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Assessment of village accessibility and community mobility to enhance socioeconomic conditions of rural communities

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Abstract The development of village roads increases the accessibility of villages and community mobility. Increasing regional accessibility and community mobility will impact the welfare of village communities. However, the development of village roads is still limited and uneven due to the limitations of the development budget and the lack of comprehensive strategic planning for village road development. The main purpose of this study is to analyze the community (farmers) assessment regarding improving the accessibility of their mobility villages due to the development of village roads. This study also examines farmers' evaluations of increased mobility related to farming and socioeconomic activities. We collected data from respondents through an interview using farmer assessments in two villages on the 5-point Likert scale. The assessment of variable indicators by respondents was analyzed descriptively. Meanwhile, the analysis of the impact of accessibility and mobility on the socioeconomic conditions of the community uses a multiple linear regression model. The farmers' assessment scores on the variable indicators, on a scale of 1 to 5, were 3.39 (village accessibility), 3.36 (community mobility), and 3.33 (socioeconomic conditions of the rural community). The development of rural roads increases the accessibility of villages and community mobility. Furthermore, increasing village accessibility and community mobility significantly impact the socioeconomic conditions of village communities. Therefore, constructing and improving village roads significantly enhances rural communities' socioeconomic conditions. The study strongly recommends that policymakers prioritize investment in rural road infrastructure to drive sustainable agriculture and rural development. Future research proposes the development of quantifiable indicators for these variables to find more robust conclusions about the socioeconomic conditions of village communities in quantitative measures.

Keywords: community mobility, community welfare, infrastructure improvement, rural roads, village accessibility

1. Introduction

Accessibility and mobility are essential factors in the development of rural areas. Accessibility is determined by the availability of road infrastructure (Setiawan et al., 2018) and is an overview of the ease of achieving a destination (Priyambodo, 2015). The availability of infrastructure is one of the strategies used to overcome poverty (Nurmala & Hutagaol, 2022). Increasing the accessibility and mobility of people and goods to and from regional centers of activity is urgently needed to drive the economy (Indrashanty & Legowo, 2017). The construction or improvement of village roads will improve the lives of village people, including increasing mobility, transportation and marketing of agricultural products (Riti et al., 2018). Road infrastructure is a fundamental means to support the smooth distribution of goods and transportation networks (Mustafa & Sasmito, 2017). The mobility variables include the number and ownership of vehicles, the road pavement type quality, and the road network (Magribi & Suhardjo, 2004).

Transport is a basic human need for accessibility and mobility, and roads are the primary function of the transportation system (Permatasari et al., 2019). The positive impact of road construction and repair is to shorten travel time and increase the distribution of goods and land value. Road infrastructure increases the flow of social mobility and supports regional economic growth (Noviyanti & Putra, 2023). Adequate transportation infrastructure must increase economic growth through accessibility and mobility (Putri & Tama, 2018).

Improving accessibility through road improvements is related to enhancing community mobility, access to markets, health services, and education (Noviyanti & Putra, 2023). The availability of infrastructure, especially road access, is a

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supporting factor for regional development. The availability of roads encourages business opportunities and the mobility of people and goods between regions (Pratiwi, 2020). Village road infrastructure can improve the welfare of rural communities by increasing the number of prosperous families, types of jobs, and education levels (Fajri, 2017). One of the strategies for developing horticultural agribusiness in rural areas is to improve the quality of village roads and farming roads (Saragih, 2018).

The priority of road network development is constructing or maintaining the road network in potential areas to support regional growth. In addition, transportation facilities need to be improved to support population mobility (Humang & Amrin, 2016). Road construction involves connecting networks between villages and regions. The economic conditions of rural communities are still deficient because road construction is not yet a priority (Utomo, 2019).

Village road construction programs can increase farmers' income (Utomo, 2019). Improving roads and accessibility for four-wheeled vehicles increases villages' economic transformation (Kamaludin & Qibthiyyah, 2022). Rural roads contribute significantly to improving the living conditions of rural residents (Tirth et al., 2021). Good-quality rural road infrastructure contributes considerably to improving socioeconomic indicators in rural areas: improving accessibility to markets, educational and health facilities, and encouraging economic activities (Akpan & Morimoto, 2022). Village roads contribute greatly to agriculture and rural development. Better rural connections improve agriculture, thus increasing labor to agriculture and the rural economy (Nuhu & Ritter, 2022).

However, poor rural road conditions hinder agricultural development because of high transportation costs and irregular transportation services (Olorunfemi, 2020). In addition, poor rural road construction badly affects the mobilization of rural human resources (Ogunsanya, 1987). Public transportation in rural areas is characterized by low accessibility, long waiting times, and commutes (Frank et al., 2021). Rural areas should prioritize the sustainable development of the mobility sector (S. Hussain et al., 2023). Essakali (2005) examines the state of rural accessibility and mobility and its influence on the social and economic dimensions of rural poverty.

Therefore, improving rural accessibility should be a national development priority, as it can promote sustainable social and economic development (Ahmed & Eklund, 2019). Funding allocation can be based on poverty levels so that rural roads provide transportation equity and reduce poverty (Naimanye & Whiteing, 2016). In addition, the rural access index can be the basis for policymakers and planners in deciding to improve rural roads (Li et al., 2022). Adequate access to rural roads is one of the main determinants of rural income (Wondemu & Weiss, 2012). Accessibility to transportation is correlated with socioeconomic factors. Higher transportation accessibility improves the social conditions of a rural area. Increasing household income impacts spending on education, health, and social ties, increasing living standards (Rahman et al., 2023).

Improving the environmental road network facilitates the accessibility and mobility of the population, optimizes the distribution of water services for agriculture, and controls the development of residential areas (Indrajaya et al., 2022). Integrating remote regions with urban centers by developing rural transportation infrastructure will increase the demand for access and mobility in rural communities (Mekonnen & Alamirew, 1970). Road connectivity is essential in rural development, transformation, and access to health, education, and other socioeconomic services (Raina & Ahmed, 2022).

