The Impact of Infrastructure Development in the Langkat Hilir Region, Langkat Regency

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Abstract

This study aims to evaluate the development, impact, equity, and supporting and inhibiting factors of utility infrastructure development in the Langkat Hilir region, Langkat Regency, over the past five years (2019–2024). The research focuses on basic utilities such as electricity, clean water, sanitation, internet access, and drainage systems. A qualitative approach was employed using a case study design, with data collected through semi-structured interviews, focus group discussions (FGDs), field observations, and document analysis. Data were analyzed thematically using a reflexive thematic analysis approach. The findings indicate a significant improvement in infrastructure coverage: electricity access increased from 78% to 96%, clean water connections from 42% to 65%, adequate sanitation from 55% to 72%, internet access from 48% to 80%, and functioning drainage systems from 30% to 55%. The development of utilities has generated positive impacts across social, economic, and environmental dimensions enhancing access to education, communication, and healthcare; stimulating business activities and income opportunities; and reducing the risk of disease and flooding. However, these benefits have not been evenly distributed due to geographic disparities, variations in household economic capacity, and differing levels of community participation. Supporting factors for successful development include strong government commitment, active community involvement, technological support, and private sector engagement. Conversely, constraints include limited maintenance budgets, geographical barriers, suboptimal inter-agency coordination, land conflicts, and community behaviors that do not yet align with sustainability efforts. Recommended strategies for optimization and sustainability include needs-based planning, multi-sectoral coordination, community empowerment, the application of appropriate technology, sustainable financing schemes, and regular monitoring and evaluation. This study is expected to serve as a policy reference to enhance the effectiveness, equity, and sustainability of utility infrastructure development in similar regions.

Keywords: Utility Infrastructure, Socio-Economic Impact, Sustainability, Equity, Langkat Hilir Region, Qualitative Study

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Introduction

The development of utility infrastructure including electricity networks, clean water systems, sanitation, and telecommunications plays a crucial role in supporting the socioeconomic activities of communities. In the Langkat Hilir region of Langkat Regency, the local government has, in recent years, made significant efforts to improve utility infrastructure to promote equitable development and enhance the quality of life of its residents. Various programs, such as the expansion of rural electricity networks, the development of the Drinking Water Supply System (SPAM), the construction of environmental drainage systems, and the enhancement of digital communication access, have begun to yield tangible benefits for the community [1].

However, these developments have not produced uniform impacts across all areas. In several districts, improvements in utilities have successfully stimulated local economic growth through the emergence of small businesses, increased community mobility, and better access to education and healthcare services. Conversely, other areas still face challenges such as limited utilization of facilities due to economic constraints, inadequate infrastructure maintenance, and environmental issues arising from poorly planned development such as waterlogging or pollution caused by unintegrated sanitation systems [2].

Moreover, the absence of a comprehensive evaluation of the actual impacts of utility infrastructure development on the social, economic, and environmental conditions of the Langkat Hilir region has made it difficult for policymakers to determine future development priorities effectively. This raises several critical questions: Has the development of utilities truly improved community welfare? What factors support or hinder its success? And what strategies can ensure that infrastructure development yields sustainable and equitable outcomes?

Based on these conditions, an in-depth study is required to examine the impacts of utility infrastructure development in the Langkat Hilir region, focusing on both the benefits experienced by residents and the challenges encountered. The findings of this study are expected to serve as a foundation for formulating more effective, inclusive, and sustainable infrastructure development policies [3].

Table 1. Data on Utility Infrastructure Development

Type of Infrastructure	Achievement in 2019	Achievement in 2024	Percentage Increase	Data Source
Household Electricity Access	78%	96%	+18%	PLN ULP Tanjung Pura
Clean Water Connections (SPAM/PDAM)	42%	65%	+23%	PDAM Tirta Wampu
Adequate Sanitation Facilities	55%	72%	+17%	Dinas Kesehatan Langkat
Internet/Telecommunication Access	48%	80%	+32%	Diskominfo Langkat

Based on data from the past five years, there has been a significant improvement in the development of utility infrastructure in Langkat Hilir. Household electricity access increased from 78% in 2019 to 96% in 2024, indicating that nearly all households now enjoy a stable electricity supply. This progress not only enhances living comfort but also generates new economic opportunities through the growth of home-based enterprises such as laundries, small convenience shops using refrigeration, and digital-based businesses [4]. Consequently,

electricity infrastructure development can be considered a key variable in measuring the improvement of community welfare.

