

DEVELOPMENT OF REGIONAL PLANNING BASED ON NORMALIZATION OF SEWERAGE CHANNELS IN STABAT DISTRICT, LANGKAT REGENCY

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Abstract

This study aims to develop regional planning based on drainage channel normalization in Stabat District, Langkat Regency, with a holistic and participatory approach. This area faces problems of flooding and waterlogging caused by drainage channels that are not functioning properly and are not integrated with existing spatial planning policies. This study identifies the existing condition of drainage channels, factors causing flooding and waterlogging, and the concept of developing regional planning that can integrate drainage channel normalization with spatial planning policies and environmental sustainability. The results of the study indicate that proper drainage channel normalization must involve all parties, including the government, community, and private sector, by considering technical, social, and environmental factors. This study recommends that drainage channel normalization be implemented with an integrated approach that involves active community participation, the use of environmentally friendly technology, and collaboration between related agencies. It is hoped that through the implementation of this strategy, the problems of flooding and waterlogging can be overcome, and the Stabat District area can develop sustainably.

Keywords: *Regional Planning, Drainage Channel Normalization, Spatial Planning, Environmental Sustainability and Community Participation.*

INTRODUCTION

Stabat District, located in Langkat Regency, is one of the areas experiencing quite rapid growth in socio-economic activities. This growth has an impact on the increasing need for adequate infrastructure, including drainage systems and drainage channels. However, in recent years, this area has often faced problems with flooding, especially during the rainy season. These floods not only disrupt community activities, but also cause material losses and threaten environmental health. One of the main causes of the flood problem is the suboptimal condition of the drainage channels. Many drainage channels experience shallowing, narrowing, and even blockages due to sedimentation and domestic waste. In addition, uncontrolled changes in land use, such as the conversion of green areas into built-up areas, worsen soil absorption and increase surface runoff. This condition shows the need for regional planning efforts that consider hydrological aspects more comprehensively.

Normalizing drainage channels is a strategic solution that can have a significant impact in reducing the risk of flooding and supporting sustainable regional development. (Sri Rejeki et al., 2024). However, normalization efforts cannot be carried out partially, but must be an integral part of holistic regional planning. In this context, regional planning based on drainage channel normalization is a relevant approach to address these challenges. In recent years, Stabat District in Langkat Regency has faced an increase in the frequency and intensity of waterlogging and local flooding, especially during high rainfall. This condition not only occurs in densely populated residential areas, but also extends to office areas, public facilities, and main roads that play an important role in community mobility. The waterlogging that occurs can even last for several hours to days, disrupting the economic, social, and educational activities of the local community. This phenomenon is inseparable from the condition of the drainage channels in the area. Many channels have become shallow due to sedimentation, are clogged with household waste, or have lost their hydrological function due to poor maintenance. Some channels have also been blocked by illegal buildings or are poorly integrated with new drainage systems that were built without considering the existing drainage layout. In addition, the weak monitoring and land use planning system has led to the emergence of built-up areas in areas prone

to flooding, which should be catchment areas or channel boundary zones. This phenomenon indicates structural and non-structural problems in the management of drainage systems and spatial planning. The imbalance between regional development and drainage channel capacity has created pressure on the environment and reduced the quality of life of the community. Therefore, a regional planning approach is needed that not only emphasizes physical development, but also considers ecological and technical aspects through a comprehensive drainage channel normalization strategy. The development of regional planning based on drainage channel normalization in Stabat District, Langkat Regency is a strategic response to the problems of flooding and waterlogging that are increasingly occurring in this area. Along with population growth, changes in land use, and increased social and economic activities, the need for an integrated drainage and water management system is becoming increasingly important. Drainage channel normalization is not only seen as a technical activity, but must be an integral part of a sustainable and adaptive regional planning approach to environmental changes. This development begins with an approach to identifying and mapping the existing conditions of drainage channels throughout the district. This data is the basis for determining the actual condition of the channel, including flow capacity, sedimentation levels, blockages, and the relationship between the main and secondary channels. Based on this data, an analysis of the environmental carrying capacity and capacity is carried out, in order to determine the area's ability to accommodate rainwater and prevent excessive surface runoff.

The next step is to prepare a technical plan for normalization which includes widening, dredging, or repairing channels that are no longer functioning optimally. In addition, this planning also includes the construction of complementary infrastructure such as retention ponds, infiltration wells, and vertical drainage systems to strengthen the surface water management system. To ensure sustainability, this normalization plan is then integrated into the Stabat District and Langkat Regency Spatial Planning Plans (RTRW). Zoning adjustments are made to maintain channel boundaries, determine water conservation areas, and control development in areas prone to flooding. This approach encourages synchronization between spatial planning policies and water resource management. This development also involves active participation from the community and stakeholders. Education, socialization, and community-based programs are encouraged so that the community is aware of maintaining clean channels, not littering, and participating in the drainage maintenance mutual cooperation program.

