



Infrastructure, Digital Connectivity, and Non-Farm Enterprises: Evidence on Household Welfare in Indonesia

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Abstract

This study aims to analyze the effects of infrastructure access and household participation in non-agricultural activities on household welfare in Indonesia. The data are derived from the fifth wave of the Indonesian Family Life Survey (IFLS-5), conducted in 2014, using a sample of 5,651 households as the unit of analysis. The findings reveal that internet access, mobile phone ownership, engagement in non-agricultural enterprises, asset ownership, the education level of the household head, and urban residence have significant positive effects on household welfare. In contrast, household size has a negative impact on welfare. Meanwhile, road and electricity access show no significant effect, likely due to their already widespread availability. These results emphasize the importance of digital transformation alongside household economic diversification in promoting welfare improvement. The novelty of this study lies in three main aspects. First, it simultaneously examines the roles of physical infrastructure, digital connectivity, and household participation in non-farm enterprises within a unified analytical framework. Second, it employs nationally representative IFLS-5 household-level data to capture welfare determinants at the micro level. Third, beyond estimating the probability of household welfare using logistic regression, this study further interprets the results through marginal effects, providing clearer policy implications regarding the relative importance of digital connectivity, income diversification, and household characteristics in improving welfare in Indonesia.

Keywords: Digital Connectivity, Household Welfare, IFLS, Infrastructure, Non-Agricultural Enterprises

JEL Classification: I31, O18, O33, R11

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Introduction

Infrastructure development is one of the key pillars in supporting economic growth, enhancing productivity, and improving societal welfare. In developing countries such as Indonesia, the role of basic infrastructure, such as roads, electricity, and the internet, not only drives national economic growth but also critically determines households' capacity to engage in and expand economic activities, particularly in the non-agricultural sector. Non-agricultural enterprises serve as an important income diversification strategy for households, especially in rural areas. These activities often provide alternative sources of income and, in many cases, become the main source of livelihood for a large share of households, particularly those living in rural and peri-urban regions.



Non-agricultural enterprises in both rural and urban areas serve as an important household strategy to increase income and reduce the risk of dependence on the agricultural sector. [Lanjouw and Lanjouw \(2001\)](#) found that such activities have great potential to reduce poverty and enhance social mobility, particularly when supported by access to markets and capital. Over the past few decades, Indonesia's structural economic transformation has shown a shift from the dominance of the agricultural sector toward the non-agricultural sector, including trade, home-based industries, and services. Data from Statistics Indonesia (BPS) indicate an increasing share of employment in the non-agricultural sector, especially since Indonesia was affected by the Covid-19 pandemic (Figure 1).

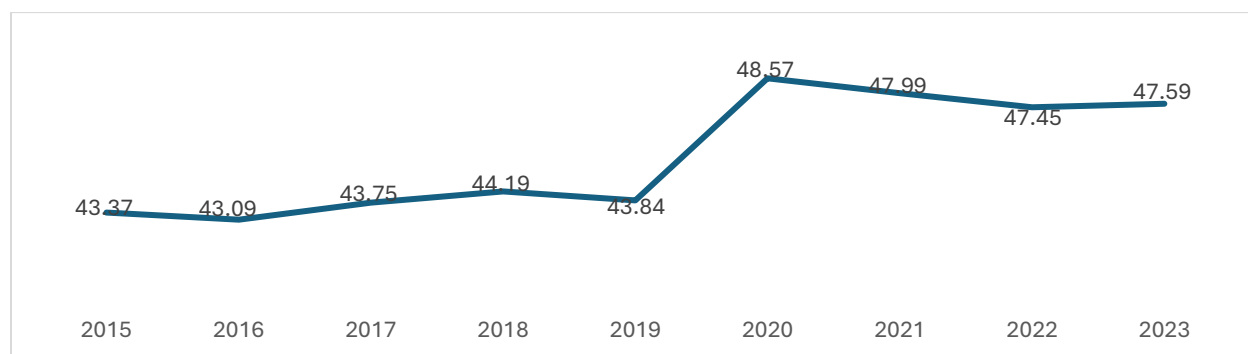


Figure 1. Proportion of Informal Employment in the Non-Agricultural Sector (%)

Source: BPS (2023)

The urgency of this study has become more pronounced in the post-COVID-19 period, during which Indonesia experienced rapid digital transformation alongside significant changes in household economic behavior. The pandemic accelerated the adoption of digital technologies for business activities, employment, education, and access to public services, making digital connectivity an increasingly important determinant of household welfare. Although the empirical analysis uses IFLS-5 household data collected in 2014, recent national statistics are presented to illustrate the current structural transformation and policy context that reinforce the relevance and urgency of this study.

At the same time, many households expanded their participation in non-farm economic activities as a strategy to diversify income sources and reduce vulnerability to economic shocks. Consequently, understanding how infrastructure and digital connectivity jointly influence household welfare has become more relevant than ever in supporting Indonesia's inclusive economic recovery.

Recent evidence indicates that rural road infrastructure remains an important challenge in Indonesia. [Wahyuni et al. \(2022\)](#) found that 43.27 percent of rural areas in Indonesia lacked access to paved road networks, while disparities in rural road connectivity persisted across regions. Limited road connectivity can increase transportation costs, restrict access to markets and public services, and constrain economic opportunities for rural communities. More recent village-level evidence from Kebumen also shows that road investments financed through the Village Fund have been associated with reductions in village poverty, although the effect becomes statistically insignificant after controlling for year effects ([Tamam & Iskandar, 2025](#)).