Rural accessibility is an essential issue in development to improve the living standards of rural communities (Soseco, 2016). In short, land transportation is necessary to support agricultural mobility, connectivity, and accessibility to increase the productivity of leading agricultural sectors that impact regional development (Juantoro et al., 2020). Road accessibility significantly affects the spatial distribution of social infrastructure in rural areas. Local governments must prioritize good road infrastructure facilities to encourage the growth of rural regions (Samuel & Frances, 2018).

However, the uneven development of village roads has resulted in limited village accessibility. Limited accessibility hinders the mobility of rural communities in carrying out economic and social activities. The lack of village road construction is caused by, among other factors, budget limitations and weak strategic planning for developing the village road network in rural regions. This research is essential for understanding the role of village road development and improvement in improving village accessibility and community mobility. In turn, the accessibility of the area and the mobility of rural communities positively impact the welfare of rural communities.

Therefore, this study aimed to assess the level of village accessibility and the mobility of village communities due to improved rural roads. Additionally, this study aimed to examine the influence of village accessibility and community mobility on improving community welfare, specifically in terms of enhancing village roads. This research focused on understanding how improved road infrastructure affects the socioeconomic conditions of rural communities.

2. Methods

2.1. Study area

This research was conducted in Perbaji village and Temburun village, Tiganderket subdistrict, Karo Regency, North Sumatra, Indonesia (see Figure 1). These two villages are adjacent and experienced the direct impact of the improvement of 8 km of rural roads in 2021. The improvement of road quality aims to improve village accessibility and community mobility in rural areas. This village road connects and enhances the connection between Perbaji and Temburun villages.

2.2. Population and sample

The study population included all residents of Perbaji village (122 households) and Temburun village (243 households). Considering that the characteristics of the population are relatively homogeneous (most of them are farmers) and not very geographically dispersed (Pontoh et al., 2019), the sample was determined to be 25% of the population. The samples included 31 households in Perbaji village and 61 in Temburun village. Sample selection uses a simple random sampling method. Probability samples, including simple random sampling, are the most accurate sample selection method (Elder, 2009). Compared with other probability sampling procedures, simple random sampling has several strengths (Daniel, 2011). The process is simple and fair because every farmer has an equal opportunity to be selected (Berndt, 2020). We used a direct face-to-face structured interview with respondents through questionnaires to collect primary data (Pontoh et al., 2019).

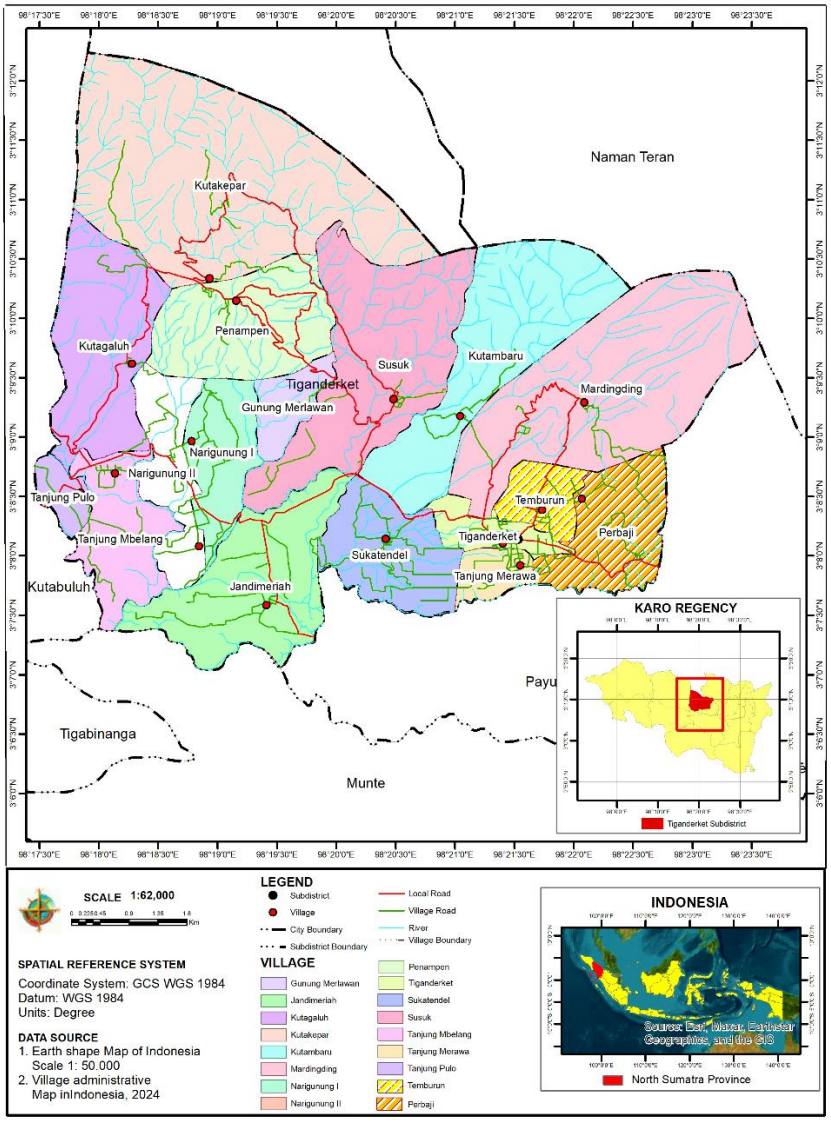

Figure 1 Study area in Perbaji and Temburun village, Tiganderket subdistrict, Karo Regency, Indonesia.

2.3. Research variables

This study identifies village accessibility and community mobility as independent variables and community socioeconomic conditions as the dependent variables (see Table 1). The variables are measured through indicators based on a 5-point Likert scale. The Likert scale is a measurement method for assessing an individual's opinion on a particular issue (A. Hussain, 2022). The Likert-type scale is commonly used when attitudes, personality characteristics, and other psychological variables are being assessed (Nadler et al., 2015).

