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INFRASTRUCTURE PLANNING OF THE ADIAN NAGINJANG IRRIGATION NETWORK: IMPLICATIONS FOR REGIONAL DEVELOPMENT AND AGRICULTURAL ECONOMY IN ASAHAN REGENCY

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Abstract

This study aims to examine the Infrastructure Planning of the Adian Naginjang Irrigation Network: Implications for Regional Development and Agricultural Economy in Asahan Regency. A qualitative research method that will be used to examine the implications of Adian Naginjang's irrigation infrastructure on regional development and agricultural economy in Asahan Regency. With a case study approach, comprehensive data collection techniques, and thematic data analysis, this study is expected to provide in-depth insights into the impact of irrigation networks in the local context, as well as support sustainable infrastructure planning and development efforts in the region. The results of the research on the construction of irrigation networks in Adian Naginjang provide important lessons for future infrastructure planning. Investment in irrigation has proven to have a wide impact on regional development and the agricultural economy. Policies that focus more on routine maintenance, technology improvement, and community participation are needed so that this infrastructure can function optimally and continue to provide benefits to the people of Asahan Regency. Overall, the Adian Naginjang irrigation network has a positive impact on regional development and agricultural economic growth in Asahan Regency. With good and sustainable management, this irrigation can be a strong foundation for productive agriculture, a thriving local economy, and improved community welfare. Future recommendations include the importance of policy support and community involvement in the maintenance and further development of this irrigation infrastructure.

Keywords: Network Infrastructure Planning, Adian Naginjang Irrigation, Regional Development and Agricultural Economy.

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Introduction

The planning of the infrastructure of the Adian Naginjang irrigation network in Asahan Regency needs to consider the importance of providing and managing adequate water resources to support regional development and improve the agricultural economy. The area has great agricultural potential, but often faces obstacles in productivity due to lack of access to an efficient irrigation system. One of the main causes is the dependence on erratic rainfall, resulting in fluctuations in production that affect food security and agricultural economic stability in the area. A good irrigation network is expected to increase the area of irrigated land and optimize agricultural yields, thus having a positive impact on farmers' income and the regional economy. Without adequate irrigation management, farmers in Asahan Regency will continue to face difficulties in achieving optimal productivity, which ultimately hampers local economic development. Furthermore, the development of irrigation infrastructure is also expected to provide long-term benefits, such as improving land quality, water use efficiency, and agricultural sustainability in the midst of climate change. Thus, the planning of the infrastructure of the Adian Naginjang irrigation network has significant implications for agriculture-based economic growth, food stability, and the improvement of community welfare in Asahan Regency (Asahan Regency Public Works Office, 2019).

The problem outlines the existing condition of Asahan Regency, especially in the agricultural sector which is highly dependent on the availability of water. The region has potential farmland, but its productivity is often hampered by its reliance on the rainy season and a lack of adequate irrigation infrastructure. The construction of the Adian Naginjang irrigation network is expected to be able to provide a stable water supply, increase the planting area, and reduce the risk of crop failure. This infrastructure is also expected to play an important role in encouraging regional economic growth through increasing crop yields and farmers' welfare. *The Adian Naginjang Irrigation Network Infrastructure Planning* focuses on the urgent need for an effective irrigation system to support the agricultural sector in Asahan Regency. This

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district is known as an area with high agricultural potential, but the availability and management of water that is not optimal is one of the main obstacles in achieving maximum productivity. Some important points in the background of the problem are as follows: Agriculture in Asahan Regency is highly dependent on rainfall, which makes agricultural productivity vulnerable to climate change and drought. The uncertainty of water supply results in many lands that are less productive or even unable to be cultivated in the dry season. This has an impact on crop yield fluctuations, which ultimately affects farmers' income and regional agricultural economic stability.