Finally, the entire development process is concluded with a continuous monitoring and evaluation system that uses technical and social indicators. Information technology such as GIS-based mapping, water sensors, and community reporting applications will be applied to improve the efficiency and transparency of drainage management in this area. With this holistic approach, the development of regional planning based on drainage normalization is expected to be able to create areas that are resilient to flooding, have good environmental quality, and support sustainable community economic development.(Sugiarto, Yamin s, et al., 2024). The problem of flooding and waterlogging in urban and semi-urban areas such as Stabat District has become an increasingly urgent issue along with increasing rainfall and uncontrolled land conversion. Various previous studies have discussed the technical aspects of drain normalization and general drainage planning approaches. However, most of these studies are still sectoral and separate from the context of overall regional planning.

Most studies only focus on the technical efficiency of channels or hydrological models, without linking them to spatial planning, land use dynamics, and the role of policies in disaster mitigation-based spatial management. In addition, participatory approaches involving local communities and stakeholders are still minimally discussed in relation to the sustainability of drainage channel management at the regional level. On the other hand, in Langkat Regency, especially Stabat District, there have not been many studies that specifically integrate drainage channel normalization efforts into spatial, structural, and sustainable regional planning. In fact, sustainable flood control requires policy interventions that combine physical, spatial, and social approaches. Therefore, this study attempts to fill the gap by presenting a new approach that combines the technical aspects of channel normalization with the context of regional planning. This study is not only oriented towards physical improvements to channels, but also how the plan can be integrated into spatial planning policies, adjusted to environmental carrying capacity, and involving the community in the process. With this approach, it is hoped that regional development in Stabat District can be more resilient, adaptive, and sustainable.

Identification of problems

Stabat District as part of a developing area in Langkat Regency, is experiencing pressure on the drainage system due to population growth, changes in land use, and limited adequate water management infrastructure. The problem of local puddles and floods that occur almost every rainy season shows that the capacity of the existing drainage channels is unable to accommodate the water discharge optimally. Many channels experience shallowing, blockage, or even damage due to lack of maintenance and conversion of channel boundaries. On the other hand, the

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regional development approach that has been applied so far tends not to be integrated with comprehensive water management planning. Spatial planning and physical development often do not consider the ecological function of drainage channels and water catchment areas. The lack of synergy between technical planning for channel normalization and spatial planning policies causes flood management to be partial and reactive.

In addition, community involvement in maintaining the cleanliness and function of channels is still low, and there is no integrated monitoring system that can detect and anticipate potential flooding early. (Akus Harmoko et al., 2024). This condition shows the need for a regional development approach based on integrated, planned, and sustainable drainage channel normalization efforts.

Formulation of the problem

Based on the problem identification above, the problem formulation in this study is as follows:

1. What is the existing condition of the drainage channels in Stabat District, Langkat Regency, in terms of technical, environmental and spatial aspects?
2. What are the factors that cause flooding and waterlogging related to the function of drainage channels and regional spatial planning?
3. What is the concept of developing regional planning that can integrate drainage normalization with spatial planning and environmental sustainability policies?
4. What is the right strategy to support the implementation of drainage normalization as part of holistic and participatory regional planning?

LITERATURE REVIEW

Regional Planning

According to Haryadi and Sari (2020), regional planning is a process of formulating spatial development policies that are comprehensive and integrated, covering physical, social, economic, and environmental aspects. In the context of areas experiencing development pressure, such as Stabat District, regional planning must be able to direct development to be in harmony with environmental carrying capacity, including drainage systems and waste channels. (Harahap et al., 2024). Haryadi also emphasized the importance of integration between macro planning (RTRW) and micro planning such as detailed spatial planning (RDTR) which functions to regulate more specific spatial functions.

Drainage and Sewerage

Yulianto (2020) stated that the drainage system is an important part of urban and regional planning that functions to drain excess water from the ground surface to receiving water bodies safely and efficiently. The main problem in many developing areas is that drainage channels are no longer able to accommodate water discharge due to sedimentation, changes in land use, and lack of maintenance. Yulianto emphasized that normalization of drainage channels must be carried out sustainably, not only for technical aspects but also considering the capacity of the ecosystem in the area.

Drainage Channel Normalization

According to Fauziah (2020), normalization of drainage channels is a technical action that aims to restore the function of water channel flow according to its design capacity. This action includes dredging, widening, straightening, or rebuilding the channel structure. However, Fauziah also reminded that the success of normalization cannot be separated from the supervision of land use and community participation in maintaining the cleanliness of the channels. In other words, normalization must be part of a comprehensive regional management strategy.

