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Transforming Welfare Through Digital Connectivity: Empirical Evidence from Indonesia

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ABSTRACT

The development of digital transformation offers considerable potential for poverty alleviation. This study examines the determinants of provincial poverty in Indonesia by analyzing panel data from 34 provinces over an eleven-year period. To obtain consistent and robust estimates in diagnostic test, a fixed effects estimator with Driscoll–Kraay standard errors is employed. The findings reveal that education has the most significant impact on poverty reduction, followed by internet access, electricity access, and economic growth, underscoring the critical role of human capital development and digital connectivity in improving household welfare. In contrast, unemployment, the expansion of oil palm plantations, and provincial GDP per capita are associated with notable increases in poverty, reflecting labor market inflexibilities and non-inclusive growth dynamics. The Gini index is not statistically significant, suggesting that short-term fluctuations in inequality do not substantially affect provincial poverty outcomes. These results highlight the need for policies that expand digital infrastructure, enhance educational attainment, and promote inclusive sectoral development while strengthening governance in resource-dependent regions.

Keywords: *Ict, Poverty Alleviation, Indonesia*

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INTRODUCTION

The advancement of information technology serves as a catalyst for economic development by enhancing productivity, providing access and insights, improving income distribution, and offering various entertainment facilities through innovations in information and communication technology (ICT). The progression of ICT is also pivotal in achieving poverty alleviation (Adam & Dzang Alhassan, 2020; Erlando et al., 2020; Mushtaq & Bruneau, 2019; Tchamyou, Erreygers, et al., 2019). Research on the impact of ICT on poverty, conducted by Niebel (2018), Mushtaq & Bruneau (2019) and Asongu et al. (2021) indicates that ICT can foster economic growth, reduce inequality, and assist in lifting individuals out of poverty. ICT contributes by providing information, access to infrastructure, and self-development tools such as skills enhancement training.

ICT comprises a series of systems that facilitate the creation of opportunities and access for individuals (Ofori et al., 2022; Tchamyou et al., 2021). In this context, assets refer

to the availability of software for various needs, including modern mass media instruments such as mobile phones, the internet, computers, and traditional mass media like radio and television. ICT is integrated into daily activities as it enhances productivity, facilitates transaction completion, creates employment opportunities, and provides access to education and general information. Theoretically, the neoclassical perspective and the Sustainable Livelihood Approach (SLA) elucidate the impact of digitalization on economic development, including poverty reduction. As articulated by Harrod Domar, economic growth can be achieved through increased investment. ICT serves as capital in enhancing productivity and access to information, thereby driving economic growth. Robert Solow, through his theory of economic growth, illustrates technology as a mechanism to accelerate economic growth and promote inclusive growth, as evidenced in China, Hong Kong, and Japan (Ofori et al., 2022).

Within the technological context, the SLA concept demonstrates that when individuals, as economic agents, have access to assets and technology, they can create opportunities for personal development. In terms of economic development, the advancement of ICT functions as a tool for generating individual opportunities. Economic development is intricately linked to the convergence of economic growth, income distribution, and poverty reduction (Dollar & Kraay, 2002; Harmáček et al., 2017; Kakwani et al., 2000; Ravallion, 2001). Efforts to alleviate poverty can be pursued through two avenues: transforming income distribution or elevating community income levels.

The convergence triangle concept elucidates that regions with stable income distribution and economic growth will experience varying effects on poverty elasticity. However, economic growth without increased economic sharing does not alter the conditions of the impoverished. Achieving economic growth is one aspect, while attaining shared prosperity is another (Ofori et al., 2022). These two components must synergize to realize inclusive economic development. Numerous studies have been conducted to examine the impact of ICT on the economy. Niebel (2018) estimates that ICT growth has varying effects on emerging, developing, and developed countries. Compared to developed nations, the impact of technological advancement in developing and emerging countries is statistically more significant on economic growth, as measured by additional output through the Cobb-Douglas production function (Niebel, 2018).

Extensive research has been conducted to explore the association between ICT and economic growth (Adam & Dzang Alhassan, 2020; Adeleye et al., 2017; S. Asongu et al., 2021; S. A. Asongu & Tchamyou, 2016; Odhiambo et al., 2023). However, there is a notable gap in studies examining the link between ICT and economic sharing or poverty reduction. Berg & Ostry (2017) underscore the necessity of evaluating ICT's role in economic development, emphasizing the need to consider social equality to foster shared prosperity.

