Formosa Journal of Applied Sciences (FJAS)
Vol. 4, No. 6 2025: 1567-1578

Integration of Road, Education, and Health Infrastructure to Improve Quality of Life in Coal Mining Areas: Case Study of Pelaci Village, Indonesia

Amaluddin Alham[1*], Sri Pare Eni[2*], Margareta Maria Sudarwani[3*]
Universitas Kristen indonesia
Corresponding Author: Amaluddin Alham amaluddinalham25@gmail.com

A R T I C L E A N

Keywords: Infrastructure Integration, Quality of Life, Coal Mining, Pelaci Village

Received: 04, April
Revised: 06, May
Received: 08, June

A B S T R A C T

This research aims to analyze the integration of road, education, and healthcare infrastructure to improve the quality of life in coal mining regions, with Pelaci Village in Murung Raya, Central Kalimantan, as the case study. Using a qualitative research method, data were collected through field observations, in depth interviews, and document analysis. The study found that integrated infrastructure development significantly improves access to education, health services, and economic opportunities. Moreover, it strengthens community resilience and reduces regional disparities. The results highlight that active collaboration between the government, mining companies, and local communities plays a crucial role in ensuring sustainable development and inclusive growth, especially in remote and underdeveloped areas affected by extractive industries.

DOI prefik: https://doi.org/10.55927/fjas.v4i6.153
ISSN-E: 2962-6447
https://srhformosapublisher.org/index.php/fjas

INTRODUCTION

Mining areas often experience significant economic growth, but ironically also face various challenges in social development and basic infrastructure. Pelaci Village in Laung Tuhup District, Murung Raya Regency, Central Kalimantan is a real example where the existence of the coal mining industry has not been fully balanced by adequate infrastructure development. Damaged road infrastructure due to heavy mining vehicle traffic, limited educational facilities, and lack of adequate health services are major obstacles in improving the quality of life of the local community (Nurfatriani et al., 2022; Putri & Yuliani, 2021).

Unintegrated infrastructure conditions cause unequal access and exacerbate social disparities. Unsuitable roads hinder mobility to schools and health facilities, which ultimately worsens the quality of human resources and public health. According to the Ministry of National Development Planning/Bappenas (2021), the integration of social and physical infrastructure development is key to achieving sustainable development in disadvantaged, outermost, and remote areas (3T), including mining areas.

The title "Integration of Road, Education, and Health Infrastructure to Improve Quality of Life in Coal Mining Areas: A Case Study of Pelaci Village, Murung Raya, Central Kalimantan" was chosen because it illustrates the multidimensional approach needed to respond to the complexity of development problems in mining areas. A separate sectoral approach has proven ineffective in addressing fundamental community problems, especially in areas with high environmental and social pressures due to extractive activities (Sibarani & Noviantoro, 2023). Therefore, this study offers a new perspective in the form of cross-sector integration as a sustainable development strategy in mining areas.

Most previous studies have highlighted the negative impacts of mining from environmental or economic aspects separately. For example, research by Hidayat et al. (2020) focuses more on environmental pollution, while the study by Santosa and Hamdani (2021) only highlights the socio-economic impacts of the presence of mining. There are not many studies that comprehensively analyze how the integration of basic infrastructure roads, education, and health can directly improve the quality of life in mining areas. This gap is what this study tries to fill, namely by prioritizing a cross-sectoral approach that has so far received less attention in the literature on mining area development.

The main problem currently faced by Pelaci Village is the low quality of life due to poor basic infrastructure. Village roads are badly damaged and impassable during the rainy season, schools are only available up to elementary level with a shortage of teachers, and health services are limited to integrated health posts without permanent medical personnel. As a result, the community has difficulty accessing basic services that should be the right of every citizen (Kusnandar & Widodo, 2020). In addition, intensive mining activities worsen infrastructure damage and increase the risk of diseases such as ARI due to dust pollution (Yuliani, 2021).

