

DEVELOPMENT OF CLEAN WATER NETWORKS IN THE DRINKING WATER MANAGEMENT SYSTEM (SPAM) IN PADANG TUALANG DISTRICT IN INCREASING THE NEED FOR CLEAN WATER

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Abstract

This study aims to explore the existing conditions and constraints faced in the management and distribution of clean water in Padang Tualang District, and to propose effective development strategies. Using a qualitative approach, this study identified key issues, including limited capacity of the water treatment system, damage to the distribution network, and uneven water quality. Various strategies are proposed, such as increasing the capacity of water treatment plants, repairing and expanding the distribution network, diversifying water sources, and empowering communities. This study provides recommendations to local governments, SPAM managers, and communities to work together to realize a more effective and sustainable clean water management system.

Keywords: *Clean Water Management, Drinking Water Management System (SPAM), Padang Tualang District, Clean Water Network Development and Infrastructure Maintenance*

INTRODUCTION

Clean water is a basic human need that is very vital to support daily life. The availability of adequate clean water not only has an impact on public health, but also has a major impact on the social and economic development of a region. (Rahmadani et al., 2023). Padang Tualang District, as one of the developing areas in Langkat Regency, faces challenges in meeting the need for clean water along with the increasing population, changes in settlement patterns, and increasing economic activities of the community. The current Drinking Water Supply System (SPAM) in Padang Tualang District is still unable to fully meet the clean water needs of all residents evenly, both in terms of quantity, quality, and continuity. Several villages and certain residential areas still experience difficulties in accessing clean water, especially during the dry season, where the water supply decreases drastically. In addition, most of the existing water distribution networks require repair, development, or expansion to optimize service coverage.

The development of clean water networks is a strategic solution to increase the effectiveness and efficiency of drinking water management systems in this region. Development efforts not only include expanding the pipe network, but also increasing production capacity, improving distribution systems, and management based on the principles of sustainability and community empowerment. (Lubis & Sugiarto, 2024). With better management, it is expected that access to clean water can increase, the quality of life of the community will be raised, and a healthier and more productive environment will be created. The need for clean water in Padang Tualang District continues to increase along with the increasing population and the development of various socio-economic activities of the community. Clean water, which should be a basic right of every individual, is in reality still a rare commodity in several areas of this district. The phenomenon of limited access to clean water is clearly visible, especially in the outskirts and new settlements, where the water distribution network system has not fully reached all levels of society. Many people in Padang Tualang District still rely on traditional water sources such as dug wells, rivers, or rainwater, the quality of which does not always meet health standards. In the dry season, this problem is exacerbated by the decreasing groundwater discharge and the drying up of natural water sources, so that the need for clean water becomes even more urgent. Not a few households have to buy clean water at high prices or travel

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long distances to get water, which of course has an impact on the family's economic burden. On the other hand, the existence of the Drinking Water Supply System (SPAM) managed by the local government or management units still faces various obstacles, ranging from limited production capacity, leaking pipe networks, to less than optimal operational and maintenance problems. As a result, water distribution is uneven and many residents have not enjoyed decent drinking water services. This condition creates a gap in meeting basic needs, which ultimately has an impact on the quality of life of the community. The phenomenon of unequal access to clean water is a real problem that must be addressed immediately through efforts to develop a more comprehensive, integrated, and sustainable clean water network. Thus, Padang Tualang District can meet the clean water needs of its people fairly and evenly, while supporting the achievement of regional development targets in the fields of health, environment, and community welfare. Clean water is a fundamental element in supporting the quality of life, health, and community welfare. In Padang Tualang District, the problem of limited access to clean water is an increasingly urgent issue to be addressed immediately. The limited capacity of the current drinking water management system (SPAM), exacerbated by population growth and expansion of residential areas, has resulted in inequality in the distribution of clean water in various regions (Sugiarto & Kustiah Ramadania, 2024). This condition not only impacts the public health aspect, but also hampers the social and economic productivity of citizens.