Research focusing on ICT's impact on poverty alleviation, as conducted by Pradhan et al. (2018); Tchamyou, Erreygers, et al. (2019); Mushtaq & Bruneau (2019);dan Pradhan et al. (2021) in Africa and Latin America, indicates two potential outcomes: ICT can drive pro-poor growth (Niebel, 2018; Tchamyou, Asongu, et al., 2019) and may also exacerbate social inequality in developing regions.

Economic digitalization serves as a mechanism for integrating ICT into daily life, thereby contributing to poverty alleviation through both direct and indirect pathways. Directly, ICT enhances the financial sector by boosting productivity, encouraging investment, and deepening financial systems. Indirectly, ICT's influence extends to sectors such as education, employment, entertainment, and healthcare (Cho et al., 2003; Elisabeth Beaunoyer et al., 2020)

Research by Budiarti and Khoirunnisa (2019) across 33 provinces in Indonesia highlighted the significant role of ICT in reducing poverty. However, Indonesia's varied economic development levels mean that regional characteristics and locations are crucial for successful poverty reduction. This research is vital for assessing ICT development across Indonesia's regions, which has often overlooked potential estimation bias. Employing a panel model is anticipated to offer fresh perspectives on poverty reduction strategies in the 34 provinces, particularly through ICT.

METHOD

This study uses panel data from 34 provinces in Indonesia from 2014 to 2024 and will be analyzed using a static panel multiple regression. This study compares the impact of ICT development and economic factors in province level of Indonesia. The estimation model as follow:

$$POV_{i,t} = \alpha_0 + \alpha_1 ICT_{i,t} + +\theta X' + \varepsilon_{i,t} \quad (1)$$

In this analysis, $POV_{i,t}$ denotes the poverty level in each province within region i and year t, as determined by headcount index calculations. The variable $ICT_{i,t}$ represents Internet penetration indicators, specifically the proportion of the population aged 15 years and older who accessed the internet in the last three months. The term $\theta X'$ encompasses other control variables, including the average years of schooling, the percentage of households with access to state electricity, the unemployment rate (defined as the percentage of the openly unemployed population), GRDP per capita measured in rupiah, the area of palm oil plantations in thousand hectares, the rate of economic growth, and the gini index, which measures income inequality. The term $\varepsilon_{i,t}$ represents the error term for province i in year t.

The selection of the panel model was conducted in accordance with established econometric practices as recommended by Wooldridge (2010). The initial step involved performing a Chow test to evaluate the presence of unobserved heterogeneity among provinces, which helps determine whether the data should be analyzed as pooled or require a fixed-effects model. Following this, a Hausman specification test was utilized to examine the correlation between individual effects and covariates, thereby informing the decision between Fixed Effects (FE) and Random Effects (RE) models. Additionally, a Breusch–Pagan Lagrange Multiplier (LM) test was employed to assess whether the RE model is more suitable than POLS by analyzing the variance of error components across panel units (Wooldridge, 2013). After establishing the baseline model, a comprehensive set of diagnostic tests was administered to identify heteroscedasticity, autocorrelation, and cross-

sectional dependence which are three typical features of a panel of provinces linked through regional economic dynamics. Recognizing that these assumption violations can result in inconsistent standard errors, this study applies the Fixed Effects estimator with Driscoll–Kraay standard errors, which effectively addresses both temporal and spatial dependencies in a large T-dimensional panel. This methodological choice ensures that the estimates of the influence of ICT on poverty are obtained with statistically sound standard errors.

FINDING AND DISCUSSION

RESEARCH RESULT

This study examines the impact of information technology utilization on poverty across 34 provinces in Indonesia over an 11-year period. As indicated in Table 1, during this timeframe, an average of 10.65% of the population lived below the poverty line, with significant regional disparities in poverty levels. The variable concerning access to communication technology reveals that, on average, 82.25% of individuals aged 15 and above accessed the internet within the past three months, indicating a relatively high level of information technology penetration. Similarly, access to electricity from official sources reached 96.33%, although certain areas still experience considerably lower electricity coverage. The average duration of schooling was 8.94 years, equivalent to the second grade of junior high school, which remains below the national target of 12 years of compulsory education.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Poverty rate	374	10.65	5.54	3.42	28.4
ICT access	374	82.46	4.77	65.58	95.29
Years of schooling	374	8.94	0.90	6.17	11.49
Unemployment	374	5.14	1.81	1.4	10.95
Electricity	374	96.33	7.39	43.14	100
GDRP per capita	374	63517.17	50995.09	13600	344350
Palm oil area	374	404.22	659.39	0	3408.68
Economic growth	374	6.52	34.28	-15.74	20.15
Gini index	374	0.35	0.04	0.24	0.46

