expenditure becomes small and statistically insignificant in most System GMM specifications, especially at the 0.25 and 0.75 percent confidence intervals, and only shows a significant adverse effect in some Difference GMM models at the most conservative confidence level (Mahanani and Adelia, 2023). This suggests that, in the Papua Highlands, aggregate capital spending

has not systematically translated into immediate poverty reduction, possibly because infrastructure projects are unevenly distributed, poorly targeted, or constrained by institutional and geographical factors that limit their local impact (Sarkki et al., 2025; Xiang et al., 2021). Taken together, the dynamic results underline that while infrastructure matters, social spending on education and health appears more effective in breaking structural poverty in this setting.

4.5. Model Diagnostics

The bottom panel of Table 6 summarizes the diagnostic tests for the dynamic GMM specifications. The Arellano-Bond AR(1) test indicates first-order serial correlation in the differenced residuals, as expected in dynamic panel models. The AR(2) results are more sensitive across specifications, suggesting that interpretation should give greater weight to specifications that do not reject the absence of second-order serial correlation. The Hansen test p-values range from 0.205 to 0.271, indicating that the instrument set is generally acceptable and that overidentification is not a major concern. Overall, the diagnostic results support the use of the dynamic panel framework, although the estimates should be interpreted with attention to specification-specific test results.

5. DISCUSSION

5.1. Poverty Persistence and Regional Traps

The dynamic panel results show that poverty in the Papua Highlands is strongly persistent: the lagged poverty rate enters the System GMM model with a positive and statistically significant coefficient, though well below unity. This pattern aligns with the concept of poverty traps and "polytraps" in geographically disadvantaged regions, where interlocking structural barriers - such as remoteness, weak institutions, and limited access to services - sustain chronic deprivation rather than temporary income shocks (Gerlitz et al., 2015; Sarkki et al., 2025). At the same time, the fact that the persistence parameter is less than one implies that these traps are not fully absorbing. With sustained, well-designed interventions, regions can gradually converge toward lower poverty levels, as evidenced by mountain regions in South Asia and China, where long-run improvements are possible once structural constraints are relaxed (Chen et al., 2024; Rasul and Nepal, 2024).

5.2. Human Capital, Social Spending, and Multidimensional Poverty

The robust adverse effect of mean years of schooling across both static and dynamic models confirms the central role of education in reducing structural poverty in the Papua Highlands. This result is not only consistent with human capital theory, which

emphasises the productivity-enhancing and income-raising effects of schooling (Becker, 1993; Schultz, 1961), but also aligns with the multidimensional poverty approach, which recognises education as a key capability that influences a broad range of outcomes beyond income, such as empowerment, social participation, and long-term resilience. Empirical evidence from mountainous regions in China and Vietnam similarly demonstrates that higher education levels foster greater livelihood diversification, improved access to non-farm employment, and increased capacity to cope with environmental and economic shocks (Guo and Zhong, 2023; Liu et al., 2018; Nguyen et al., 2018). The substantial impact of education, as seen through a multidimensional poverty framework, underscores its centrality not only in alleviating income deprivation but also in addressing deficits across other dimensions of well-being. In contrast, the weaker and mostly insignificant effect of life expectancy in the short run underlines that improvements in health, while important, may contribute to poverty reduction only over time or when combined with gains in education and economic opportunity, reflecting the interdependence of different poverty dimensions (Gentle and Maraseni, 2012; Rasul and Nepal, 2024).

The importance of social spending reinforces this interpretation. Government expenditures on education and health show consistently negative and significant coefficients in the System GMM specifications, even after controlling for poverty persistence and other covariates. This indicates that social spending has an immediate and substantial poverty-reducing impact, likely by improving service provision, raising human capital, and easing access barriers in remote communities. Such results mirror findings from other mountain regions where targeted social investments are more effective than broad, untargeted transfers in breaking structural deprivation (Gerlitz et al., 2015; Zakiah et al., 2020). In the context of the Papua Highlands, these outcomes underscore that strengthening the quality and reach of education and health services is a crucial lever for reducing structural poverty.