This inequality in infrastructure access creates disparities in economic opportunities across regions and directly affects household welfare. Adequate road access and electricity availability have been shown to promote the growth of small enterprises in rural areas ([Dercon et al., 2009](#)), while internet connectivity has the potential to expand markets, improve operational efficiency, and open new distribution channels for goods and services, even in remote areas ([Deichmann et al., 2016](#)). According to endogenous growth theory, infrastructure plays a crucial role in enhancing economic productivity and fostering long-term growth ([Romer, 1990](#)). [Calderón and Servén \(2010\)](#) found that improvements in both the quality and quantity of infrastructure have positive effects on economic growth and inequality reduction. Well-developed roads can reduce logistics costs, reliable electricity can increase production capacity, and internet access can accelerate the flow of information and facilitate business marketing.

Various studies have shown that the presence of basic infrastructure, particularly roads and electricity, significantly contributes to improving household welfare. Adequate roads enhance interregional connectivity,

accelerate labor mobility, and facilitate market access for small and medium-sized enterprises (World Bank, 2020). Meanwhile, access to electricity increases household productivity and enables the diversification of economic activities, including home-based enterprises (Dinkelman, 2011; Peters et al., 2019). Advances in technology and the internet have also created new employment opportunities, improved access to market information, and expanded opportunities for online skill training (Hilbert, 2016; Hjort & Poulsen, 2019).

Despite substantial progress in infrastructure development, considerable disparities in digital access remain across Indonesian regions, particularly between Java and non-Java provinces as well as between urban and rural areas. To address these challenges, the Indonesian government has prioritized digital transformation through initiatives such as the “1,000 Digital Villages Program and the Indonesia Digital Economy Masterplan 2021–2024”, aiming to improve digital inclusion and strengthen local economic resilience. These efforts are also consistent with the Sustainable Development Goals (SDGs), particularly Goal 1 (No Poverty) and Goal 9 (Industry, Innovation, and Infrastructure), which emphasize inclusive economic opportunities and resilient infrastructure.

Household welfare is generally measured using various indicators such as income, consumption, assets, housing conditions, health, and even happiness. Infrastructure can influence welfare both directly (e.g., through reduced transportation or energy costs) and indirectly (through higher business income). Access to infrastructure enables households to seize broader economic opportunities, increase income, and reduce vulnerability to economic shocks. The combination of infrastructure access and engagement in productive activities is essential for strengthening household economic resilience in developing countries.

In the Indonesian context, several studies such as Suryahadi et al. (2009) and Resosudarmo and Yamazaki (2011) have shown that infrastructure development contributes to poverty reduction and welfare improvement. Better rural road conditions significantly reduce the likelihood of households falling into poverty (Achjar & Panennungi, 2009). Furthermore, the shift from the agricultural to the formal non-agricultural sector and income derived from non-agricultural activities have a significant impact on improving household welfare (Moeis et al., 2020; Watema et al., 2025).

Specifically, non-agricultural enterprises hold great potential for improving welfare at the micro level. Nevertheless, existing empirical studies generally examine physical infrastructure, digital infrastructure, or non-farm participation separately. Limited evidence simultaneously evaluates how these three dimensions interact in influencing household welfare using nationally representative household-level data. Therefore, this study seeks to fill this gap by integrating these dimensions within a unified empirical framework. Based on this gap, this study addresses the following research question: “To what extent do physical infrastructure, digital connectivity, and household participation in non-farm enterprises influence household welfare in Indonesia?”

The novelty of this study lies in three important aspects. First, it simultaneously analyzes the effects of physical infrastructure, digital connectivity, and non-farm enterprises on household welfare within a unified empirical framework. Second, it utilizes nationally representative IFLS-5 household-level data to capture welfare determinants at the micro level. Third, beyond estimating the probability of household welfare using logistic regression, this study employs marginal effects analysis to provide more intuitive policy interpretations regarding the relative importance of each determinant. Therefore, this study aims to examine how physical infrastructure, digital connectivity, and household participation in non-farm enterprises affect household welfare in Indonesia and to provide policy recommendations for promoting inclusive and sustainable welfare improvement.

Literature Review

Infrastructure and Economic Development

According to Romer (1990) endogenous growth theory, infrastructure is a crucial factor in enhancing economic productivity and fostering long-term growth. Investment in infrastructure can also generate positive externalities for economic activities. Infrastructure such as roads facilitates the mobility of goods and labor, electricity enables more efficient production processes, and the internet provides access to information, technology, and new markets. In Indonesia, infrastructure is also an important indicator in the Village Development Index and the Human Development Index (HDI). Infrastructure not only affects economic activity at the macro level but also, at the micro level, influences household decisions regarding employment choices, access to education, healthcare, and other basic services.