Source: Statistic Indonesia, processed, 2025

Conversely, variables indicative of economic structure demonstrate more pronounced disparities. Throughout the observation period, the unemployment rate showed moderate fluctuations, averaging 5.14%, with a range from 1.40% to 10.95%. This range reflects varying labor market conditions across different regions. The distribution of oil palm plantation areas was notably uneven, as evidenced by a high standard deviation, highlighting the concentration of commodity-based economic activities in specific regions. Similarly, disparities in economic capacity were apparent in the Gross Regional Domestic Product (GRDP) per capita. Economic growth also presented extreme values with substantial standard deviations, suggesting the presence of economic shocks or uneven

dynamics. Meanwhile, income inequality, as measured by the Gini index, fell within the moderate range, with an average value of 0.353. Collectively, these descriptive statistics underscore significant structural inequalities in social, educational, and economic dimensions, underscoring the necessity for further empirical analysis to comprehend the impact of communication technology on anti-poverty actions.

Tabel 2. Correlation Matrix

Variable	Poverty rate	ICT access	Years of schooling	Unemployment	Electricity	Ln GDRP per capita	Palm oil area	Eco growth	Gini index
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Poverty rate	1								
ICT access	-0.2211***	1							
Years of schooling	-0.356***	-0.1118**	1						
Unemployment	0.1982**	0.0896*	-0.4256***	1					
Electricity	-0.6149***	-0.3332***	-0.4562***	0.1500**	1				
Ln GDRP per capita	-0.3744***	-0.1459**	0.4912***	0.1829**	0.1392**	1			
Palm oil area	-0.2611***	-0.1014*	0.0290	-0.0012	0.0426	0.2951***	1		
Economic growth	0.0814	0.0267	0.0359	0.1436**	-0.0704	-0.0955*	-0.0451	1	
Gini index	0.2869***	0.1515**	-0.0909*	0.0195	-0.1337**	-0.0819	-0.3557***	-0.0237	1

Note: Coefficients from correlation models *, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.**

Source: Statistic Indonesia, processed, 2025

The analysis of correlation patterns among variables in Table 2. indicates that several factors are significantly associated with the reduction of poverty levels. Internet penetration, particularly, shows a negative correlation with poverty, implying that

increased public access to the internet enhances opportunities for productivity, access to economic information, and availability of education and employment services. This finding is consistent with other variables such as the average length of formal schooling, the quality and coverage of electricity infrastructure, per capita income, and the size of oil palm plantations, all of which also exhibit a negative relationship with poverty. Essentially, the development of human capital, the provision of essential infrastructure, higher income levels, and the presence of a plantation-based economy contribute to alleviating poverty.

On the other hand, unemployment is positively correlated with poverty, suggesting that regions with higher unemployment rates tend to have a greater concentration of impoverished individuals. This correlation is logical, as limited employment opportunities directly reduce household income. Additionally, both economic growth and inequality are positively correlated with poverty. This pattern indicates that the current economic growth process is not inclusive, with its benefits primarily accruing to non-poor groups. As a result, even with economic improvements, the unequal distribution of benefits may widen the welfare gap and leave impoverished populations behind.