Integration of Regional Planning and Drainage Management

Syafrudin and Lestari (2020) explained that drainage management cannot stand alone, but must be integrated with regional planning so that the drainage system can adapt to the development of settlements and infrastructure. They put forward a system-based management model, which includes mapping of channel networks, calculating water discharge, land use analysis, and spatial flood control strategies. Their research emphasizes that this approach is not only technical, but also requires spatial and institutional policy interventions.

Research Framework

The problem of flooding and inundation that occurs periodically in Stabat District, Langkat Regency, shows that the drainage system in this area is no longer able to function optimally. Various factors such as shallowing of

channels, blockages due to garbage, changes in land use, and lack of maintenance are the main causes of disruption to water flow. On the other hand, the development of the region that continues to grow does not fully consider the existence and function of drainage channels as vital infrastructure in water management and disaster mitigation.

Kerangka Pemikiran Penelitian



Figure 2.1 Framework of Thought

Through a regional planning approach based on the normalization of drainage channels, this research starts from the assumption that solving drainage problems cannot be done partially, but must be integrated into spatial planning policies and comprehensive regional management.(Hidayat et al., 2023). Normalization efforts must be structured in a broader context, namely aligning physical improvements to channels with spatial arrangements, the environment, and active community involvement. This framework is built on the basis of regional planning theories, drainage management, and sustainable development concepts. This study will analyze the existing condition of drainage channels, identify key problems, and then formulate a regional development strategy that integrates channel normalization actions with spatial planning policies. This strategy is expected to be able to create a region that is adaptive to climate change, has minimal flood risk, and is ecologically sustainable. Thus, the research thought process starts from problem identification → analysis of drainage system and land use → technical and spatial approach → integration in regional planning → preparation of regional development strategy based on drainage normalization.

RESEARCH METHODS

Types of research

This study uses a qualitative research method with a descriptive approach. According to Moleong (2021), qualitative research aims to understand the phenomena that occur in the field through the collection of narrative and descriptive data, so that it can produce a deep understanding of the problems being studied.(Sugiarto, Kamakaula, et al., 2024). This study focuses on the development of regional planning based on drainage channel normalization in Stabat District, Langkat Regency, to analyze the existing problems and potentials related to drainage channel infrastructure in the area.

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Research Location

This research was conducted in Stabat District, Langkat Regency, which is one of the areas that often faces flooding problems due to a suboptimal drainage system. This location was chosen because it has potential problems that are relevant to the focus of the research, namely the normalization of drainage channels as part of regional planning development.

Figure 1. Map of Stabat District



Population and Sample

The population in this study is the community living in Stabat District, including related stakeholders such as local government, related agencies, and regional planning experts. The sample of this study was selected using a purposive sampling technique, where the selected informants are parties who have knowledge and experience related to the topic of normalization of drainage channels and regional planning. The selected informants are expected to provide relevant and in-depth data regarding the problem being studied.

Data collection technique

Data collection techniques in this study consist of:

1. In-depth Interviews: Interviews were conducted with stakeholders, such as village officials, regional planning experts, and local communities to obtain information about the problems faced in regional planning and drainage. According to Creswell (2021), in-depth interviews allow researchers to dig up information directly and understand individual perspectives on the research topic.
2. Participatory Observation: Researchers conducted direct observations in the field to see the condition of the drainage channels and existing regional planning. This observation helped researchers in obtaining contextual data on the ongoing conditions in Stabat District.
3. Documentation: Data collection through existing documents, such as regional planning reports, feasibility studies, and other technical documents relevant to this research. Documentation provides a valid and accountable source of data in research (Sugiyono, 2021).

Data Analysis Techniques

Data obtained from various sources will be analyzed using a thematic analysis approach. According to Braun & Clarke (2021), thematic analysis involves identifying key themes in the data that relate to the research question. This process is carried out by organizing data, identifying patterns, and interpreting the meaning contained in the data.

The steps of data analysis in this study are:

1. Transcription of interview results and field observations.
2. Coding data to identify major categories.
3. Arrangement of themes based on the categories found.
4. Analysis and interpretation of findings related to the development of regional planning based on drainage normalization.

Data Validity

To ensure data validity, this study uses triangulation techniques, which involve the use of multiple data sources to ensure the accuracy and consistency of the information obtained. This source triangulation helps increase the credibility of research findings (Flick, 2021).

Research Procedures

Research procedures according to (Sugiarto, Kamakaula, et al., 2024) consists of several stages, namely:

1. Research Preparation: The researcher conducted a literature study to understand relevant theories and develop a research conceptual framework.
2. Data Collection: Researchers conducted interviews with selected informants, field observations, and collected related documents.
3. Data Analysis: The data obtained was analyzed to find the main themes and compile recommendations for the development of regional planning based on drainage normalization.
4. Report Preparation: Researchers prepare research reports containing the findings obtained during the research.

RESULTS AND DISCUSSION

What is the existing condition of the drainage channels in Stabat District, Langkat Regency, viewed from technical, environmental and spatial aspects?