Research conducted by [Calderón and Servén \(2010\)](#) shows that improvements in both the quality and quantity of infrastructure have a positive impact on economic growth and inequality reduction. Well-developed roads reduce logistics costs, adequate electricity increases production capacity, and internet access accelerates business processes, particularly in marketing. Numerous studies indicate that the availability of basic infrastructure, especially roads and electricity, significantly contributes to improving household welfare. Adequate road infrastructure enhances interregional connectivity, accelerates labor mobility, and facilitates market access for small and medium enterprises ([World Bank, 2020](#)). Meanwhile, access to electricity increases household productivity and enables the diversification of economic activities, including home-based enterprises ([Dinkelman, 2011](#); [Peters et al., 2019](#)). Advances in technology and internet access also create new employment opportunities, improve access to market information, and expand opportunities for participating in online skills training ([Hilbert, 2016](#); [Hjort & Poulsen, 2019](#)).

Non-Agricultural Enterprises

Non-agricultural enterprises in both rural and urban areas represent an important strategy for households to increase income and reduce the risks associated with dependence on the agricultural sector. [Lanjouw and Lanjouw \(2001\)](#) find that such activities have significant potential to reduce poverty and enhance social mobility, particularly when supported by access to markets and capital. Participation in this sector is also strongly influenced by external factors such as the availability of infrastructure, as well as the socio-economic conditions of households. Good road access enables more efficient transportation of raw materials and final products and expands market reach. Adequate electricity is essential for business operations, especially for enterprises relying on electronic equipment or machinery. Meanwhile, the internet plays a crucial role in marketing strategies, access to information, and product innovation.

Several studies in Indonesia show a positive relationship between infrastructure development and the growth of micro, small, and medium enterprises (MSMEs). Recent evidence further highlights the role of digital infrastructure in supporting rural economic development. Using village-level data from Indonesia, [Trihandika et al. \(2024\)](#) found that stronger internet signal strength increases the number of small and micro enterprises (SMEs), which in turn has a positive and significant effect on the local economy. These findings suggest that improved digital connectivity can facilitate business development and strengthen economic activity in rural areas. [Amalia and Budiman \(2024\)](#) demonstrate that digitalization, particularly through the use of e-commerce platforms and digital literacy, plays a significant role in increasing the income of rural MSMEs. Furthermore, digital technology not only supports product marketing and branding but also fosters a more adaptive and sustainable business ecosystem ([Sari & Ahmadi, 2024](#)), and is considered capable of empowering rural MSMEs by improving access to training, information, and new market opportunities ([Ratama et al., 2024](#)).

Research by [Nasution and Siregar \(2020\)](#) shows that the availability of well-developed village roads increases the likelihood of establishing household-scale enterprises. The transition from the agricultural sector to the non-agricultural sector is one of the key features of structural transformation in economic development. Studies by [Ellis \(2000\)](#) and [Lanjouw and Lanjouw \(2001\)](#) emphasize the importance of diversification into non-agricultural activities to improve income and strengthen household economic resilience in rural areas. Non-agricultural enterprises encompass a wide range of activities, including trade, small-scale manufacturing, services, and informal entrepreneurship, which often provide more stable and higher income compared to the agricultural sector.

Household Welfare

Household welfare is generally measured using various indicators such as income, consumption, assets, housing conditions, health, and even subjective well-being. Research conducted by [Calderón and Servén \(2010\)](#) shows that improvements in both the quality and quantity of infrastructure have a positive impact on economic growth and inequality reduction. Infrastructure can influence welfare both directly (e.g., through reduced transportation or energy costs) and indirectly (through increased business income). Access to infrastructure enables households to access broader economic opportunities, increase income, and reduce vulnerability to economic shocks.

The combination of infrastructure access and engagement in productive activities is key to building household economic resilience in developing countries. In the context of Indonesia, several studies, such as those by [Suryahadi et al. \(2009\)](#) and [Resosudarmo and Yamazaki \(2011\)](#), have shown that infrastructure

development contributes to poverty reduction and improved welfare. Improvements in rural road conditions significantly reduce the probability of households falling into poverty (Achjar & Panennungi, 2009). In addition, the transition from the agricultural sector to the formal non-agricultural sector, as well as income derived from non-agricultural activities, has a significant positive impact on household welfare (Moeis et al., 2020; Watema et al., 2025).

In welfare economics, household welfare is often associated with consumption capacity. Consumption is considered more stable than income because households tend to smooth consumption over time, as emphasized by Deaton (1992). The use of per capita expenditure is consistent with welfare literature, as consumption better reflects living standards than income. Therefore, consumption expenditure per capita is considered a more accurate indicator for measuring welfare levels. The median is often used in welfare statistics because it is more robust to outliers. Using the median allows for capturing the typical welfare condition of households within a population, as discussed by Cowell (2011). Empirical studies in Indonesia (Suryahadi & Al, 2012) also confirm that median expenditure provides a more accurate representation of the welfare of the majority of households.

Accordingly, this study uses median per capita expenditure as the main proxy for household welfare. From an inequality perspective, as introduced by Atkinson (1970), the distribution of expenditure is crucial in measuring welfare. The median is considered to represent a fair midpoint in the distribution, making it suitable as a cutoff or benchmark for distinguishing between poor and non-poor households. From a welfare economics perspective, household consumption expenditure is widely recognized as an important measure of economic well-being because it reflects households' ability to obtain goods and services that contribute to their living standards. The World Bank identifies consumption expenditure as a prevailing measure of welfare in many low- and middle-income countries and uses consumption-based welfare measures in poverty and inequality analysis (World Bank, 2024). In Indonesia, household expenditure is also central to the official measurement of poverty. Statistics Indonesia (BPS) determines the poverty line based on the minimum expenditure required to meet basic food and non-food needs, with the calculation derived from household consumption data collected through the National Socio-Economic Survey (Susenas) (Badan Pusat Statistik, 2023). Therefore, per capita household expenditure provides a relevant and contextually appropriate indicator for assessing household welfare and living standards in Indonesia.

