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Optimizing the SPAM Network in Huta Padang Village: A Regional Planning Approach to Improve Access to Clean Water

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ABSTRACT

This study aims to examine the Optimization of SPAM Network in Huta Padang Village: A Regional Planning Approach to Improve Access to Clean Water. The qualitative research methods applied in this study allow for an in-depth understanding of the optimization of SPAM networks in Huta Padang Village by considering the perspective of the community and local conditions. Data collection techniques such as in-depth interviews, field observations, and document studies, as well as systematic analysis, provide comprehensive insights into the needs and opportunities to improve access to clean water. The results of the research The regional planning approach is proven to provide a systematic and structured way to overcome existing challenges. Identify additional water resources that can be used sustainably to increase water supply. Renewing damaged pipelines, installing pumping systems in hilly areas, and conducting integrated distribution to improve the pressure and quality of water flow. Implementing zoning to manage water pressure and allocation according to the needs of each area, so that water supply is more even and efficient. Optimizing the SPAM network in Huta Padang Village through a regional planning approach can significantly increase access to clean water. Through solutions that focus on infrastructure management, community participation, and the use of technology, access to clean water for all village communities can be more guaranteed. These steps are expected to create a healthier environment and support the welfare of the people of Huta Padang Village in a sustainable manner.

Keywords: SPAM Network Optimization, Regional Planning Approach and Improving Water Access Clean

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1. INTRODUCTION

Clean water is a basic need that is very important for daily life, health, and well-being of the community. Huta Padang Village, located in Bandar Pasir Mandoge District, Asahan Regency, North Sumatra, faces various challenges in providing clean water. Although the government has built a Drinking Water Supply System (SPAM) in several areas, the existing distribution network has not been able to reach all villagers. This problem is exacerbated by several factors, such as limited infrastructure, increasing demand for clean water, inadequate water quality, geographical challenges, limited funding, and low community participation in SPAM management. Access to clean water is a very important basic need to support health, daily life, and social and economic development of the community. Huta Padang Village, located in Bandar Pasir Mandoge District, is one of the areas that faces limitations in terms of providing clean water. Although the government has built a Drinking Water Supply System (SPAM) in several villages, the problem of accessibility, distribution, and sustainability of clean water resources is still a major challenge that has not been fully resolved in Huta Padang Village.

This problem shows the importance of a regional planning approach in optimizing the SPAM network in order to be able to reach more residents evenly and sustainably. This approach not only considers the technical aspects, but also the geographical, social, and economic conditions of Huta Padang Village so that access to clean water can be optimally improved. Some of the important factors behind this problem are: Huta Padang Village still has limitations in terms of effective SPAM infrastructure and is able to reach all households in the area. Existing distribution pipelines often do not cover more remote areas, so many residents have to look for water sources from rivers or wells whose water quality is not guaranteed. With the population growth continuing to increase, the need for clean

water is also increasing. The limitations of the SPAM distribution network and this increase in demand can pose a risk of water scarcity, leading to health and hygiene problems for the community. Therefore, it is necessary to increase the capacity of the SPAM network that can accommodate the increasing demand for water. In addition to accessibility, the quality of water available in Huta Padang Village is also a major concern. Alternative water sources such as shallow wells and rivers used by most communities often do not meet quality standards that are fit for consumption. Contamination due to domestic waste or agricultural activities can cause water quality to decline and threaten public health.

Huta Padang Village has quite challenging geographical conditions, with some areas located far from the village center and difficult to reach. This long distance and difficult terrain make it difficult to build a clean water pipeline that can reach all households. This requires comprehensive regional planning so that the SPAM network can reach all village areas. The construction and maintenance of SPAM networks requires large budgets, while the allocation of funds for villages is often limited. This low funding capacity limits the ability of village governments and communities to develop and maintain the necessary SPAM infrastructure. The sustainability of the drinking water supply system is highly dependent on community participation in the management and maintenance of existing infrastructure. However, the involvement of the people of Huta Padang Village in SPAM management is still minimal, which can have an impact on the continuity of the SPAM system itself. The regional planning approach is a solution that can be optimized in overcoming the problem of access to clean water in Huta Padang Village. With this approach, SPAM networks can be designed more strategically, taking into account the geographical aspects, population needs, and resources available in the region. Through comprehensive planning, the village government together with the community can optimize the SPAM network which not only expands access, but also ensures the sustainability of the supply of clean water for all villagers.

