

## ANALYSIS OF THE IMPACT OF NATIONAL STRATEGIC INFRASTRUCTURE DEVELOPMENT (TRANS-SUMATRA TOLL ROAD) ON CHANGES IN SPATIAL PATTERNS AND ACCESSIBILITY IN NORTH LABUHANBATU REGENCY

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### ABSTRACT

The development of the trans-sumatra toll road, particularly the rantau prapat–kisaran section, has had a significant impact on changes in spatial patterns, accessibility, and local economic potential in north labuhanbatu regency. this study employs a descriptive qualitative approach, with data collection techniques including in-depth interviews, participatory observation, and documentation. research informants consist of affected communities, policymakers, and local business actors. the results indicate that toll road development has led to land-use conversion from agriculture to residential, industrial, and commercial uses, as well as changes in settlement patterns and the distribution of economic activities. improved accessibility generated by the toll road and supporting facilities, such as aek kanopan terminal, has accelerated population mobility and goods distribution, reduced logistics costs, and expanded market reach. moreover, this infrastructure development has stimulated local economic growth by increasing agricultural sector income and creating new trade opportunities. overall, the development of the toll road and its supporting infrastructure is generally aligned with the spatial plan (rtrw) of north labuhanbatu regency, although continuous monitoring is required to maintain spatial balance and prevent land-use conflicts. this study provides important insights for sustainable infrastructure development planning in north sumatra.

### Introduction

The development of national strategic infrastructure is one of the priorities of the Indonesian government in order to accelerate economic growth, improve connectivity between regions, and strengthen the distribution of goods and services. One of the infrastructure projects that has a significant impact is the Trans-Sumatra Toll Road, which

is designed to connect various provinces on the island of Sumatra and facilitate people's mobility and logistical flows. The construction of this toll road is expected to reduce transportation costs, increase investment, and encourage economic development along the toll corridor. In North Labuhanbatu Regency, the construction of the Trans-Sumatra Toll Road is an important phenomenon because this area was previously still dominated by a relatively traditional spatial pattern with limited adequate transportation networks. Accessibility to economic centers, settlements, and public facilities is still limited, so that population mobility and the distribution of goods are hampered. The presence of toll roads is predicted to bring significant changes to the spatial pattern of the region, both in terms of the development of settlements, industrial estates, and public service centers. Good development planning is needed so that the policies that will be issued by the Regional Government on the construction of the Trans Sumatra Toll Road can have a good impact on the community, this is in line with what is explained by (Sugiarto et al, 2024) planning acts as a guide to direct development efforts towards achieving the vision and mission that has been set.

However, in addition to the potential economic benefits, toll road construction also brings challenges, especially related to rapid and unplanned changes in spatial patterns. Increased accessibility can encourage the conversion of land from agriculture to settlements or industries, create pressure on existing spatial planning, and raise the risk of development inequality between regions. This is relevant to be analyzed, considering that infrastructure development decisions that are not accompanied by proper spatial planning can have an impact on environmental degradation, socio-economic disparities, and imbalances in regional development. And what cannot be ruled out is the characteristics of the community that will be affected by development, development must be able to accommodate all characteristics that are affected by development, the community that accepts and rejects development must also be able to be overcome by providing the right policies. The character of the inhabitants of a place will also be very influential in the spatial planning of an area (Nuraini et al, 2021; Nuraini et al, 2023)

The construction of the Trans-Sumatra Toll Road, especially the Rantau Prapat-Kisaran section (Rantaran Toll Road), is one of the government's strategic efforts to improve inter-regional connectivity on the island of Sumatra. This toll road is planned to pass through Rantau Prapat City in Labuhanbatu Regency, Kisaran City in Asahan Regency, and North Labuhanbatu Regency (Aek Kanopan District, NA IX-X District or Marbau District), and will be part of the main corridor connecting south to north Sumatra, including Medan. The presence of this toll road is predicted to significantly increase regional accessibility, shorten travel time, and open up opportunities for economic growth along the corridor. This will change the transportation pattern in North Labuhanbatu Regency, the role and benefits of transportation can be seen from several aspects including economic, social, political, and environmental aspects (Jinca, 2002). This means that the weakness of the transportation sector will hinder the growth rate of other sectors. Transportation routes are one of the regional infrastructures that need to be considered in Planning (Nuraini et al, 2023), therefore the impact of development that will affect the economy, social and other things also affects road and transportation conditions.