To determine the most suitable model, this study employed a static panel analysis using the Chow test, the Hausman test, and the LM test, along with diagnostic tests to examine the characteristics of the data used. The results are as follows:

Table 3. Model Selection and Diagnostic Tests

Uji	Hasil	Implikasi
Chow test	p=0.000	FE > -POLS
LM Breusch Pagan	p=0.000	RE > POLS
Hausman	p=0.000	FE > RE
Wald est	Prob > chi2 = 0.000	Heteroscedasticity
Wooldrige autocorelation	Prob > F = 0.000	Autocorelation
Pesaran test	p=0.000	Cross-section dependency

Source: STATA, processed, 2025

Based on model testing, the fixed effects (FE) approach was chosen for its ability to effectively control for provincial effects that are significantly correlated with the independent variables. However, residual diagnostic tests indicate that the standard FE model requires further adjustments. The heteroscedasticity test revealed non-homogeneous residual variances across provinces, while the Wooldridge test confirmed the presence of autocorrelation in the time dimension, a common issue in short time-series panels. Additionally, the Pesaran CD test identified cross-sectional dependence, suggesting that economic shocks in one province can affect others. These three assumption violations imply biased standard errors in the conventional FE model, thereby undermining the validity of statistical inferences. To address these issues simultaneously, this study employs fixed effects with Driscoll–Kraay standard errors (FE–DK). The Driscoll–Kraay estimator is designed to provide consistent standard errors despite heteroscedasticity, autocorrelation, and cross-sectional dependence, making it highly suitable for the context of panel data on

structurally interconnected Indonesian provinces. Thus, FE–DK is the most appropriate and robust econometric model, providing a reliable basis for identifying the causal relationship between internet access and poverty levels across provinces.

Table 4. Result of ICT Access to Poverty Levels in Indonesia

Variable	OLS	RE	FE	FE-Discroll Kraay
	(1)	(2)	(3)	(4)
ICT access	-0.0371	-0.0211**	-0.021**	-0.0211*
	(0.0459)	(0.0093)	(0.0089)	(0.112)
Years of Schooling	0.0729*	-1.8677***	-1.9334***	-1.9334***
	(0.3162)	(0.1506)	(0.1464)	(0.1877)
Unemployment	-0.3371**	0.2034***	0.2177***	0.2177***
	(0.1251)	(0.0436)	(0.042)	(0.0384)
Electricity	-0.4678***	-0.0371**	-0.0315**	-0.0315**
	(0.0329)	(0.0119)	(0.0114)	(0.013)
Ln GDRP per capita	-2.7152***	0.3052**	0.3545**	0.3545**
	(0.4234)	(0.1406)	(0.1357)	(0.1181)
Palm oil area	-0.0008*	0.0003	0.0005*	0.0005**
	(0.0003)	(0.0003)	(0.0002)	(0.0001)
Economic growth	0.0039	-0.0014	-0.0015	-0.0015**
	(0.0060)	(0.0011)	(0.0011)	(0.0004)
Gini index	21.9251***	2.0787	1.7841	1.7841
	(5.149)	(2.3936)	(2.4184)	(3.0233)
Cons	73.898***	27.406***	26.9276***	26.9276***
	(7.0344)	(2.6149)	(2.4496)	(2.9873)
Numb. of Obs	374	374	374	374
R-square	52%	-	-	
Adj. R-square	0.511	-	-	
Max lag	-	-	-	2
Control of diagnostic test	No	No	No	Yes

Note: Coefficients from regression models *, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.**

Source: Statistic Indonesia, processed, 2025

In Indonesia, where regional and digital infrastructure disparities are prevalent, accurately measuring ICT access is vital for the government to develop more targeted, inclusive, and evidence-based poverty alleviation policies. Table 4 presents the regression results for various models. In model 4 FE-DK, the independent variable, ICT access, reveals that a 1 percent increase in the population aged 15+ who accessed the internet in the past three months reduces the poverty rate by 0.021 percentage points, significant at the 10% level. The average years of schooling show that each additional year of schooling in a province decreases the poverty rate by 1.93 percentage points, significant at the 1% level. These findings confirm that education is the most significant factor in poverty reduction, as extended schooling increases the likelihood of employment in modern, more productive sectors.

The coefficient results for unemployment indicate that a 1 percent rise in unemployment results in a 0.218 percentage point increase in the poverty rate. This supports the theory that higher unemployment rates lead to more individuals living without income, significantly impacting the poor. As expected, electricity access reduces poverty by 0.031 percentage points. Although the effect is modest, electrification is statistically proven to benefit poverty reduction, particularly in remote areas, by enhancing community productivity. Interestingly, per capita GRDP is positively correlated with poverty increases. This finding suggests that increases in per capita income do not fully reflect the community's real income. This phenomenon of growth without equity occurs because the income increase is not inclusive, with the economic benefits primarily enjoyed by the upper-middle class rather than the poor.