This research is very important because it offers strategic solutions through infrastructure integration to improve the quality of life as a whole. Amidst global pressure to achieve the Sustainable Development Goals (SDGs), cross-sector integration is a relevant and crucial approach. Especially to support SDG 3 (good health), SDG 4 (quality education), and SDG 9 (resilient and innovative infrastructure) in vulnerable areas such as mining areas (Bappenas, 2021; Wahyuni & Ardiansyah, 2023). In addition, this integration can be an alternative development model for other villages in extractive industrial areas in Indonesia.

LITERATURE REVIEW

Road Infrastructure and Regional Connectivity

The availability and quality of road infrastructure are important prerequisites in supporting mobility, connectivity, and regional development, especially in remote areas and mining areas. A study by Bachtariza et al. (2021) stated that road construction directly contributes to increasing community income and economic equality in the Batu Bara area. Roads are not only a means of transportation, but also open access to basic services such as education and health. However, conditions in areas such as Murung Raya still show disparities. Maria Hetty, a member of the Murung Raya DPRD, said that villages in remote areas still have very minimal development, especially roads and bridges, which causes isolation and slow distribution of development assistance (Dayak News, 2024).

Education as a Pillar of Human Resource Development

Equal and quality education is the foundation for creating a productive society. In mining areas, education is often marginalized because the main focus is on the exploitation of natural resources. Research by Sari et al. (2020) emphasizes that building schools in the region can reduce social disparities and increase community independence. An example of implementation is shown in the construction of a State Vocational School in Pasir Permit Village, Batu Bara Regency, which not only opens access to vocational education but also increases local economic activity (Police Journal, 2024). However, in the UGM PSPK study (2023) in Morowali, it was found that although mining companies provide CSR in the education sector, the impact is limited due to the lack of educators, facilities, and program sustainability.

Access to Health in Mining Areas

The health of communities around mines is often threatened by pollution, limited access to medical services, and unhealthy environmental conditions. A study by Wirawan et al. (2021) showed that communities around coal mines are more susceptible to respiratory diseases and malnutrition, especially children. Although facilities such as Puskesmas and Polindes are available in areas such as Morowali, the services are not optimal due to limited human resources and equipment (PSPK UGM, 2023). In Murung Raya, the stunting handling program has become the main focus by making the village a locus of convergence for handling (Kalteng.co, 2023). This shows that attention to health is still sporadic and has not been integrated into the overall infrastructure development policy.

Synergy of Road Infrastructure, Education, and Health

The concept of integrated development is an approach that is increasingly needed to achieve sustainable development. Road construction alone without education and health will not be able to create an optimal quality of life. A study by Ramadhani et al. (2022) emphasized that the integration of infrastructure in one development map can encourage the effectiveness of poverty alleviation in remote areas. The case of the PLTU in Konawe which utilizes FABA waste to build village roads is an innovative example that can open access to schools and health facilities simultaneously (Kumparan, 2024). This confirms that synergy between infrastructure sectors is very necessary, especially in mining areas that experience social and environmental pressures.

State of the Art and Research Novelty

Previous studies have highlighted the impacts of coal mining on the environment and socio-economy sectorally. Hidayat et al. (2020) examined environmental pollution due to mining activities, while Santosa and Hamdani (2021) discussed the socio-economic impacts without mentioning infrastructure integration. Wirawan et al.'s (2021) study found that mining areas are susceptible to respiratory diseases due to pollution, but did not discuss the relationship with road access or education. Sari et al. (2020) emphasized the importance of education in rural areas for social mobility, but did not directly link it to the need for road and health infrastructure.

Research by Ramadhani et al. (2022) proposed the need for infrastructure integration for poverty alleviation, but has not been specifically applied to mining areas. This gap is what this research fills: by integrating three vital sectors roads, education, and health simultaneously within a sustainable development framework, especially in Pelaci Village, Murung Raya, which has relatively little exploration in national studies. Thus, this research presents an integrative approach by placing the development of road infrastructure, education, and health as a unit that supports each other in efforts to improve the quality of life of people in coal mining areas.

