Long-Term Impact Evaluation of Socio-Economic Infrastructure Development Programs on Welfare Improvement in Samosir Regency

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Abstract
Socio-economic infrastructure development is one of the key factors in enhancing community welfare. This study aims to evaluate the long-term impact of socio-economic infrastructure development programs on community welfare in Samosir Regency. Employing a qualitative descriptive method with a SWOT analysis approach, the study identifies the strengths, weaknesses, opportunities, and threats related to the implementation of infrastructure policies in the region. Data were collected through surveys of 200 respondents, interviews with policymakers, and analysis of secondary data from official sources. The findings indicate that infrastructure development has had a positive impact on community welfare, particularly in terms of mobility, economic opportunities, and tourism sector growth. However, challenges remain, such as disparities between urban and rural areas, limited access to basic services, and inadequate maintenance of existing infrastructure. Underutilized yet effective strategies, such as community-based infrastructure management, the use of renewable energy, and results-based financing, should be urgently implemented to ensure the sustainability and equitable distribution of infrastructure benefits throughout Samosir Regency.

Keywords: Infrastructure, Welfare, SWOT, Development

Introduction

The development of socio-economic infrastructure in Samosir Regency has become a top priority in efforts to improve community welfare. Various projects have been implemented, including the construction of roads, healthcare facilities, educational institutions, and tourism sector development (Linda et al., 2024; Nuraini, 2024). However, despite significant investments, challenges remain in ensuring that the benefits of such development are equitably distributed among all segments of the population.

One phenomenon reflecting these challenges is the rising poverty rate in Samosir Regency in recent years. Although infrastructure has expanded, the available employment opportunities have not yet been able to absorb the local workforce optimally (Hartini et al., 2023; Hidayat et al., 2023). The disparity between urban and rural areas also remains a major issue, where access to basic services such as healthcare and education is still limited in some remote areas.

Moreover, the tourism sector, which serves as one of the key drivers of Samosir's economy, continues to face various challenges in delivering widespread economic benefits. Several studies have shown that although there has been an increase in tourist numbers, the positive economic impact has not been fully felt by local communities due to their limited participation in the tourism value chain.

Previous research has discussed the impact of infrastructure on community welfare. For example, Amalia (2023) found that road infrastructure development has a positive correlation with increased rural household income. Similarly, Marianto (2023) highlighted that quality infrastructure enhances economic productivity and overall welfare. At the international level, Khandker et al. (2009) emphasized that rural infrastructure development in Bangladesh significantly contributed to poverty reduction and sustainable improvements in welfare.

However, there remains a lack of research that specifically addresses the long-term impacts of socio-economic infrastructure development programs on community welfare in Samosir Regency. Therefore, this study is essential to fill that knowledge gap and to provide data-driven recommendations for local policymakers.

Theoretical Framework

A. Definition of Social and Economic Infrastructure

Social and economic infrastructure are key components in the development of any region. Social infrastructure includes facilities that support the improvement of community quality of life, such as education, healthcare, and housing (Calderón & Servén, 2010). Meanwhile, economic infrastructure encompasses facilities that support economic activity, such as roads, transportation, energy, and telecommunications (Fan & Chan-Kang, 2008).

According to Todaro and Smith (2020), well-developed infrastructure enhances production efficiency, reduces transaction costs, and creates new economic opportunities for the community. Adequate infrastructure also contributes to welfare improvement by providing better access to essential services and increasing a region’s economic competitiveness.

B. Theories of Economic Growth and Development

In the field of economic development, several theories explain the role of infrastructure in improving societal welfare:

1. **Endogenous Growth Theory (Romer, 1990)**
   This theory emphasizes that investment in infrastructure can enhance long-term productivity by improving human capital, fostering innovation, and increasing

production efficiency. Well-developed infrastructure enables broader access to education and healthcare, which in turn supports sustainable economic growth.

2. **Structuralist Development Theory (Lewis, 1954)**
   Lewis proposed that economic growth in developing countries occurs through the transformation from traditional sectors to modern sectors. Adequate infrastructure supports this process by connecting rural areas to larger markets, increasing labor mobility, and accelerating the adoption of new technologies.
3. **Myrdal's Theory of Circular Causation (1957)**
   Myrdal explained that infrastructure development generates positive economic multipliers, where increased accessibility and inter-regional connectivity stimulate new investments, raise household incomes, and reduce regional disparities.

C. Infrastructure and Community Welfare

Various studies have demonstrated that infrastructure has a direct impact on community welfare. Research by Khandker et al. (2009) in Bangladesh showed that rural road construction reduced poverty and improved well-being by enhancing access to markets and social services. In Indonesia, a study by Amalia (2023) found that road infrastructure development contributed to increased household income in rural areas of Soppeng Regency. Similarly, Marianto (2023) concluded that infrastructure significantly improves quality of life in remote village communities.

Moreover, a cross-country study by Calderón and Servén (2010) in developing countries showed that investment in infrastructure has a positive effect on long-term economic growth and helps reduce social inequality. In other words, infrastructure development that is oriented toward community needs can serve as a powerful tool for enhancing welfare and narrowing socio-economic gaps.