Research Methodology

The data used in this study are derived from the fifth wave of the Indonesian Family Life Survey (IFLS-5), which was conducted in 2014. IFLS is a nationally representative, large-scale longitudinal survey covering both individuals and households in Indonesia. The unit of analysis in this study is the household, with a final sample consisting of 5,651 households. The survey instrument is longitudinal in nature and designed to collect extensive information at both the individual and household levels, including indicators such as types of economic activities, consumption, income, assets, education, health status, infrastructure access, marital status, and others (Strauss et al., 2016).

Based on the objective of this study to identify household access to infrastructure and participation in non-agricultural activities as a form of economic independence influencing household welfare in Indonesia, the empirical model of this research can be formulated as follows:

$$WLF_i = \beta_0 + \beta_1 MAR_i + \beta_2 ROAD_i + \beta_3 HP_i + \beta_4 INT_i + \beta_5 ELC_i + \beta_6 NFE_i + \beta_7 AST_i + \beta_8 FAM_i + \beta_9 AREA_i + \beta_{10} EDUC_i + \varepsilon_i \quad (1)$$

Equation 1 indicates that household welfare (WLF), as the dependent variable, is measured using monthly household per capita expenditure, which serves as a proxy for household welfare. Following the expenditure-based welfare approach commonly adopted in household surveys, a binary welfare variable is constructed by comparing each household's per capita expenditure with the sample median. Households whose monthly per capita expenditure is above the sample median are classified as $WLF = 1$, whereas those with expenditure equal to or below the sample median are classified as $WLF = 0$. The level of household welfare is assumed to be influenced by several variables, such as infrastructure access and connectivity (market location (MAR), type of road ($ROAD$), mobile phone ownership (HP), internet access (INT), and electricity access (ELC)), economic independence (ownership of non-agricultural enterprises (NFE)), total household assets

(*AST*), number of household members (*FAM*), residential area (*AREA*), and the education level of the household head (*EDUC*).

The analytical method employed is logistic regression. To further interpret the results, a marginal effect estimation is conducted to measure the change in the probability of the dependent variable resulting from a change in the independent variables method consists of techniques and steps in the implementation of the research.

Results and Discussion

Results

The total number of observations in this study is 5,651 households. This research describes the welfare conditions of Indonesian households as reflected by various internal factors owned by each household and external factors present in their surrounding environment. Table 1 presents the descriptive statistics of the research variables, which include household welfare, infrastructure access, demographic characteristics, and economic participation. Based on Table 1, approximately 49 percent of households can be categorized as prosperous, while the remain in the less prosperous category, with per capita expenditure below the median of the observed household group. In addition, around 38 percent of households have relatively easy access to markets, where the market location is within the neighbourhood of the household's residence. In this study, nearly all households already have access to paved roads, either asphalt, concrete, or hardened surfaces.

Table 1. Descriptive Statistics of the Data

Variable	Mean	Std. Dev	Min	Max
Household Welfare	0.49	0.50	0	1
Market Location	0.38	0.49	0	1
Type of Road	0.98	0.11	0	1
Mobile Phone	0.56	0.49	0	1
Internet Access	0.15	0.36	0	1
Electricity Access	0.99	0.08	0	1
Non-agricultural Enterprises	0.42	0.49	0	1
Assets	3.77	1.29	0	8
Number of Household Members	4.26	1.63	2	16
Residential Area	0.52	0.49	0	1
Education Level	7.57	4.24	0	18

Source: Processed Data (2026)

Connectivity access can also be seen from mobile phone ownership, where more than half of households already possess modern communication devices. However, internet access remains low, with an average of only 0.15, indicating that only about 15 percent of households utilize the internet despite the relatively high rate of mobile phone ownership. The limited internet access may contribute to a digital divide and constrain information-based economic opportunities, particularly for rural households. Hence, mobile phones are likely used primarily for basic communication rather than for productive purposes such as accessing market information or conducting business activities. This finding aligns with the literature emphasizing that information technology can only effectively improve welfare when supported by adequate internet access (Donner, 2008).

Almost all households have access to electricity, with an average value of 0.99, indicating that electricity is no longer a major constraint. The high proportion of households with road and electricity access confirms that basic infrastructure has been relatively evenly distributed across most regions. Approximately 42 percent of households participate in economic activities outside the agricultural sector, reflecting income diversification, although less than half of households are actually involved. This finding supports the literature highlighting the importance of household economic diversification in reducing vulnerability to agricultural shocks and enhancing welfare stability (Barrett et al., 2001; Ellis, 2000). According to the theory of household income diversification in developing countries, such diversification serves as an essential strategy to mitigate risks associated with the agricultural sector and to promote economic stability (Barrett et al., 2001; Ellis, 2000).