Stabat District is one of the areas with quite complex geographical characteristics. The existence of drainage channels in this area, which function to drain rainwater and domestic waste, plays an important role in water management and disaster mitigation such as flooding. Based on the results of data collection through interviews, field observations, and documentation studies, the existing condition of drainage channels in Stabat District can be analyzed from three main aspects, namely technical, environmental, and spatial aspects.

1. Technical Aspects

Technically, the condition of the drainage channels in Stabat District is still inadequate. Based on field observations, most of the drainage channels in this area have not been designed with an effective and efficient system. The existing drainage channels are generally small and do not have sufficient capacity to drain large water discharges, especially during the rainy season. This causes waterlogging or flooding that occurs quite often in several areas of Stabat. One of the main technical problems is the presence of drainage channels that are clogged by garbage and sedimentation. This shows a lack of attention to the maintenance and management of drainage channels, which should be a priority in regional infrastructure development. In addition, some drainage channels are not connected to the main channels that can drain water to the final disposal site, causing water to overflow and inundate residential areas. The existence of drainage channels that are irregular and do not have a systematic design also affects the effectiveness of the drainage system in Stabat District. According to research conducted by Sutanto (2021), inadequate and poorly maintained drainage channel infrastructure can cause more severe environmental damage, including repeated flooding, which threatens public safety and health.

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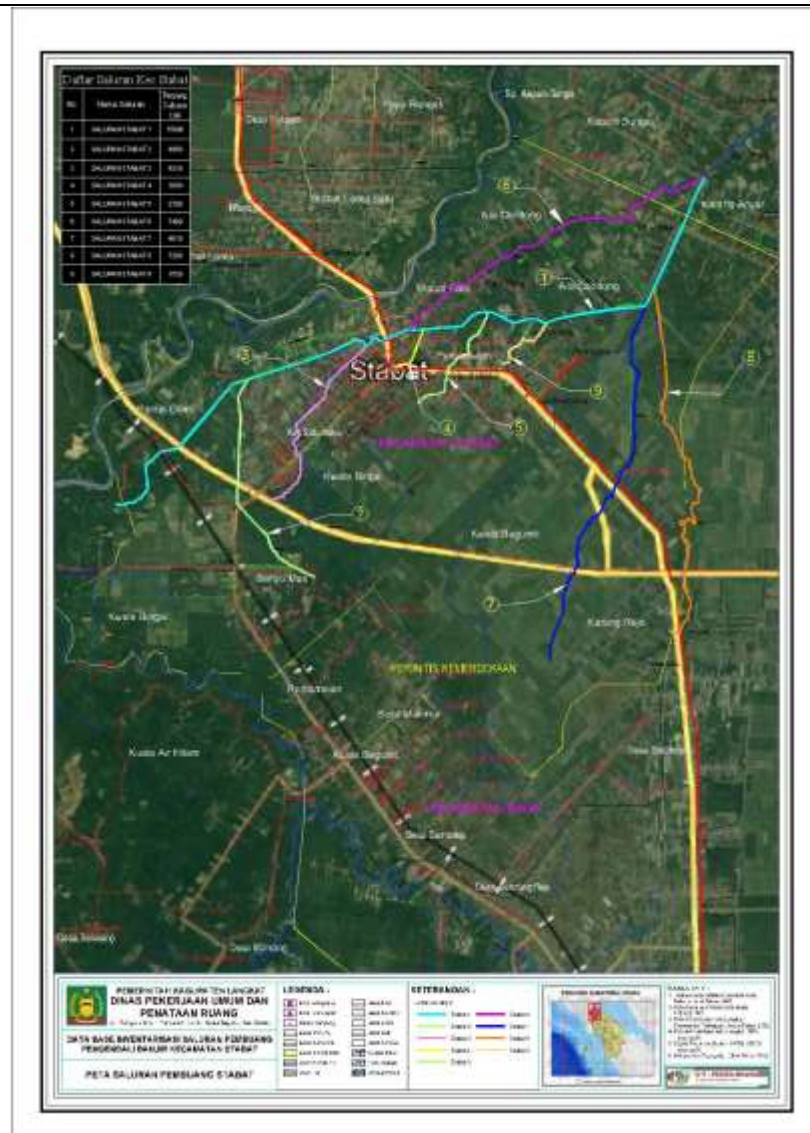


Figure 2. Stabat Drainage Channel Map

2. Environmental Aspects

In terms of the environment, the existence of poorly managed drainage channels in Stabat District has a negative impact on water quality and public health. Drains that do not function properly can cause groundwater and river pollution due to the mixing of rainwater with domestic waste. Many drainage channels in Stabat District are used to accommodate household wastewater, which if not managed properly, can pollute the surrounding environment. In addition, drains that are inundated with garbage and mud can also become breeding grounds for disease vectors, such as mosquitoes that carry dengue fever. This worsens the quality of life of local communities, who are often affected by diseases related to unhealthy environments. With these environmental problems, drain management becomes an important issue that needs serious attention in regional planning. Based on a report from the Ministry of Environment and Forestry (2021), poor drain management can cause significant environmental degradation, with impacts on water quality that can affect public health, as well as creating pollution that damages local ecosystems.

