Analysis of Ferry Transportation Development in Improving Accessibility and Connectivity between Lake Toba Regions

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Abstract

The demand for means of transportation needed to cross through the Tigaras- Simanindo and Ajibata- Tomok trips are increasing every year, in 2022 will by this time have a load factor directly above 85%, but this high demand is not complemented by an improvement in existing facilities/infrastructure, instigating congestion. The bottleneck of ferry transportation is due to the lack of transport capacity and the long headway for ship departures, causing a buildup of vehicles lining up to cross and hindering smooth inter-regional connectivity on Lake Toba. To increase inter-regional connectivity in the area, it is necessary to develop ferry transportation, both to improve facilities, and infrastructure and to develop its operations. The aims of this study were (1) to analyze the accessibility and connectivity of ferry transportation on the Tigaras- Simanindo and Ajibata- Tomok routes; (2) to analyze the operation pattern of ferry transportation following current conditions; and (3) to analyze the development of cross-Tigaras – Simanindo and Ajibata- Tomok crossings in increasing accessibility and inter-regional connectivity. The method used in this research is quantitative with a descriptive model. The result of this research is solving the problem in the existing conditions can be done by increasing the operating pattern of ferry transportation, on the Tigaras- Simanindo line by adding ships that operate as many as 4 ships/day with a frequency of 28 trips/day and operate two temporary existing piers on the Ajibata- Tomok adds 2 ships/day with a frequency of 12 trips/day and operates one existing wharf. Meanwhile, to solve long-term problems, the development of ferry transportation must be carried out by improving facilities and infrastructure by seven ships/day with a frequency of 71 trips/day and operating three piers on the Tigaras- Simanindo line while on the Ajibata- Tomok line as many as 6 ships/ day with a frequency of 53 trips/day and two operational jetties. With the development

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of crossing transportation, there is an increase in the accessibility of Kab. Simalungun – Samosir at 9.06%/ year in and Kab. Toba Samosir-Samosir at 11.49 %/year and triggering an increase in connectivity between districts. Simalungun – Samosir 18.08%/ year and Kab. Toba Samosir-Samosir of 22.76%/year.

Keywords: Demand, Development of ferry transportation, Accessibility, and Connectivity

Introduction:

Lake Toba is a lake with an area of 1,130 km2 which is located in the center of the northern part of Sumatra island and is surrounded by 8 districts namely, Kab. Karo, Kab. Simalungun, Kab. Toba Samosir, Kab. North Tapanuli, Kab. Humbang Hasundutan, Kab. Samosir, Kab. Mr. Bharat and Kab. Dairy. Based on the geographical location of Kab. Samosir is located on land or islands that are separated by waters from seven other districts. With these geographical conditions, the Samosir people rely heavily on ferry transportation as a mode of transportation used for mobility to and from Samosir Island. Ferry transportation is a mode of transportation that connects land that is cut off by waters that function as mobile bridges. Ferry transportation is one of the transportation alternatives in archipelagic areas to create inter-regional connectivity and encourage synergistic and equitable economic growth in archipelagic areas which are separated by waters.

Literature Review:

Ferry transportation on Lake Toba currently consists of six crossing routes, namely, the Tigaras- Simanindo crossing that connects (Simalungun Regency - Samosir Regency), the Ajibata-Ambarita crossing (Toba Samosir Regency - Toba Regency), the Ajibata crossing - Tomok (Toba Samosir Regency - Samosir Regency), Muara - Sipinggan crossing (North Tapanuli Regency - Samosir Regency), Balige - Onanrunggu crossing (Toba Samosir Regency - Samosir Regency), Muara - Onanrunggu crossing (North Tapanuli Regency – Samosir Regency).