The variable concerning the area of oil palm plantations exhibits a positive correlation with poverty; specifically, an increase of 1,000 hectares in oil palm plantations is associated with a rise in poverty by 0.00047 percentage points. This phenomenon is attributed to the tendency of oil palm expansion to favor large corporations rather than impoverished households. The conversion of land reduces community access, and the presence of companies, despite labor absorption, does not significantly enhance the welfare of the population. Instead, it contributes to an unequal distribution of profits within the plantation industry. The existence of oil palm plantations presents a dual challenge: while it augments national income through exports and palm oil production, it simultaneously poses a risk of agrarian conflict. The conversion of land to oil palm plantations results in the displacement of smallholders, a dominant role for corporations, and negligible absorption of local labor. Furthermore, the distribution of profits from the oil palm industry is uneven, failing to positively impact the income of the impoverished (Castellanos-Navarrete et al., 2021).

Economic growth is associated with a reduction in poverty rates, as indicated by a coefficient of 0.0015 percentage points. However, this effect is relatively modest, as aggregate economic growth does not directly benefit the impoverished population. Economic growth that lacks concurrent advancements in digitalization and human capital does not significantly contribute to poverty alleviation, as noted in the previous study (Cheng et al., 2021; Jamil, 2022; Pradhan et al., 2021). Conversely, income inequality exhibits a positive correlation with poverty across 34 provinces, although this relationship is not statistically significant. This phenomenon may be attributed to the heterogeneity among provinces, where a high Gini coefficient does not necessarily correspond to a substantial number of impoverished individuals, particularly if there are improvements in infrastructure.

DISCUSSION

Research on the impact of information technology development has emerged as a significant topic of discussion across various countries. Previous studies have demonstrated that Information and Communication Technology (ICT) can stimulate economic growth and alleviate poverty. Internet access, particularly, has been shown to reduce household

poverty, especially in rural and developing regions (Phan, 2023). This conclusion is further corroborated by the role of digitalization in financial services, which has also been found to mitigate poverty at the provincial level in Indonesia (Andrian et al., 2021; Erlando et al., 2020; Fauzan et al., 2020).

The role of technology in alleviating poverty has been examined by Asfaw et al. (2012), De Janvry & Sadoulet (2002), and Pretty & Bharucha (2014) particularly within the agricultural sector, where it has resulted in increased productivity, job creation, and higher consumption levels among impoverished populations. This technological advancement has also promoted labor integration into the high-tech manufacturing sector in developed countries (Van Dijk, 2017; Van Roy et al., 2018) and has supported the growth of micro, small, and medium enterprises (MSMEs) in developing countries (Agyekum et al., 2022; Chege & Wang, 2020). In Togo, Wonyra et al. (2021) have highlighted the significance of information and communication technology (ICT) development as a critical mechanism for enhancing living standards, reducing economic inequality and poverty, and protecting individuals from potential losses during the development process. The study emphasizes the need to address inequalities in ICT access by expanding infrastructure and increasing public awareness of ICT services (Ejemeyovwi & Osabuohien, 2020).

Furthermore, the digitalization of information and the expansion of internet access can significantly improve access to capital, education, and self-development opportunities, thereby reducing multidimensional poverty in developing countries, including Indonesia (Ahmad et al., 2020; Lashitew et al., 2019). Communities lacking internet access or experiencing digital poverty are at a higher risk of remaining trapped in a persistent cycle of poverty compared to those with internet access.

To achieve this objective, it is important for the government to enhance internet accessibility, particularly in provinces characterized by high levels of poverty. This expansion should be complemented by efforts to increase digital literacy, thereby optimizing internet utilization through productive channels. The integration of the internet into various sectors, including education, healthcare, micro, small, and medium enterprises, financial services, and productive financing (Adam & Dzang Alhassan, 2020; Islam & Hasan, 2023; Ziemba & Grabara, 2024) is essential to improve productivity and the welfare of society. The internet's impact is more pronounced in rural and vulnerable regions (Phan, 2023). Consequently, policies should be directed towards these groups to mitigate income inequality. Initiatives such as subsidy programs or affordable internet, digital literacy training, and the integration of internet services with public and financial services can enhance the effectiveness of poverty reduction efforts (Kouladoum et al., 2022; Phan, 2023) These programs should be intensified in areas with significant poverty concentrations and agrarian economic structures, such as NNT, parts of Sulawesi, and Papua, utilizing digitalization to bolster the economic mobility of impoverished households.