3. Spatial Aspect

From a spatial perspective, drainage channels in Stabat District are unevenly distributed throughout the region. Some densely populated residential areas are not equipped with adequate drainage channels, while in more open and sparsely populated areas, drainage channels are quite easily accessible. This uneven distribution of drainage channels makes most residential areas vulnerable to waterlogging and flooding. In terms of regional planning, drainage channels are often not integrated with the wider spatial plan. Most drainage channels are built without

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considering optimal water flow patterns or without good coordination between related agencies. This results in a lack of connectivity between drainage channels, which results in water accumulation in several areas. According to a study conducted by Rahmawati (2021), spatial planning that does not accommodate good drainage infrastructure can cause difficulties in managing flooding and reducing its impact on the community. Therefore, it is necessary to make improvements that include the development of more systematic drainage channels, as well as more holistic regional planning by considering drainage aspects.

What are the factors that cause flooding and waterlogging related to the function of drainage channels and regional spatial planning?

1. Inadequate Drainage Capacity

One of the main factors causing flooding and waterlogging is the inadequate capacity of drainage channels to accommodate large volumes of water, especially during heavy rain. Drains in many areas are often not designed with sufficient capacity to drain large amounts of rainwater. This condition is exacerbated if the design of the drainage channel does not take into account sudden surges in water discharge. As a result, water overflows and inundates roads, settlements, and other areas. This condition can occur in areas with rapid development without considering the capacity of drainage channels that are in accordance with the characteristics of the area. For example, in areas that are developing rapidly but are not supported by an adequate drainage system, existing drainage channels will have difficulty draining excess water, resulting in pooling that has the potential to cause flooding.

2. Closing and Narrowing of Drainage Channels

Narrowing or blocking of drainage channels due to irregular development or settlements is also a factor causing flooding and waterlogging. In many cases, the construction of houses or buildings built on drainage channels or near rivers blocks the flow of water. This causes the drainage channels to not function optimally, sometimes even causing water to be retained at certain points, causing local flooding. Drainage channel blockages also often occur due to public indifference to the importance of maintaining the cleanliness of drainage channels. Garbage thrown into the channels will cause blockages, which in turn reduce the capacity of water flow and increase the risk of waterlogging and flooding.

KONDISI EKSISTING SALURAN PEMBUANG PENGENDALI BANJIR KEC. STABAT																			
No.	Nama Saluran (RT/RW/Desa/Kelurahan)	Desa/Kelurahan	RT/RW	Tinggi Salur	Peninggian Salur	Lebar Salur	Bendungan				Jenis Saluran				Lokasi				Kondisi Saluran
							Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	
1	SALURAN STABAT 1 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 001	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
2	SALURAN STABAT 2 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 002	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
3	SALURAN STABAT 3 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 003	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
4	SALURAN STABAT 4 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 004	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
5	SALURAN STABAT 5 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 005	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
6	SALURAN STABAT 6 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 006	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
7	SALURAN STABAT 7 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 007	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
8	SALURAN STABAT 8 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 008	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
9	SALURAN STABAT 9 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 009	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran
10	SALURAN STABAT 10 (S. 7200000 - 90.400000) (S. 7000000 - 90.400000)	Kelurahan Stabat, Kecamatan Stabat, Kabupaten Langkat	01/0001 010	0.7 m	0.000	0.0 m	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran	Saluran

Figure 3. Condition of Stabat Drainage Channel

3. Uncoordinated Spatial Changes

Uncoordinated or poorly planned spatial changes can worsen the condition of drainage and drainage channels in an area. Poor spatial planning often ignores rainwater management, such as not providing enough green open space or ignoring adequate drainage channels. In some cases, settlements built in areas that were previously water catchment areas or wetlands, cause water flow to no longer be absorbed properly into the ground and instead flow to the surface, triggering flooding. In addition, infrastructure development that does not pay attention to the availability of drainage channels can also increase the burden on the drainage system. For example, increasing the number of vehicles and denser land use increases the volume of rainwater that must be managed, while the capacity of the drainage channels does not increase.

4. Changes in Land Use Patterns

Changes in land use patterns from open areas to built-up areas, such as housing, commercial, and industrial, can worsen drainage conditions. Development that does not take water infiltration into account can cause increased surface flow, which cannot be channeled through existing drainage channels. In densely built-up areas, hard ground surfaces (e.g., concrete and asphalt) reduce the soil's ability to absorb rainwater, which then flows into drainage channels in greater quantities, causing drainage channels to become overwhelmed and eventually causing waterlogging or flooding.