2.4. Measurement procedure

The variable is measured through the indicators of each variable with the following procedure: (i) Each variable indicator is described as a statement that is explicitly easy for the farmer sample to understand; (ii) the research samples give their

opinions on indicators by using the five-point Likert scale (Jieří et al., 2021): 5 (strongly agree), 4 (agree), 3 (moderately agree), 2 (disagree), and 1 (strongly disagree); (iii) the total score for each variable is the sum of respondents' answers to all variable indicators; and (iv) the total score for each variable is then analyzed via a multiple linear regression equation with the following Eq. (1). Weijters et al. (2010) concluded that a Likert scale with a midpoint results in a lower level of extreme response. For the general population, such as the population of rural communities (farmers) in this study, a fully labeled 5-point scale is recommended.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 \qquad (1)$$

where Y is the total score of the variable socioeconomic condition of the community, X_1 is the total score of village accessibility, and X_2 is the total score of community mobility.

Table 1 Variables, indicators, and measurements.

Variable	Indicator	Measurement
Village accessibility (X_1)	Travel time is getting shorter	Likert scale
	Transportation costs are getting more affordable	
	Capacity building and quality of village roads	
	Land use change	
	Ease of marketing agricultural products	
	Ease of obtaining agricultural production facilities	
Community mobility (X_2)	Increased travel frequency/intensity	Likert scale
	Improved inter-village connections	
	Improved public transportation services	
	Increased movement of goods and information	
	Increased motor vehicle ownership	
	Adequacy of village road length	
Socioeconomic conditions of the community (Y)	Increased agricultural production	Likert scale
	Increase in household income	
	Ease of access to education and health services	
	Ease of access to government services	
	Ease of access to clean water and electricity infrastructure	
	Ease of access to sociocultural facilities	

The study conducts relevant tests for scale category data, namely, validity tests, reliability tests, coefficient determination tests, F tests (simultaneously tests), and t tests (partial tests). Validity and reliability are two crucial concepts in academic research. Measurement validity is essential when conducting research (Peeters & Harpe, 2020). Reliability and validity remain the right concepts to achieve rigor in qualitative research (Morse et al., 2002). Careful research design and establishing clear operational definitions improve the validity and reliability of research findings (William, 2024). The validity of the indicator is tested via the value of the Pearson correlation coefficient (correlated item total correlation) or the r statistic. If the r statistic > r table, then the statement item is said to be valid, and vice versa. The reliability of the instrument is tested via Cronbach's alpha values. Cronbach's alpha is one of the most widely used measures of reliability in the social and organizational sciences (Bonett & Wright, 2015). Cronbach's alpha is a statistic commonly used by authors to show that the tests and scales adopted for research fit the purpose (Taber, 2018).

The determination coefficient measures the goodness of fit of the multiple linear regression equations. The coefficient of determination, R^2, is the proportion of variation in the Y value described by the model; R^2 is usually expressed in percentage variations described by independent variables (Starbuck, 2023; Weisberg, 2014; Wild & Seber, 2000). The influence of independent variables (village accessibility and community mobility) simultaneously on the dependent variable (socioeconomic conditions of the community) was evaluated via the F test. If the value of Sig < 0.05, then the independent variables significantly affect the dependent variables, and vice versa. The influence of each independent variable on the dependent variable was tested via a partial test, t test. If the value of Sig < 0.05, then the independent variable partially has a significant effect on the dependent variable, and vice versa (Gujarati, 1988; Koutsoyiannis, 1977; Pindyck & Rubinfeld, 1991). Operationally, the research data were processed via SPSS 26.

3. Results

3.1. Variable description

On the basis of six indicators of village accessibility variables (travel time, transportation costs, village road quality, land use, marketing access, and access to agricultural inputs), the farmers' assessments ranged from moderately agree to agree, with an average score of 3.39. The variable of community mobility has an average score of 3.36, which is also in the range of moderately agree to agree. These variable indicators include travel intensity, intervillage connections, public transportation services, the flow of goods and information, motorcycle ownership, and village road length. Moreover, the farmers' assessment

of the variables related to the socioeconomic condition of the community is 3.33. The indicators that measure these variables are agricultural production, household income, access to education and health, government services, clean water and electricity, and access to sociocultural facilities (Table 2).

Table 2 The answers of the respondents to the variable indicators.

Variable	Indicator	Average score
Village accessibility (X_1)	Travel time is getting shorter	3.13
	Transportation costs are getting more affordable	3.15
	Capacity building and quality of village roads	3.54
	Land use change	3.17
	Ease of marketing agricultural products	3.66
	Ease of obtaining agricultural production facilities	3.68
The average score of X_1		3.39
Community mobility (X_2)	Increased travel frequency/intensity	3.53
	Improved intervillage connections	3.65
	Improved public transportation services	3.23
	Increased movement of goods and information	3.51
	Increased motor vehicle ownership	3.29
	Adequacy of village road length	2.96
The average score of X_2		3.36
Socioeconomic conditions of the community (Y)	Increased agricultural production	3.12
	Increase in household income	3.47
	Ease of access to education and health services	3.27
	Ease of access to government services	3.64
	Ease of access to clean water and electricity infrastructure	3.30
	Ease of access to sociocultural facilities	3.17
The average score of Y		3.33

3.2. Variable and indicator validity

The validity of variables was measured on the basis of the Pearson correlation coefficient or indicator-total correlation (Odom & Morrow, 2009; Ramdan, 2019; Wijaya & Kloping, 2021). On the basis of Table 3, all variables were declared valid because the variable and total scores had a significant correlation (Pearson's r table=0.205, df=90, α=5%).

The same method (indicator total correlation) is used to measure the validity of the indicator. Table 4 shows that all indicators are declared valid because each indicator has a significant correlation with the total score of the indicator.

Table 3 Variable validity test.

Variable	r statistic	Validity
Village accessibility (X_1)	0.567**	Valid
Community mobility (X_2)	0.807**	Valid
Socioeconomic conditions of the community (Y)	0.712**	Valid

Table 4 Test the validity of the indicator.