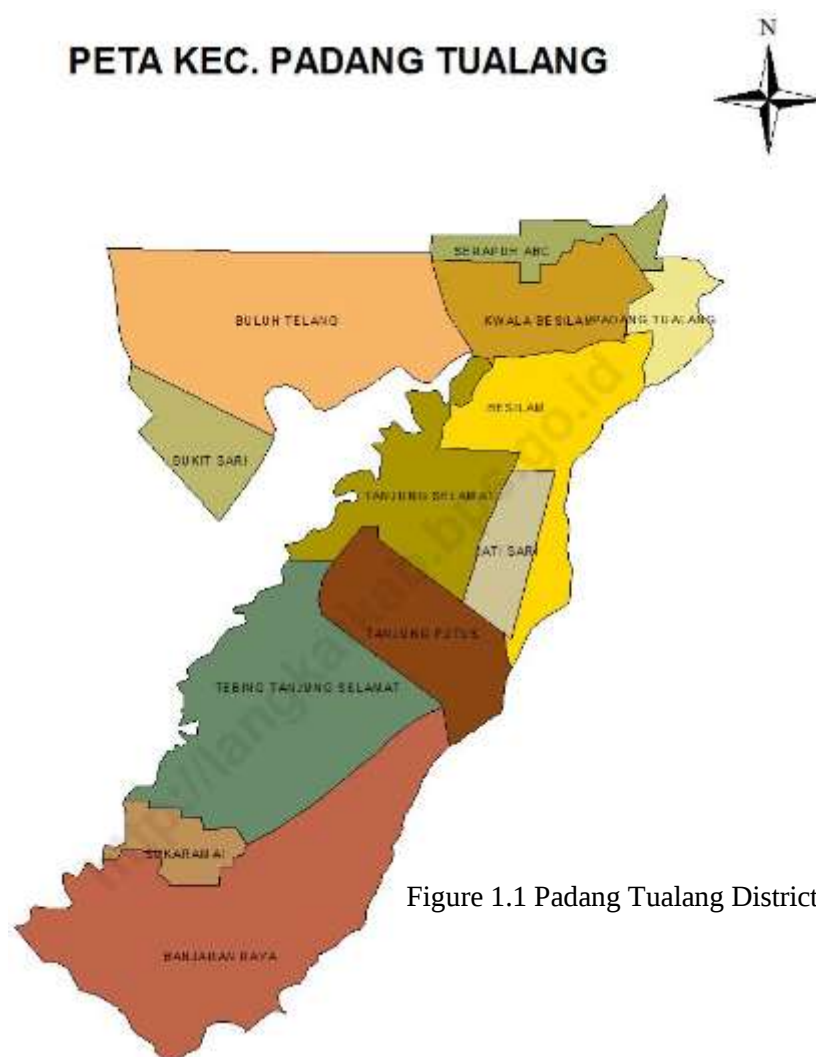


Figure 1.1 Padang Tualang District

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Figure 1.2 Existing Map of Padang Tualang District



Figure 1.3 Existing Map of Padang Tualang District

The urgency of this research lies in the need to accelerate the development of clean water networks that are able to meet the needs of the entire community evenly, effectively, and sustainably. Without planned and data-based development efforts, the potential for a clean water crisis in the future will be even greater, which will certainly have serious consequences for social life, public health, and environmental stability in Padang Tualang District. In addition, this study is important to provide recommendations based on scientific studies to local governments and other stakeholders, in formulating more optimal drinking water management policies, programs, and strategies. With the results of this study, it is expected to support regional development efforts that are oriented towards improving the quality of basic community services, realizing equitable infrastructure development, and accelerating the achievement of sustainable development goals (SDGs), especially on targets related to access to clean water and proper sanitation for all. Thus, research on "Development of Clean Water Networks in the Drinking Water Management System (SPAM) in Padang Tualang District in Increasing Clean Water Needs" is very important and relevant to be implemented at this time.

Identification of problems

In an effort to meet the basic needs of the community, the availability of clean water is an important factor that must be considered. In Padang Tualang District, there are various problems related to the provision and distribution of clean water, including:

1. Unequal access to clean water networks throughout sub-districts, especially in outlying areas and new settlements.
2. The capacity of the Drinking Water Management System (SPAM) is still limited so that it is not yet able to meet the needs of the entire population.
3. The occurrence of leaks and damage to the water distribution network hinders the effectiveness of clean water distribution.
4. The quality of the water produced does not fully meet health standards, especially during the dry season.
5. Lack of sustainable management and maintenance of clean water infrastructure.
6. Lack of community participation in maintaining and supporting the drinking water supply system.
7. Increasing population growth and economic activity have increased pressure on the need for clean water.