The current condition of road infrastructure in North Labuhanbatu Regency still requires serious attention. Based on data from North Labuhanbatu Regency in Numbers, in 2024, of the total length of the regency roads of 1,023.34 km, only about 317.97 km are in

good condition, while 611.1 km have been severely damaged. The majority of the roads are still gravel/stone (540.09 km), with less than half the length of paved roads (365.4 km) and the rest dirt roads. This condition shows that accessibility between regions in North Labuhanbatu is still limited and vulnerable to obstacles, especially in the rainy season. The construction of toll roads is expected to be a catalyst for significant changes in terms of population mobility and distribution of goods, thereby improving the connectivity of areas that have been constrained by inadequate road infrastructure.

Apart from accessibility, the construction of toll roads also has implications for changes in spatial patterns in North Labuhanbatu Regency. Studies on land cover changes show that there is a change in land use from agricultural areas to residential and industrial areas. City identity is formed through the relationship between space, social activities, and cultural values that develop in the lives of urban communities, so that public space becomes one of the key elements in shaping the image and character of the city (Sugiarto, 2019). This is in accordance with the discussion (Nuraini, 2019) which shows that the structure of residential space and the quality of open space have a direct influence on the pattern of activities and social interactions. This phenomenon is increasingly relevant as accessibility caused by toll road construction increases, so that areas that were previously relatively remote are now easier to reach, triggering new development dynamics. This shift can drive local economic growth, but it also demands careful spatial planning so that land change does not result in space-use conflicts, environmental degradation, or development inequality.

From an economic perspective, North Labuhanbatu Regency has great potential in the agricultural sector, especially oil palm and rubber. However, limited access to the market is an obstacle in optimizing this potential. Increased accessibility due to tolls can open up more efficient distribution opportunities and connect local products to wider economic centers. Research shows that road infrastructure development can drive regional economic growth, where a 1% increase in road infrastructure can add about 0.08% of Gross Domestic Product (GDP). Thus, toll roads not only have an impact on physical mobility, but also on regional economic dynamics.

The Spatial Planning (RTRW) of North Labuhanbatu Regency for 2015–2035 emphasizes the importance of spatial planning for protected, cultivated, and residential areas. The integration of toll road construction with RTRW is important so that the use of space remains optimal and sustainable. In addition, the planned construction of a terminal in Aek Kanopan District will further improve the accessibility of local transportation, with the main network connected to the toll road. This shows that toll roads are not just a means of transportation, but also a trigger for spatial and connectivity changes that support economic growth and regional development. Thus, the construction of the Trans-Sumatra Toll Road in North Labuhanbatu Regency can be analyzed from two main perspectives: changes in spatial patterns due to land conversion and increased accessibility that affect population mobility and logistics flows. This study aims to explore how the toll road changes the dynamics of space and accessibility in this region, so that it can be the basis for sustainable and strategic regional planning.

The construction of the Trans-Sumatra Toll Road in North Labuhanbatu Regency is one of the national strategic infrastructure projects that has a wide impact on regional, economic, and spatial development. Although these tolls are expected to improve connectivity, shorten travel times, and expand access to economic centers, the changes

they bring about to spatial patterns and accessibility in local areas are not yet fully understood. The urgency of this research arises for several reasons. First, changes in accessibility due to toll roads can trigger the conversion of land from agriculture to residential, industrial, or commercial areas. Without proper understanding, this conversion has the potential to cause development imbalances, land use conflicts, and pressure on the environment. This research is important to map the extent to which changes in spatial patterns occur and how they affect the planned spatial layout.

Second, North Labuhanbatu Regency has limited road infrastructure and most of it is in poor condition. Increased accessibility due to toll roads is expected to encourage community mobility, efficiency of goods distribution, and economic growth. However, the real implications for local people's lives, settlement patterns, and economic activities have not been systematically documented. This research will provide empirical data that supports local government and spatial planning decision-making in utilizing toll roads optimally. Third, the construction of toll roads and supporting infrastructure such as the terminal in Aek Kanopan provides opportunities as well as challenges for local economic development. This research is important to understand the relationship between increased accessibility and economic dynamics, so that the potential of the agricultural, trade, and industrial sectors can be maximized without damaging the balance of space and the environment.