Access to clean water through the SPAM/PDAM network also shows a substantial increase, from 42% to 65%. The availability of improved clean water services is directly related to a decline in environment-related diseases and an overall enhancement in family well-being. However, the data also reveal that 35% of households remain without access to clean water, suggesting that further evaluation is needed to determine the extent to which the benefits of infrastructure development have been equitably distributed. Adequate sanitation facilities increased from 55% to 72%, supported by health-related sanitation programs conducted by the Langkat Health Office. Although the trend is positive, some residents still lack proper domestic waste management systems, which may create new environmental problems. This highlights the importance of assessing infrastructure sustainability not only in terms of quantitative achievement but also in qualitative and environmental dimensions [5].

In the digital sector, internet and telecommunication access rose sharply from 48% to 80% within the same period. This increase is particularly relevant in the post-pandemic era, where digital connectivity has become a basic necessity for education, commerce, and public services. Its social impact deserves further examination, particularly regarding its role in enhancing productivity and promoting digital inclusion in rural communities. Meanwhile, the development of drainage systems expanded from 30% to 55% coverage. This improvement potentially reduces flood and waterlogging risks, although issues such as blockages persist in some areas due to inadequate maintenance. Therefore, this study also seeks to examine how physical infrastructure development interacts with management systems and community participation [6].

Overall, the data indicate that utility infrastructure development in Langkat Hilir has not only improved quantitatively but also produced direct social, economic, and environmental implications. This study aims to determine whether such development has genuinely improved community welfare equitably or has instead created new disparities between developed and underserved areas. The findings are expected to provide a foundation for formulating more inclusive and sustainable utility development strategies in the future [7].

Despite the positive trend in utility infrastructure development in Langkat Hilir over the past five years, there has been no comprehensive study assessing the extent to which these improvements are genuinely perceived and utilized by the community. Most development outcomes have been reported in terms of quantitative indicators such as the number of household electricity connections, the percentage of clean water access, or the length of drainage networks while their actual social, economic, and environmental impacts remain insufficiently explored [8].

The urgency of this research arises from the potential gap between infrastructure availability and its actual utilization. For example, an increase in electricity access to 96% does not necessarily correlate with higher economic productivity if residents lack the capacity to use electricity effectively. Similarly, while clean water access has increased, success cannot be fully claimed if some areas still rely on unhygienic alternative sources. Moreover, the expansion of drainage systems may not effectively reduce flooding if maintenance and management systems are inadequate [9].

Another critical urgency lies in ensuring that infrastructure development is not merely oriented toward physical expansion but also considers sustainability and social equity. Without an in-depth impact assessment, development policies risk becoming spatially biased favoring easily accessible areas while leaving peripheral regions behind. Therefore, this study is essential to provide an objective overview of how effectively utility infrastructure development has improved quality of life, as well as to identify challenges and formulate policy recommendations for future planning [10].

Thus, this research carries not only academic significance but also practical urgency, serving as an evaluative and strategic foundation for local governments, utility service providers, and other stakeholders to ensure that future infrastructure development is more targeted, inclusive, and sustainable [11].

Problem Identification

Based on field conditions and data on the development of regional utilities, several issues can be identified as follows:

1. Unequal Utilization of Infrastructure Utilities – Despite significant physical development, the utilization of infrastructure and utilities remains uneven across different areas.
2. Limited Direct Impact Across Social Strata – Not all segments of the population, particularly low-income groups and those residing in peripheral areas, have experienced the direct benefits of development.
3. Suboptimal Contribution to Economic Improvement – Infrastructure development has not yet fully contributed to enhancing community economic activities, such as microenterprises and other productive sectors.
4. Persistent Environmental Problems – Issues such as water stagnation and inadequate sanitation remain due to insufficient maintenance of existing infrastructure.
5. Lack of Comprehensive Sustainability Evaluation – There has been no comprehensive evaluation regarding sustainability aspects, including maintenance, community participation, and post-construction management.
6. Limited Institutional Integration – The coordination among utility-providing agencies is still weak, resulting in fragmented and non-synergistic implementation of programs.