Formulation of the problem

Based on the identification of the problem, the formulation of the problem in this study is:

1. What is the existing condition of the clean water network in the Drinking Water Management System (SPAM) in Padang Tualang District?
2. What are the obstacles faced in the management and distribution of clean water in Padang Tualang District?
3. What is an effective clean water network development strategy to improve the fulfillment of clean water needs of the community in Padang Tualang District?

LITERATURE REVIEW

2.1 Water Resources Management

Clean water management is an important aspect in meeting the basic needs of the community. According to Siregar (2022), good water resource management can increase community access to clean water by reducing dependence on poorly managed water sources. The Drinking Water Management System (SPAM) is one solution to ensure equitable and sustainable distribution of clean water. Good water management requires maintaining an efficient distribution network and capacity planning in accordance with population growth.

2.2 Clean Water Network Development

The development of a clean water network is one of the strategic steps to increase the distribution of drinking water in areas with limited access. According to Putra et al. (2022), the design of a good clean water distribution network must consider geographic factors, water needs, and resource capacity. In Padang Tualang District, the development of a clean water network focuses on increasing the capacity and quality of existing infrastructure. With the development of this network, it is hoped that the community can receive clean water evenly and sustainably (Akus Harmoko et al., 2024).



Figure 2.2.1 Figure of Clean Water Network Development in Padang Tualang District



Figure 2.2.2 Figure of Clean Water Network Development in Padang Tualang District

2.3 Clean Water Quality

Water quality is an important factor in the drinking water management system. Salim (2022) stated that good water quality is highly dependent on proper infrastructure management and maintenance. Therefore, the construction and development of clean water networks must not only pay attention to the quantity aspect, but also the quality of the water produced. Its filtration, proper processing, and maintenance of an integrated water distribution system can improve the quality of water reaching consumers.

2.4 Challenges in SPAM Management in Remote Areas

Managing clean water systems in remote areas, such as Padang Tualang District, has its own challenges. As expressed by Arifin and Hasan (2022), these challenges include limited infrastructure, funding, and community participation in system maintenance. For this reason, a community-based approach is needed that can involve the community in maintaining the clean water network and support the sustainability of the system that has been built.

2.5 The Impact of SPAM on Community Welfare

One of the main objectives of SPAM development is to improve community welfare. According to Ramadhan et al. (2022), the provision of affordable and quality clean water will have a direct impact on people's quality of life, health, and productivity. In Padang Tualang District, with the development of an efficient clean water network, the community can reduce the burden of searching for clean water which has so far disrupted daily activities, and improve their overall standard of living.

2.6 Framework

1. Clean Water Needs Problem in Padang Tualang District

The need for clean water is a crucial issue that needs to be addressed in many areas, including Padang Tualang District. Currently, there is still an imbalance in the distribution of clean water that affects the quality of life of the community. This problem includes the quality and quantity of water that is insufficient for the daily needs of the community.

2. Drinking Water Management System (SPAM) as a Solution

SPAM is a system designed to provide clean water to the community by managing water resources in a planned and structured manner. With efficient SPAM, water distribution problems can be overcome, as well as improving the quality of life of the community, reducing diseases related to the consumption of water that is not maintained in quality.

3. Clean Water Network Development

The development of clean water distribution networks is key to ensuring that treated water reaches the community evenly and continuously. A good network must take into account topographic factors, water needs, and water resource capacity.

4. Clean Water Quality in SPAM

Good water quality is the main requirement for the success of the SPAM system. Proper management starting from the water source, processing, to distribution will determine the quality of water received by the community.

5. Challenges and Obstacles

Some of the main challenges faced in developing SPAM in remote areas are budget limitations, technological limitations, and low community participation in system maintenance.

6. Positive Impact of SPAM Development

The development of SPAM will have an impact on improving the quality of people's lives, better health, and increased productivity.

Providing affordable and quality clean water will reduce the economic burden on communities and improve their welfare.