The irrigation infrastructure in this region is not adequate enough to accommodate the needs of large agricultural land. The limitations of the irrigation network cause uneven distribution of water, so that many agricultural lands are not optimally drained. This also results in increased land management costs for farmers, as well as a decrease in the efficiency of water resource use. Asahan Regency has great potential to become one of the food barns, especially in the agri-food sector such as rice and horticultural crops. However, this potential has not been maximized due to the lack of infrastructure support needed to increase productivity. An adequate irrigation network is expected to be able to expand the planting area, increase planting intensity, and improve the quality of agricultural products, which will ultimately support the welfare of the community and increase the contribution of the agricultural sector to the regional economy. In addition to agriculture, the development of irrigation infrastructure is expected to have a long-term effect on the development of the region as a whole. With a planned irrigation network, it is hoped that there will be an increase in land productivity, an increase in community welfare, and the opening of new jobs. Good infrastructure also contributes to creating sustainable regional development, reducing economic inequality between regions, and supporting the achievement of food security. The process of planning and building irrigation networks faces various challenges, ranging from budget constraints, the need for accurate land mapping, to the involvement of local communities. In addition,

effective planning requires synergy between local governments, communities, and related parties to ensure the success and sustainability of this irrigation project.

Asahan Regency has natural resources and land potential for agriculture, especially in food commodities such as rice, corn, and horticulture. However, the imbalance between land potential and actual productivity indicates infrastructure, technology, and management barriers. This condition causes agricultural products to not fully contribute to regional economic development, while most people depend on the agricultural sector as the main source of livelihood. Agricultural activities in Asahan are currently greatly influenced by rainfall patterns that are often unstable. Dependence on rain results in agricultural products being vulnerable to drought or extreme climate change. This has an impact on food security as well as uncertainty in farmers' incomes, which in turn affects the local economy. An adequate irrigation system is essential to maintain the stability of agricultural production throughout the year and reduce dependence on weather factors. Supporting infrastructure, especially irrigation networks, agricultural access roads, and markets, is still limited in many areas of Asahan Regency. Without good infrastructure, farmers face difficulties in increasing productivity and expanding market access for their crops. Irrigation infrastructure, in particular, plays an important role in regulating a consistent water supply, which has a direct impact on planting area and planting frequency. Without an adequate irrigation network, farmers cannot maximize crop yields, and agriculture is difficult to develop.

The agricultural sector is the main contributor to the economy of Asahan Regency, but the productivity of this sector is still low compared to its potential. By improving irrigation systems and other supporting infrastructure, the contribution of the agricultural sector to Regional Original Revenue (PAD) can be increased. More productive agriculture will also open additional jobs, increase farmers' household incomes, and encourage agriculture-based downstream industries, such as food processing and product distribution. Regional development through increasing agricultural productivity will contribute to sustainable development in Asahan

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Regency. Good infrastructure, such as irrigation networks, not only increases agricultural yields but also helps reduce the migration of people from rural to urban areas. In addition, sustainable development of the agricultural sector can reduce economic disparities between regions, create local food security, and support government efforts to develop regions equitably. Comprehensive infrastructure planning faces a variety of challenges, including budget constraints, interagency coordination, and the need to involve local communities in the management of agricultural facilities. Synergy between local governments, farmers, and the private sector is urgently needed to overcome these obstacles and ensure the smooth implementation of planned agricultural infrastructure projects. By looking at the various obstacles and potentials above, the development of agricultural infrastructure, especially irrigation networks, is very important to improve the agricultural economy and regional development in Asahan Regency. Adequate irrigation infrastructure is expected to increase productivity, improve farmers' welfare, and support sustainable regional development. This research will explore the implications of infrastructure development on the agricultural economy, the quality of life of the community, and the development of the Asahan Regency area as a whole.

Method Approach

Qualitative research is a method that emphasizes a deep understanding of social phenomena and human behavior, focusing on the context in which these phenomena occur. According to Sugiyono (2019), Moleong (2004), Nuraini et al, (2023a) the qualitative method aims to obtain a comprehensive and interpretive understanding of a certain situation or problem by exploring the subjective views of informants. In the context of this research, qualitative methods are expected to be able to capture the impact of irrigation networks on socio-economic aspects in Asahan Regency through the perspective of the community and local stakeholders.

This research method uses a case study approach which according to Creswell (2019), allows researchers to delve into one or several cases in a real context. This

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approach is very suitable to explore the Adian Naginjang irrigation project as one of the main cases that has implications for regional development and agricultural economy in Asahan. This case study will focus on how irrigation infrastructure plays a role in increasing agricultural productivity and influencing local economic well-being (Nuraini et al, 2023b; Nuraini, 2017; Hidayat et al, 2023)

The data in this study were collected through several complementary methods, including in-depth interviews, field observations, and document analysis (Hartini et al, 2023). In-depth interviews are the main technique for collecting qualitative data, which allows researchers to obtain in-depth information regarding informants' perceptions and experiences. According to Sugiyarto (2019), in-depth interviews are very useful for expressing opinions and perspectives that are not easy to measure with quantitative methods. In this study, interviews will be conducted with farmers, local governments, and other parties involved in irrigation projects to understand the direct and indirect impacts of the Adian Naginjang irrigation network. Field observations will be carried out to see firsthand the condition of irrigation infrastructure and how the infrastructure is used by the local community. According to Moleong (2019), observation is an important method in qualitative research because it can provide a real picture and avoid bias from the subjective perception of informants. This observation includes observations on irrigation systems, agricultural land use, and community behavior and activities in utilizing irrigation facilities.