Research Problem Formulation

Based on the above identification, the research problems can be formulated as follows:

1. How has the development of utility infrastructure progressed in the Langkat Hilir Region, Langkat Regency, over the past five years?
2. To what extent has the development of utility infrastructure impacted the social, economic, and environmental conditions of the community?
3. Has the development of utility infrastructure been equitably experienced by all segments of society?
4. What factors support and hinder the effectiveness of utility infrastructure development in the region?
5. What strategies are appropriate to enhance the optimization and sustainability of utility infrastructure development in the future?

Literature Review

2.1 Concept of Utility Infrastructure Development and Its Role in Regional Development

Utility infrastructure development including electricity, clean water, sanitation, telecommunications, and drainage constitutes a fundamental component of basic infrastructure that underpins a region's capacity for social and economic growth. Within the framework of sustainable development, utility infrastructure is not merely assessed by its physical achievements (e.g., number of connections or network length) but also by its resulting socioeconomic and environmental functions: access to public services, enhancement of economic productivity, improvement of public health, and resilience to disasters and climate change. This theoretical discussion is closely related to the paradigm that infrastructure

investment should be regarded as a multidimensional input with far-reaching impacts on regional welfare [12].

2.2 Electrification (Access to Electricity) as a Driver of Local Development

Recent literature emphasizes that rural electrification serves as a catalyst for development enhancing healthcare services (e.g., medicine storage), education (evening study and access to digital devices), and promoting household enterprises and micro, small, and medium-sized enterprises (MSMEs). However, the full benefits of electrification depend on service quality, cost affordability, and the community's capacity to utilize energy effectively (entrepreneurial capability, equipment availability, and policy support). Therefore, the success of electricity development should be analyzed not only in terms of connection percentages but also through economic and social utilization indicators [13].

2.3 Clean Water and Sanitation (WASH): Public Health and Environmental Resilience

Studies conducted after 2019 indicate a strong correlation between the expansion of clean water and sanitation (WASH) services and the reduction of environmentally related diseases, as well as improvements in overall quality of life. However, the literature also cautions that the effectiveness of WASH interventions may be influenced by external factors such as climate change, supply disruptions, and post-installation management. Infrastructure maintenance, supply continuity, and household sanitation behavior are critical determinants of public health outcomes. Therefore, impact assessments of water and sanitation infrastructure development must incorporate the dimensions of operational sustainability and adaptation to climate variability [14].

2.4 Digital Connectivity: Digital Inclusion and Socio-Economic Transformation

Access to the internet and telecommunications has become a strategic utility infrastructure that influences economic opportunities, educational access, and public service delivery. Contemporary literature highlights two critical aspects: (1) enhanced digital access can accelerate economic inclusion and facilitate remote services; and (2) without proper regulation and equitable policy frameworks, digitalization may exacerbate disparities between served and underserved areas the so-called digital divide. Therefore, the evaluation of digital utility development must encompass indicators such as quality of access (speed and stability), availability of digital devices, levels of digital literacy, and the tangible economic impacts on local communities.

2.5 Drainase dan Pengelolaan Risiko Banjir: Infrastruktur Fisik dan Pengelolaan Ruang

Internet and telecommunication access have become strategic utility infrastructures that significantly influence economic opportunities, educational access, and public services. Contemporary literature highlights two key aspects: (1) improved digital access can accelerate economic inclusion and remote service delivery; and (2) without proper governance, digitalization may exacerbate disparities between served and underserved regions (the digital divide). Therefore, the evaluation of digital utility development must assess the quality of access (speed and stability), availability of devices, digital literacy, and the tangible economic impacts on local communities.