In terms of wealth, the average number of household assets is 3.77 (on a scale of 0–8), indicating a moderate level of asset ownership. The types of assets considered in this study include ownership of residential houses and land, other buildings, non-business land, vehicles, electronic appliances, savings/deposits/stocks, receivables, and jewelry. The relatively moderate average asset value (3.77) with substantial variation suggests inequality in asset ownership distribution. This pattern is also reflected in the standard deviation of the household head's education level (4.24), indicating disparities in educational attainment. Both variables are likely to be important determinants of household welfare, as access to education and asset ownership serve as fundamental forms of capital for enhancing productivity and economic opportunity.

The average education level of household heads is 7.57 years, with a wide range (0–18 years), meaning that most household heads have completed education equivalent to junior high school, though there is significant variation from no schooling to university-level education. This highlights the inequality in human capital quality. Both variables align with human capital theory (Becker, 1993), which emphasizes that education and assets play crucial roles in improving productivity and welfare.

The household structure shows an average of 4.26 members per household, ranging from 2 to 16 members. This is consistent with the typical medium-sized family structure in Indonesia. While the average reflects a standard household size, the wide variation (up to 16 members) may imply dependency burdens that affect the allocation of household resources. Meanwhile, the distribution of residential areas (0.52) indicates a relatively balanced representation between rural and urban households.

Overall, the descriptive statistics suggest that households in the sample have relatively good access to basic infrastructure (roads and electricity) but continue to face disparities in welfare, internet access, and education. Moreover, diversification into non-agricultural sectors shows potential but remains underutilized by most households. Academically, these findings support the frameworks of human capital theory (Becker, 1993) and infrastructure-based development theory (Todaro & Smith, 2015).

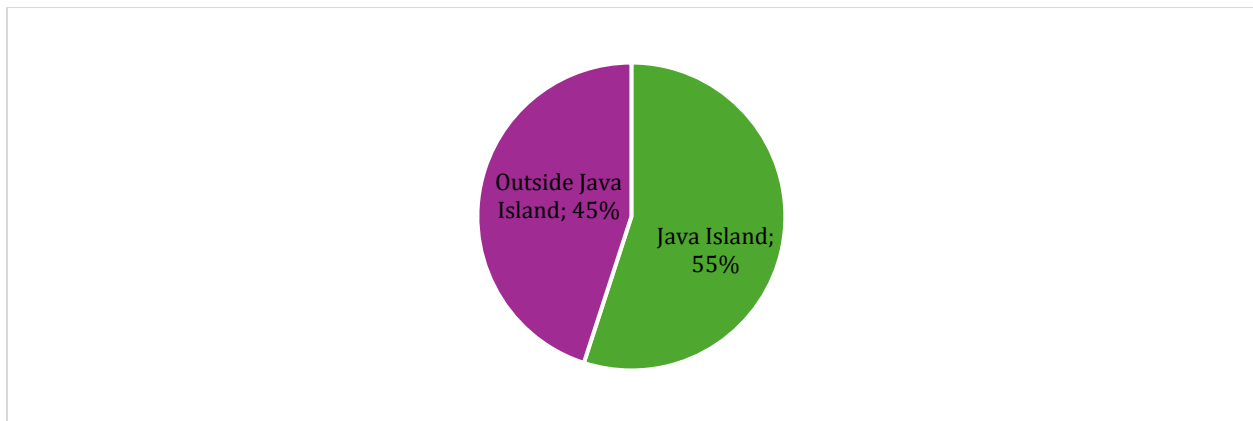


Figure 2. Distribution of Household Locations

Based on Figure 2, it can be observed that the majority of households in the sample reside on Java Island, accounting for 55 percent, while the remaining 45 percent are located outside Java. This indicates that the proportion of households is relatively balanced between Java and non-Java regions, although Java remains dominant. This condition aligns with Indonesia's demographic reality, where Java serves as the most densely populated island as well as the center of economic growth and national infrastructure development. According to Statistics Indonesia (BPS), approximately 55.88 percent of Indonesia's population resided on Java Island in 2024, making Java the most populous island in the country (Badan Pusat Statistik, 2025a). This substantial concentration of population provides a demographic basis for the relatively large representation of households from Java in the study.

Meanwhile, the proportion of households outside Java Island, which reaches 45 percent, indicates a relatively balanced and inclusive data distribution. Thus, this study can describe household conditions not only in relatively developed and densely populated regions (Java Island) but also in other areas with more diverse social, economic, and geographical characteristics. This finding is important because location often influences

household access to public facilities, infrastructure, and economic opportunities (Peters et al., 2019; Resosudarmo et al., 2020).

Table 2. Household Characteristics by Residential Area

Variable	Area	
	Rural	Urban
<i>Household Welfare</i>		
Yes	1,169	1,656
No	1,555	1,271
<i>Market Location</i>		
Within the Neighborhood	839	1,349
Outside the Neighborhood	1,885	1,578
<i>Paved Road (Asphalt/Concrete/Hardened)</i>		
Yes	2,647	2,927
No	77	0
<i>Mobile Phone</i>		
Yes	1,315	1,853
No	1,409	1,074
<i>Internet Access</i>		
Yes	253	603
No	2,471	2,324
<i>Electricity Access</i>		
Yes	2,694	2,920
No	30	7
<i>Non-agricultural Enterprises</i>		
Yes	952	1,415
No	1,772	1,512

Source: Processed Data (2026)

Table 2 shows significant differences between rural and urban households in terms of welfare, infrastructure access, asset ownership, and participation in non-agricultural enterprises. First, in terms of household welfare, 49 percent of households are classified as prosperous, or with per capita expenditure above the average. The number of prosperous households is higher in urban areas than in rural areas, indicating a persistent spatial disparity in household welfare. This pattern is consistent with recent evidence from Statistics Indonesia (BPS), which shows that poverty remains substantially higher in rural areas than in urban areas. In 2025, the poverty rate was 10.72 percent in rural areas, compared with 6.60 percent in urban areas (Badan Pusat Statistik, 2025b). Similarly, the World Bank (2025) reports that although Indonesia has continued to reduce poverty, rural poverty remains higher than urban poverty, indicating that improvements in national welfare have not been evenly distributed across residential areas. Urban households generally have better access to labor markets, educational services, and healthcare facilities that support welfare (Suryahadi & Al, 2012).