In addition, an understanding of how changes in accessibility due to toll roads affect population mobility, economic activity, and spatial transformation is essential. This analysis not only assists local governments in formulating sustainable spatial management policies, but also provides a basis for spatial planning that is adaptive to changes in strategic infrastructure. Therefore, this study is focused on exploring the impact of the construction of the Trans-Sumatra Toll Road on changes in spatial patterns and accessibility levels in North Labuhanbatu Regency, so that it can be a reference in more integrated and sustainable regional planning.

### **Problem Identification**

Based on the background, discussion, and urgency of the research, the issues that arise can be identified as follows:

1. **Limited Accessibility Before Toll Road Construction**  
The district road infrastructure is mostly in poor condition (dirt roads, gravel, and asphalt are limited), so the mobility of residents and the distribution of goods are still limited.
2. **Potential Changes in Spatial Patterns**  
Increased accessibility due to toll roads can encourage land conversion from agriculture to residential, industrial, and commercial areas, which has the potential to cause spatial imbalances.
3. **Impact on the Local Economy**  
North Labuhanbatu Regency has economic potential in the agricultural sector, but it is not optimal due to limited access to markets and economic centers. The construction of toll roads is expected to improve this, but the real impact has not been measured systematically.
4. **Conformity with Spatial Planning and Government Policies**

The construction of toll roads must be in line with the Regional Spatial Plan (RTRW) so that land use remains sustainable and does not damage the environment.

5. Development of Supporting Infrastructure

The plan to build a terminal in Aek Kanopan as part of the toll road needs to be analyzed for its impact on local mobility and accessibility.

### **Problem Formulation**

Based on the identification of the above problems, this study formulated the following problems:

1. How has the spatial pattern in North Labuhanbatu Regency changed due to the construction of the Trans-Sumatra Toll Road?
2. How does the increase in accessibility caused by the Trans-Sumatra Toll Road affect population mobility and the distribution of goods in North Labuhanbatu Regency?
3. What is the impact of the construction of the Trans-Sumatra Toll Road on the local economic potential, especially the agricultural and trade sectors?
4. To what extent is the construction of the Trans-Sumatra Toll Road and its supporting infrastructure (e.g. the Aek Kanopan terminal) in accordance with the Regional Spatial Plan (RTRW) of North Labuhanbatu Regency?

### **Literature Review**

#### **Transportation Infrastructure and Regional Development**

Transportation infrastructure is a vital element in regional development because it functions as a link between regions, facilitates the mobility of goods and people, and supports economic distribution. According to Prasetyo and Firdaus (2009), good infrastructure development will ensure efficiency, facilitate the movement of goods and services, and increase economic added value. The construction of toll roads, as part of transportation infrastructure, has the potential to improve accessibility between regions. This is in line with the opinion of Fadhi et al. (2022), who stated that the development of transportation infrastructure can affect regional economic growth.

#### **Changes in Spatial Patterns Due to Infrastructure Development**

The development of infrastructure, including toll roads, can cause changes in the spatial pattern of an area. These changes include land conversion, land use changes, and shifts in economic activity. According to Kholifah (2025), the construction of toll roads can cause changes in consumer movement patterns and a decrease in customers due to changes in accessibility. In addition, Paulia (2025) added that changes in land use, limited access to agricultural land, and shifts in work patterns are things that need to be observed in the construction of toll roads.

#### **Accessibility and Mobility of the Population**

High accessibility allows for more efficient population mobility, facilitates the distribution of goods, and improves connectivity between regions. Nurhamidah (2023) explained that the transportation system is very closely related to socioeconomic changes, including the

movement of people, goods, and the level of accessibility in an area. Increasing accessibility through the construction of toll roads can shorten travel time, reduce transportation costs, and improve the efficiency of goods distribution. This can have a positive impact on the economy of the area passed by toll roads.

### **Social and Economic Impacts of Toll Road Development**

The construction of toll roads not only has an impact on the physical aspect, but also on the social and economic aspects of the community. According to Ahmad (2022), the construction of toll roads can increase entrepreneurial opportunities and economic growth in the area passed. However, negative impacts also need to be considered, such as a decline in environmental quality, changes in people's lifestyles, and potential social conflicts due to land conversion. Therefore, it is important to conduct a thorough social and economic impact analysis in every toll road construction project.