The Tigaras- Simanindo and Ajibata - Tomok crossings are congested crossings because they have a vehicle load factor above 85%, while the other four crossings still have a vehicle load factor below 85%. Based on data from the Ministry of Transportation, in 2022 the load factor for vehicles on the Tigaras- Simanindo route will be 87.7% and on the Ajibata-Tomok route, it will be 98.6%. However, the high demand for vehicles wishing to cross the two crossings is not matched by the existing facilities, resulting in frequent traffic jams due to the accumulation of 300 - 500 m of vehicles at the port entrance. This congestion problem arises due to transportation accessibility problems, especially in the parameters of facilities/infrastructure and the frequency of transportation services. According to Tamin (2000), the parameters of transportation accessibility consist of travel time, travel distance, travel costs, frequency of transportation services, and facilities/infrastructure.

The problem of congestion that occurs on the Tigaras- Simanindo and Ajibata- Tomok routes is caused by a lack of capacity and the number of facilities/infrastructure available on the two crossing routes. The Tigaras- Simanindo track has a facility/infrastructure capacity of 20 vehicles/hour while the demand for existing vehicles is 26 vehicles/hour and the Ajibata-Tomok track has a capacity of 24 vehicles/hour while the demand for existing vehicles is 34 vehicles/hour. This problem is compounded by the ship's departure headway which is quite long, which is 2.5 hours, even though the sailing distance is only 5.6 miles, whereas for cross crossings with services > 6 trips/day and within < 10 sailing miles, the ideal headway is one hour. This shows that there

are accessibility problems in both parameters, namely the facilities/infrastructure and the frequency of transportation services which are unable to cope with the high demand for vehicles wanting to cross, causing congestion and disrupting smooth inter-regional connectivity on Lake Toba.

Hence, to solve the accessibility problems that exist on the Tigaras- Simanindo and Ajibata -Tomok routes, it is necessary to analyze the development of ferry transportation (improvement of ferry facilities and infrastructure and development of crossing transport operating patterns) in increasing transportation capacity and also shortening the headway and increasing the frequency of ship departures and increasing inter-regional connectivity on Lake Toba.

Development can be interpreted as an activity to add, improve, improve or expand (Sirojuzilam and Mahalli, 2010). The territory is a collection of areas spread out as a geographical unit in shape and size. Regions have natural resources and human resources as well as geographic positions that can be processed and utilized efficiently and effectively through comprehensive planning (Miraza, 2005).

The territory is a space that is a geographical unit and all elements related to it whose boundaries and systems are determined based on administrative and/or functional aspects (UU No. 26 of 2007). While Rustiadi, et al. (2018) explained that a region can be defined as a geographical unit with certain specific boundaries where the components of the region interact functionally with each other. So regional boundaries are not always physical and definite but are often dynamic. Regional components include natural biophysical components, artificial resources (infrastructure), humans, and institutional forms. Thus the term area emphasizes the interaction between humans and other resources within a certain geographic unit boundary.

Sirojuzilam (2005) states that regional development means increasing the value of regional benefits for the community, a certain area can accommodate more residents, with an average level of community welfare, lots of facilities/infrastructure, goods or services available, and business activities. Increased community, both in terms of type, intensity, service, and quality. Mulyanto (2008) defines regional development as any government action that will be carried out together with the actors to achieve a goal that is beneficial for the region itself as well as for the administrative unit of which the territory is a part, in this case, the Unitary State of the Republic of Indonesia.

Regional development is an effort to spur socio-economic development, reduce regional disparities and maintain environmental sustainability. Broadly speaking, regional development is defined as an effort to formulate and apply a theoretical framework to economic policies and development programs that consider regional aspects by integrating social and environmental aspects towards achieving optimal and sustainable welfare (Nugroho and Dahuri, 2004).

The definition of transportation (Nasution, 2015) is defined as the transfer of goods and people from the place of origin to the destination. So with these activities, there are three things, namely the presence of cargo to be transported, the availability of vehicles as means of transportation, and the presence of roads that can be traversed. It is the process of moving from the place of origin where the transportation activity begins to the destination where the activity ends. For this reason, with the movement of goods and people, transportation is one of the sectors that can support economic activity (the promoting sector) and service providers (the servicing sector) for economic development.