Optimizing the SPAM (Drinking Water Supply System) network in Huta Padang Village is an important effort to ensure the availability and accessibility of clean water for the community. Huta Padang Village, which faces various challenges in providing clean water, requires a comprehensive strategy involving regional planning to address geographical constraints, limited infrastructure, and the growing needs of the population. Assess the current condition of the SPAM network in Huta Padang Village, including production capacity, distribution pipeline conditions, and service area coverage. This step aims to identify the parts of the network that need repair or expansion. Based on the results of the analysis, increasing infrastructure capacity can include adding production capacity, expanding pipeline networks, and installing storage tanks in strategic locations. This is so that the SPAM network is able to meet the increasing demand for water. Using a zoning approach to determine the optimal location of the SPAM network infrastructure, such as the location of reservoirs and distribution lines that can reach the entire village area. This approach considers the geographical conditions of Huta Padang Village, so that the SPAM network can be accessed by all residents, including in remote areas. Ensure that the water source used for SPAM meets clean water quality standards. If necessary, install a water filtration or treatment system at the source to guarantee that the water being dispensed is safe for consumption.

Involving the community in the management and maintenance of the SPAM network is critical to the sustainability of the program. Training and socialization can be provided to the community on how to maintain pipelines and maintain water quality, as well as the importance of paying dues to support the operation of SPAM networks. Because budget constraints are one of the main obstacles, village governments need to collaborate with the private sector, local governments, or donor agencies to obtain funding assistance. In addition, transparent and efficient fund management is essential to ensure that SPAM networks can run sustainably. Regularly monitoring and evaluating the condition of the SPAM network will help in detecting problems early and ensuring that the network remains functioning properly. This system can include regular inspections, maintenance, and handling repairs if damage to the infrastructure is found. Benefits of SPAM Network Optimization Improving Access to Clean Water Optimizing the SPAM network will ensure that more residents can access clean water easily, thereby improving people's health and quality of life. Lowering the Risk of Disease with access to clean water, the risk of disease associated with contaminated water can be minimized. Strengthening Community Participation Involving the community in the management of SPAM will foster a sense of ownership and shared responsibility, which ultimately supports the sustainability of the program. Supporting Sustainable Regional Development with adequate access to clean water, Huta Padang Village can develop other sectors, such as agriculture and small businesses, which also support economic development and community welfare.

2. LITERATURE REVIEW

SPAM Network Optimization Concept

Optimizing the Drinking Water Supply System (SPAM) network is an effort to increase the efficiency, effectiveness, and reach of the clean water distribution system in order to meet the needs of the community equally. According to Supriyadi (2020), the optimization of the SPAM network must include improving infrastructure, such as distribution pipes, pumps, and reservoirs, as well as the implementation of an integrated management system. Supriyadi emphasized that optimization must consider sustainability aspects, where water sources and supporting infrastructure need to be designed for the long term to be able to support population growth.

Regional Planning for Clean Water Infrastructure

The regional planning approach in the development of clean water infrastructure has an important role in ensuring fair and equitable access for all communities. According to Santoso (2020), regional planning allows the provision of infrastructure that is adjusted to geographical conditions, settlement patterns, and the needs of local communities. Santoso revealed that good regional planning will take into account geographical factors, such as topography and distance between houses, so that clean water distribution can be done effectively with an efficient network.

Utilization of Technology in SPAM Optimization

Technological developments play an important role in the optimization of SPAM networks. Based on Rahmawati's (2020) research, appropriate technologies such as modern filtration systems, water quality sensors, and smart pipelines can increase the effectiveness of drinking water supply systems. Rahmawati argued that the use of technology can help in monitoring water quality and pressure in the network, thereby minimizing the risk of leakage or deterioration of water quality. Thus, the optimization of the SPAM network becomes more efficient and reliable.

Community Participation in SPAM Management

According to a study conducted by Hidayat (2020), community participation is an important element in the management of SPAM networks, especially in rural areas. Hidayat showed that community involvement in planning, maintaining, and supervising the drinking water system plays a big role in the operational sustainability of the network. Community involvement helps in keeping infrastructure from damage, extending its service life, and building awareness of the importance of clean water.