### **Research Methodology**

#### **Research Approach**

This study uses a descriptive qualitative approach to understand in depth the impact of the construction of the Trans-Sumatra Toll Road on changes in spatial patterns and accessibility in North Labuhanbatu Regency. This approach was chosen because it is able to explore complex social and economic phenomena and provide a rich contextual understanding of the experiences and perceptions of affected communities.

According to Paulia (2025), qualitative approaches allow researchers to understand social and economic dynamics holistically, especially in the context of infrastructure development that directly affects people's lives.

#### **Research Location and Time**

This research was carried out in North Labuhanbatu Regency, North Sumatra Province, Indonesia. The research location was chosen because it is one of the areas passed by the Trans-Sumatra Toll Road, especially the Rantau Prapat-Kisaran section. The research period lasted from November 2025 to January 2026, with consideration to obtain relevant and up-to-date data on the impact of toll road construction on local communities.

#### **Research Informant**

Research informants were selected using the purposive sampling technique, which is the selection of informants based on certain criteria relevant to the focus of the research. The criteria for informants include:

1. Directly affected communities: Residents who live along the toll road and are affected by the construction and operation of the toll road that will be carried out.
2. Local policy makers: Local government officials involved in the planning and implementation of toll road construction to be implemented.

3. Local economic actors: Entrepreneurs, farmers, and micro, small and medium enterprises (MSMEs) who interact directly with the impact of toll road construction.

The number of informants is adjusted to the needs of the data and the depth of information obtained, taking into account the principle of saturation point, which is the point at which the information obtained no longer provides significant new data.

### **Data Collection Techniques**

The data collection techniques used in this study include:

1. In-depth interview: To explore the perceptions, experiences, and views of informants regarding the impact of toll road construction on spatial patterns and accessibility.
2. Participatory observation: The researcher is directly involved in community activities to observe the social and economic changes that occur during the toll road construction process.
3. Documentation: Collect secondary data in the form of spatial planning documents, local government reports, and other related literature.

### **Data Analysis Techniques**

The collected data was analyzed using an interactive qualitative analysis technique consisting of three main components:

1. Data reduction: The process of selecting, focusing, and simplifying data obtained from the field.
2. Data presentation: Compilation of data in the form of a systematic narrative to facilitate understanding.
3. Conclusion drawing and verification: Drawing conclusions based on the data that has been analyzed and verifying its truth through triangulation of sources and techniques.

According to Miles and Huberman (1994), qualitative data analysis is dynamic and takes place continuously throughout the research process, thus allowing researchers to understand phenomena in depth and contextually.

### **Data Validity and Reliability**

To ensure the validity and reliability of the data, this study uses triangulation techniques, namely:

1. Source triangulation: Comparing data obtained from various informants with different backgrounds.
2. Triangulation techniques: Using various data collection techniques to verify the consistency of information.
3. Time triangulation: Collecting data at different times to see the consistency of information over time.

## Results and Discussion

### How has the spatial pattern in North Labuhanbatu Regency changed due to the construction of the Trans-Sumatra Toll Road

The construction of the Trans-Sumatra Toll Road, especially the Rantau Prapat-Kisaran section, has had a significant impact on changes in spatial patterns in North Labuhanbatu Regency. This toll road serves not only as a transportation route, but also as a catalyst for spatial and economic transformation in the region through which it passes. One of the main impacts of toll road construction is the conversion of land use. Recent data and studies show that areas along the toll corridor have shifted land use from agricultural areas to settlements, industrial areas, and commercial areas. This phenomenon is in line with the opinion of Kholifah (2025) that the construction of toll roads increases the strategic value of land around toll access so as to encourage the conversion of agricultural land into non-agricultural productive land. This can be seen from the increase in housing and trade center construction in several villages along the toll road, including around Aek Kanopan and Rantau Prapat Districts.