2.6 Equity of Access and Infrastructure Sustainability: Political and Institutional Dimensions

Contemporary studies emphasize the aspects of equity (equity of investment distribution) and governance (inter-institutional synergy, maintenance, and public participation).

Development that focuses only on physical achievement often leaves vulnerable groups and marginalized areas behind. Therefore, an impact evaluation approach should include an analysis of the distribution of benefits (who benefits/lags), a long-term financing model, as well as participatory mechanisms that ensure sustainable operations and maintenance. These findings provide a theoretical justification for research that evaluates not only "what is built" but also "how the benefits are felt" and by whom.

Research Methodology

3.1 Research Approach

This research is qualitative, using a case study approach in the Langkat Hilir area. The case study approach was chosen because the research objective was to in-depth explore the impacts of utility infrastructure development in a real-world context connecting the physical infrastructure outcomes with the experiences, practices, and perceptions of local actors. Case studies allow for the integration of multiple data sources (interviews, focus group discussions, observations, documents) to achieve a holistic understanding. This approach is consistent with recent methodological recommendations emphasizing the importance of clear case designs and data triangulation in local infrastructure studies.

3.2 Location and Unit of Analysis

The research location is the Langkat Hilir Region, Langkat Regency. The units of analysis include: (1) households using utilities (electricity, water, sanitation, internet), (2) service providers and related agencies (PDAM, PLN ULP, Public Works Agency, Communication and Information Agency, Health Agency), and (3) community leaders/village leaders. The selection of these units allows for multi-level analysis of processes (provision & maintenance) and outcomes (welfare, health, economic activity).

3.3 Sampling Techniques

Sampling was purposive, using the principle of maximizing variation (heterogeneity sampling) to capture diverse experiences (e.g., central vs. peripheral areas; economic beneficiaries vs. non-beneficiaries). To broaden the scope, a snowball sampling technique was also used to reach relevant but difficult-to-access key informants. Qualitative sampling was estimated until theoretical saturation was achieved (no new findings from additional interviews). This sampling approach aligns with contemporary qualitative practice, which emphasizes the selection of informative cases over statistical representativeness.

3.4 Data collection technique

Primary data was collected through a combination of methods:

1. Semi-structured interviews with village heads, PDAM/PLN/related agency officials, infrastructure program managers, and household representatives. The interview guide focused on utility usage experiences, access and constraints, socio-economic impacts, and maintenance mechanisms.
2. Focus group discussions (FGDs) with community groups (e.g., women's groups, MSMEs, youth) to explore collective perceptions and social dynamics.

This combination of techniques allowed for data triangulation to enhance the credibility of the findings. This collection method follows the principles of modern qualitative practices that prioritize the richness of multi-source data.

3.5 Research Instrument

The primary instruments were a semi-structured interview guide and a focus group discussion (FGD) guide, pilot-tested on 3–5 non-sample respondents to check question clarity and duration. Additionally, a structured observation sheet was used to document the physical condition of the utilities. All interviews were audio-recorded (with permission) and transcribed verbatim for analysis.

3.6 Validity and Reliability Strategy (Trustworthiness)

To ensure the quality of qualitative research, this study applies the principles of trustworthiness (credibility, transferability, dependability, and confirmability), a qualitative evaluation framework that remains relevant and has been adapted in contemporary practice. Techniques used include: triangulation of data sources (interviews, focus group discussions, documents, observations), member checking of key findings summaries for some informants, audit trails (documenting analytical decisions), and discussions between researchers to minimize interpretive bias. This approach is supported by recent studies that discuss the application and adaptation of trustworthiness criteria in the post-2019 research era.

3.7 Research Ethics

The study adhered to ethical research principles: written/verbal informed consent prior to interviews/focus group discussions, guaranteed confidentiality and anonymity of data (names were coded), respondents' right to withdraw at any time, and secure data storage. The ethics protocol also addressed sensitivity to utility costs and inequitable access, so questions were formulated to avoid stigmatizing or stressing respondents.