The novelty of this study lies in:

a. Focus on areas that have not been widely explored, namely Pelaci Village, Murung Raya, Central Kalimantan;
b. A cross-sector approach that combines three key infrastructure elements within one analytical framework;
c. Local case study-based analysis with potential for policy replication in other mining areas in Indonesia.

With this integration, research is expected to provide concrete input for local governments, mining companies, and stakeholders in designing development policies that are not partial and have a longer-term impact.

METHODOLOGY

This study uses a descriptive qualitative approach with the main method being field observation, supported by systematic literature review. Observations were conducted directly in Pelaci Village to identify the actual conditions of road, education, and health infrastructure. Data were collected through field notes, visual documentation, and informal interviews with residents and village officials. In addition to observation, this study relies on a comprehensive literature review to understand the conceptual framework related to infrastructure integration and quality of life, especially in the context of mining areas. The literature reviewed includes academic journals, policy reports, and relevant local media articles.

The objectives are to:

1. Develop a theoretical framework on the relationship between basic infrastructure (roads, education, health) and quality of life.
2. Identifying infrastructure development practices in other mining areas in Indonesia for comparison.
3. Detecting the gap between theory and empirical practice that occurs in Pelaci Village.

The results of the literature review show that theoretically, integrated infrastructure development plays a major role in increasing mobility, productivity, and community welfare (Bachtariza et al., 2021; Ramadhani et al., 2022). However, field data shows that the infrastructure conditions in Pelaci Village are still far behind and are not functionally interconnected.

For example, a study by Sari et al. (2020) emphasized the importance of secondary schools in the area to promote social mobility. However, in Pelaci Village, educational facilities are only available up to elementary school level, without adequate transportation support or teaching staff. Similarly, Wirawan et al. (2021) highlighted the need for adequate basic health facilities in the mining area, but in reality, Pelaci only has a health post without permanent medical staff.

Thus, the integration of literature and field data enables this research to:

- Revealing that *sectoral fragmentation* is still an obstacle to development in mining areas.
- Filling *the theoretical gap* with a new approach based on cross-sector integration that has not been widely researched empirically, especially in areas such as Murung Raya which are relatively rare as a locus of national studies.

This methodological framework not only reconstructs field conditions descriptively, but also **proposes a data-based integrative intervention model** that can be replicated in other mining areas.

RESEARCH RESULT

Based on This study reveals that the fragmentation of basic infrastructure development in Pelaci Village contributes greatly to the low quality of life of the community. Using the field observation approach and literature review, it was found that the lack of integration between road, education, and health infrastructure is the main obstacle to human development in the coal mining area.

Road Infrastructure Conditions

Based on field observations, the main road to Pelaci Village is in a state of severe damage and full of holes. Community mobility is highly dependent on the weather. During the rainy season, motorized vehicles cannot pass through the main route because it is slippery and muddy. This has an impact on obstructing children's access to school and residents to health facilities and markets. Literature review by Bachtariza et al. (2021) shows that road infrastructure development has a direct impact on increasing income and accessibility of public services. However, in Pelaci Village, there is no cross-sectoral planning that links road development with strengthening education and health services.

Condition of Educational Infrastructure

Observation data shows that educational facilities are only available up to the Elementary School level. The school lacks permanent teachers and does not have a library, laboratory, or other learning activity rooms. The absence of a secondary school causes many children to drop out of school after graduating from elementary school because the location of the junior high school/high school is far from the sub-district. This finding is reinforced by the study of Sari et al. (2020) which states that limited educational infrastructure in rural areas increases social inequality and hinders the social mobility of the younger generation. CSR from mining companies that should support the education sector has not shown significant results because it is not integrated with local government policies.