Second, regarding market access, the data show that 38.7 percent of markets are located within the households' residential area. Most rural households must access markets located outside their villages, while in urban areas, most markets are available within the city. This indicates that rural households face higher transaction costs due to geographic distance to markets (Barrett, 2008).

Third, in terms of road infrastructure, 98.6 percent of households live in areas with good road access. Almost all rural and urban households have adequate road access (asphalt, concrete, or hardened roads), although a small portion of rural households remain disconnected from high-quality roads. This reflects the success of infrastructure development but also highlights that road quality equality remains an issue, especially in remote rural areas.

Fourth, for mobile phone ownership and internet access, a clear digital divide is evident. Urban households are more likely to own mobile phones and have internet access than rural households. This phenomenon reflects a digital divide that hinders the adoption of digital technology among rural communities (Nugroho, 2020). However, literature shows that the use of information technology can enhance productivity and welfare (Horrihan, 2016).

Fifth, in terms of electricity access, almost all households in both rural and urban areas in the study sample are connected to electricity. This finding is consistent with the national electrification trend reported by the Ministry of Energy and Mineral Resources (ESDM), which recorded an electrification ratio of 99.83 percent in 2024 ([Kementerian Energi dan Sumber Daya Mineral Republik Indonesia, 2025](#)).

Sixth, in the aspect of non-agricultural enterprises, urban households are more likely to engage in non-agricultural activities compared to rural ones. This aligns with the literature suggesting that business diversification is more developed in urban areas due to better access to markets, infrastructure, and business networks ([Reardon et al., 2007](#)). In contrast, rural households remain heavily dependent on the agricultural sector.

Overall, these findings reinforce the existence of structural rural–urban disparities in terms of welfare, market access, digital asset ownership, and non-agricultural business opportunities. Efforts to achieve more equitable development should focus on improving market access in rural areas, strengthening road infrastructure, and accelerating digital technology adoption to reduce inequality.

The logit estimation results in Table 3 reveal several important findings. To evaluate the adequacy of the estimated logistic regression model, the Hosmer–Lemeshow goodness-of-fit test was performed. The test yielded a Hosmer–Lemeshow χ^2 statistic with a p-value of 0.1916, indicating no statistically significant difference between the observed and predicted probabilities of household welfare. Therefore, the null hypothesis that the model fits the data cannot be rejected, suggesting that the logistic regression model provides an adequate fit for the observed data.

Table 3. Logistic Regression Estimation of Household Welfare

Variable	1	2	3	4
Market Location	0.163*** (0.0563)	0.152*** (0.0566)	0.112* (0.0601)	0.115* (0.0602)
Type of Road	-0.0491 (0.233)	-0.113 (0.232)	-0.356 (0.249)	-0.398 (0.249)
Mobile Phone	0.641*** (0.0583)	0.619*** (0.0585)	0.408*** (0.0623)	0.309*** (0.0665)
Internet Access	0.712*** (0.0853)	0.718*** (0.0866)	0.545*** (0.0922)	0.419*** (0.0980)
Electricity Access	0.371 (0.339)	0.292 (0.338)	-0.112 (0.415)	-0.125 (0.415)
Non-Agricultural Enterprises		0.458*** (0.0561)	0.389*** (0.0602)	0.395*** (0.0604)
Assets			0.404*** (0.0247)	0.390*** (0.0249)
Number of Household Members			-0.349*** (0.0214)	-0.354*** (0.0216)
Residential Area			0.458*** (0.0604)	0.424*** (0.0609)
Education Level				0.0355*** (0.00852)
_cons	-0.847** (0.388)	-0.879** (0.387)	-0.331 (0.486)	-0.385 (0.485)
N	5,651	5,651	5,651	5,651
Wald chi2	294.04	341.68	737.80	749.48
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.0400	0.0486	0.1256	0.1278
Log likelihood	-3760.48	-3726.75	-3424.98	-3416.42
Hosmer–Lemeshow p-value	0.9973	0.0993	0.0983	0.1916

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

In addition, the model was estimated using robust standard errors to improve the reliability of statistical inference by accounting for potential heteroskedasticity. First, the market location variable has a positive and significant coefficient across all specifications. This indicates that proximity or easier access to markets increases the likelihood of a household being categorized as prosperous.

Second, the road type variable is not statistically significant and even tends to have a negative coefficient. This finding suggests that while road access is important, it does not directly enhance welfare unless accompanied by access to information and other economic opportunities.