5. Drainage Blockage and Sedimentation

Another factor that affects the function of drainage channels is blockages caused by the accumulation of waste, organic material, or sedimentation. Clogged drainage channels cannot accommodate rainwater optimally, which eventually causes water to overflow and inundate the surrounding area. In open channels, sedimentation of mud and sand can reduce channel capacity, slow water flow, and cause a decrease in drainage function. Drainage channel blockages can also occur in areas that do not have a good waste management system. Waste that is disposed of carelessly can enter the channel and block the flow of water, causing puddles even at low rainfall intensity.

6. Lack of Maintenance and Care of Drains

Poorly maintained drainage channels are also one of the causes of flooding and waterlogging. Poor drainage channel maintenance will worsen the performance of the drainage system, such as decreased water flow capacity due to garbage accumulation, sedimentation, or physical damage to the channel. Lack of attention to drainage channel maintenance makes the drainage system inefficient, so that when the rainy season comes, the drainage channels cannot drain water properly, which causes pooling or flooding.

7. High Rainfall

In addition to factors related to drainage channels and regional planning, high rainfall is also an important factor in flooding. In areas that already have fairly good drainage channels, very high rainfall can exceed the capacity of the channels to accommodate water, so that flooding or inundation still occurs. Climate change that causes unpredictable rainfall also plays a role in worsening existing drainage problems. Floods and waterlogging in Stabat District or other areas can be caused by various interrelated factors, especially related to imperfect drainage channels and poor spatial planning. To overcome this problem, a holistic approach is needed that includes improving the drainage system, better drainage maintenance, and spatial planning that takes into account water management needs, by involving the community in maintaining the cleanliness of drainage channels and improving more environmentally friendly development patterns.

How is the concept of developing regional planning that can integrate normalization of drainage channels with spatial planning and environmental sustainability policies?

1. Integration of Drainage Planning with Spatial Planning

The development of regional planning that integrates drainage channel normalization must consider the close relationship between the drainage system and spatial planning policies. This aims to create an infrastructure system that is not only efficient in managing water flow, but also supports the sustainability of optimal space for development. First of all, in regional spatial planning, drainage channels need to be positioned as an integral part of the overall regional planning structure. In this case, zoning arrangements and location selection for various types of land use must consider the needs and capacity of drainage channels that can drain rainwater without causing puddles or flooding. The preparation of spatial planning that is friendly to drainage infrastructure can be done by considering several principles:

- a) **Appropriate Land Use Planning:** The development of residential, commercial, and industrial areas must be adjusted to the available drainage capacity, as well as the potential for water absorption in the soil. Intensive land use must be equipped with large and effective drainage channels.
- b) **Reduction of Non-Irreversible Surfaces:** In regional planning, areas with open land and water catchment areas should be maintained, as well as introducing greener development concepts, such as green open spaces, parks, and water catchment gardens that can increase the soil's ability to absorb rainwater, reducing the volume of water flowing into drains.

2. Drainage Channel Normalization as Part of City Infrastructure

Drainage normalization is an important part of water management in urban areas. However, to make drainage normalization sustainable, it must be viewed not only as a technical project, but also as part of a comprehensive regional planning. Drainage normalization can be done by repairing and increasing the capacity of existing drainage channels through several steps:

- a) **Drain Capacity Enhancement:** Increase the size and design of drains to carry more water, especially in flood-prone areas. Drains need to be designed with a capacity that matches the rainfall and water flow patterns in the area.
- b) **Maintenance and Waste Management:** Conduct routine maintenance to keep the channels clean from waste, mud, and sediment that can block water flow. In this case, maintenance must be part of sustainable spatial planning and environmental management policies.

In addition, the existing drainage system must also be integrated with environmentally friendly technology, such as the use of ecosystem-based drainage channels (eco-drainage), which do not only rely on physical channels, but also use ecological principles to manage rainwater.

3. Environmental Sustainability Management

Regional planning that integrates drainage normalization must also prioritize environmental sustainability. This concept of sustainability leads to the use of principles that support the preservation of natural resources and reduce negative impacts on the ecosystem.

For this reason, several steps that can be taken in sustainable regional planning are:

- a) **Use of Green Technology in Drainage Infrastructure:** Drains and other drainage systems need to be integrated with green technology, such as vegetation-based water absorption systems or the use of permeable materials on road surfaces and parking areas. This can reduce surface runoff that flows directly into drains and increase water absorption into the soil.
- b) **Ecosystem-Based Area Planning:** Designing areas that have natural drainage systems, such as open channels, and maintaining water catchment areas. Areas such as wetlands can be used as temporary storage areas for rainwater before it is channeled to the main drainage channel.
- c) **Waste and Waste Management:** Integrating good waste management policies with drainage is essential. In this regard, implementing an effective and sustainable waste management system will reduce the amount of waste contaminating drainage, as well as prevent blockages that can reduce drainage capacity.