D. Long-Term Impact Evaluation of Infrastructure Development

The long-term impact evaluation of socio-economic infrastructure development programs can be conducted using several approaches, including:

1. **Econometric Approaches**
   a) The ARDL Panel Model and Error Correction Model (ECM) are used to analyze the long-term relationship between infrastructure and economic welfare indicators (Pesaran et al., 2001).
   b) The Difference-in-Differences (DiD) model is applied to measure the effect of infrastructure development on socio-economic variables before and after the implementation of related policies (Card & Krueger, 1994).
2. **Welfare Index Approaches**
   a) The Human Development Index (HDI) is used to assess the impact of infrastructure development on education, health, and income levels within the community.
   b) The Multidimensional Poverty Index (MPI) is employed to examine how infrastructure development contributes to the reduction of poverty in its various dimensions (Alkire & Foster, 2011).
3. **Case Study Approach**
   a) Case studies are used to examine the specific impact of infrastructure development on local communities, for example, the effect of highway construction on economic growth and community welfare in Samosir Regency.

Conceptual Framework

Based on the theoretical foundation and previous research, this study proposes a conceptual framework suggesting that socio-economic infrastructure development has a positive relationship with the improvement of community welfare in Samosir Regency. This relationship can be explained through the following mechanisms:

Figure 1. Conceptual Framework of the Study

Conceptual Framework

The conceptual framework of this study is illustrated below:

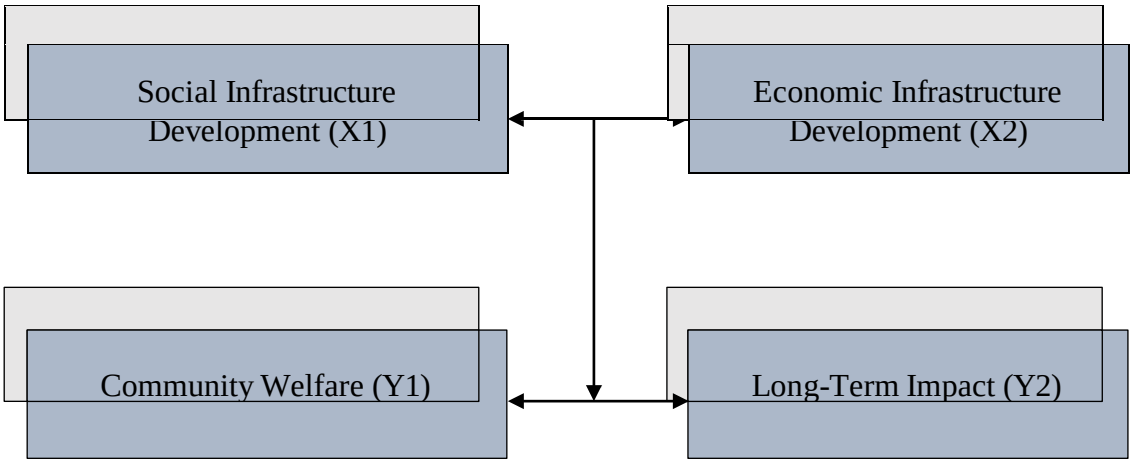

Figure 2. Conceptual Framework

This study posits that the development of social infrastructure (X1) and economic infrastructure (X2) has a direct influence on the improvement of community welfare (Y1). The long-term impact (Y2) is measured by the extent to which infrastructure development benefits the socio-economic life of the people in Samosir Regency.

Results and Discussion

A. General Overview of Samosir Regency

Samosir Regency is one of the regions in North Sumatra Province, known for its tourism potential around Lake Toba and its rapidly developing socio-economic infrastructure in recent years. However, despite various development programs being implemented, the long-term impact on community welfare remains a key question that requires thorough analysis.

Table 1. Community Satisfaction with Infrastructure (%)

Infrastructure	**Infrastructure**	**Infrastructure**	**Infrastructure**	**Infrastructure**	**Infrastructure**
Roads & Transportation	15%	35%	30%	15%	5%
Health	10%	25%	40%	20%	5%
Education	12%	28%	38%	18%	4%
Telecommunications	20%	30%	25%	15%	10%
Clean Water & Sanitation	8%	20%	35%	25%	12%

The table above shows that:

a. Road and transportation infrastructure receives relatively high satisfaction levels, although 15% of respondents expressed dissatisfaction.
b. The health and education sectors still require significant improvement, as a large portion of the community only felt "moderately satisfied" or even less.
c. Telecommunications infrastructure has developed fairly well, with 50% of respondents reporting satisfaction or high satisfaction.
d. Access to clean water remains a major challenge, with a relatively high dissatisfaction rate (37%).

Table 2. Impact of Infrastructure on Household Income (%)

Income Category	**Before Infrastructure Development**	**After Infrastructure Development**
< Rp 1.000.000	35%	20%
Rp 1.000.000 – Rp 2.500.000	40%	45%
Rp 2.500.000 – Rp 5.000.000	20%	25%
> Rp 5.000.000	5%	10%

The table above shows that:

a. There has been a significant increase in household income, particularly among those previously earning less than Rp 1,000,000.
b. Infrastructure development has had a positive impact by creating new business opportunities and improving the economic welfare of the community.