To ensure the validity and reliability of the data, this study will use the data triangulation technique. According to Miles and Huberman (2019), triangulation is an effective way to confirm findings by comparing information from different sources or methods. Triangulation will be carried out by comparing data from interviews, observations, and document analysis, so that the conclusions produced can be more accurate and convincing.

Results & Discussion

Theory and Concept of Irrigation as an Important Infrastructure in Agriculture

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Experts generally emphasize the importance of irrigation in increasing agricultural productivity. According to Nugroho (2019), irrigation infrastructure not only plays a role in ensuring a stable water supply for agricultural land, but also as the main foundation to achieve national food security. Without an effective irrigation system, agriculture can only rely on rainfall, which makes crop yields unstable and vulnerable to droughts or climate change. In addition, according to Sari and Utami (2019), irrigation infrastructure also contributes to optimizing land use, increasing the crop index (IP), and allowing farmers to carry out multiple planting patterns. Thus, adequate irrigation can expand the planting area, improve production quality, and increase farmers' income significantly.

The Effect of Irrigation on the Regional Agricultural Economy

According to Rahmawati (2019), the construction of irrigation networks has a direct impact on increasing productivity and profits in the agricultural sector. Rahmawati emphasized that good irrigation infrastructure can increase crop yields and lower farmers' operational costs because less water is wasted. This infrastructure also plays a role in the price stability of agricultural products, as the availability of consistent supply throughout the year reduces dependence on fluctuating market prices. Suharto (2019) also mentioned that the development of irrigation infrastructure has the potential to improve the economic welfare of rural communities by creating new jobs, both in construction and irrigation management. Adequate infrastructure allows farmers to use land more intensively, thereby reducing poverty in rural areas that depend on the agricultural sector.

Implications of Irrigation on Regional Development

Irrigation not only contributes to the agricultural sector, but also has a significant impact on the overall development of the region. According to Irawan (2019), the development of irrigation networks is part of a sustainable regional development strategy because it creates infrastructure that can improve connectivity between regions and support broader economic activities, such as the distribution of

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agricultural products and access to markets. In addition, according to Mulyadi (2019), irrigation infrastructure helps in leveling development between regions, especially between rural and urban areas. Good irrigation can reduce economic inequality, allowing rural communities to reap benefits on par with urban communities in terms of economic development. This infrastructure also supports the development of other facilities such as access roads and local markets, all of which increase the economic value of the region.

Challenges in Irrigation Infrastructure Development

While the benefits are clear, some experts have also identified challenges in the planning and development of irrigation infrastructure. According to Santoso (2019), the main obstacle in irrigation projects is the problem of funding and coordination between agencies that are not optimal. Infrastructure development requires large investment and long-term planning, as well as cooperation from various parties including local governments, communities, and the private sector. According to Putri (2019), the involvement of local communities in irrigation management is very important to ensure the sustainability of the project. Putri emphasized that training and empowerment of farmers in irrigation management and maintenance can increase the effectiveness and longevity of the irrigation network. Good management by the community can also reduce

The condition of irrigation infrastructure in Asahan Regency

Asahan Regency has a number of irrigation networks that aim to support the agricultural sector, which is one of the backbones of the regional economy. However, the condition and quality of this infrastructure varies depending on the region and age of the network. Some irrigation networks have been functioning well and supporting agricultural systems efficiently, while others need improvement or improvement to be able to meet the needs of agricultural land optimally. The irrigation network in Adian Naginjang is one of the important irrigation projects that seeks to increase agricultural productivity in the region. This infrastructure is

designed to provide a stable water supply for agricultural lands in the surrounding area, especially in the dry season.