**Figure 1 Construction of the Trans-Sumatra Toll Road**

In addition to land conversion, toll road construction also causes changes in the pattern of spatial activities. Communities that were previously isolated now have faster access to city centers and other economic zones. Nurhamidah (2023) emphasized that increased accessibility will affect human movement and the distribution of goods, so that the pattern of use of public spaces, business centers, and social facilities tends to experience new concentrations near toll entrances. This has implications for a more focused regional arrangement of transport corridors, creating new growth pathways beyond traditional urban centres. The construction of toll roads in North Labuhanbatu Regency is likely to have 2 (two) toll gates with alternatives in Aek Kanopan District, NA IX-X District and Marbau District. This must be a concern and adjust to the spatial pattern, road conditions, economy and character of the community around the possible exit of the toll road.



**Figure 2 Simpang Suka Rame (alternative toll gate of Kualuh Hulu District)****Figure 3 Junction Panigoran (alternative toll gate of Na IX-X District)****Figure 4 Marbau Junction (Marbau District toll gate alternative)**

The next impact is a shift in density and settlement patterns. Increased accessibility encourages population migration to more strategic areas, especially close to toll gates. This phenomenon can lead to urban sprawl or the linear spread of settlements along toll roads, which needs to be anticipated through sustainable spatial planning. According to Paulia (2025), toll road construction needs to be integrated with the Regional Spatial Plan (RTRW) so that the growth of new spaces can be controlled and reduce the risk of land use conflicts.

In addition to the physical aspect, changes in spatial patterns can also be seen in shifting economic functions. Traditional agricultural areas are beginning to diversify economically, where some land is used for commercial businesses, transportation services, and light industries that take advantage of easy access to toll roads. This is in line with the findings of Fadhi et al. (2022) that the development of transportation infrastructure increases regional economic growth opportunities, while changing local economic structures and patterns of space utilization.

Thus, the construction of the Trans-Sumatra Toll Road in North Labuhanbatu Regency has led to a change in the spatial pattern that is multifaceted, including:

1. Land conversion from agriculture to settlement, industry, and trade.
2. Changes in the concentration of economic and social activities around the toll corridor.
3. A shift in settlement patterns and population density towards strategic areas near toll gates.

4. The transformation of local economic functions from agrarian to more diverse and integrated with transportation networks.

This phenomenon of spatial pattern change shows that toll roads are not only a means of transportation, but also a regional development instrument that affects spatial structure, distribution of economic activities, and land governance. More research is needed to map long-term impacts and design adaptive and sustainable spatial strategies

### **How does the increase in accessibility caused by the Trans-Sumatra Toll Road affect population mobility and distribution of goods in North Labuhanbatu Regency**

Increasing accessibility is one of the most significant impacts of the construction of the Trans-Sumatra Toll Road, especially the Rantau Prapat-Kisaran section that crosses North Labuhanbatu Regency. This toll road provides faster and more efficient connectivity between rural areas, city centers, and strategic economic zones in North Sumatra. The main impact of this increase in accessibility can be analyzed through two main aspects, namely population mobility and distribution of goods.

#### **1. Population Mobility**

Increasing accessibility directly makes it easier to move residents from one region to another. According to Nurhamidah (2023), better access to transportation encourages people to be more flexible in carrying out social, educational, and work activities. In North Labuhanbatu Regency, this toll road allows people in previously remote areas, such as Aek Kanopan District, to more easily access public service centers, educational facilities, and economic centers such as Rantau Prapat and Kota Kisaran. This phenomenon also has an impact on changes in mobility behavior. Residents tend to travel long distances more often for work or trade, which was previously hampered by poor road conditions and long travel times. In addition, ease of access encourages the emergence of new mobility patterns, such as urban-rural commuting, where villagers can work or do business in the city without having to change permanent residences.

#### **2. Distribution of Goods**

In addition to human mobility, the Trans-Sumatra Toll Road plays an important role in the efficiency of goods distribution. Fadhi et al. (2022) stated that improving the quality of transportation infrastructure can reduce logistics costs, speed up delivery times, and expand the distribution range of goods. In North Labuhanbatu, this toll facilitates access for oil palm, rubber, and other agricultural products farmers to regional and national markets. Agricultural products that were previously difficult to reach due to poor road conditions can now be distributed faster, increasing farmers' competitiveness and income. Another impact of increased accessibility is the emergence of a concentration of economic activities along toll corridors, including distribution centers, logistics warehouses, and transportation services. This drives supply chain efficiency and creates a more integrated distribution network between manufacturers, distributors, and consumers. Paulia (2025) emphasized that toll road construction can trigger local economic growth through increased mobility and accessibility, as well as affect the structure and distribution pattern of economic activities in the affected areas.