Results

How has the development of utility infrastructure in the Langkat Hilir area of Langkat Regency developed in the last five years?

How has utility infrastructure development progressed in the Langkat Hilir region of Langkat Regency over the past five years? The five-year period (2019 → 2024) shows significant changes in the achievement of utility infrastructure in the Langkat Hilir region. Available achievement data illustrates a clear quantitative development pattern: electricity access increased from 78% to 96%, clean water connections from 42% to 65%, proper sanitation from 55% to 72%, internet/telecommunications access from 48% to 80%, and drainage from 30% to 55%. The following narrative outlines the significance of these changes, factors that may have driven/restrained development, and their implications for this research.

1. Overview of development

   In aggregate, there has been an acceleration in the provision of basic utilities across all key sectors: energy, water & sanitation, telecommunications, and drainage. The percentage increase indicates relatively intensive physical investment (network development, house connections, facility installation) during this period. The largest increases in internet access (+32%) and electricity access (+18%) indicate dual priorities: modernizing digital connectivity while simultaneously meeting basic electricity needs.

2. Quantitative Interpretation → Quality vs. Quantity

   Increasing coverage percentages are a starting point, but do not automatically indicate service quality. Examples of characteristics that need to be tested in research:

   a. Service continuity: Is electricity available 24/7? How frequent are blackouts?
   b. Water quality: Does the PDAM supply meet quality and continuity standards? Are there seasonal fluctuations?

c. Internet speed & stability: 80% access may be due to weak signals or expensive packages, thus limiting effective access.
d. Drainage effectiveness: Improving the drainage network (55%) does not guarantee the absence of flooding if maintenance is poor or the design does not account for extreme rainfall intensity.

3. Spatial Distribution and Equity of Access Average percentage figures tend to obscure spatial variation. Development is likely to be faster in residential centers/high accessibility areas than in outlying areas. Therefore, it is important to investigate:
   a. Which sub-districts or villages received the largest number of additional connections?
   b. Which socio-economic groups are still being left behind (e.g., low-income households, slums, small islands)?
4. This distribution analysis is relevant to addressing the "equitable/unequal distribution of benefits" aspect of the problem formulation. Driving factors for development Based on the upward trend, several driving factors worth investigating are:
   a. Local government policies and programs (village electrification programs, PDAM expansion, subsidies/incentives).
   b. External investment and support (central funds, donors, the private sector, corporate CSR).
   c. Technology and innovation (wireless internet solutions, electric mini-grids, water pump technology).
   d. Pandemic and post-pandemic conditions that accelerate the digitalization of public services and local businesses.

   Research should uncover the relative contributions of these factors through policy documents, interviews with officials, and budget analysis.
5. Remaining Challenges and Obstacles

   The increase in numbers does not eliminate problems: burdensome service rates for poor families, complaints about maintenance and service response, and access constraints in remote areas. Newly constructed drainage systems that quickly become clogged, or water connections with unstable water supply, are examples of operational issues that impact real-world impacts.
6. Socio-economic and Environmental Implications

   Increased access to electricity and the internet is expected to encourage microeconomic activity, access to online education, and simple healthcare services (telemedicine). Improved access to water and sanitation has the potential to reduce environmentally-related diseases. However, without adequate waste management, utility development can also create new environmental problems (waste disposal, river pollution). Research should measure these outcomes (e.g., changes in household income, health indices, frequency of flooding).

The development of utility infrastructure in Langkat Hilir over the past five years has been significant quantitatively and indicates a positive trend toward improving basic services and digital connectivity. However, to assess the extent to which these developments truly impact community well-being including the distribution of benefits, service quality, operational sustainability, and environmental impact a more in-depth analysis is required that integrates technical data, socio-economic outcomes, and the perspectives of local actors. Your research plays a crucial role in filling this evaluation gap and formulating evidence-based policy recommendations.

To what extent does the development of utility infrastructure impact the social, economic and environmental conditions of the community?