Variable	Indicator	r statistic	Validity
Village accessibility (X_1)	X_{11}	0,490**	All indicators are valid
	X_{12}	0.550**	
	X_{13}	0.388**	
	X_{14}	0.509**	
	X_{15}	0.494**	
	X_{16}	0.331**	
Community mobility (X_2)	X_{21}	0.298**	All indicators are valid
	X_{22}	0.354**	
	X_{23}	0.475**	
	X_{24}	0.661**	
	X_{25}	0.616**	
	X_{26}	0.497**	
Socioeconomic conditions of the community (Y)	Y_1	0.329**	All indicators are valid
	Y_2	0.531**	
	Y_3	0.422**	
	Y_4	0.548**	
	Y_5	0.607**	
	Y_6	0.436**	

3.3. Instrument reliability

The Cronbach's alpha value is 0.492. On the basis of the range of Cronbach's alpha values used by many authors, as reported in the Taber (2018) study, the Cronbach's alpha value as a result of this study is 'accepted' because it is in the range of 0.45–0.98.

3.4. Coefficient of determination

The coefficient of determination (R-square, R^2) measures how much the independent variable explains the variation in the dependent variable. The coefficient of determination is the proportion of the total variability in the dependent variable that is accounted for by the regression equation in the independent variables (Hahn, 1973). Chicco et al. (2021) suggested the use of the R-square as a standard metric to evaluate regression analyses in any scientific domain.

The output of SPSS 26 shows that the R-square is 0.193. The small R-square in this study can be attributed to the small number of independent variables for which cross-sectional and primary data were used (Reisinger, 1997). Village accessibility and community mobility can explain 19.30% of the variation in the socioeconomic conditions of the community. The value of this determination coefficient is minimal. However, with a value of Sig (0.000) that is less than α (1%), the regression model or equation has adequate goodness of fit. According to Ozili (2023), low R-square models are acceptable in empirical social science research. A low R-square value is not necessarily bad. A low R-square of at least 0.1 (or 10%) is acceptable, provided that some or most independent variables are statistically significant. Therefore, the logical implication is that further research needs to identify other relevant independent variables.

3.5. Simultaneous test (F-test)

The influence of village accessibility (X_1) and community mobility (X_2) simultaneously on the socioeconomic condition of the community (Y) was tested via a simultaneous test (F test). On the basis of the variance analysis, the F statistic was 10,621, with a Sig value of 0.000. Thus, village accessibility and community mobility simultaneously significantly affect the socioeconomic condition of the community at the level of α (1%). The significant F test results find that at least one independent variable significantly affects the dependent variable. Since the F test shows a significant influence, it is followed by the t test. After examining the F test and the results' significant effect, we can proceed to the statistical test for individual coefficients (Evans & Rosenthal, 2009). A t test was conducted to determine which independent variable significantly affected the dependent variable.

3.6. Partial test (t-test)

The influence of village accessibility and partial community mobility on the socioeconomic condition of the community was determined via the t test. Table 5 shows the results of regression data processing regarding regression coefficients, standard deviations, t statistics, and Sig values. Community mobility significantly affects the socioeconomic condition of the community at the α level (1%). The value of Sig < 0.01 determines the significance. Village accessibility also significantly affects the socioeconomic condition of the community at the α level (10%), where the value of Sig (0.069) < 0.1.

Table 5 Partial test (t test).

Variable	Regression coefficients	Standard error	t-statistic	Sig.
Constant	7.443	2.897	2.569	0.012
Village accessibility (X_1)	0.198*	0.108	1.840	0.069
Community mobility (X_2)	0.418**	0.104	4.018	0.000

Dependent Variable: Socioeconomic conditions of the community, *significant at α 10%, **significant at α 1%.

4. Discussion

The study revealed that improving the quality of village roads enhances the accessibility of village areas and community mobility. This enhancement is evident in various aspects, including reduced travel time, lower transportation costs, improved village road quality, better land use, and increased access to marketing agricultural products and agricultural inputs. Furthermore, the increase in community mobility includes travel intensity, intervillage connections, public transportation services, the flow of goods, services, information, motorcycle ownership, and the length of village roads. These findings suggest a promising future in which the socioeconomic conditions of village communities can be significantly improved, leading to increased agricultural production, higher farmer household income, better access to education and health services, government services, clean water, electricity, and sociocultural facilities.

These findings align with those of Baral (2023), who stated that improving rural roads is a priority because it impacts crop diversification, increases income sources, reduces poverty, increases household income, increases access to health facilities, and increases access to education. Infrastructure improvements through rural road construction programs impact agricultural production decisions, such as diversifying crops, adopting modern agricultural technology, and increasing hired

labor (Shamdasani, 2021). The construction of rural roads substantially improves the welfare and resilience of rural households (Nakamura et al., 2019). Rural road rehabilitation significantly impacts the development of local markets in rural areas (Mu & van de Walle, 2011).

The study of Wiegand et al. (2023) proves that improving roads leads to improved household welfare, housing quality, and school enrollment. Road upgrades support the structural transformation of households from subsistence farming to market-oriented activities. A study by Kongolo (2020) concluded that better rural roads would benefit more smallholders and individuals in rural areas. Central and regional governments need to formulate policies to improve and maintain rural roads to support and accelerate the development of rural areas. Adequate rural road infrastructure is associated with increased access to basic services. Inadequate road infrastructure indicates a need for access to primary health care and education (Sewell et al., 2019). Road connectivity has a catalytic effect on economic and social development as well as poverty alleviation in rural areas (Kanuganti et al., 2017).

However, the construction and improvement of village roads face various challenges, especially budget limitations and the need for more strategic planning for rural road development. Integrating transportation planning with broader socioeconomic development strategies is essential in the future. High costs in rural areas, associated with limited connectivity, limit the economic activity of most poor people living in remote areas (Shamdasani, 2021). Rural road infrastructure plays an essential role in poverty alleviation. The key factors affecting the sustainable development of rural road infrastructure are economic capacity, management capacity, policy support, public participation, and terrain conditions (Li et al., 2024).