4. Education and Public Awareness

The success of the concept of developing regional planning that integrates drainage normalization and spatial planning policies and environmental sustainability is highly dependent on the active role of the community. Therefore, education and increasing awareness of the importance of maintaining the cleanliness of drainage channels, the importance of green open spaces, and the use of environmentally friendly drainage systems must be part of public policy. In addition, community participation in the planning and implementation of drainage management projects is also important, because local communities have knowledge and understanding of regional conditions that can provide positive contributions to drainage management and maintenance efforts.

5. Government Policy and Inter-Agency Coordination

Successful regional planning development cannot be separated from the role of the government in formulating policies that support drainage management and environmental sustainability. The government needs to provide clear regulations regarding technical standards for the construction of environmentally friendly drainage channels and spatial planning policies that support sustainable water management. In addition, coordination between related agencies, such as the public works department, the regional development planning agency (Bappeda), and the

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environmental department, is essential to ensure that every aspect of drainage management is well integrated into regional planning. The concept of developing regional planning that integrates drainage channel normalization with spatial planning and environmental sustainability policies is a holistic and comprehensive approach to managing drainage infrastructure in urban areas. By designing a better and more environmentally friendly drainage system, as well as supporting the sustainability of open spaces and good waste management, it is expected to reduce the risk of flooding, waterlogging, and negative impacts on the environment. Integration between spatial planning policies and sustainable drainage channel management will create a more resilient, safe, and comfortable area for its residents.

What is the right strategy to support the implementation of drainage normalization as part of holistic and participatory regional planning?

1. Integrated Approach in Drainage Infrastructure Planning

One of the main strategies in implementing drainage channel normalization is to adopt an integrated approach in planning drainage infrastructure at the regional level. This planning must involve all related aspects, from technical needs, social aspects, to environmental factors. This approach involves cooperation between various parties, including local governments, communities, the private sector, and related institutions that can contribute to the management and maintenance of drainage channels.

Steps that can be taken:

- a) **Comprehensive Drainage System Planning:** A site drainage plan should include primary, secondary, and tertiary drains, as well as nature-based solutions such as water catchment gardens or bioswales. Each drain should be designed with a capacity appropriate to the site's conditions and the amount of rainfall it experiences.
- b) **Integration with Spatial Planning:** Drainage planning must be in line with existing regional spatial planning policies. Site selection for housing, industrial and commercial development must consider the capacity and sustainability of existing drainage systems, as well as pay attention to water absorption management.

2. Community Empowerment and Participation

A very important strategy in supporting the implementation of drainage normalization is community empowerment and encouraging their active participation in every stage of planning, implementation, and maintenance. Local communities have very valuable knowledge about local conditions, including existing drainage problems. Therefore, they need to be involved to ensure that the plans made are truly in accordance with the needs and real conditions in the field.

Steps that can be taken:

- a) **Socialization and Education:** Conducting socialization to the community about the importance of a good drainage system, as well as the negative impacts of clogged or poorly functioning drainage channels. This education program can also include the importance of maintaining the cleanliness of drainage channels and reducing littering.
- b) **Participation in Planning:** Holding a meeting forum with the community to discuss plans for improving and normalizing the drainage channel. Community opinions and aspirations regarding the location, design, and implementation of the drainage channel are essential to creating a solution that is appropriate and acceptable to all parties.
- c) **Involvement in Maintenance:** Communities can play a role in maintenance and monitoring activities of drainage channels, such as cleaning drainage channels regularly, recycling waste, or playing a role in community-based waste management systems.

3. Collaboration between Government, Private Sector, and Community

The implementation of drainage normalization requires close collaboration between the government, private sector, and community sectors. Each party has complementary roles and responsibilities. The government as a policy maker and budget provider, the private sector as a partner in providing technology and funding, and the community as users and supervisors of drainage channels, all have important roles in the success of this project.

Steps that can be taken:

- a) **Public-Private Partnership:** Encourage cooperation between the government and the private sector in funding and developing drainage infrastructure. For example, the private sector can be involved in the construction of large drainage channels or the development of supporting infrastructure such as green open spaces and water catchment parks.

- b) Sustainable Funding: Develop a funding strategy that involves funds from various sources, including local government budgets, corporate social responsibility (CSR) funds from companies, and community participation in the form of self-funding or in-kind assistance.
- c) Cooperation in Maintenance: Drain maintenance must involve cooperation between the government, the private sector, and the community. For example, the private sector can provide technology for more efficient monitoring and maintenance of drains, while the community can be involved in routine maintenance activities.

4. Use of Technology and Innovation

To support more effective and efficient drainage normalization, technology and innovation can be used in the design and management of drainage systems. Environmentally friendly and data-based technology can improve drainage performance and reduce negative impacts on the environment.