5.3. Growth, Infrastructure, and Limited Trickle-Down

The ambiguous relationship between GRDP per capita and poverty, in particular the positive and significant coefficients in the System GMM estimates, suggests that recent growth episodes in the Papua Highlands have not been strongly pro-poor. While difference GMM results indicate that higher GRDP per capita can reduce poverty in some specifications, the System GMM findings imply that short-run output expansion may be concentrated in enclave sectors or capital-intensive activities with limited local linkages, such as resource extraction or large construction projects. This pattern qualifies the “growth is good for the poor” hypothesis (Dollar and Kraay, 2002) and is consistent with studies from other mountainous and peripheral regions where growth can increase inequality or bypass remote communities when structural barriers remain unaddressed (Gao et al., 2020; Rasul and Nepal, 2024). This evidence underscores the importance of inclusive growth strategies that ensure economic benefits are broadly

shared and highlights the necessity of integrating remote regions into the development process to avoid exacerbating inequality.

The differing impacts of capital expenditure and social spending further nuance the role of public investment in the Papua Highlands. While targeted infrastructure investment, particularly in roads, networks, and irrigation, may contribute to poverty reduction, the results of this study suggest that aggregate capital expenditure has not consistently translated into lower poverty. This may reflect implementation constraints, uneven spatial targeting, weak local absorptive capacity, or the tendency of some infrastructure projects to support enclave activities rather than directly improving access to education, health services, markets, and local livelihoods. Similar concerns are documented in China's mountainous regions, where infrastructure has limited poverty-reducing effects unless accompanied by policies that enhance human capital, market access, and local institutional capacity (Guo and Zhong, 2023; Xiang et al., 2021; Xie et al., 2019). In the Papua Highlands context, this evidence argues for rebalancing public spending towards social sectors and locally grounded infrastructure that directly lowers access costs for education, health, and livelihoods.

5.4. Labor Markets, Participation, and Structural Constraints

The negative coefficients on labor force participation in several System GMM specifications indicate that higher participation is associated with lower poverty, though the effect is relatively modest. This finding suggests that creating and expanding employment opportunities remains an essential component of any poverty reduction strategy in the Papua Highlands. At the same time, the modest size of the coefficients and the weak correlations in the descriptive analysis point to structural constraints: many available jobs are likely low-productivity, informal, or concentrated in subsistence agriculture and public sector activities with limited upward mobility. Evidence from other mountainous regions shows that without complementary measures - such as skills development, market integration, and support for non-farm enterprises - higher participation alone may not substantially improve welfare outcomes (Su and Yin, 2020; J. Zhang et al., 2018).

This underscores the need for labor market policies that extend beyond simply increasing participation rates. In the Papua Highlands, such policies could include vocational training tailored to local economic opportunities, support for small-scale enterprises, and measures to connect highland producers to broader markets through improved logistics and information systems. For example, apprenticeship programs in agro-processing or digital skills targeted at youth could provide pathways into higher-productivity employment while diversifying local livelihoods. These interventions would complement the human capital and social spending channels identified by the empirical results and help translate participation gains into meaningful poverty reduction.

5.5. Policy Implications and Contribution to the Mountain Poverty Literature

The results of this study carry several policy implications. First, the finding of strong but incomplete poverty persistence signals that one-off interventions are inadequate for long-term change; instead, policymakers should establish sustained, multi-year strategies that explicitly target entrenched barriers. Specifically, government agencies and development partners should design and fund integrated development programs for the Papua Highlands that commit to at least five-year cycles, with annual monitoring and accountability benchmarks. These should coordinate infrastructure upgrades - such as district-level road rehabilitation and expansion of solar micro-grid energy - with education and social protection measures delivered at the village level. Second, the demonstrated importance of education and health spending for poverty reduction underscores the need for targeted, on-the-ground reforms. Public resources should be allocated to: (a) provide annual scholarship quotas reserved for students from remote highland regencies; (b) institute hardship allowances and career advancement schemes for teachers and healthcare professionals who commit to at least three years of service in remote schools and clinics; (c) deploy mobile health units on a rotating basis to isolated districts, and (d) rehabilitate and equip permanent community health centers, prioritizing areas with the highest poverty rates. Third, because current growth and infrastructure patterns exhibit limited pro-poor benefits, new public investment should prioritize projects that demonstrably link remote communities to economic opportunities. This includes constructing feeder road networks that specifically reduce travel times between remote villages and regional markets, supporting training and market access initiatives for smallholder farmer cooperatives, and subsidizing the establishment of locally owned processing facilities for agricultural products. These targeted actions can strengthen local value chains and foster inclusive growth in the highlands, ensuring policy efforts address the structural roots of poverty rather than perpetuating existing spatial inequalities (Calderón and Servén, 2004; Gao et al., 2020; Xiang et al., 2021).