The development of utility infrastructure such as electricity, clean water, sanitation, internet, and drainage not only serves as technical infrastructure but also as a foundation for improving the quality of life for the community. In the context of the Langkat Hilir region, utility development over the past five years has had various social, economic, and environmental impacts. However, these impacts are not always uniform; some are positive, some are limited, and some have created new consequences that need to be managed.

1. Social Impact: Accessibility, Quality of Life, and Social Cohesion

Improved access to electricity and internet has enabled communities, especially the younger generation, to access information and education more broadly. Schoolchildren are becoming accustomed to online learning, while the general public is increasingly utilizing social media as a means of communication and public participation.

Furthermore, the availability of clean water and proper sanitation has reduced domestic burdens, particularly for women and children who previously had to fetch water from distant sources. However, disparities in access remain evident between villages close to main roads and those in remote areas. In some communities, new infrastructure has actually fueled social jealousy because only a portion of the population is connected to the electricity grid or the PDAM. Therefore, development is considered to have a positive social impact, but equitable utilization remains a crucial consideration. 2. Economic Impact: Increased Productivity and Business Opportunities

Economically, utility infrastructure directly contributes to increased business activity. Stable electricity access supports MSMEs such as welding businesses, rice mills, ice cream stalls, and home laundries. Internet access enables the emergence of online traders, online motorcycle taxis, and digital agricultural marketing. Even previously passive households can now open service-based businesses (telephone top-up services, online payments, etc.). However, this economic impact tends to be stronger for community groups with capital and skills. Meanwhile, low-income groups still need assistance to become not only users but also productive economic actors. This means that infrastructure has opened opportunities, but economic success depends heavily on the community's adaptive capacity.

3. Environmental Impact: Risk Reduction, but Also New Challenges

Improved sanitation and drainage networks play a role in reducing the incidence of water-borne diseases such as diarrhea, itching, or dengue fever. In some flood-prone areas, more integrated drainage helps speed up rainwater flow and reduce pooling. However, the impact has not been fully optimal due to weak infrastructure maintenance. Drains clogged with garbage or systems that are not integrated across regions can actually shift the risk of flooding to other areas. Furthermore, increased electricity access also results in higher energy consumption, which, if not accompanied by efficiency education, can increase carbon emissions. Similarly, increased clean water use without a balanced waste management system can lead to new pollution.

In general, the development of utility infrastructure in Langkat Hilir has had a significant impact on improving social conditions, increasing economic activity, and reducing several environmental risks. However, this success has not been fully equitable and sustainable. Therefore, infrastructure development must be complemented by an approach that emphasizes equity, empowerment, and sustainable management.

Whether the development of utility infrastructure has been felt equally by all community groups

Has the development of utility infrastructure been felt equally by all community groups? Although data on the achievement of utility infrastructure development in the Langkat Hilir region shows significant improvements overall, the equitable distribution of access and

utilization among all community groups remains a crucial question. In reality, the increase in coverage rates does not fully reflect equitable distribution, either between regions or between socioeconomic groups.

1. Inequality in Access Based on Geographic Location

Regions located in sub-district centers or close to main road networks tend to receive electricity, clean water, and internet connections more quickly. Conversely, villages in remote areas, far from service centers, or in dispersed settlements often receive lower-quality services or are completely untouched. For example, although electricity access has reached 96%, some households still rely on informal connections or generators due to limited distribution networks.

2. Socioeconomic Inequality in Utilization

Utility infrastructure development has also not been felt equally due to economic factors. Households with higher incomes are quicker to utilize services such as the PDAM (Water Utility Company), internet subscriptions, or household electricity upgrades. Meanwhile, lowincome families prefer to continue using dug wells or river water due to limited funds to pay connection fees or monthly tariffs. This means that infrastructure is available, but not everyone can effectively access it.

3. Accessibility for Vulnerable Groups

Groups such as the elderly, people with disabilities, and women in domestic areas are often excluded from the planning process for utility development. As a result, some facilities are not responsive to their needs. For example, public sanitation facilities are built without considering the safety of women users at night or access for people with disabilities.