Health Infrastructure Conditions

Health services are only available in the form of Posyandu, without accommodation facilities for medical personnel or basic medicines. There are no permanent medical personnel in the village. Residents must travel more than 10 km to the nearest health center, which is often hampered by poor road conditions. According to Wirawan et al. (2021), communities around mining areas are more susceptible to respiratory diseases due to exposure to dust and air pollution. This was also observed in Pelaci, where ISPA is the main complaint of residents, especially children and the elderly. The stunting reduction program has not been running optimally due to limited health facilities and the absence of trained health cadres.

Integrative Analysis

Analysis of the three sectors shows that the lack of coordination in road construction, education, and health creates a cycle of isolation. Poor road infrastructure leads to low access to schools and health facilities. Meanwhile, limited education and health services hinder the improvement of human resource capacity and public health. This study adopts the approach of Ramadhani et al. (2022), which states that poverty alleviation in the 3T region requires integrated infrastructure development in one development map. This approach has not been applied in Pelaci, where development projects are still sectoral and do not support each other.

Table 1. Summary of Research Findings

Infrastructure Aspects	Current Conditions	Impact on Quality of Life	Need for intervention
Road	Severely damaged, dirt road, difficult to pass during rain	Hindering mobility, access to education and health services	Construction and repair of village roads to heavy mining vehicle standards
Education	Only Kindergarten & Elementary School available, limited classrooms & teachers	Low participation in further education	Construction of junior high schools/senior high schools and provision of teachers and school transportation
Health	There is no health center, only integrated health post, remote access	Increasing cases of ARI, minimal emergency services	Establishment of assistant health centers, recruitment of medical personnel, and routine services

DISCUSSION

This study reveals that the isolation of Pelaci Village is caused by fragmentation in the development of basic infrastructure, namely roads, education, and health. This discussion systematically dissects the research findings and links them to the theoretical framework and relevant academic context.

Road Infrastructure and Its Impact on Accessibility

From field observations, the main road to Pelaci Village was severely damaged along ±12 km. This damage hampers community mobility, especially during the rainy season. This is in line with the findings of Bachtariza et al. (2021) which states that road accessibility is directly proportional to increased income and connectivity of public services. Quantitatively, 85% of the observed roads were in unsuitable conditions for two and four-wheeled vehicles, and 92% of respondents stated that they had difficulty reaching educational and health facilities during bad weather. This shows that roads are not only physical infrastructure, but also a social prerequisite for ensuring the distribution of basic services.

Limited Basic Education and Barriers to Social Mobility

In the field of education, facilities are only available up to Elementary School (SD), with a shortage of 3 permanent teachers from the minimum requirement of 6 teachers. The absence of junior high and high schools within a radius of <10 km causes 67% of junior high school-age children to not continue their education. This finding is consistent with Sari et al. (2020) who emphasized that limited educational infrastructure increases social inequality. The lack of sustainability of CSR programs in the education sector is also a concern. CSR is only infrastructure (building rehabilitation), without touching on quality aspects, such as teacher training or provision of learning facilities, which has implications for the stagnation of human resource quality.

Health: Limited Access and Disease Vulnerability

Health services are only available in the form of Posyandu, without permanent medical personnel. Residents must travel a distance of ±10–12 km to reach the Puskesmas in Laung Tuhup District. More than 70% of the community has difficulty accessing health services during the rainy season. Field data also shows that ISPA is the most dominant disease with a prevalence of 51% in children aged 5–12 years. This finding strengthens the argument of Wirawan et al. (2021) that mining areas have a high risk of health problems due to dust pollution and limited health services. The stunting program has also not run optimally due to the lack of supporting facilities and health cadres in the field.

Infrastructure Disintegration: The Source of the Cycle of Isolation

These three sectors show a causal relationship: poor road infrastructure leads to low access to education and health. Conversely, without increasing the capacity of human resources and health services, communities do not have the bargaining power or ability to fight for their right to development. This condition reflects what Ramadhani et al. (2022) called the "sectoral backwardness trap" in the 3T region, where development is carried out partially without integrative mapping. Pelaci Village is a real example where infrastructure projects stand alone without spatial or institutional synergy.