However, the condition of this irrigation infrastructure still faces several challenges:

1. Damage to Irrigation Canals: Some parts of the irrigation network in Adian Naginjang have been damaged, such as cracks in the canal walls and sedimentation that obstructs the flow of water. According to a report from the Asahan Regency Public Works Office (2019), this infrastructure maintenance is often limited by the existing budget, so only minor repairs are carried out periodically.
2. Limited Canal Capacity: Current irrigation infrastructure is still limited in terms of capacity, so during the dense growing season or when rainfall is reduced, water distribution is often insufficient. This causes some areas of agricultural land to experience water shortages, which negatively affects crop yields.
3. Erosion and Sedimentation Control: Erosion in upstream areas as well as sedimentation in irrigation canals are major challenges. According to Rahmawati (2019), sedimentation slows down the flow of water and reduces the volume that can be channeled to agricultural land. Infrastructure improvements to control erosion and reduce sedimentation need to be made to improve network efficiency.

The management and maintenance of irrigation infrastructure in Adian Naginjang also faces challenges. Irrigation management involves cooperation between local governments, irrigation managers, and water-user farmer groups (P3A). However, coordination and communication between these parties are still often hampered, causing infrastructure maintenance and repairs not to be carried out optimally. Often, maintenance is done only when significant damage occurs, not as part of a long-term prevention strategy. According to Siregar (2019) dan Sugiarto (2019, the lack of routine maintenance accelerates damage to infrastructure and reduces water use efficiency. Some recommendations to improve maintenance management include the development of training programs for farmers and increased community participation in the maintenance of irrigation infrastructure. The

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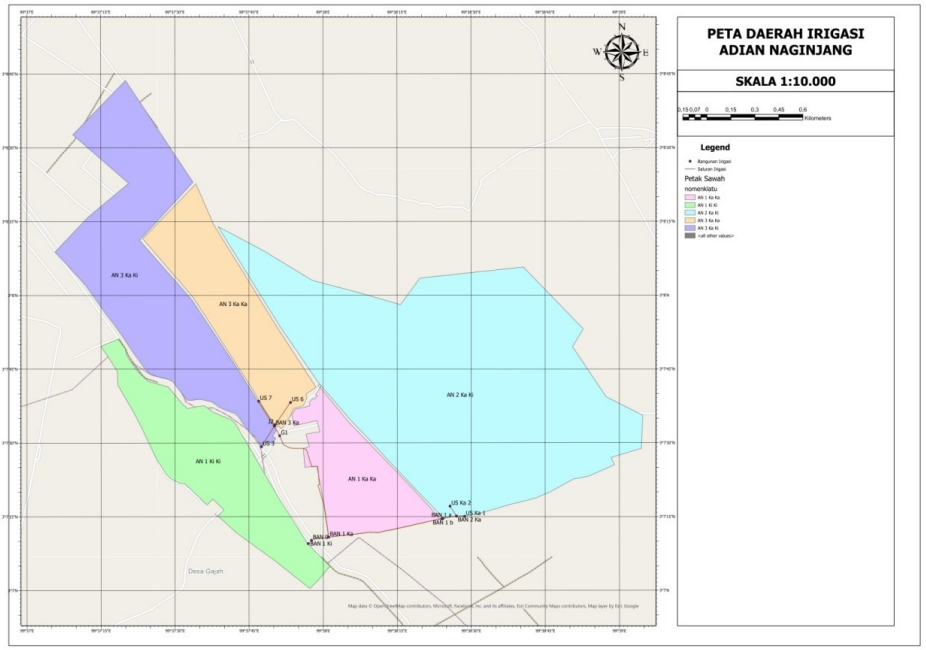
condition of irrigation infrastructure in Adian Naginjang is currently facing various challenges that affect agricultural productivity and regional development. Factors such as physical damage to the channel, limited capacity, and suboptimal maintenance management are the main obstacles to the sustainability of irrigation in the region. The improvement efforts carried out aim to improve this condition, with the hope that better irrigation infrastructure will support the improvement of the agricultural economy and more sustainable regional development in Asahan Regency.



The irrig **ıjang** *work: Implications for Regional Development and Agricultural Economy in Asahan Regency* includes a discussion of the main obstacles faced in the planning and construction of the irrigation network in Adian Naginjang. Here are some of the main obstacles affecting the implementation of this irrigation project:

Geographical Constraints and Natural Conditions

1. Challenging Topography**.**

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The Adian Naginjang region has a varied topography with several highland and valley areas. This condition poses a challenge in building stable irrigation channels, especially in maintaining consistent water flow and avoiding erosion. Uneven Rainfall Extreme weather changes and uneven rainfall patterns can lead to water shortages in the dry season or excess water in the rainy season. This results in the need for a more flexible water flow management system.