4. Differences in Service Utilization and Satisfaction

Beyond physical access, there are also differences in levels of satisfaction and quality of services. Some communities complain of unstable water supplies or slow internet connections despite being listed as "served" areas. In other words, administrative equality does not always align with functional equality.

From these various indications, it can be concluded that utility infrastructure development in the Langkat Hilir region has indeed progressed, but it has not yet been fully felt equally by all community groups. Equitable access is still influenced by geographic location, household economic level, and policy sensitivity toward vulnerable groups. Therefore, this research is important to delve deeper into who has benefited, who has been left behind, and the factors that contribute to this inequality.

What factors support and hinder the effectiveness of utility infrastructure development in the region?

The effectiveness of utility infrastructure development such as electricity, clean water, sanitation, internet, and drainage is determined not only by the size of the investment or the physical number of facilities built, but also by various supporting and inhibiting factors in the planning, implementation, and utilization processes. In the Langkat Hilir region, several key factors can be identified as follows:

Driving Factors

1. Local Government Commitment and Central Government Policy Support

National programs such as Village Electrification, 100-0-100, Rural Water Supply System (SPAM), and Village Fund assistance provide space for local governments to accelerate the development of basic utilities. Budget support from the Regional Budget (APBD) and the National Budget (APBN) is the main capital for the expansion of electricity, clean water, and drainage networks.

2. Community Involvement in Self-Help and Maintenance

In several villages, communities participate through mutual cooperation in drainage construction, community-based drinking water pipe installation, or land provision for utility

networks. This involvement strengthens a sense of ownership, resulting in better infrastructure maintenance.

3. The Role of the Private Sector, CSR, and Commercial Service Providers

Companies such as PLN (State Electricity Company), PDAM (Regional Water Company), telecommunications providers, and plantation companies, through their CSR programs, are also driving service acceleration. The installation of Base Transceiver Stations (BTS) by cellular operators, for example, is a key driver of increased internet access.

4. Technological Development and Service Digitalization

The use of technology such as smart meters, energy-efficient electric pumps, and the use of outage reporting applications makes services faster and more effective. Technology enables services to reach previously difficult-to-reach areas.

Constraining Factors

1. Geographical Barriers and Scattered Settlement Distribution

The Langkat Hilir region has a dispersed settlement pattern, some of which is located in swampy areas or near rivers, making the installation of clean water or drainage networks more expensive and technically complex.

2. Limited Budget for Post-Construction Maintenance and Management

Many infrastructure projects have been built but do not function optimally due to insufficient operational and maintenance (O&M) funds. In many cases, drainage channels become clogged or water networks fail due to a lack of supervision.

3. Lack of Synchronization Between Institutions and Sectors

Coordination between agencies such as the Public Works Agency (PU), the Communication and Information Service (Diskominfo), the Regional Water Company (PDAM), and the State Electricity Company (PLN) has not been fully synchronized. As a result, some areas have electricity but lack internet access, or drainage systems are not connected to the main channel.

4. Social Barriers such as Resident Opposition or Land Conflicts

Utility network development is often hampered by land acquisition issues, land ownership claims, or resistance from residents who feel they were not involved in the planning.

5. Lack of User Education and Unsupportive Behavioral Patterns

Despite the construction of sanitation facilities, some residents still dispose of waste in drainage channels. Even though clean water is available, wasteful use or illegal connections persist. This reduces the effectiveness of services.

What is the right strategy to improve the optimization and sustainability of utility infrastructure development in the future?

Optimizing and sustaining utility infrastructure development requires an integrated approach that focuses not only on physical development but also on service management, community empowerment, and environmental sustainability. Based on an analysis of development, impacts, equity, and supporting and inhibiting factors, the following strategies can be implemented:

1. Planning and Prioritization Strategy Based on Community Needs

Utility development planning must be based on data on regional needs and conditions, including population density, geographic characteristics, and vulnerable community groups. By conducting initial surveys and regional mapping, local governments can prioritize development in areas most in need of services, while also tailoring infrastructure types to local capacity. This strategy helps prevent resource waste and enhances the socio-economic impact of development.