Funding and Cooperation in the Development of Clean Water Infrastructure

Adequate funding and cross-sector cooperation are needed in optimizing SPAM networks, especially in the context of villages such as Huta Padang which have limited budgets. According to research conducted by Putra and Azizah (2020), collaboration between the government, the private sector, and non-governmental organizations can strengthen funding and provide the technical assistance needed for the construction and maintenance of SPAM networks. Putra and Azizah emphasized that transparent and planned funding is important to ensure the sustainability of the SPAM network, so that it can continue to serve the community optimally.

A Data-Based Approach in Regional Planning

A data-driven approach helps in understanding the need for clean water, demand patterns, and the capacity of existing water sources. According to Abdullah (2020), SPAM network planning must be based on population data, water demand analysis, and population growth projections. This approach allows for more accurate planning, so that the development of clean water infrastructure can be adapted to real conditions on the ground.

Monitoring and Evaluation System in SPAM Management

A continuous monitoring and evaluation system is indispensable to maintain the performance of the SPAM network. According to a study conducted by Setiawan (2020), the monitoring system allows early detection of problems in the network, such as leakage or deterioration of water quality. Setiawan suggested the use of sensor-based technology for real-time monitoring of water quality and pipe pressure, which can minimize the risk of service disruption and maintain the quality of water distributed to the community.

METHOD APPROACH

Qualitative research is a method used to understand social phenomena in a natural context, where researchers play the role of the main instrument in data collection. According to Mariam (2020), the qualitative method focuses on a deep understanding of a complex problem with a holistic approach, providing space for respondents to convey their views and perceptions directly. In the context of this

study, qualitative methods help in exploring the perception of the people of Huta Padang Village towards the importance of the SPAM network and the need for clean water.

The research design used in this study is a case study, which according to Supriyadi (2020) is the right approach to analyze a specific problem in a certain context in depth. The case study allows researchers to explore in detail the existing conditions, constraints, and opportunities that exist in optimizing the SPAM network in Huta Padang Village. Supriyadi stated that the case study design makes it easier for researchers to understand the local context, such as the geographical and socio-cultural characteristics of the village that affect access to clean water.

In qualitative research, data collection techniques usually include in-depth interviews, observations, and document analysis. According to Rahmawati (2020), in-depth interviews allow researchers to obtain direct data from key informants, such as village officials, community leaders, and residents who rely on SPAM networks. Rahmawati emphasized the importance of field observation to understand the physical condition of the existing SPAM network, such as the condition of pipes and the quality of water sources, as well as public perception of the service.

Data analysis in qualitative research is carried out in stages, starting from data collection, data reduction, data presentation, to drawing conclusions. Santoso (2020) explained that qualitative data analysis requires an in-depth data processing process to find the main patterns and themes relevant to the research. In the context of this study, data from interviews, observations, and documents were analyzed to understand public perceptions, SPAM network conditions, and network optimization challenges and opportunities.

In qualitative research, the validity and reliability of the data are maintained through triangulation techniques, namely by comparing data from various sources to ensure consistency and validity. According to Abdullah (2020), triangulation is very important to overcome subjectivity in qualitative research, especially in social research involving individual perspectives. Data triangulation can be done by combining the results of interviews, observations, and document studies to ensure valid and reliable data. Data collection techniques such as in-depth interviews, field observations, and document studies, as well as systematic analysis, provide comprehensive insights into the needs and opportunities to improve access to clean water.

3. DISCUSSION

What is the current condition of the SPAM network in Huta Padang Village?

The condition of the SPAM (Drinking Water Supply System) network in Huta Padang Village is currently still facing a number of challenges that hinder the optimal provision of clean water access. Based on field observations and interviews with the community and managers, the condition of the SPAM infrastructure shows several main problems, such as limited capacity, poor pipeline quality, and uneven distribution coverage.