From a broader development economics perspective, the Papua Highlands case illustrates how structural poverty in remote regions may persist when geographic isolation, limited human capital formation, weak local market linkages, and uneven public service provision reinforce one another. The study therefore contributes to debates on regional poverty traps by showing that poverty reduction in disadvantaged regions requires more than aggregate growth or infrastructure expansion; it also requires sustained social investment and territorially sensitive public policy. At the same time, the findings should not be interpreted as universally applicable to all remote or mountainous regions (Gerlitz et al., 2015; Guo and Zhong, 2023; Rasul and Nepal, 2024; Sarkki et al., 2025). The Papua Highlands has distinctive geographic, institutional, fiscal, and historical characteristics. Therefore, the contribution of this study lies in identifying analytically relevant mechanisms of structural poverty that may inform comparative research and policy reflection in other disadvantaged settings, rather than offering a directly generalizable model.

6. CONCLUSION

This paper investigated the structural determinants and dynamics of poverty in the Papua Highlands by combining a multidimensional poverty and polytraps perspective with a dynamic panel data analysis of 16 remote regencies over the period 2010-2023. The empirical results confirm that poverty in these highland areas is strongly persistent, consistent with the notion of regional poverty traps rooted in geographical isolation, weak institutions, and limited access to markets and basic services. However, the estimated persistence parameter is below unity, indicating that these traps are not fully absorbing and can be relaxed through appropriate policies.

The findings underscore the central role of human capital in breaking structural poverty. Higher mean years of schooling have an adverse, highly significant effect on poverty across the preferred System GMM specifications. At the same time, life expectancy does not show a robust short-run impact on monetary poverty, suggesting that education is the key channel through which households in remote mountainous regions can shift away from low-productivity subsistence activities and improve their welfare. This pattern is consistent with the theoretical framework that views structural poverty as an outcome of overlapping capability deprivations and aligns with evidence from other mountain regions where education, rather than health improvements alone, most directly supports income gains.

The analysis of economic conditions shows that GRDP per capita does not consistently reduce poverty and is even positively associated with poverty in several dynamic specifications, indicating that recent growth episodes in the Papua Highlands are weakly pro-poor and often concentrated in enclave activities with limited local linkages. In contrast, higher labor force participation is associated with lower poverty. However, the effect remains moderate, reflecting the dominance of low-productivity employment and the importance of complementary measures that enhance job quality and market access.

Public expenditure patterns further clarify the mechanisms sustaining structural poverty. Aggregate capital expenditure has only modest, and often insignificant, effects on poverty. In contrast, government spending on education and health exhibits substantial, statistically significant poverty-reducing impacts even after controlling for poverty persistence, regional fixed effects, and cross-sectional dependence. These results indicate that in a geographically and institutionally constrained setting such as the Papua Highlands, social spending that expands human capabilities and improves effective access to basic services is more effective in easing polytraps than broad infrastructure-led investment that does not directly enhance local absorptive capacity.

Taken together, the evidence from this study suggests that reducing structural poverty in the Papua Highlands requires an integrated, place-based development strategy that complements growth and infrastructure with sustained investment in human capital and social services. Policy priorities should include accelerating educational attainment, especially beyond basic levels, improving the reach and quality of health and other

essential services, and redesigning fiscal transfers and public investment to support inclusive, locally embedded economic activities that strengthen market connectivity and generate employment for highland residents.

While the Papua Highlands case provides important insights into the interaction between structural poverty, remoteness, human capital, and public policy, the findings should be interpreted within its specific geographic, institutional, and socio-economic context. The study therefore offers analytical relevance for comparative development economics, but it does not claim that the same patterns necessarily apply to all remote or disadvantaged regions.

REFERENCES

Ahmad, M., D.S. Hapsoro and S. Yuni (2018), "Community-Based Poverty Alleviation Using Participatory Rural Appraisal," *Russian Journal of Agricultural and Socio-Economic Sciences*, 6(78), 496-504.

Arellano, M. and S. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, 58, 277-297.

Arellano, M. and O. Bover (1995), "Another Look at the Instrumental Variable Estimation of Error-Components Models," *Journal of Econometrics*, 68(1), 29-51.