Local government agencies and other relevant institutions in developing countries allocate large budgets to constructing rural roads. However, without a robust and systematic methodology, road construction relies largely on ad-hoc decisions and subjective assessments of public officials. Therefore, Hasan et al. (2022) suggest a rural road planning and prioritization model with two main components, namely developing a core network of participation with local stakeholders and prioritizing roads on the basis of cost-benefit analysis (CBA) and multicriteria analysis (MCA).

Therefore, this study suggests that local governments should prioritize investments in rural road infrastructure to promote sustainable rural development. By enhancing accessibility and mobility, governments can create a more equitable transportation system that addresses the needs of rural communities. Improving and expanding rural transportation infrastructure significantly benefits rural communities. The local government must improve policies, prioritize construction and maintenance, and expand pro-poor transport strategies and interventions (Kaiser & Barstow, 2022). According to Walle (2002), given the information and resource constraints, the most effective investments are chosen from the poverty alleviation perspective. Many countries have investment gaps in public infrastructure. Neupane et al. (2020) examined the need for increased maintenance budgets and provided recommendations for decision-makers to prioritize rural road projects.

The study's implications are significant for various stakeholders involved in rural development, infrastructure planning, and policy-making. The findings suggest that policymakers should prioritize rural road infrastructure improvements as a strategic approach to enhance village accessibility, community mobility, and community conditions. This strategy can lead to a more effective allocation of resources and funding to reduce socioeconomic poverty and promote sustainable development in rural regions.

The study acknowledges several limitations that may affect the generalizability and applicability of the findings. This localized focus may limit the applicability of the findings to other rural areas with different socioeconomic and infrastructure conditions. The use of a cross-sectional design, which captures data at a single point in time, limits the ability to assess the long-term impacts of road improvements on community mobility and socioeconomic conditions. Longitudinal studies would be beneficial in understanding the sustained effects over time. Reliance on self-reported data through surveys may introduce bias, as respondents might provide socially desirable answers or need to recall their experiences accurately. This subjectivity can affect the validity of findings related to community mobility and socioeconomic conditions.

5. Conclusions

The farmers' assessments of village accessibility variables, on a scale of 1--5, ranged from moderately agree to agree, with an average score of 3.39. The variable of community mobility, also on a scale of 1--5, has an average score of 3.36, which is also in the moderately agree-to-agree range. Moreover, the farmers' assessment of the variables related to the socioeconomic condition of the community is 3.33.

Village accessibility and community mobility partially significantly affect the socioeconomic condition of the community. The development of rural roads increases the accessibility of villages in terms of travel time, transportation costs, village road quality, land use, market access for agricultural products, and access to agricultural inputs. Improving village roads also increases community mobility in terms of travel intensity, intervillage connections, public transportation services, the flow of goods and information, motorcycle ownership, and the length of village roads. Furthermore, improving village accessibility and community mobility affects rural communities' conditions. The socioeconomic aspects that have experienced significant increases are agricultural production, farmers' household income, access to education and health services, access to government services, access to clean water and electricity, and access to sociocultural facilities.

The study underscores the implications of the findings on the impact of rural road infrastructure and community mobility on community socioeconomic conditions. An enhanced rural road infrastructure facilitates access to vital services such as healthcare, education, and markets, which are essential for improving rural communities' quality of life and economic opportunities. The study strongly recommends that policymakers prioritize investments in rural road infrastructure to foster sustainable rural development.

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Ethical considerations

Our institution does not require ethical approval to report research results using questionnaires for data collection. However, we obtained direct consent from all respondents before conducting interviews to collect data.

Conflict of interest

The authors declare that they have no conflicts of interest.

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References

Ahmed, S., & Eklund, E. (2019). Rural accessibility, rural development, and natural disasters in Bangladesh. *Journal of Developing Societies*, *35*(3), 391–411. https://doi.org/10.1177/0169796X19868318

Akpan, U., & Morimoto, R. (2022). An application of Multi-Attribute Utility Theory (MAUT) to the prioritization of rural roads to improve rural accessibility in Nigeria. *Socioeconomic Planning Sciences*, *82*(101256), 1–10. https://doi.org/10.1016/j.seps.2022.101256

Baral, P. (2023). A review on rural road improvement and its impact on socioeconomic development of Kaski District. *Journal of Advanced Academic Research*, *10*(1), 10–18. https://doi.org/10.3126/jaar.v10i1.54601

Berndt, A. E. (2020). Sampling Methods. *Journal of Human Lactation*, *36*(2), 224–226. https://doi.org/10.1177/0890334420906850

Bonett, D. G., & Wright, T. A. (2015). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior*, *36*(1), 3–15. https://doi.org/10.1002/job.1960

Chicco, D., Warrens, M. J., & Jurman, G. (2021). The coefficient of determination R-squared is more informative than SMAPE, MAE, MAPE, MSE and RMSE in regression analysis evaluation. *PeerJ Computer Science*, *7*(e623), 1–24. https://doi.org/10.7717/PEERJ-CS.623

Daniel, J. (2011). *Sampling Essentials: Practical Guidelines for Making Sampling Choices*. SAGE Publications, Inc.

Elder, S. (2009). Module 3: Sampling Methodology. In *Statistics and Data Analysis in Geochemical Prospecting*. Geneva: International Labour Organization. https://doi.org/10.1007/978-94-010-2334-4_9

Essakali, M. D. (2005). Rural access and mobility in Pakistan: A policy note. *Transport Note Series*, *28*(35675), 1–12. http://documents.worldbank.org/curated/en/455561468067733530/Rural-access-and-mobility-in-Pakistan-a-policy-note

Evans, M. J., & Rosenthal, J. S. (2009). Chapter 29: Multiple Regression. In *Probability and Statistics: The Science of Uncertainty* (pp. 659–687). https://www.stat.berkeley.edu/~brill/Stat131a/29_multi.pdf

Fajri, L. M. N. (2017). Pengaruh pembangunan infrastruktur jalan terhadap peningkatan kesejahteraan masyarakat desa (Studi kasus di Desa Jenggala Kecamatan Tanjung Kabupaten Lombok Utara). *Jurnal SIKAP*, *1*(1), 11–22. https://ejournal.unwmataram.ac.id/sikap/article/view/134/86

Frank, L., Dirks, N., & Walther, G. (2021). Improving rural accessibility by locating multimodal mobility hubs. *Journal of Transport Geography*, *94*(103111), 1–12. https://doi.org/10.1016/j.jtrangeo.2021.103111

Gujarati, D. N. (1988). *Basic Econometrics*. Singapore: McGraw-Hill Book Co.