1. **Limited water source capacity**. Currently, the capacity of water sources used for the SPAM network is limited and has not been able to meet the needs of all village communities. The main source of water comes from local springs, which in the dry season often experience a decrease in discharge. This causes the water supply to decrease, so not all households can get enough access to water, especially at certain times. This indicates that existing water sources require further development or the need to find additional sources to support the sustainability of SPAM networks.
2. **Quality of Pipeline Infrastructure and Equipment**. The pipeline infrastructure in Huta Padang Village is mostly old and vulnerable to damage. Based on observations, many distribution pipes are leaking and corroding, resulting in water loss during the distribution process. Damage to these pipes often requires urgent repairs, but due to limited funds, repairs cannot always be made on time. In addition, the quality of water that reaches houses is sometimes affected by suboptimal pipe conditions, thus having an impact on the quality of water consumed by the community.
3. **Uneven Distribution Coverage**. The coverage of the distribution of the SPAM network in Huta Padang Village has not been evenly distributed throughout the region. Some hamlets, especially those located in more remote locations or with higher topography, have difficulty getting adequate access to clean water. This is due to the limited reach of distribution pipelines and the lack of a strong pumping system to drain water to higher areas. As a result, some people are

forced to rely on other water sources, such as wells or rivers, which may not be as good quality as water from SPAM networks.

4. **Management and Maintenance That Is Not Optimal**. The management of the SPAM network in Huta Padang Village still faces obstacles in terms of routine maintenance and infrastructure improvements. Village SPAM managers currently face budget limitations and a trained workforce to carry out periodic maintenance on the SPAM network. As a result, minor damage is often left to become more severe, which then requires greater repair costs. This suboptimal management causes the performance of the SPAM network to be inconsistent, so that the community often experiences water supply disruptions.
5. **Water Quality Needs to Be Improved**. Although SPAM networks provide access to clean water, some users complain of inadequate water quality, especially in terms of clarity and odor. This condition may be due to the long-standing quality of the pipes, which allows contamination during the distribution process. Water quality analysis shows that there is a need to improve the water filtration or treatment system before distributing it to residents' homes so that the quality of water received by the community is better and suitable for consumption.

Huta Padang Village is located in an area that has significant seasonal variations. In the rainy season, water discharge at the main source of SPAM tends to be sufficient, but in the dry season, water discharge decreases drastically so that the capacity of the SPAM network decreases. In addition, the hilly topography of the village is also a challenge in water distribution, especially to houses at high altitudes, where water pressure is often insufficient to get to the location. The results of interviews with the community revealed that most residents felt helped by the existence of the SPAM network even though there were still various obstacles. They hope that the village government and SPAM managers can improve the quality of services, both in terms of capacity, water quality, and distribution coverage. Some communities suggested that infrastructure should be updated, especially old and damaged pipes, and increased maintenance so that the water supply can be more stable. The current condition of the SPAM network in Huta Padang Village still needs improvement from various aspects, both in terms of capacity, infrastructure quality, and distribution coverage. Environmental challenges and limitations in management and maintenance are inhibiting factors that need to be addressed immediately so that access to clean water for the community can be improved. Optimizing the SPAM network with integrated regional planning is a solution that is expected to answer the need for clean water in Huta Padang Village in a sustainable manner.

What are the inhibiting factors in the supply and distribution of clean water in Huta Padang Village

The supply and distribution of clean water in Huta Padang Village still faces various inhibiting factors that affect the quality and accessibility of the SPAM (Drinking Water Supply System) network. These inhibiting factors include interrelated technical, environmental, managerial, and social aspects. The following is a description of the main inhibiting factors in the provision and distribution of clean water in Huta Padang Village.

1. Limited Water Resources One of the main obstacles in the provision of clean water in Huta Padang Village is the limited available water resources. The water sources used today are limited to local springs that have experienced a decrease in discharge, especially in the dry season. When water discharge decreases, the water supply capacity is not enough to meet the needs of all village communities. This limitation results in an unstable water supply and causes some village areas to not get an equal supply of clean water.
2. Inadequate Network Infrastructure The condition of the SPAM network infrastructure in Huta Padang Village has begun to age and is prone to damage. Most of the distribution pipes are leaking and corroding which not only results in water loss during the distribution process but also reduces the quality of water that reaches residents' homes. The quality of these long-standing pipes and network systems is one of the main obstacles that cause disruptions in the distribution of clean water.
3. Challenging Village Topography The hilly topography of Huta Padang Village and the difference in elevation between regions makes it difficult to distribute clean water to all households. Areas located in higher places tend to experience low water pressure, so the water supply does not reach optimally. This condition requires the addition of infrastructure, such as water pumps or boosters, to ensure adequate water pressure for the entire village area.