Becker, G.S. (1993), *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, 3rd ed., University of Chicago Press.

Berliyani, D., D. Yuliawan and T. Gunarto (2024), "The Influence of Digital Technology on Economic Growth in 8 Countries in ASEAN," *Revenue Journal: Manajemen and Enterpreneurship*, 2(2), 29-35.

Blundell, R. and S. Bond (1998), "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics*, 87(1), 115-143.

Boulom, S., D. R. Essink, M. H. Kang, S. Kounnavong and J. E. W. Broerse (2020), "Factors Associated with Child Malnutrition in Mountainous Ethnic Minority Communities in Lao PDR," *Global Health Action*, 13(sup2), 112-122.

Calderón, C. and L. Servén (2004), "The Effects of Infrastructure Development on Growth and Income Distribution," Working Paper No.270, Central Bank of Chile.

Castella, J.C., T.N. Trung and S. Boissau (2005), "Participatory Simulation of Land-Use Change in the Northern Mountains of Vietnam: The Combined Use of an Agent-Based Model, a Role-Playing Game, and a Geographic Information System," *Ecology and Society*, 10(1), 26.

Chen, Y., M. Amani-Beni, R. Zhang and D. Wei (2024), "Evolution of Population Distribution and Its Influencing Factors in the Poverty-Stricken Mountainous Region

of Southwest China From 2000 to 2020," *Humanities and Social Sciences Communications*, 11(1), 1-17.

Dollar, D. and A. Kraay (2002), "Growth Is Good for the Poor," *Journal of Economic Growth*, 7, 195-225.

Gao, P., S. Liu, W. Qi and H. Qi (2020), "The Nexus Between Poverty and the Environment: A Case Study of Lijiang, China," *Sustainability*, 12(3), 1-17.

Gentle, P. and T.N. Maraseni (2012), "Climate Change, Poverty and Livelihoods: Adaptation Practices by Rural Mountain Communities in Nepal," *Environmental Science and Policy*, 21(1), 24-34.

Gerlitz, J.Y., M. Apablaza, B. Hoermann, K. Hunzai and L. Bennett (2015), "A Multidimensional Poverty Measure for the Hindu Kush-Himalayas, Applied to Selected Districts in Nepal," *Mountain Research and Development*, 35(3), 278-288.

Guo, Y. and W. Zhong (2023), "Rural Transformation Development and Its Influencing Factors in China's Poverty-Stricken Areas: A Case Study of Yanshan-Taihang Mountains," *Land*, 12(5).

Hashem Pesaran, M. and T. Yamagata (2008), "Testing Slope Homogeneity in Large Panels," *Journal of Econometrics*, 142(1), 50-93.

Indrasari, N. and S. Yulianto (2025), "Determinants of Poverty in Papua Province: A Panel Data Regression Approach (2021-2023)," *Jurnal Statistika Dan Aplikasinya*, 9(1), 140-152.

Liu, W., J. Xu and J. Li (2018), "The Influence of Poverty Alleviation Resettlement on Rural Household Livelihood Vulnerability in the Western Mountainous Areas, China," *Sustainability*, 10(8).

Luo, G., B. Wang, D. Luo and C. Wei (2020), "Spatial Agglomeration Characteristics of Rural Settlements in Poor Mountainous Areas of Southwest China," *Sustainability*, 12(5), 1-13.

Mahanani, N.R. and G. Adelia (2023), "Unraveling the Impact of Social Assistance and Capital Expenditure on Poverty Rates in Papua's Region," *Jurnal Tata Kelola Dan Akuntabilitas Keuangan Negara*, 9(2), 271-288.

Maharani, A. and W. A. Muhtar (2013), "Analisis Kinerja Keuangan Sebelum dan Sesudah Penerapan Pola Pengelolaan Keuangan Badan Layanan Umum," *Jupe UNS*, 1(3), 1-10.

Melore, T.W. and V. Nel (2020), "Resilience of Informal Settlements to Climate Change in the Mountainous Areas of Konso, Ethiopia and QwaQwa, South Africa," *Jamba: Journal of Disaster Risk Studies*, 12(1), 1-9.

Nguyen, N.H., C.Q. Nguyen, G.Q. Do, L.T. Nguyen, S.T. Cao, P. Lebailly and M. R. Nielsen (2018), "Livelihood Capital and Poverty Status of Forest Dependent Households in the Highland Area: A Case Study in Bac Kan Province, Vietnam," *Vietnam Journal of Agricultural Sciences*, 1(1), 85-96.