Steps that can be taken:

- a) Utilization of Technology-Based Monitoring Systems: Using sensor-based sewer monitoring technology to detect sewer conditions in real-time. This allows early detection of blockages, damage, or exceeded sewer capacity, so that corrective action can be taken immediately.
- b) Nature-Based Drainage Infrastructure: Implementing nature-based solutions, such as bioswales, rain gardens, or the use of permeable materials for roads and sidewalks. These solutions not only increase the capacity of the drains, but also provide additional benefits such as water filtration and improved environmental quality.

6. Periodic Monitoring and Evaluation

Regular monitoring and evaluation of the performance of normalized drainage channels needs to be carried out to ensure that the drainage system is functioning properly and in accordance with the objectives of regional planning. This evaluation process is important to identify potential problems and to make continuous improvements.

Steps that can be taken:

- a) Drainage Infrastructure Audit: Conduct regular audits to check the condition of drains that have been normalized. This audit aims to evaluate the effectiveness of normalization and see whether the drains can drain water optimally.
- b) Data Collection for Improvement: Collecting data periodically on water discharge, rainfall frequency, and drainage channel conditions to assess whether the channel capacity is sufficient or needs to be enlarged.

7. Implementation of Supportive Policies and Regulations

Policies and regulations that support effective and sustainable drainage management are essential to ensure the success of drainage normalization. Local governments need to formulate policies that clearly and firmly regulate drainage planning, land use, and drainage maintenance.

Steps that can be taken:

- a) Adequate Regulation: Establish regulations governing technical standards for the construction of drainage channels as well as drainage management obligations for each new development.
- b) Sanctions and Incentives: Providing incentives for communities or developers who build environmentally friendly drainage infrastructure, as well as providing sanctions for parties who violate the provisions on drainage management.

The right strategy to support the implementation of drainage channel normalization as part of holistic and participatory regional planning involves an integrated approach in planning, community empowerment, collaboration between parties, use of technology, and policies that support environmental sustainability. By integrating these elements, drainage channel normalization projects can be implemented effectively and can provide long-term benefits for water management, flood mitigation, and community quality of life.

CLOSING

Based on the discussion that has been done, it can be concluded that the normalization of drainage channels in Stabat District, Langkat Regency, is an important step in overcoming the problem of flooding and waterlogging that often occurs. Holistic and participatory regional planning is needed to ensure that the drainage system built can support environmental sustainability, meet community needs, and be in line with existing spatial planning policies.

Some important things that can be concluded are as follows:

1. **Integration of Drainage Infrastructure and Spatial Planning**
Drainage systems must be designed taking into account appropriate spatial planning and land use policies, to avoid environmental degradation and reduce the impact of flooding.
2. **Community empowerment**
Communities must be actively involved in the planning, implementation and maintenance of drainage channels in order to create solutions that meet local needs and increase environmental awareness.
3. **Collaboration between parties**
The success of the drainage normalization project is highly dependent on cooperation between the government, private sector, and community in terms of funding, implementation, and maintenance.
4. **Use of Technology**
The use of technology, both for monitoring drainage systems and in the design of nature-based infrastructure, can increase the effectiveness of drainage channels and provide greater environmental benefits.
5. **Implementation of Supportive Policies**
Clear rules and regulations regarding the construction and management of drainage channels must be implemented to maintain the sustainability and effectiveness of the drainage system.

Suggestion

Based on these conclusions, some suggestions that can be given are as follows:

1. **Drainage Infrastructure Capacity Improvement**
The government needs to increase the capacity of existing drainage channels by improving and expanding the drainage network in flood-prone areas. The addition of larger drainage channels and nature-based drainage systems (such as rain gardens or bioswales) can be a solution to increase rainwater absorption.
2. **Formulation of Stricter Spatial Planning Policies**
A more robust, data-driven spatial planning policy is needed to avoid development in flood-prone areas and integrate drainage channels into any new development planning.
3. **Education and Socialization Program**
To support the success of drainage management, it is important to run education and outreach programs to the community regarding the importance of maintaining the cleanliness of drainage and managing waste wisely.
4. **Active Community Participation**
Involving the community in every stage of planning and implementation, and giving them the opportunity to play a role in maintaining drainage channels, will increase awareness and sense of responsibility for environmental sustainability.
5. **Routine Monitoring and Evaluation**
Periodic monitoring and evaluation of the performance of the normalized drainage channels needs to be carried out to ensure that the drainage system functions properly and in accordance with the expected objectives. Data collection and feedback from the community also need to be used as evaluation material for further improvement.
6. **Cross-Sectoral Cooperation**
Local governments, the private sector, and communities need to strengthen cross-sectoral cooperation in wastewater management. For example, the private sector can contribute to funding or infrastructure development, while the government is responsible for regulation and policy.

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