Third, the variables of mobile phone ownership and internet access are consistently positive and significant. The results indicate that households with mobile phone ownership and internet access are more likely to be associated with higher welfare status than households without these forms of digital connectivity. This finding aligns with the view that communication technology expands social networks, access to market information, job opportunities, and public services, thereby improving household income.

Table 4. Marginal Effects of Household Welfare

Variable	1	2	3	4
Market Location	0.0385*** (0.0133)	0.0354*** (0.0132)	0.0235* (0.0126)	0.0240* (0.0126)
Type of Road	-0.0116 (0.0552)	-0.0264 (0.0543)	-0.0747 (0.0521)	-0.0831 (0.0519)
Mobile Phone	0.152*** (0.0132)	0.144*** (0.0131)	0.0855*** (0.0129)	0.0646*** (0.0138)
Internet Access	0.168*** (0.0197)	0.168*** (0.0197)	0.114*** (0.0191)	0.0875*** (0.0203)
Electricity Access	0.0878 (0.0800)	0.0681 (0.0789)	-0.0234 (0.0870)	-0.0261 (0.0866)
Non-Agricultural Enterprises		0.107*** (0.0128)	0.0815*** (0.0124)	0.0825*** (0.0124)
Assets			0.0846*** (0.00472)	0.0815*** (0.00478)
Number of Household Members			-0.0731*** (0.00403)	-0.0739*** (0.00405)
Residential Area			0.0959*** (0.0124)	0.0886*** (0.0125)
Education Level				0.00742*** (0.00177)

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

Furthermore, the electricity access variable is not significant, likely because the electrification rate is already high, making it no longer a differentiating factor for household welfare. Participation in non-agricultural enterprises has a positive and significant effect on welfare, confirming that diversifying income sources into non-agricultural sectors provides greater stability and higher income compared to households relying solely on agriculture.

The number of assets variable is also positive and significant, meaning that the more assets a household owns, the higher its probability of being classified as prosperous. Conversely, the number of household members has a negative and significant effect, indicating that larger household sizes reduce the likelihood of achieving welfare due to increased dependency burdens.

In addition, households residing in urban areas have a higher probability of being prosperous than those in other regions, as reflected by the positive and significant coefficient of the area variable. Education level also shows a positive and significant effect, albeit with a relatively small magnitude, reinforcing the role of education in improving employment opportunities and productivity, which ultimately contribute to household welfare.

The marginal effect results in Table 4 indicate the probability impact on household welfare. First, the market location variable produces a positive and significant coefficient across all models. This means that households located closer to or with easier access to markets have a 2.3–3.9 percentage point higher probability of being prosperous compared to those with limited market access. Although the effect slightly decreases when additional control variables are included, the result remains statistically significant.

Second, the road type variable (paved/asphalt/concrete) is not significant, with a small and negative coefficient. This indicates that road availability does not have a direct effect on household welfare in this model, possibly because road access is already relatively widespread, and thus no longer serves as a key differentiating factor.

Third, mobile phone ownership and internet access variables are both positive and significant across all models. Households owning mobile phones have a 6–15 percentage point higher probability of being prosperous compared to those without phones. This highlights the importance of communication tools in facilitating access to information and economic opportunities. Moreover, internet access increases the probability of household welfare by approximately 8.7–16.8 percentage points, suggesting that digitalization effectively expands income-generating opportunities.

Fourth, electricity access is not significant in any of the models, implying that electricity is no longer a differentiating factor for welfare since nearly all households are already electrified.

Participation in non-agricultural enterprises shows a positive and significant coefficient. Households engaged in non-agricultural activities have an 8–10 percentage point higher probability of being prosperous compared to those not involved in such activities. The number of assets variable is positive and significant, meaning that each additional asset correlates with an approximate 8 percentage point increase in the probability of being prosperous. Asset ownership functions as an economic buffer and a form of capital accumulation that strengthens household welfare. Conversely, each additional household member decreases the probability of being prosperous by about 7.3 percentage points, indicating that a larger dependency burden reduces welfare likelihood.

Furthermore, the residential area and education level of the household head variables are both positive and significant. Urban households have an 8.9–9.6 percentage point higher probability of being prosperous compared to rural households, confirming the persistent welfare disparity between urban and rural areas. Additionally, each additional year of education increases the probability of welfare by about 0.7 percentage points. Although the effect size is relatively small, it is consistent with human capital theory, which posits that education remains a vital long-term asset for enhancing income and welfare.

Discussions

The findings of this study are consistent with those of [Deaton \(1997\)](#) and [Fields \(2011\)](#), who emphasized that household economic welfare is largely influenced by access to resources and economic opportunities. The market location variable was found to have a positive and significant effect on the likelihood of households being categorized as prosperous. This indicates that proximity to markets reduces transaction costs and expands household access to basic needs and business opportunities. Theoretically, market access is one of the key determinants of welfare, as it enhances the integration of household economic activities with production and consumption ([Todaro & Smith, 2015](#)). Empirical research by [Nasution and Siregar \(2020\)](#) in Indonesia also found that the presence of nearby markets contributes to increased household income and consumption.