Hahn, G. J. (1973). The coefficient of determination exposed! *Chemical Technology*, *3*(10), 609–612. https://www2.hawaii.edu/~cbaajwe/Ph.D.Seminar/Hahn1973.pdf

Hasan, M. M. U., Quium, A. S. M. A., Rahman, M., Khatun, F., Akther, M. S., Haque, A., Jahan, S., Islam, I., Ahmed, T., & Shubho, T. H. (2022). A Methodology for planning and prioritization of rural roads in Bangladesh. *Sustainability (Switzerland)*, *14*(4), 1–16. https://doi.org/10.3390/su14042337

Humang, W. P., & Amrin, A. (2016). Peningkatan akses jalan untuk menunjang distribusi hasil produksi Kota Terpadu Mandiri (KTM) Air Terang Kabupaten Buol. *Pena Teknik: Jurnal Ilmiah Ilmu-Ilmu Teknik*, *1*(2), 111–124. https://doi.org/10.51557/pt_jiit.v1i2.61

Hussain, A. (2022). A descriptive analysis and interpretation of data from Likert scales in educational and psychological research. *Indian Journal of Psychology and Education*, *12*(2), 13–16.

Hussain, S., Ahonen, V., Karasu, T., & Leviäkangas, P. (2023). Sustainability of smart rural mobility and tourism: A key performance indicators-based approach. *Technology in Society*, *74*(102287), 1–18. https://doi.org/10.1016/j.techsoc.2023.102287

Indrajaya, I., Rusida, R., & Baharuddin, A. F. (2022). Strategi pembangunan infrastruktur kawasan permukiman perkotaan Kota Belopa Kabupaten Luwu. *Jurnal Ilmiah Ecosystem*, *22*(1), 136–146. https://doi.org/10.35965/eco.v22i1.1402

Indrashanty, A., & Legowo, P. S. (2017). Aksesibilitas dan mobilitas transportasi di Provinsi Bengkulu dalam konteks negara maritim dan penguatan daerah tertinggal. *Jurnal PenelitianTransportasi Multimoda*, *14*(2), 95–104. https://doi.org/https://doi.org/10.25104/mtm.v14i2.171

Jieří, M., Cristina, P. R., Carlos, F., Jean-Pierre, M., & Tristan, M. (2021). The 5-Item Likert Scale and Percentage Scale Correspondence with Implications for the Use of Models with (Fuzzy) Linguistic Variables. *Revista de Metodos Cuantitativos Para La Economia y La Empresa*, *31*, 3–16.

https://doi.org/10.46661/REVMETODOSCUANTECONEMPRESA.4010

Juantoro, E. E., Magribi, L. O. M., Lakawa, I., & . S. (2020). Kajian infrastruktur transportasi darat dalam pengembangan wilayah Kecamatan Tongauna Kabupaten Konawe. *Sultra Civil Engineering Journal*, *1*(2), 44–53. https://doi.org/10.54297/sciej.v1i2.143

Kaiser, N., & Barstow, C. K. (2022). Rural transportation infrastructure in low-and middle-income countries: A review of impacts, implications, and interventions. *Sustainability (Switzerland)*, *14*(2149), 1–48. https://doi.org/10.3390/su14042149

Kamaludin, A. S., & Qibthiyyah, R. M. (2022). Village road quality and accessibility on transforming rural development. *Agraris*, *8*(2), 160–180. https://doi.org/10.18196/agraris.v8i2.13618

Kanuganti, S., Dutta, B., Sarkar, A. K., & Singh, A. P. (2017). Development of a need-based approach for rural road network planning. *Transportation in Developing Economies*, *3*(14), 1–11. https://doi.org/10.1007/s40890-017-0044-y

Kongolo, M. (2020). Perceived role of rural roads in supporting and enhancing rural and agricultural development in Mwanza Region, Tanzania. *Issues in Social Science*, *8*(1), 1–49. https://doi.org/10.5296/iss.v8i1.17067

Koutsoyiannis, A. (1977). *Theory of Econometrics: An Introductory Exposition of Econometric Methods* (2nd ed.). New York: Harper & Row Publishers, Inc.

Li, Lv, S., Cui, J., Hou, D., Liu, Y., & Li, W. (2024). Sustainability constraints on rural road infrastructure. *Sustainability (Switzerland)*, *16*(16), 1–15. https://doi.org/10.3390/su16167066

Li, W., Zhou, Q., Zhang, Y., & Chen, Y. (2022). Visualizing rural access index and not served rural population in Africa. *Environment and Planning A*, *54*(2), 215–218. https://doi.org/10.1177/0308518X211035786

Magribi, L. O. M., & Suhardjo, A. (2004). Aksesibilitas dan pengaruhnya terhadap pembangunan di perdesaan: Konsep model sustainable accessibility pada kawasan perdesaan di Provinsi Sulawesi Tenggara. *Jurnal Transportasi*, *4*(2), 149–160. https://doi.org/https://doi.org/10.26593/jtrans.v4i2.1775.%25p

Mekonnen, N., & Alamirew, B. (1970). The effect of rural road transport on crop commercialization: Evidence from the Ethiopian living standard measurement survey. *Ethiopian Journal of the Social Sciences and Humanities*, *13*(2), 81–108. https://doi.org/10.4314/ejossah.v13i2.4