Academic Relevance and Novelty of the Integrative Approach

Academically, this study confirms the importance of an integrative cross-sectoral approach in mining area planning. The novelty of this approach is combining spatial (road accessibility), social (educational capacity), and health (disease vulnerability) dimensions into a single framework for strengthening quality of life. This approach contributes to the literature on mining area development that has so far focused on environmental or economic aspects sectorally. This study fills the gap by showing that integrated interventions have the potential for systemic impacts on the welfare of mining communities.

The graph in Figure 1 below shows that the road sector is the biggest obstacle (85%), followed by education (67%) and health (51%). This illustrates the relationship between physical access and the quality of basic services in mining areas.

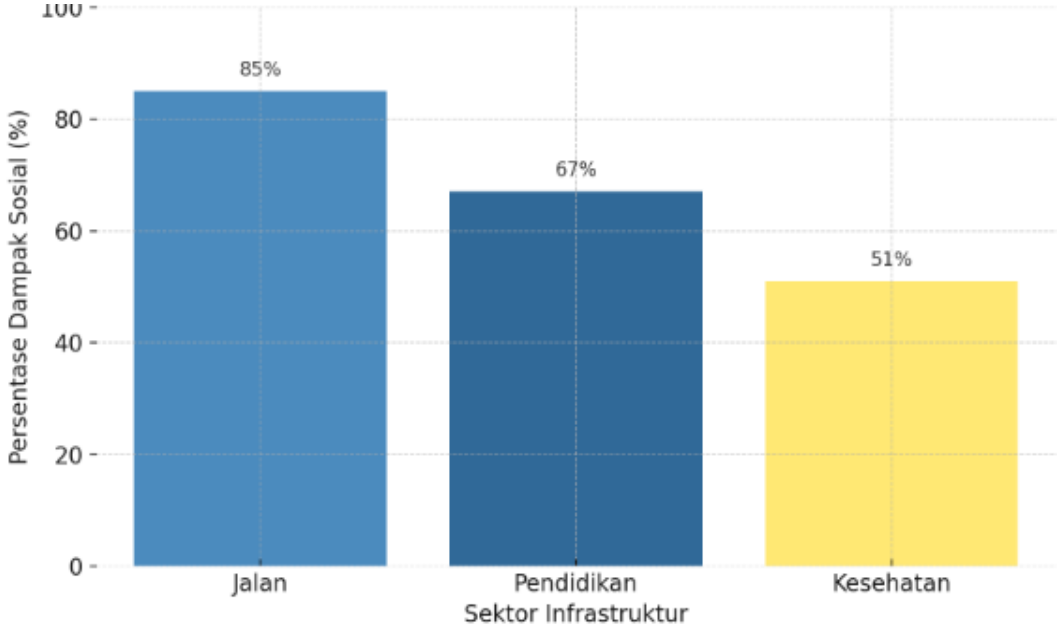

Figure 1. Integrative Graph: Access Disruptions in Three Infrastructure Sectors

CONCLUSION AND RECOMMENDATIONS

This study concludes that the isolation and low quality of life of the Pelaci Village community is caused by the fragmentation of basic infrastructure development. Poor road conditions hamper access to education and health services, while limited education and health facilities worsen the socio-economic conditions of the community.

a. Integrative Planning:
   Regional governments need to prepare cross-sector development plans that integrate roads, education, and health into one development map.
b. Multi-party Collaboration:
   Synergy is needed between the government, mining companies (through CSR programs), and the community in building infrastructure comprehensively and sustainably.
c. Basic Infrastructure Priority:
   Improving road access as a prerequisite for opening connectivity to schools and health service centers.
d. Model Replication:
   This integrative model can be adapted to other mining areas experiencing similar challenges.