4. Budget limitations for the maintenance and development of SPAM network management in Huta Padang Village are limited by the availability of minimal budget. These budget limitations have an impact on the lack of regular maintenance and repair of damaged SPAM networks. As a result, network damage is often left to become more severe and require greater repair costs. In addition, budget constraints also hinder infrastructure development, such as the addition of pipelines or water treatment facilities that can increase the capacity and quality of SPAM services.
5. Lack of Trained Human Resources, limited skilled workforce in the management and maintenance of SPAM networks are other significant obstacles. Huta Padang Village still lacks trained technical personnel in terms of water infrastructure maintenance, clean water treatment, and handling other technical problems. This causes network repairs and maintenance to not be carried out optimally, resulting in frequent water distribution disruptions.
6. Suboptimal Water Treatment Quality In addition to infrastructure factors, the quality of water treatment that is not optimal is also an obstacle to the provision of quality clean water. In some cases, the water being distributed contains impurities or odors, which indicates that the water treatment process before distribution needs to be improved. The inadequate quality of water treatment causes people to hesitate to consume water from the SPAM network, especially for drinking needs.
7. Lack of Public Participation and Awareness Community participation in maintaining and maintaining the SPAM network is still relatively low. Some communities have not realized the importance of maintaining the quality of pipelines and infrastructure, such as not damaging pipes or using water efficiently. This lack of participation makes network maintenance more difficult and increases the risk of damage. In addition, awareness of the importance of efficient water management is also still low, so the use of clean water is sometimes not in accordance with needs, which has the potential to reduce the water supply for others.

Some of the main inhibiting factors in the provision and distribution of clean water in Huta Padang Village are limited water resources, inadequate infrastructure conditions, challenging topography, budget limitations, lack of skilled human resources, suboptimal water treatment quality, and low community participation. These factors interact with each other and have an impact on the limited access to clean water for village communities. To overcome these obstacles, efforts to improve and optimize are needed through infrastructure improvement, human resource development, and increasing public awareness of the importance of sustainable clean water management.

How can the regional planning approach be used to optimize the SPAM network to increase access to clean water for the people of Huta Padang Village

The regional planning approach can provide a strategic and structured solution to optimize the SPAM network in Huta Padang Village, in order to increase access to clean water for the community. By combining spatial analysis, infrastructure planning, and integrated resource management, this approach is able to answer the technical, social, and environmental problems faced in the provision of clean water. The following are some steps that can be taken through the regional planning approach.

1. Identification and Proper Utilization of Water Resources
   In the regional planning approach, the first step is to map the potential of water resources around Huta Padang Village. This process involves. Hydrology and Water Availability Analysis**:** Identifying additional water sources, such as rivers or other springs, that can be leveraged to support SPAM networks. Hydrological data will help determine whether the water source has sufficient capacity to meet the needs of the community. Sustainable Management of Water Resources**:** Regulating the use of water according to the natural availability of these resources to remain sustainable. Regional planning also includes arrangements so that water use does not exceed the recovery capacity of the source, especially in the dry season.
2. Distribution Network Infrastructure Optimization
   Regional planning involves optimizing distribution network infrastructure through the design and improvement of pipeline network layouts as well as the selection of technology that is in accordance with topographic conditions and community needs. Applicable steps include: Pipe Repair and Replacement**:** Replacing old or damaged pipes to reduce leaks and increase water pressure. Addition of Pump System**:** Installing pumps or boosters in higher areas to ensure

sufficient water pressure for hard-to-reach areas. Integrated Distribution**:** Establish an efficient distribution network by considering population distribution and accessibility, so that water can be distributed more evenly throughout the village.