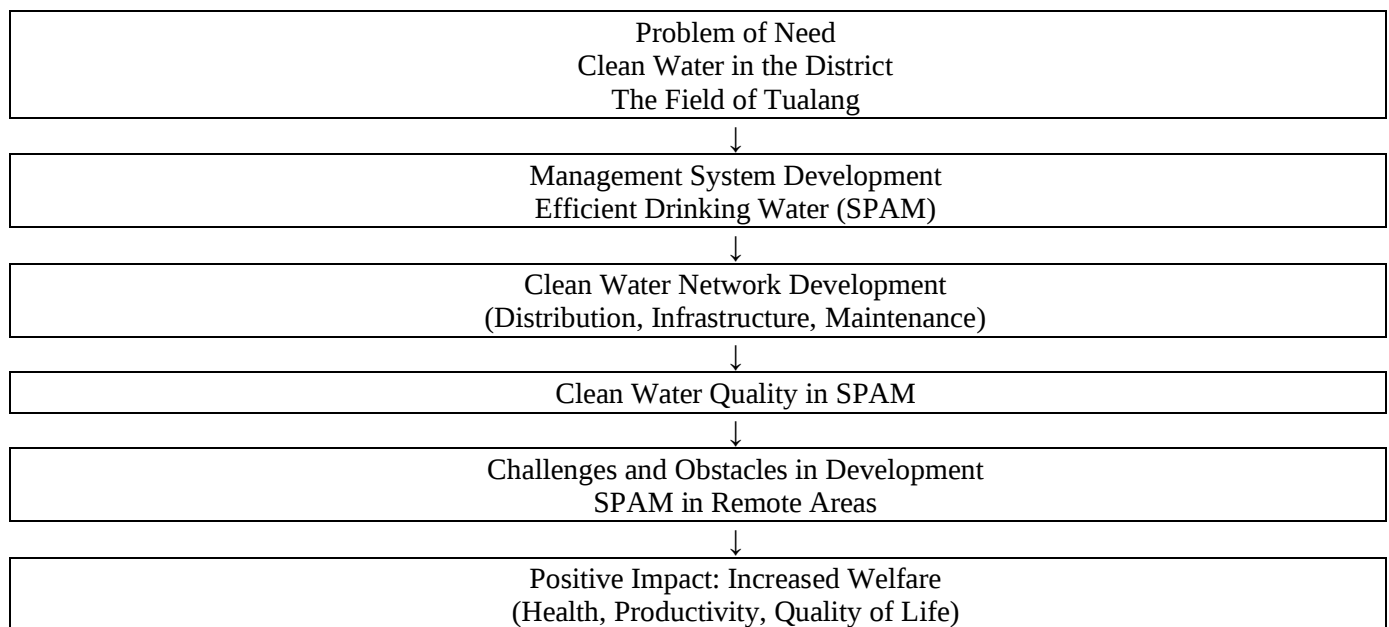


Figure 2.1 Framework of Thought

RESEARCH METHODS

3.1 Types of Research

The type of research used in this study is descriptive qualitative research. Descriptive qualitative research aims to describe existing phenomena in depth without manipulating existing variables. According to Suharto (2022), qualitative research provides a better understanding of social realities, including factors that influence the development of clean water networks in areas such as Padang Tualang District.

3.2 Research Approach

The approach used is a case study approach with in-depth data collection techniques through interviews, observations, and documentation. This approach allows researchers to obtain more holistic and contextual information regarding problems in the field (Iskandar, 2022). The case study approach is useful for assessing and analyzing phenomena that occur in Padang Tualang District related to SPAM management. (Sugiarto et al., 2024).

3.3 Research Location

This research was conducted in Padang Tualang District, Langkat Regency, which is a developing area and faces challenges in providing clean water. The selection of this location is based on the urgent need for the development of a better drinking water management system.

3.4 Population and Sample

The population in this study were people living in Padang Tualang District, as well as related agencies such as related agencies, SPAM managers, and local governments. Samples were taken purposively, namely by selecting individuals or groups who have knowledge or experience related to drinking water management systems and clean water needs in the area (Kusnadi, 2022).

3.5 Data Collection Techniques

Some data collection techniques used in this study are as follows:

- In-depth Interviews: Conducted with stakeholders, such as village heads, SPAM managers, and communities who experience the direct impact of the clean water distribution system.
- Participatory Observation: Researchers directly observe the condition of the clean water management system in the field, including the condition of the infrastructure and water distribution practices.
- Documentation: Collecting data from reports related to clean water management in Padang Tualang District, including technical data on clean water network infrastructure and water management policies.

3.6 Data Analysis

The collected data will be analyzed using thematic analysis techniques. This analysis allows researchers to identify themes or patterns that emerge from the existing data. According to Aulia (2022), thematic analysis in qualitative research is very useful for finding relationships between data and formulating findings that are relevant to research objectives.