Morse, J. M., Barrett, M., Mayan, M., Olson, K., & Spiers, J. (2002). Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods*, *1*(2), 13–22. https://doi.org/10.1177/160940690200100202

Mu, R., & van de Walle, D. (2011). Rural roads and local market development in Vietnam. *Journal of Development Studies*, *47*(5), 709–734. https://doi.org/10.1080/00220381003599436

Mustafa, & Sasmito, C. (2017). Implementasi pembangunan infrastruktur jalan desa. *JISIP: Jurnal Ilmu Sosial Dan Ilmu Politik*, *6*(3), 72–76. https://doi.org/https://dx.doi.org/10.33366/jisip.v6i3.1462

Nadler, J. T., Weston, R., & Voyles, E. C. (2015). Stuck in the middle: The use and interpretation of mid-points in items on questionnaires. *Journal of General Psychology*, *142*(2), 71–89. https://doi.org/10.1080/00221309.2014.994590

Naimanye, A. G., & Whiteing, T. (2016). Poverty-centered rural road funds sharing in sub-Saharan Africa. *Proceedings of the Institution of Civil Engineers: Transport*, *169*(6), 387–396. https://doi.org/10.1680/jtran.15.00071

Nakamura, S., Bundervoet, T., & Nuru, M. (2019). Rural roads, poverty, and resilience: Evidence from Ethiopia. *Policy Research Working Paper*, *8800*, 1–27. https://doi.org/10.1080/00220388.2020.1736282

Neupane, P., Thida, K., Phommasone, P., & Yeom, C. (2020). The Analysis of investment gap in rural road maintenance: A case study of developing country. *International Journal of Innovative Science and Research Technology*, *5*(5), 1022–1026. https://doi.org/10.38124/ijisrt20may716

Noviyanti, N., & Putra, I. M. (2023). Dampak perbaikan jalan terhadap kondisi social ekonomi masyarakat Desa Klumpang Kebun Kecamatan Hamparan Perak Kabupaten Deli Serdang. *Jurnal Darma Agung*, *31*(3), 178–197. https://doi.org/10.46930/ojsuda.v31i3.3418

Nuhu, Y. B., & Ritter, K. (2022). The impacts of good road connections on rural farming in Shongom Local Government Area of Gombe state, Nigeria. *Studia Mundi – Economica*, *9*(1), 119–134. https://doi.org/10.18531/studia.mundi.2022.09.01.119-134

Nurmala, N., & Hutagaol, M. P. (2022). Membandingkan pengaruh infrastruktur terhadap kemiskinan di kawasan Barat dan Timur Indonesia serta implikasi kebijakan. *Risalah Kebijakan Pertanian Dan Lingkungan*, *9*(3), 188–207. https://doi.org/10.29244/jkebijakan.v9i3.34834

Odom, L. R., & Morrow, J. R. (2009). What's this r ? A correlational approach to explaining validity, reliability, and objectivity coefficients. *Measurement in Physical Education and Exercise Science*, *10*(2), 137–145. https://doi.org/10.1207/s15327841mpee1002

Ogunsanya, A. A. (1987). Rural accessibility problems and human resource development: A case study from Nigeria. *Journal of Rural Studies*, *3*(1), 31–42. https://doi.org/10.1016/0743-0167(87)90005-2

Olorunfemi, S. O. (2020). Rural road infrastructural challenges: An impediment to agricultural development in Idanre Local Government Area of Ondo State, Nigeria. *Ghana Journal of Geography*, *12*(2), 108–124. https://doi.org/10.4314/gjg.v12i2.5

Ozili, P. K. (2023). The acceptable R-square in empirical modeling for social science research. *Munich Personal RePEc Archive*, *115769*(January), 134–143. https://doi.org/10.4018/978-1-6684-6859-3.ch009

Peeters, M. J., & Harpe, S. E. (2020). Updating conceptions of validity and reliability. *Research in Social and Administrative Pharmacy*, *16*(8), 1127–1130. https://doi.org/10.1016/j.sapharm.2019.11.017

Permatasari, C. A., Soedwiwahjono, S., & Nurhadi, K. (2019). Kesiapan fungsi Jalan Perintis Kemerdekaan, Pandanaran, Nangka Gumulan setelah adanya kantor pemerintahan terpadu Kabupaten Boyolali. *Desa-Kota*, *1*(2), 153–166. https://doi.org/10.20961/desa-kota.v1i2.14612.153-166

Pindyck, R. S., & Rubinfeld, D. L. (1991). *Econometric Models and Economic Forecasts* (3rd ed.). New York: McGraw-Hill, Inc.

Pontoh, N. K., Hudalah, D., Indrajati, P. N., & Viantari, D. (2019). *Dasar-Dasar Survei untuk Perencanaan Wilayah & Kota* (1st ed.). ITB Press.

Pratiwi, N. N. (2020). Kajian tipologi pedesaan dalam mengatasi disparitas wilayah perbatasan Kecamatan Paloh. *UNIPLAN: Journal of Urban and Regional Planning*, *1*(1), 31–39. https://doi.org/10.26418/uniplan.v1i1.43049

Priyambodo, P. (2015). Analisis aksesibilitas dan level of service angkutan jalan lintas Surabaya-Kediri. *Warta Penelitian Perhubungan*, *27*(2), 129–137. https://doi.org/10.25104/warlit.v27i2.779

Putri, A. A., & Tama, Y. P. (2018). Pengembangan infrastruktur transportasi berkelanjutan di Kawasan Perdagangan Cokroaminoto sebagai bentuk kontribusi kota humanis. *Jurnal Transportasi Multimoda*, *9*(1), 45–55. https://doi.org/10.25104/mtm.v20i1.2146

Rahman, J., Chakma, A., Rahman, H., Hossain, A., & Islam, T. (2023). Present status and prioritization of rural road accessibility: A case study of Sunamganj

districts of Bangladesh. *Multidisciplinary Science Journal*, *5*(1), 1–11. https://doi.org/10.31893/multiscience.2023003