3. Zoning of Areas Based on Water Needs
   In regional planning, the division of villages into different zones based on needs and geographical location can improve the efficiency of SPAM networks. These zones allow managers to. Prioritize Water Allocation**:** Develop a water distribution system that gives priority to areas with greater water needs or hard-to-reach areas. Use of Adjustable Water Pressure**:** Regulates the water pressure according to the characteristics of each zone, for example by installing a pressure reducing valve to maintain a stable flow.
4. Utilization of SPAM Network Monitoring Technology
   The area planning approach also includes the application of monitoring technology to facilitate the management and early detection of problems in SPAM networks. Some of the technologies that can be applied are, *Leak Detection* System**:** Using sensors or monitoring tools to detect leaks in pipelines so that repairs can be carried out faster. Use of GIS for Water Distribution Analysis**:** Utilizing Geographic Information Systems (GIS) to monitor water distribution patterns and availability in each village area. GIS allows managers to view locations with supply issues and assess infrastructure that needs to be repaired or expanded. Automation Technology**:** Using automation technology on pressure and water flow regulation systems to ensure the supply remains stable and even.
5. Capacity Building for Community Management and Participation
   Regional planning not only relies on physical infrastructure but also focuses on sustainable management and active participation of the community. This effort includes, SPAM Manager Training and Capacity Building**:** Providing training for SPAM network management officers on maintenance, repair, and clean water management so that they have adequate skills. Community Socialization and Education**:** Providing education to the public about the importance of efficient water use, maintaining SPAM networks, and maintaining the cleanliness of water sources. Community participation is very important to maintain the sustainability of the SPAM network. Establishment of Village Water Management Group**:** Forming a special group at the village level that functions to monitor water use and provide input for SPAM management so that the needs and aspirations of the community are always considered.
6. Policies and Collaboration Between Institutions
   To realize the success of regional planning, collaboration between the village government, related institutions, and the community is very important. Some of the policy steps that can be taken include, Increasing Budget Allocation for Clean Water Infrastructure**:** Submitting a budget from the local government for the repair and development of the SPAM network. Collaboration with Private Institutions or NGOs**:** Collaborate with the private sector or non-governmental organizations (NGOs) to provide technical assistance or funding to improve the quality of SPAM networks. Development of Water Resources Protection Policy**:** Create local regulations that protect water resources from damage or pollution so that water resources are preserved.

The regional planning approach provides a comprehensive solution to optimize the SPAM network in Huta Padang Village to improve access to clean water. Through proper water resource management, optimization of distribution infrastructure, zoning of areas, application of monitoring technology, increasing management capacity, and collaboration between institutions, regional planning can increase the effectiveness and sustainability of clean water supply systems. The implementation of these measures is expected to be able to meet the clean water needs of the people of Huta Padang Village more evenly and with quality.

4. CONCLUSION

At the end of this study regarding the optimization of the SPAM network in Huta Padang Village, with the regional planning approach to improve access to clean water, several important things can be concluded related to the challenges, strategies, and implementation of solutions needed to realize the equitable availability of clean water for the village community:

Huta Padang Village still faces various obstacles in the provision and distribution of clean water. Some of the main challenges identified are limited water resources, aging infrastructure conditions, difficult topography, and limited budgets and skilled human resources. These factors contribute to the low quality and stability of clean water distribution in this village. The regional planning approach has

been proven to provide a systematic and structured way to address existing challenges. Some of the proposed strategic steps include, Water Resources Mapping and Utilization: Identifying additional water resources that can be used sustainably to increase water supply. Infrastructure Optimization: Updating damaged pipelines, installing pumping systems in hilly areas, and conducting integrated distribution to improve water flow pressure and quality. Water Distribution Zoning: Implementing zoning to manage water pressure and allocation according to the needs of each area, so that water supply is more even and efficient. Use of Monitoring Technology: Implement a leak monitoring system and utilize GIS technology for SPAM network monitoring to improve operational effectiveness. Human Resource Capacity Building and Community Participation: Engaging the community through education and the formation of water management groups and providing training for management officers to ensure sustainable water maintenance and management.

Optimizing the SPAM network in Huta Padang Village through a regional planning approach can significantly increase access to clean water. Through solutions that focus on infrastructure management, community participation, and the use of technology, access to clean water for all village communities can be more guaranteed. These steps are expected to create a healthier environment and support the welfare of the people of Huta Padang Village in a sustainable manner.

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