2. Limited Resources and Budget.

   Budget limitations Planning and development of irrigation infrastructure requires a large budget, especially for areas that have many natural constraints. According to data from local governments (2019), the available budget is often limited so that development is only carried out gradually or limited to minor improvements. Limited Human Resources, limited number of experts and experienced workers in the field of irrigation development are also an obstacle. Experts are needed to design and manage effective irrigation infrastructure, while an experienced workforce is essential to support timely and quality development.

3. Technical Obstacles in Development

   Erosion and Sedimentation Problems Erosion in the upstream area and sedimentation that occurs in irrigation canals are major obstacles that hinder the flow of water. Without proper handling, sedimentation can accelerate channel damage and reduce the capacity of water flowing to farmland. Damage to Channels and Infrastructure In some cases, the infrastructure that has been built has been damaged due to poor material quality or due to inadequate maintenance. These constraints often slow down the construction process and increase maintenance costs.

4. Technology Limitations

   Lack of Modern Moder Technology to manage irrigation, such as humidity sensors or automatic flow meters, is still minimal in this region. According to Santoso (2019), the application of this technology can improve the efficiency of water flow and reduce waste, but budget limitations hinder its implementation.

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Lack of Integrated Irrigation System An integrated irrigation system that combines various water sources and automatic regulation methods has not been implemented in the Adian Naginjang irrigation network. These systems can help keep water supplies stable throughout the year, but they require significant investments.

5. Management and Coordination Obstacles

   Lack of Inter-Agency Coordination Irrigation infrastructure development involves various parties, such as local governments, farmer groups, and technical agencies. Ineffective inter-agency coordination often hampers project implementation due to differences in priorities and asynchronous allocation of resources. Low Community Participation **T**he involvement of the community, especially farmer groups, in irrigation planning and maintenance is still low. According to Sudirman (2019), low community participation can have an impact on the lack of regular maintenance and supervision of infrastructure, which ultimately accelerates the damage to irrigation canals.

6. Environmental Impact

   Influence on the Surrounding Ecosystem The construction of irrigation networks can change water flow patterns and affect local ecosystems, such as natural water sources, soil, and habitats for local flora and fauna. According to the KLH report (2019), irrigation projects must take into account their environmental impact to avoid unwanted damage to the natural environment around Adian Naginjang. **Excessive Use of Fertilizers and Pesticides** An increase in the area of irrigated agricultural areas is often followed by the use of large amounts of fertilizers and pesticides. These chemicals can be carried away by irrigation water and contaminate channels and water sources, negatively impacting the quality of the environment around irrigation networks.

7. Maintenance and Maintenance Obstacles

   Lack of Routine Maintenance Regular maintenance is necessary to keep irrigation canals functioning optimally, but budget constraints often result in

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maintenance only being carried out when there is major damage. This accelerates infrastructure damage and reduces the life of irrigation canals. **The Role of P3A (Water User Farmers Association) is Less Optimal** P3A should play an active role in the management and maintenance of irrigation. However, in some regions, the role of P3A is still not optimal, both due to limited funds and low understanding of the importance of this role.

Obstacles in the planning and construction of the irrigation network Adian Naginjang show that many factors affect the success of irrigation projects. The challenges faced include geographical factors, budget limitations, technical constraints, technological limitations, ineffective coordination, and environmental impacts. Therefore, comprehensive and sustainable planning, with the support of the government and strong community participation, is needed to overcome these obstacles and realize an irrigation network that can support regional development and a better agricultural economy in Asahan Regency.

The impact of the existence of this irrigation network on agricultural economic growth and regional development

Impact on Agricultural Economic Growth The existence of adequate irrigation networks allows for a more stable and sufficient distribution of water for agricultural land needs, especially in the dry season. With a guaranteed water supply, the productivity of crops such as rice, corn, and horticulture increases, so that farmers can produce larger and quality harvests. This has a direct impact on increasing farmers' income. Good irrigation allows farmers to grow different types of crops in addition to traditional ones, so they can diversify their commodities. According to Santoso (2019), crop diversification can increase income because farmers have the opportunity to market various products outside the main harvest season. Irrigation systems reduce farmers' reliance on rainfall, which is often erratic and can affect planting times. With irrigation, farmers can plan planting patterns more consistently and increase planting frequency, which in turn

increases the number of harvests in a year. With the increase in productivity and diversification of commodities, the agricultural sector creates more jobs for the surrounding community. This has a positive impact on the absorption of local labor, both in the process of planting, maintenance, to harvesting and product distribution.