B. SWOT Analysis of Research Findings

Based on survey results and interviews, the SWOT analysis related to the influence of infrastructure on community welfare in Samosir Regency is as follows:

Table 3. SWOT Analysis of Socio-Economic Infrastructure Development

Aspect	**Internal Factors**
Strengths	- Rapid development of road and telecommunication infrastructure.
	- Tourism growth as a new income source.
	- Increased business opportunities and employment.
Weaknesses	- Unequal distribution of health and education infrastructure.
	- Limited access to clean water and sanitation.
	- Disparities between urban and rural areas.
Aspect	**External Factors**
Opportunities	- Lake Toba's tourism potential boosts the local economy.
	- Government continues to expand strategic infrastructure programs.
	- Investor support for creative economy development.
Threats	- Lack of infrastructure maintenance.
	- Economic instability due to external factors (e.g., inflation, global crisis).
	- Environmental impact from large-scale infrastructure projects

Source: Research Findings, 2025

C. Positive Impacts of Infrastructure Development

The study concludes that socio-economic infrastructure development has had positive impacts on the community, particularly in the following areas:

1. **Improved mobility and accessibility** → The development of roads and transportation infrastructure has made it easier for people to engage in economic and social activities.
2. **Increased business and employment opportunities** → Better infrastructure allows the community to run businesses more effectively and increase their incomes.
3. **Growth of the tourism sector** → Infrastructure improvements around Lake Toba have attracted more tourists, boosting the local economy.

D. Challenges and Solutions in Infrastructure Development

Despite the benefits, several challenges remain that need to be addressed:

1. **Persistent disparities between urban and rural areas** → Solution: Promote equitable development with a focus on remote and underdeveloped regions.
2. **Limited access to clean water and sanitation** → Solution: Accelerate government-led clean water provision projects for rural communities.
3. **Insufficient maintenance of existing infrastructure** → Solution: Establish a sustainable and routine infrastructure maintenance system.

Conclusion

This study evaluates the long-term impact of socio-economic infrastructure development programs on community welfare in Samosir Regency using a SWOT analysis approach. The findings indicate that both social and economic infrastructure development has significantly contributed to improving community welfare, particularly in terms of accessibility, business opportunities, and the growth of the tourism sector. The construction of roads and transportation infrastructure has enhanced mobility and broadened access to markets and social services, while the growing telecommunications infrastructure has supported the expansion of the digital economy in the region.

Despite these benefits, major challenges persist, including disparities between urban and rural areas, limited access to healthcare, education, and clean water in remote regions. Furthermore, although household income has increased, a large proportion of the population remains engaged in informal sectors with unstable welfare conditions. External factors such as global economic uncertainty and inadequate infrastructure maintenance also threaten the long-term sustainability of these development gains. The SWOT analysis conducted in this study highlights that the potential for infrastructure development in Samosir remains significant, particularly with the support of the Lake Toba tourism sector. However, to ensure that development has widespread and sustainable effects, more targeted strategies are needed to address existing weaknesses and capitalize on available opportunities. In this context, infrastructure development should not be treated merely as a short-term project, but as a long-term investment that continues to deliver benefits to community welfare.

Based on the research findings, several key actions must be taken to ensure that infrastructure development yields maximum benefits for the community. One underutilized yet proven-effective strategy is the implementation of community-based infrastructure models. This approach encourages community participation in the planning, development, and maintenance of infrastructure, ensuring that development is aligned with real community needs and fosters stronger ownership. Additionally, innovation in resource management is essential—for instance, the use of renewable energy technologies such as solar panels to support public facilities in remote areas with limited electricity access. Similar initiatives have been successfully implemented in several villages, enhancing quality of life without overburdening government budgets.

Moreover, local governments need to take a more active role in establishing partnerships with the private sector and academic institutions to create more effective infrastructure management systems. For example, adopting **result-based financing** models—where funding is disbursed based on measurable outcomes—can promote accountability and efficiency. While this model is still rare, it has shown success in some small-scale infrastructure projects across regions. To promote equitable development, it is crucial for local governments to allocate more funding toward strengthening basic infrastructure in rural areas, ensuring better access to healthcare, education, and clean water. This should be done gradually, prioritizing the most underserved areas so that infrastructure development does not remain concentrated in urban centers but reaches the broader community across Samosir Regency.

Lastly, there is an urgent need for a more structured infrastructure maintenance system. Many facilities that have been built are underutilized or deteriorating due to poor maintenance. Implementing a **community-based maintenance model**, in which local residents are trained and incentivized to maintain infrastructure, can help sustain development outcomes without depending solely on central government intervention. If these strategies are effectively implemented, infrastructure development in Samosir Regency can serve not only as a short-term economic stimulus but also as a strong foundation for long-term, sustainable community welfare. Therefore, innovative approaches that have

proven successful but remain underutilized must be widely adopted so that the benefits of development can truly be felt by all segments of society.

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