The impact of ICT penetration may vary across regions. As evidenced by studies in Sub-Saharan Africa, the effects of ICT are heterogeneous and depend upon infrastructure and institutional quality (Cheng et al., 2021; Dzator et al., 2023; Niebel, 2018; Vu, 2017). These findings reflect the conditions across 34 provinces. Indonesia exhibits disparities in

digital infrastructure among provinces, which influences the heterogeneity of the observed data.

The impact of the internet on labor absorption is notably positive. The advent of broadband internet has facilitated the creation of job opportunities, particularly in highly skilled and remote sectors, thereby contributing to increased incomes (Adam & Dzang Alhassan, 2020; Cheng et al., 2021; Islam & Hasan, 2023; Niebel, 2018; Pradhan et al., 2021; Vu, 2017). This development underscores the recent trend of the internet enhancing economic inclusivity by broadening access to information and employment opportunities.

Furthermore, the internet serves not only as a tool for poverty alleviation but also as a catalyst for altering production patterns. It mitigates the pressure on natural resources by transitioning production from the extractive sector, characterized by low value-added intensity, to the service or non-farm sector, which offers higher value (Dzator et al., 2023; Giller et al., 2021; Gómez-Carmona et al., 2023; Li et al., 2020). In the agricultural domain, internet usage can contribute to long-term poverty reduction by enhancing agricultural efficiency, improving market access, providing commodity price information, and supporting smart farming, cultivation techniques, and weather engineering. This is particularly relevant in regions like Indonesia, where the agricultural sector is predominant. The integration of ICT in this sector is anticipated to alleviate regional poverty.

Moreover, digitalization reduces transaction costs, broadens economic opportunities, facilitates access to financing tailored to community needs, and expands the social networks of impoverished groups. These findings are consistent with Rashid Khan et al. (2019) assertion that technology usage enhances the quality of life for disadvantaged groups through social cost transfers.

Within the educational landscape, the integration of ICT has played a crucial role in bridging the gap in access to education during the Covid-19 pandemic. The shift towards digital learning has allowed students from economically disadvantaged backgrounds to continue their education from home, thereby positioning ICT as a long-term tool for poverty reduction (S. Asongu et al., 2021; Korkmaz et al., 2022; Mhlanga et al., 2022)The role of ICT is consistent with Romer's theory of endogenous economic development, which identifies technology, along with human capital and fixed production factors, as a driver of economic growth (Ravallion, 2012; Wan et al., 2021). Enhancing digital access is a strategy for poverty alleviation, aligning with the sustainable development goals, particularly pillar 1: eradicating poverty in all its forms globally.

The study faced limitations due to the exclusion of data from 38 provinces, attributed to the restricted observation period. Furthermore, the study did not utilize data over an extended period because of the constraints in ICT data availability, rendering long-term projections impractical.

CONCLUSION

Information and Communication Technology (ICT) has rapidly evolved over two decades through technological advances and widespread internet implementation. Studies show ICT supports inclusive development, though its effects on household welfare depend on infrastructure and institutional quality. The digital divide has widened disparities in digital literacy and ICT benefits, particularly affecting rural areas and low-income groups.

From this study found that human capital and basic infrastructure are key determinants of poverty reduction across Indonesian provinces. Education is crucial for anti-poverty initiatives, while internet connectivity and electricity access significantly improve population well-being by expanding market access, employment opportunities, and productivity. Internet access enables income generation and economic development. Although economic growth reduces poverty, its impact is moderate. Unemployment and oil palm plantation expansion increase poverty levels, indicating suboptimal benefits for vulnerable groups. Increasing per capita Gross Regional Domestic Product (GRDP) correlates with increased poverty, suggesting non-inclusive economic growth. The insignificant gini index indicates inequality variations between provinces do not statistically influence poverty.

This research emphasizes the need for inclusive development through digital infrastructure expansion, education enhancement, and productive employment policies. Oil palm sector governance reform is needed for equitable economic distribution. Future studies could use dynamic panels, institutional variables, or microdata to examine ICT's effects on poverty reduction.

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