Impact on the Development of Supporting Infrastructure The existence of irrigation that increases agricultural activities also encourages the development of road and transportation infrastructure around Adian Naginjang. Better roads and transportation facilities allow for more efficient distribution of agricultural produce, reduce logistics costs, and accelerate market access. With more abundant crops, the demand for storage and processing facilities for agricultural products is also increasing. Facilities such as storage warehouses and crop processing sites, such as rice mills or vegetable processing, can be built around these irrigated areas to support the agricultural industry. With the increase in productivity and income, the welfare of farmers in the Adian Naginjang area in general has increased. According to a survey from the Central Statistics Agency of Asahan Regency (2019), the increase in farmers' income has an impact on their ability to meet basic needs and improve the standard of living of their families. Developing agriculture often gives birth to new MSMEs in the agricultural sector, such as fertilizer businesses, seeds, agricultural tools, or agricultural product processing. These MSMEs contribute to the regional economy and create new job opportunities for the surrounding community.

Impact on Regional Development The existence of irrigation infrastructure that supports agriculture increases the attractiveness of investment in Asahan Regency, especially in the agricultural sector and related industries. Investors are more interested in investing in areas that have infrastructure that supports business sustainability, so there is an opportunity to accelerate regional development. With the increase in economic activity in the agricultural sector, taxes from this sector as well as levies generated from related businesses can make a greater contribution

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to regional revenues. This in turn strengthens regional finances that can be used for infrastructure development and other public services. A good irrigation network supports the creation of an integrated agricultural ecosystem, where agricultural production, processing, and distribution can run efficiently. With this ecosystem, Asahan Regency can develop integrated agricultural centers that support the regional economy, while increasing regional food stability. The existence of an irrigation network supports stable agricultural production, so that it can increase food security in Asahan Regency. When food production meets local needs, the region is no longer dependent on external supply, which in turn strengthens the region's agricultural economic position.

With irrigation, people become more aware of the importance of water resource management and the benefits of good irrigation infrastructure. Education about water management and irrigation maintenance can be one of the positive impacts for the surrounding community. With irrigation infrastructure, communities and local governments can be more open to the application of modern agricultural technology, such as drip irrigation, soil management technology, and more efficient planting innovations. This has an impact on improving people's skills and insights in the agricultural sector. The existence of the Adian Naginjang irrigation network has brought various positive impacts to agricultural economic growth and regional development in Asahan Regency. This impact can be seen in increasing farmers' productivity and income, developing supporting infrastructure, and improving the welfare of the local community. Good irrigation infrastructure not only encourages economic growth, but also strengthens food security and attracts investment to these areas. Thus, the development of irrigation such as in Adian Naginjang is a strategic step to accelerate regional development and improve the quality of life of the people in Asahan Regency.

Conclusion

The existence of the Adian Naginjang irrigation network plays a significant

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role in increasing agricultural productivity in Asahan Regency. With a more stable water supply, farmers can optimize the planting cycle and increase crop yields. This not only has an impact on farmers' income but also on local food security, because consistent production of agricultural products can meet regional needs. The development of irrigation infrastructure is also a driver of local economic growth, especially through the diversification of agricultural commodities and the increase in community income. An adequate irrigation network allows farmers to grow various types of commodities, increase product competitiveness, and encourage the emergence of micro, small, and medium enterprises (MSMEs) in the agricultural sector.

The Adian Naginjang irrigation network makes a real contribution to regional development by encouraging the improvement of supporting infrastructure, such as roads and transportation facilities needed for the distribution of agricultural products. This impact is also seen in the increasing investment interest in the region, which accelerates the development of the region and opens up new economic opportunities. The increase in income and welfare of the community is one of the direct results of this irrigation network. Farmers' economic well-being is improving, allowing them to improve their living conditions and access to education and health services. The existence of irrigation also encourages public awareness of the importance of water and other natural resource management.

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