### **Conclusion**

Overall, the construction of the Trans-Sumatra Toll Road improves accessibility in North Labuhanbatu Regency, which has an impact on:

1. Increasing population mobility for work, education, and social affairs.
2. Changes in new mobility patterns, including urban-rural commuting.
3. Efficient distribution of goods, accelerating travel time, and lowering logistics costs.
4. Increasing local economic opportunities through the concentration of economic activities in the toll corridor.

This phenomenon shows that toll roads not only function as a means of transportation, but also become an important instrument in encouraging socio-economic dynamics and more equitable regional growth. Further analysis is needed to map the long-term impact on population distribution patterns, business locations, and economic development in North Labuhanbatu Regency

### **What is the impact of the construction of the Trans-Sumatra Toll Road on the local economic potential, especially the agricultural and trade sectors**

The construction of the Trans-Sumatra Toll Road, especially the Rantau Prapat-Kisaran section, has a significant impact on the local economic potential in North Labuhanbatu Regency, especially in the agricultural and trade sectors. Modern and high-capacity toll road infrastructure improves regional connectivity, thereby opening up new economic opportunities for local communities and strengthening regional integration with regional and national markets.

#### **1. Impact on the Agricultural Sector**

North Labuhanbatu Regency has considerable agricultural potential, especially in palm oil, rubber, and palm oil commodities. However, limited market access due to inadequate road conditions has been an obstacle for farmers in selling their products efficiently. The construction of the toll road increases accessibility to the market center, so that the travel time from the production site to the distribution center can be significantly shortened. According to Fadhi et al. (2022), the development of adequate transportation infrastructure can reduce logistics costs and increase the efficiency of distribution of agricultural products. In North Labuhanbatu Regency, this is expected to encourage an increase in farmers' income, expand marketing networks, and increase the competitiveness of local agricultural products. In addition, toll access allows for the entry of new agricultural technologies and investment in the agricultural sector, which can improve productivity and the quality of agricultural products.

#### **2. Impact on the Trade Sector**

The increase in accessibility due to toll roads also has an impact on the trade sector. Toll roads facilitate the flow of goods in and out of the region, so that local business actors can expand market reach and reduce transportation costs. According to Paulia (2025), the construction of toll roads can create a concentration of new economic activities along the toll corridor, including trade centers, modern markets, and logistics warehouses. This phenomenon can be seen from the increase in trade activities around toll access and new terminals such as in Aek Kanopan. Local traders now have the opportunity to sell their products to major cities and even to other provinces, increasing trade volumes and strengthening the local economy. In addition, toll roads also encourage the emergence of

supporting businesses such as restaurants, petrol stations, and transportation services, which contribute to increasing economic activity in the affected areas.

### 3. Integration of the Agriculture and Trade Sectors

The impact of toll road construction is not only felt separately in the agricultural and trade sectors, but also creates synergy between the two. Agricultural products can be distributed more quickly and cheaply to the market, while more active trade supports the economic growth of the region. This is in line with the findings of Ahmad (2022), who stated that the development of transportation infrastructure increases entrepreneurial opportunities and local economic growth through better connectivity.

Overall, the construction of the Trans-Sumatra Toll Road in North Labuhanbatu Regency has a positive impact on the local economic potential, with details:

1. Improve the efficiency of agricultural product distribution and expand market access.
2. Encourage the growth of the trade sector through ease of transportation and reduction of logistics costs.
3. Generating synergies between the agricultural and trade sectors that support local economic growth.
4. Creating new business opportunities and economic activities along the toll corridor.

This phenomenon confirms that toll roads play a role not only as a means of transportation, but also as a driver of economic growth and socio-economic transformation in the area they pass through. Further analysis is needed to identify the long-term impact on agricultural productivity, local trade structures, and community welfare in North Labuhanbatu Regency

### **The extent to which the construction of the Trans-Sumatra Toll Road and its supporting infrastructure (e.g. the Aek Kanopan terminal) is in accordance with the Regional Spatial Plan (RTRW) of North Labuhanbatu Regency**

The construction of the Trans-Sumatra Toll Road in North Labuhanbatu Regency, especially the Rantau Prapat-Kisaran section, along with supporting infrastructure such as the Aek Kanopan Terminal, is part of a national strategic project that has major implications for regional spatial planning. The suitability of this development with the Regional Spatial Plan (RTRW) of North Labuhanbatu Regency for 2015-2035 is an important aspect to ensure that development is carried out in a sustainable, orderly, and not causing land use conflicts.