[Asadullah and Savoia \(2018\)](#) also showed that education and diversification into non-agricultural enterprises play important roles in reducing economic vulnerability in developing countries. Households that diversify into non-agricultural sectors have a higher likelihood of achieving prosperity. Theoretically, income diversification serves as a household strategy to reduce risks and enhance income stability ([Ellis, 2000](#)). This finding aligns with [Asih \(2024\)](#), who found that off-farm employment improves the welfare of rural households in Indonesia by increasing household income and economic mobility. The findings highlight the importance of income diversification through non-agricultural activities as an alternative livelihood strategy for rural households that may reduce dependence on agricultural income. Regarding telecommunications, these findings support [Aker and Mbiti \(2010\)](#), who found that mobile phone use in Africa improves market efficiency, reduces transaction costs, and ultimately increases smallholder welfare. Similarly, [Hilbert \(2016\)](#) demonstrated that internet access significantly expands economic opportunities for households in developing countries.

The insignificance of electricity and road variables is consistent with the argument of [Khandker et al. \(2013\)](#) in Vietnam, who found a similar pattern where electrification had a significant impact on welfare only in regions with large access gaps, while in areas with already high access levels, the effect was weak. Basic infrastructure tends to have welfare effects only when accompanied by productive access to other opportunities such as information, markets, and business activities. This suggests that during the observation period, road access was not a dominant factor influencing welfare. This can be explained by the fact that road development generally has long-term effects, while short-term benefits are more directly associated with digital access and non-agricultural business opportunities.

Furthermore, this study shows that digitalization factors (telephone and internet), non-agricultural business diversification, and asset ownership play a greater role in improving welfare compared to physical infrastructure such as roads and electricity. In other words, infrastructure development contributes to welfare

only when it is productively utilized. This finding is consistent with [Aker and Mbiti \(2010\)](#), who showed that telecommunications access improves market efficiency and welfare in Africa, and [Khandker et al. \(2013\)](#), who emphasized that basic infrastructure yields significant welfare impacts only when used productively.

The result also aligns with studies in Indonesia by [Febriani and Suryahadi \(2019\)](#), who found a positive impact of internet access on household welfare, and [Suryahadi and Sumarto \(2003\)](#), who highlighted the role of business diversification in reducing economic vulnerability. These findings also support [Stiglitz \(2000\)](#) transaction cost theory, which argues that communication technology lowers information search costs, accelerates transaction flows, and opens new business opportunities. Similarly, [Sujaarwoto and Tampubolon \(2016\)](#) in Indonesia found that internet access not only enhances objective welfare but also improves subjective well-being.

Asset ownership was also found to have a significant positive effect on welfare. Assets function as economic buffers during shocks and serve as capital for developing household enterprises. This finding is consistent with the asset accumulation theory of [Carter and Barrett \(2006\)](#), which states that ownership of physical and financial assets forms a foundation for sustaining household welfare in developing countries. Conversely, the number of household members had a significant negative effect. Larger households tend to have lower welfare probabilities due to higher per capita consumption burdens.

Households residing in urban areas have a higher likelihood of achieving welfare than those in rural areas. This finding is consistent with the concept of urban bias ([Lipton, 1977](#)), which posits that urban areas enjoy better access to markets, infrastructure, and public services, ultimately leading to higher welfare. The education level of the household head supports the human capital theory ([Becker, 1993](#)), which asserts that education enhances labor productivity and, consequently, household welfare. Empirical studies in Indonesia, such as [Suryadarma et al. \(2006\)](#), also found that education improves employment opportunities in modern sectors with higher wages, thereby enhancing welfare.

Although this study controls for several household characteristics, the cross-sectional nature of IFLS-5 limits our ability to completely eliminate potential endogeneity arising from omitted variables or reverse causality. Therefore, the estimated relationships should be interpreted as statistical associations rather than definitive causal effects. Future research may employ panel data methods, instrumental variables, or quasi-experimental approaches to better address these issues.

Conclusion

The factors that most strongly increase the likelihood of household welfare are internet access, mobile phone ownership, participation in non-agricultural enterprises, and asset ownership. Conversely, the factor that reduces welfare probability is the number of household members, reaffirming that per capita consumption burdens rise with larger household sizes. Education and geographical location also contribute positively, although their effects are relatively smaller compared to digital and economic factors. On the other hand, basic infrastructure variables such as roads and electricity are not significant, likely due to their already widespread access or their benefits being realized over the long term. Overall, these findings demonstrate that digital transformation, income diversification, and the strengthening of household economic capacity play a greater role in improving welfare than physical infrastructure development.

The policy implications of this study highlight that strengthening digital infrastructure (telecommunications and internet) has a greater impact on household welfare than focusing solely on physical infrastructure such as roads or electricity. Improving market access should also be a priority, as proximity to markets increases opportunities for households to raise their income. Non-agricultural business diversification should be encouraged through skill training programs and access to business financing, particularly in rural areas. Although the effect of education is relatively modest, education policy remains essential because it represents a long-term investment in improving labor quality. Managing household dependency burdens through family planning programs and providing social protection are important to prevent economic vulnerability. Finally, inclusive development strategies must be prioritized to ensure that welfare disparities between urban and rural areas do not widen further.

CRediT Author Statement

Vitriyani Tri Purwaningsih: Conceptualization/Formulation of ideas, Formal analysis/Techniques, and Writing Original Draft. **Asih Murwiati:** Development/Design of methodology. **Resha Moniyana Putri:** Data

collection/Curation. **M. Mufti Hudani:** Data collection/Curation and Translate. **Moria Yasa Mahrusjaya:** Layout, Formatting/Editing.

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