Raina, A., & Ahmed, S. (2022). Rural road connectivity and access to health care services in Poonch District of Jammu and Kashmir (J & K). *Regional Economic Development Research*, *3*(2), 241–252. https://doi.org/10.37256/redr.3220221356

Ramdan, I. M. (2019). Reliability and validity test of the Indonesian version of the Hamilton Anxiety Rating Scale (HAM-A) to measure work-related stress in nursing. *Jurnal Ners*, *14*(1), 33–40. https://doi.org/10.20473/jn.v13i2.10673

Reisinger, H. (1997). The impact of research designs on R2 in linear regression models: An exploratory meta-analysis. *Journal of Empirical Generalisations in Marketing Science*, *2*, 1–12. http://members.byronsharp.com/empgens/ResearchDesignsR2.pdf

Riti, A., Kusumua, A. R., & Rande, S. (2018). Studi tentang pembangunan infrastruktur jalan di Desa Datah Bilang Ilir Kecamatan Long Hubung Kabupaten Mahakam Ulu. *EJournal Administrasi Negara*, *6*(3), 7953–7965. https://ejournal.an.fisip-unmul.ac.id

Samuel, A. A., & Frances, F. A. (2018). Rural accessibility and distribution of social services in Ise-Orun Local Government Areas of Ekiti State, Nigeria. *Humanities and Social Sciences*, *6*(4), 103–108. https://doi.org/10.11648/j.hss.20180604.11

Saragih, J. R. (2018). Strategi pengembangan agribisnis hortikultura di wilayah pedesaan. *Talenta Conference Series: Local Wisdom, Social, and Arts*, *1*(1), 062–069. https://doi.org/10.32734/lwsa.v1i1.143

Setiawan, R., Purba, A., & Sutiyoso, B. U. (2018). Pengaruh aksesibilitas dan karakteristik sosial ekonomi terhadap mobilitas masyarakat (Studi di Kecamatan Tanjung Karang Pusat Kota Bandar Lampung). *Diaspora: Eksakta*, *1*(1), 57–70. https://pasca.unila.ac.id/wp-content/uploads/2019/01/9_Eksakta-16.pdf

Sewell, S. J., Desai, S. A., Mutsaa, E., & Lottering, R. T. (2019). A comparative study of community perceptions regarding the role of roads as a poverty alleviation strategy in rural areas. *Journal of Rural Studies*, *71*(October), 1–12. https://doi.org/10.1016/j.jrurstud.2019.09.001

Shamdasani, Y. (2021). Rural road infrastructure & agricultural production: Evidence from India. *Journal of Development Economics*, *152*(102686), 1–16. https://doi.org/10.1016/j.jdeveco.2021.102686

Soseco, T. (2016). The relationship between rural accessibility and development. *Jurnal Ekonomi Dan Studi Pembangunan*, *8*(2), 131–140. https://doi.org/10.17977/um002v8i22016p131

Starbuck, C. (2023). The Fundamentals of People Analytics with Applications in R. In *The Fundamentals of People Analytics with Applications in R*. Springer Nature Switzerland AG. https://doi.org/10.1007/978-3-031-28674-2

Taber, K. S. (2018). The use of Cronbach's Alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

Tirth, V., Wagale, M., Singh, A. P., Sarkar, A. K., Singh, R. K., Algahtani, A., & Islam, S. (2021). Investigating the adverse impacts of rural roads using a fuzzy multicriteria approach. *Journal of Civil Engineering and Management*, *27*(6), 441–453. https://doi.org/10.3846/jcem.2021.15264

Utomo, B. T. (2019). Pengaruh pembangunan infrastruktur terhadap peningkatan ekonomi masyarakat di Kabupaten Sinjai. *Urban and Regional Studies Journal*, *1*(2), 50–57. https://doi.org/10.35965/ursj.v1i2.1081

Walle, D. Van de. (2002). Choosing rural road investment to help reduce poverty. *World Development*, *30*(4), 575–589. http://documents.worldbank.org/curated/en/103921468739559248/Choosing-rural-road-investments-to-help-reduce-poverty

Weijters, B., Cabooter, E., & Schillewaert, N. (2010). The effect of rating scale format on response styles: The number of response categories and response category labels. *International Journal of Research in Marketing*, *27*(3), 236–247. https://doi.org/10.1016/j.ijresmar.2010.02.004

Weisberg, S. (2014). *Applied Linear Regression* (4 Edition). John Wiley & Sons, Inc. http://scioteca.caf.com/bitstream/handle/123456789/1091/RED2017-Eng-8ene.pdf?sequence=12&isAllowed=y%0Ahttp://dx.doi.org/10.1016/j.regsciurbeco.2008.06.005%0Ahttps://www.researchgate.net/publication/305320484_SISTEM_PEMBETUNGAN_TERPUSAT_STRATEGI_MELESTARI

Wiegand, M., Koomen, E., Pradhan, M., & Edmonds, C. (2023). The impact of road development on household welfare in rural Papua New Guinea. *Journal of Development Studies*, *59*(6), 933–953. https://doi.org/10.1080/00220388.2023.2188111

Wijaya, M. C., & Kloping, Y. P. (2021). Validity and reliability testing of the Indonesian version of the eHealth Literacy Scale during the COVID-19 pandemic. *Health Informatics Journal*, *27*(1), 1–10. https://doi.org/10.1177/1460458220975466

Wild, C., & Seber, G. (2000). Chapter 15 - Multiple Regression 15.1. In *Quality* (pp. 1–8). The University of Auckland.

William, F. K. A. (2024). Mastering validity and reliability in academic research: Meaning and significance. *International Journal of Research Publications*, *144*(1), 287–292. https://doi.org/10.47119/ijrp1001441320246160

Wondemu, K. A., & Weiss, J. (2012). Rural roads and development: Evidence from Ethiopia. *European Journal of Transport and Infrastructure Research*, *12*(4), 417–439. https://doi.org/10.18757/ejtir.2012.12.4.2977