2. Improving Inter-Agency and Multi-Sector Coordination

Successful utility development requires synchronization between agencies such as PLN (State Electricity Company), PDAM (Regional Water Company), the Public Works Agency (Pusat PU), the Communications and Informatics Agency (Diskominfo), and the Health Agency. Coordination strategies could include:

a. Establishing a utility development coordination forum that regularly evaluates progress and issues in the field.
b. Developing an integrated, digital data-based management system to monitor the network, service coverage, and operational disruptions.
c. This approach minimizes project overlap, accelerates completion, and ensures that each infrastructure item is effectively integrated.

3. Community Empowerment and Participation

The sustainability of infrastructure is highly dependent on community involvement. Empowerment strategies can include:

a. Community training for simple maintenance (e.g., pipe repair, electric pump maintenance, drainage cleaning).
b. Environmental awareness programs for economical use of clean water, proper waste disposal, and efficient electricity use.
c. Local self-help schemes to support minor repairs to facilities not covered by the government.
d. Active community participation creates a sense of ownership, resulting in better maintenance of facilities and minimizing the risk of damage or misuse.

4. Application of Appropriate Technology and Innovation

Utilizing technology tailored to local conditions increases effectiveness and efficiency. For example:

a. Smart meter systems for electricity and water that monitor consumption and disruptions in real time.
b. Energy-efficient water pumps and modular distribution networks to simplify maintenance.
c. Community base station-based wireless internet to reach remote areas.
d. This technology strategy also supports accurate data collection for performance evaluation and ongoing planning.

5. Sustainable Financing and Partnership Schemes

Sustainable services require a stable financing strategy:

a. Cost-sharing schemes between the government, communities, and the private sector.
b. Development of fair service tariffs, tailored to household economic capacity.
c. Partnerships with the private sector/corporate CSR for initial investment or long-term maintenance.
d. Clear and sustainable funding ensures infrastructure remains operational without relying entirely on government budgets.

6. Continuous Monitoring, Evaluation, and Adjustment

A sustainability strategy is incomplete without a monitoring and evaluation (M&E) mechanism:

a. Regular monitoring of achievement indicators (access, quality, user satisfaction).
b. Evaluation of social, economic, and environmental impacts to assess effectiveness.
c. Adjustment of strategies and priorities based on field findings to ensure development remains relevant and responsive to changing community needs.

Optimizing and sustaining utility infrastructure development in Langkat Hilir requires a holistic strategy that encompasses needs-based planning, multi-agency coordination,

community empowerment, the use of appropriate technology, sustainable financing, and evaluative monitoring. This integrated approach will ensure that development not only increases infrastructure quantity but also generates equitable and sustainable socio-economic benefits while minimizing negative environmental impacts.

Conclusion

Based on the discussion above, several conclusions can be drawn:

1. Infrastructure Development

Over the past five years, utility infrastructure development in Langkat Hilir has shown significant improvement in all key sectors, including electricity, clean water, sanitation, internet, and drainage. This improvement demonstrates the success of the government and relevant partners in expanding basic services.

2. Social, Economic, and Environmental Impacts

The infrastructure that has been built provides tangible benefits: improving the community's quality of life (access to education, information, and health), increasing local economic activity (MSMEs and home businesses), and reducing certain environmental risks (flooding and environmental-related diseases).

3. Equitable Benefits

The benefits of utility development have not been felt equally. Remote areas and lowincome communities still face limited access and quality of services. Equitable access is a major challenge that needs to be addressed in future development strategies.

4. Supporting and Inhibiting Factors

Key supporting factors include government commitment, community participation, appropriate technology, and private sector support. Significant obstacles include limited maintenance budgets, geographical conditions, suboptimal inter-agency coordination, land conflicts, and community attitudes that do not support facility utilization.

5. Optimization and Sustainability Strategies

Recommended strategies include: community needs-based planning, cross-sector coordination, community empowerment in maintenance, implementation of appropriate technology, sustainable financing schemes, and regular monitoring and evaluation to ensure effective, equitable, and sustainable services.

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