3.7 Data Validity

The validity of the data in this study was maintained through triangulation techniques, which involve cross-checking data from various sources and data collection techniques (Sari, 2022). By using triangulation, researchers can verify the accuracy and consistency of the data obtained, both from interviews, observations, and documentation.

RESULTS AND DISCUSSION

What is the existing condition of the clean water network in the Drinking Water Management System (SPAM) in Padang Tualang District?

Padang Tualang District, located in Langkat Regency, still faces significant challenges in meeting the clean water needs of the community. The Drinking Water Management System (SPAM) in this area is already operational, but it is still not fully able to overcome the problem of clean water distribution evenly throughout the district. Although there are adequate water treatment installations in several locations, the available capacity is not yet able to meet the growing needs. One of the main problems is the limited water production capacity of the existing treatment installations. Along with population growth and the addition of new settlements, the amount of clean water needed is much higher than the available capacity. This causes a shortage of water supply, especially during the dry season, when the discharge of natural water sources (such as rivers and springs) decreases drastically.

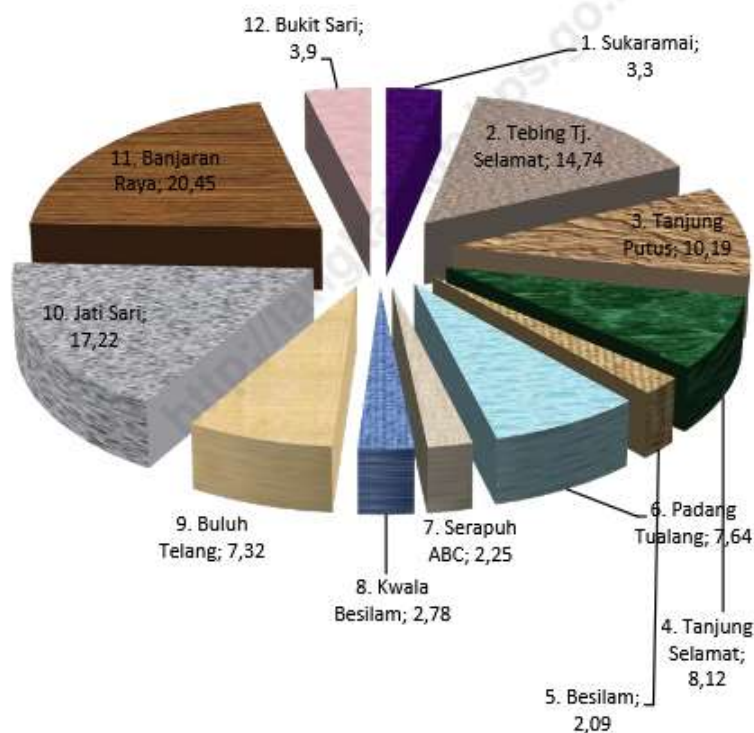


Figure 4.1 Area Ratio Graph

In addition, the quality of water produced by SPAM in several areas has not fully met the health standards set by the government. Some residents still complain about the smell or turbidity of the water being distributed, especially in channels that are further from the processing installation center. This shows that the management and maintenance of the water treatment system and distribution channels are not optimal. Another problem that has a significant impact is damage and leaks in the clean water distribution network. Many old or poorly maintained pipes cause leaks that hinder the distribution of water to people's homes. This not only reduces the amount of water reaching consumers, but also causes a significant waste of resources, as well as increasing operational costs for repairs and maintenance. Uneven water distribution is also an important issue. Several areas located far from water sources or treatment plants often experience water shortages, especially during peak hours of demand. The distribution network that is not yet well integrated and the limited pipe network result in many areas not being reached by clean water services.

In terms of management, SPAM in Padang Tualang District still faces challenges in terms of human resources, budget constraints, and lack of sustainable infrastructure maintenance. Without coordinated efforts between local governments, managers, and the community, clean water management tends to be reactive and not proactive enough to address existing problems. Overall, the existing condition of the clean water network in Padang Tualang District shows that the current drinking water management system is not optimal in meeting the clean water needs of the community evenly and sustainably. More structured improvement and development efforts are needed to ensure that clean water can be accessed by all levels of society, both in terms of quantity and quality.

What are the obstacles faced in the management and distribution of clean water in Padang Tualang District?