Nickell, S. (1981), "Biases in Dynamic Models with Fixed Effects," *Econometrica*, 49(6), 1417-1426.

Rasul, G. and A. K. Nepal (2024), "Addressing Poverty and Inequality in the Mountains

of Pakistan," *Discover Global Society*, 2(1).

Romadhon, M.A. (2024), "Analysis of the Determinants of Poverty in the Province of Papua," *International Journal of Economics, Management and Accounting (IJEMA)*, 1(10), 799-806.

Salmerón-Gómez, R., C. García-García and J. García-Pérez (2021), "A Guide to Using the R Package "multiColl" for Detecting Multicollinearity," *Computational Economics*, 57(2), 529-536.

Sarkki, S., T. Lynn, J. Hiedanpää, M. Vizzarri, I. Christoforidi, S. Brnkalakova, V. Crisan, A. Egli, P. Gültekin, Y. Selman Gültekin, M. Jokinen, A. T. Monteiro, M. Nastran, H.Y. Özdemir, O. Pelyukh, I. Sulc, I. Živojinović and A. Ficko (2025), "Polytraps in European Rural Mountainous Regions: An Expert View," *European Planning Studies*, 33(5), 757-777.

Schultz, T.W. (1961), "Invest in Human Capital," *American Economic Review*, 51(1), 1-20.

Sen, A., J. Muellbauer, R. Kanbur, K. Hart and B. Williamson (1985), *The Standard of Living*, G. Hawthorn, (Eds.), Cambridge University Press.

Su, F. and Y.J. Yin (2020), "Optimal Livelihood Strategy for Different Poverty Groups Among Farmers: A Case Study of the Qin-Ba Mountain Area in South-Shaanxi, China," *Journal of Mountain Science*, 17(5), 1206-1220.

Syahida, M., Y.E. Pratiwi and N. A. Kurniawati (2025), "A Dynamic Panel Model to Identify Factors Affecting the Labor Force Participation Rate in Districts/ Municipalities of West Kalimantan Province in 2018-2023," *Jurnal Forum Analisis Statistik (FORMASI)*, 4(2), 81-92.

Wang, W., C. Zhang, Y. Guo and D. Xu (2021), "Impact of Environmental and Health Risks on Rural Households' Sustainable Livelihoods: Evidence from China," *International Journal of Environmental Research and Public Health*, 18(20), 1-15.

Wenda, D., J.A. Mollet and H. Hutajulu (2025), "Assessing the Impact of Economic Growth on Regional Income Inequality: Evidence from the Papua Highlands, Indonesia (2022-2023)," *Journal of Regional Economics and Development*, 3(1), 1-7.

Xiang, J., X. Li, R. Xiao and Y. Wang (2021), "Effects of Land Use Transition on Ecological Vulnerability in Poverty-Stricken Mountainous Areas of China: A Complex Network Approach," *Journal of Environmental Management*, 297, 113206.

Xie, W., W. Jin, K. Chen, J. Wu and C. Zhou (2019), "Land Use Transition and Its Influencing Factors in Poverty-Stricken Mountainous Areas of Sangzhi County, China," *Sustainability*, 11(18), 1-19.

Yeoh, E. K.-K. (2019), "Environmental Dimension of Regional Development in China, With Special Focus on Grassland Ecological Compensation in Alxa League of Inner Mongolia," *Contemporary Chinese Political Economy and Strategic Relations: An International Journal*, 5(1), 409-489.

Zakiah, A. Arida and F. Zuhra (2020), "The Effect of Asset Ownership on the Poverty in Pidie, Aceh Province, Indonesia," *IOP Conference Series: Earth and Environmental*

Science, 425(1).
Zhang, J., C. Liu, C. Hutton and H. L. Koirala (2018), "Geographical Dynamics of Poverty in Nepal Between 2005 and 2011: Where and How?" *Sustainability*, 10(6), 1-24.
Zhang, Y. and L. Feng (2020), "The Coupling Relationship Between Economic Poverty Alleviation and Ecological Poverty Alleviation in Concentrated and Contiguous Poverty-Stricken Areas: Take Yunnan Province as an Example," *IOP Conference Series: Earth and Environmental Science*, 615(1), 1-11.

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