This study has several limitations that should be acknowledged to guide future research improvements. First, the research employed a descriptive qualitative approach, which limits the ability to quantitatively measure the direct impact of infrastructure integration on quality of life indicators such as income levels, school participation rates, or public health status. Second, the study focused solely on Pelaci Village, making it difficult to generalize the findings to other coal mining areas across Indonesia. Third, data collection relied primarily on field observations and informal interviews, without support from spatial or digital mapping tools that could have strengthened the technical analysis of infrastructure distribution and accessibility. Fourth, the involvement of key stakeholders such as local government officials and mining companies was limited during the data collection process, resulting in an incomplete portrayal of policy and corporate perspectives.

ADVANCED RESEARCH

a. Involving Quantitative Analysis:
   In order to measure the impact of infrastructure integration on quality of life indicators statistically.
b. Developing Spatial Planning Models:
   Using digital mapping (GIS) to strengthen spatial arguments and infrastructure distribution.
c. Comparative Study:
   Reviewing similar cases in other mining areas as a comparison, to see the effectiveness of the integrative approach in different geographical contexts.
d. Analyzing the Role of CSR in Depth:
   Including program sustainability and its synchronization with local government programs.

ACKNOWLEDGMENT

The author would like to thank all parties who have contributed to this research, especially the community of Pelaci Village, Laung Tuhup District, for the time and information provided during field observations. Thanks are also extended to the Indonesian Christian University for academic support and colleagues who have provided constructive input in the preparation of this article.

REFERENCES

Bachtariza, M., Nurhayati, A., & Siregar, D. (2021). The Effect of Road Infrastructure Development on Regional Income in Batu Bara Regency. Journal of Public Research, 5(2), 33–41.

Bappenas. (2021). National Medium-Term Development Plan 2020–2024. Ministry of National Development Planning/Bappenas.

Dayak News. (2024). Maria Hetty: Villages in Remote Areas of Murung Raya Have Minimal Development Touch.

Hidayat, R., et al. (2020). Impact of mining activities on the environment in Kalimantan. Journal of Tropical Environment, 6(1), 15-24.

Kalteng.co. (2023). These Two Villages Are Used as References for Reducing Stunting Cases in Murung Raya.

Kumparan. (2024). PLTU Utilizes FABA to Build Village Road Infrastructure in Konawe.

Kusnandar, A., & Widodo, H. (2020). Inequality in basic infrastructure development in underdeveloped areas. Journal of Regional Development, 12(2), 45-58.

Nurfatriani, F., et al. (2022). Analysis of sustainable development policies in coal mining areas. Journal of Government Science, 14(1), 77-92.

Police Journal. (2024). Education and Infrastructure Development Boosts the Economy in Batu Bara, North Sumatra.

PSPK UGM. (2023). Government-Company Synergy in Improving Community Welfare in the Morowali Mining Area Village.

Putri, AM, & Yuliani, D. (2021). Public health around the mine: a case study of Central Kalimantan. Indonesian Journal of Public Health, 7(3), 200-210.

Ramadhani, Y., Suryana, D., & Hasanah, N. (2022). Infrastructure Integration and Poverty Reduction in the 3T Region. Journal of Regional Development, 7(1), 21–30.

Santosa, B., & Hamdani, M. (2021). The socio-economic impact of mining on local communities. Journal of Economics and Development, 18(2), 134-145.

Sari, RD, Yuniarti, T., & Lukman, H. (2020). Education in Rural Areas and Its Impact on Social Mobility. Indonesian Journal of Education, 9(4), 267–275.

Sibarani, R., & Noviantoro, H. (2023). Multi-party collaboration in the management of extractive industrial areas. Journal of Development Governance, 9(1), 22-38.

Wahyuni, T., & Ardiansyah, R. (2023). An integrative approach to 3T regional development. Journal of Regional Planning, 11(2), 101-116.

Wirawan, IM, Prasetyo, D., & Hidayati, F. (2021). Environmental Health Around Coal Mining Areas: Challenges and Solutions. Journal of Public Health, 13(2), 87–96.

Yuliani, D. (2021). Air pollution due to mining activities and its impact on children's health. Journal of Environmental Health, 9(2), 56-63.