Clean water management and distribution in Padang Tualang District faces various obstacles that affect the quality and efficiency of clean water services to the community. Although efforts have been made by the government and related agencies to provide clean water, a number of obstacles are still the main challenges in achieving it. Some of the significant obstacles include the following:

1. Infrastructure and Production Capacity Limitations

One of the main obstacles in clean water management in Padang Tualang District is the limited production capacity of the existing water treatment plant (IPA). The current capacity is unable to keep up with the rate of population growth and new settlements that continue to develop. As a result, the water supply is insufficient,

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especially during the dry season when natural water discharge decreases. Although there are several water sources used for SPAM, their capacity is limited and cannot fully meet the increasing need for clean water.

2. Distribution Network Damage and Leaks

The clean water distribution network in Padang Tualang District also faces problems with damage and leaks in old or poorly maintained pipes. Leaks in pipes cause significant loss of water volume before it reaches consumers, resulting in waste of processed water resources. In addition, damage to the distribution network also increases operational costs for maintenance and repairs, which should be diverted to improving service quality.

3. Uneven Water Distribution

Although there is a water distribution system that has been built, many areas in Padang Tualang District still have difficulty getting access to clean water evenly. Several areas located far from the processing installation center or water source experience supply problems, especially during peak hours of use. This distribution inequality is also caused by the limited pipe network, where several areas have not been reached by the existing distribution network.

4. Inadequate Water Quality

The quality of water distributed by SPAM in Padang Tualang District is also an obstacle. Although the water treatment process has been carried out, several areas still experience problems with the quality of the water produced. Water that reaches people's homes sometimes does not meet the established health standards, such as cloudy or smelly water. This is due to limited water treatment facilities, as well as a lack of monitoring of the quality of water produced and distributed.

5. Suboptimal Management and Maintenance

Another challenge is the management and maintenance of clean water networks which are still considered less than optimal. Human resources involved in clean water management are often limited in number and skills. In addition, the lack of budget for infrastructure maintenance and repairs causes some damage to the distribution network not to be repaired immediately, which worsens the water supply problem. Without effective management, clean water systems tend to be reactive, only dealing with problems after they arise, rather than anticipating problems before they occur.(Hidayat et al., 2023).

6. Limited Community Participation

One of the factors that influences the success of clean water management is community participation in maintaining and caring for existing facilities. However, many residents are less aware of the importance of their role in maintaining the cleanliness and smoothness of the clean water distribution system. Lack of public awareness of water channel maintenance and leak reporting causes the distribution system to often break down without being repaired immediately. Increasing public awareness and participation in this matter is a big challenge.

7. Social and Economic Challenges

In addition to technical and infrastructure issues, social and economic factors also contribute to the constraints in clean water management. In some areas, especially in border areas or remote areas, people have difficulty paying the increasing costs of clean water services, especially for families with limited economy. The inability of some people to pay water bills often leads to the unsustainability of the clean water service system, which worsens the water supply problem.

The obstacles faced in the management and distribution of clean water in Padang Tualang District require serious attention from the local government, SPAM managers, and the community. To overcome this problem, strategic steps are needed that include increasing water production capacity, improving distribution networks, regular maintenance of infrastructure, and strengthening the role of the community in maintaining the sustainability of the clean water management system. The right solution will be able to improve the quality and quantity of clean water supply, as well as improve the quality of life of the community in Padang Tualang District.

What is an effective clean water network development strategy to improve the fulfillment of clean water needs for the community in Padang Tualang District?

The development of an effective clean water network in Padang Tualang District is very important to meet the increasing needs of clean water for the community. Given the existing problems, the development of a clean water network needs to be carried out with an integrated approach, considering technical, social, economic, and environmental aspects. The following are some strategies that can be applied to improve the fulfillment of clean water needs for the community in Padang Tualang District:

1. Increasing the Capacity of the Water Treatment System (SPAM)

One of the main strategies that needs to be done is increasing the capacity of the existing water treatment system (SPAM). The capacity of the water treatment plant must be adjusted to the rate of population growth and the

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increasing need for clean water. This can be done by expanding or building new water treatment plants with larger capacities, as well as utilizing the latest technology that is more efficient and environmentally friendly. In addition, efforts to find and develop new water sources (such as deep wells, springs, or rainwater utilization) need to be a primary focus to reduce dependence on limited water sources.