#### 1. Suitability of Land Function

The RTRW of North Labuhanbatu Regency regulates spatial arrangement for various functions, including protected areas, cultivation, settlements, and economic zones. The construction of toll roads and terminals has been planned to pass through corridors that are in line with the RTRW, utilizing most of the land earmarked for transportation and economic activities. According to Kholifah (2025), integration between infrastructure projects and RTRW can minimize the risk of uncontrolled land conversion and maintain a balance between economic zones and the environment. At some point, the toll road crosses productive agricultural areas. In this case, conformity with the RTRW emphasizes the need for compensation or relocation of agricultural land, as well as zoning arrangements to avoid land fragmentation. Thus, toll roads are not only a transportation route, but also integrated with a sustainable space utilization plan.

#### 2. Aek Kanopan Terminal and Supporting Infrastructure

The plan to build a terminal in Aek Kanopan acts as a transportation node that connects toll roads with the local transportation system. This terminal is designed in accordance with the RTRW which regulates the location of public transportation facilities in the centers of economic activity, so that it does not cause disturbances to residential areas or protected areas. Paulia (2025) emphasizes that alignment between transportation infrastructure and spatial planning is essential to optimize social and economic benefits, while minimizing negative impacts on the environment.

### 3. Impact on Spatial Planning and Regional Balance

The construction of toll roads and terminals can encourage changes in spatial patterns, including the growth of settlements and commercial areas around toll access. According to the RTRW, these changes must be controlled through strict zoning planning and spatial arrangements so as not to cause urban sprawl or land use that is not in accordance with its function. Nurhamidah (2023) emphasized that the integration of infrastructure with RTRW is important to maintain the harmony of physical development and economic activities with environmental conservation.

### 4. Challenges and Adjustment Efforts

While most of the development has complied with the provisions of the RTRW, challenges remain, such as potential land use conflicts, the need to relocate facilities, and pressures on agricultural areas. Therefore, continuous monitoring and evaluation is needed to ensure that toll roads and terminals support economic growth and mobility, without undermining the planned balance of space.

Overall, the construction of the Trans-Sumatra Toll Road and its supporting infrastructure in North Labuhanbatu Regency is relatively in accordance with the RTRW, with transportation corridor planning that refers to zoning and land functions that have been determined. This alignment allows toll roads and terminals to provide maximum benefits for mobility, distribution of goods, and economic growth, while maintaining a balance of spatial and environmental planning. However, continuous adjustment and supervision are still needed to deal with the dynamics of changing spatial patterns that occur due to this development.

## Conclusion

Based on data analysis, this study produced several main conclusions as follows:

1. **Spatial Pattern Changes:** The construction of the Trans-Sumatra Toll Road led to the conversion of land from agriculture to settlements, industrial estates, and trade centers. In addition, settlement patterns have shifted towards toll corridors, creating a new concentration of economic activity along transportation routes.
2. **Improved Accessibility and Mobility:** Toll roads and supporting infrastructure, such as the Aek Kanopan Terminal, improve population mobility and the efficiency of goods distribution. Citizens now have easier access to service centers, education, and markets, while the distribution of agricultural products and trade has become faster and cheaper.
3. **Local Economic Impact:** Increased toll accessibility drives local economic growth, increases farmers' incomes, expands trade reach, and creates new business opportunities in the service and logistics sectors.

4. Conformity with RTRW: In general, the construction of toll roads and supporting terminals has followed the provisions of the Regional Spatial Plan (RTRW) of North Labuhanbatu Regency. Nonetheless, continuous monitoring and evaluation are necessary to maintain a balance in the use of space and avoid long-term negative impacts.
5. Policy Implications: This study emphasizes the importance of integrating infrastructure development with sustainable spatial planning, in order to ensure maximum socio-economic benefits and minimize negative impacts on the environment and local communities.

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