2. Improvement and Expansion of Distribution Network

Improving the water distribution network is also key to ensuring that water reaches people's homes evenly and on time. This includes repairing old and damaged pipes, as well as replacing pipes with more durable and efficient materials. In addition, expansion of the distribution network must also be carried out, especially for areas that have not been reached by clean water services, such as outlying areas and new settlements. In this case, the government needs to collaborate with various parties, both the public and private sectors, to fund and implement this expansion project.

3. Periodic Maintenance and Monitoring

The strategy for developing a clean water network not only includes the construction and expansion of infrastructure, but also involves regular and ongoing maintenance. Routine and timely maintenance is essential to prevent damage to the distribution network and ensure that water quality is maintained. In addition, it is important to implement a sophisticated monitoring and supervision system at every stage of water distribution, from processing to distribution to consumers. Sensor technology and remote monitoring can help identify leaks or pipe damage more quickly, so that repairs can be made immediately.

4. Diversification of Water Sources

To increase the resilience of clean water supply, diversifying water sources is an important strategy. Not only relying on one water source, such as a river or a particular spring, Padang Tualang District can utilize several alternative water sources. For example, utilizing deeper groundwater sources that have a more stable supply, and implementing rainwater processing technology for certain areas that have high rainfall. Rainwater purification and processing technology can be used as a backup that can reduce dependence on the main water source, as well as support long-term water security.

5. Community Empowerment and Education

To ensure the sustainability of clean water management, community participation is very important. Communities need to be empowered to understand the importance of using water wisely and maintaining the cleanliness of their surroundings.(Saputra & Sugiarto, 2024). One way to achieve this is by conducting educational programs about the importance of water conservation and how to maintain the cleanliness of the water distribution network. Communities can also be involved in water infrastructure maintenance and monitoring activities, for example through community-based monitoring systems or water user groups that can report problems related to clean water.

6. Innovation in Water Technology and Management

The use of environmentally friendly and efficient technology in clean water management is essential to increase effectiveness and reduce operational costs. One of them is wastewater treatment technology that can be reused for non-consumption purposes, such as irrigation or environmental cleanliness. Another innovation that can be applied is data-based monitoring technology that can provide more accurate information on water distribution, network conditions, and the quality of the water being distributed. This technology can improve clean water management more efficiently and sustainably.

7. Collaboration between stakeholders

The development of an effective clean water network cannot be done by one party alone. Collaboration between local governments, communities, the private sector, and related institutions is essential to create comprehensive and sustainable solutions. The government can provide policy and funding support, while the private sector can be involved in the management and provision of infrastructure. Communities also need to be involved in every stage of planning, implementation, and maintenance of the clean water supply system.

The strategy for developing clean water networks in Padang Tualang District must involve a holistic and sustainable approach, which includes increasing water treatment capacity, repairing and expanding distribution networks, regular maintenance, diversifying water sources, and empowering communities. With the implementation of these strategies, it is hoped that the community's clean water needs can be met evenly and sustainably, so that the community's quality of life can be improved and the problem of clean water shortages can be overcome effectively.

CLOSING

Conclusion

Clean water management and distribution in Padang Tualang District still faces a number of significant obstacles, such as limited capacity of the water treatment system, damage to the distribution network, inconsistent water quality, and uneven distribution. This problem is exacerbated by the lack of sustainable maintenance and management, as well as limited budget and human resources. To improve the fulfillment of the community's clean water needs, a comprehensive strategy is needed, including increasing the capacity of the water treatment system, improving the distribution network, diversifying water sources, and empowering the community. With the right steps and cooperation between related parties, clean water management in Padang Tualang District can be more effective and sustainable.

Suggestion

1. Infrastructure Improvement: Increasing the capacity of water treatment plants and improving existing distribution networks to meet the clean water needs of the community more evenly.
2. Diversification of Water Sources: Developing alternative water sources such as deep groundwater, rainwater utilization, and other water sources to reduce dependence on a single source.
3. Routine Maintenance: Prepare a plan for regular maintenance and repair of the distribution network to prevent damage and leaks that reduce the efficiency of clean water distribution.
4. Community Empowerment: Increasing community awareness and participation in maintaining the sustainability of the clean water management system, and involving them in maintenance and supervision.
5. Use of Advanced Technology: Utilizing data-based monitoring and management technology to improve water distribution efficiency and service quality.
6. Collaboration Between Stakeholders: Increasing cooperation between local governments, communities, and the private sector to fund, manage, and maintain clean water management systems in a more sustainable manner.

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