Transportation is an act or activity of transporting or moving cargo (goods and people) from one place to another (Adisasmita, 2011). The purpose of transportation is to provide access to socialize, get the services and goods we need in an easy, low-cost way, and have little impact

(Hairulsyah, 2013). Transportation is said to be good if the journey is fast enough, there are no traffic jams; the frequency of services is sufficient, safe, and free from the possibility of accidents, and comfortable service conditions. Sinulingga and Puteri (2018) state that achieving ideal conditions is largely determined by various factors that are components of this transportation, namely the condition of the infrastructure (roads), the road network system, the condition of the facilities (vehicles), and the mental attitude of the users of these transportation facilities.

Accessibility is defined as a measure of the capacity of a location to be reached by a location of origin or to reach a different location. Therefore the capacity and arrangement of transportation infrastructure are key elements in determining accessibility (Aminah, 2007). Tamin (2000) revealed that accessibility can also be expressed by distance. If a place is close to another place, it can be said to have high accessibility, and vice versa. So a different area must have different accessibility because the activities of the area are spread in an uneven space. However, land designated for a port has a location that is not arbitrary, so the location is very far from the city because it has to pay attention to aspects of security, regional development, and others. Accessibility to the airport is low because of its location which is very far from the city center, but this can be overcome by providing a transportation network system that can be passed at high speed. This means that currently the measure of accessibility which is measured by distance is no longer used, but can be measured based on travel time. The parameters of transportation accessibility consist of travel time, travel distance, travel costs, frequency of transportation services, and facilities/infrastructure (Tamin, 2000).

According to Aminah (2007), connectivity is part of the existence of transportation or transportation and is realized from the movement of people and or goods from/to other locations. "Something that connects the location of origin with the destination location of the trip can be in the form of roads (for land transportation modes), routes (for water transportation modes: river, lake, sea), routes (for air modes), and rail tracks (for rail transportation modes). This is in line with Rodrigue, (2006) in the Geography of Transport System; Connectivity is a relationship between nodes or points connected by links or lines. In sea transportation, the points of connectivity are represented by ports/stop points of ships/modes of sea transportation as the link.

Transportation connectivity can be seen from the capacity served, and the areas that can be served by each mode of transportation such as the number, hours of service, and service performance (Kuswati, 2017). There are three principles of the concept of connectivity, among others; first, maximizing growth through regional unity, not uniformity (inclusive development) by connecting growth centers. Second, expanding growth through regional connectivity through an intermodal supply chain system that connects hinterland and lagging regions with growth centers. Third, achieving inclusive growth by connecting remote areas with basic infrastructure and services in obtaining development benefits (Aminah, 2007).

According to Rodigue (2006) in the Geography of Transport System, Connectivity is a relationship between nodes or points connected by links or lines. In transportation, connectivity points are represented by transportation infrastructure. Connectivity is a direct description of mobility, whether it is the movement of people, goods, or information. A well-developed and efficient transport system implies a high degree of connectivity. Strengthening regional connectivity is one of the strategies pursued to accelerate and expand regional development.

Important elements in transportation connectivity are the point of origin/end of the connection, path as a connection medium, capacity of connection line, availability of connection line, condition of material crossing the connection line (transportation mode conditions), certain conditions that allow material to cross connection line (regulation of modes on certain

lines/trajectories), considerations of connectivity effectiveness, and considerations of connectivity efficiency.

Transportation connectivity can apply to networks within the region (intra-islands) as well as to connections with areas outside the region (inter-islands). Connectivity is connecting or the connection of something with something else. Connectivity is important as a keyword for inter-regional development, between regions in Indonesia which have thousands of islands and regions and regions spread throughout the archipelago.

According to Law Number 17 of 2008 concerning Shipping article 1, Shipping is an integrated system consisting of transportation in waters, ports, safety and security, and protection of the maritime environment. Transportation in water is the activity of transporting or moving passengers and goods using ships. Types of transportation in the waters include sea transportation, river and lake transportation, and ferry transportation. According to Law Number 17 of 2008 concerning Shipping (Article 22, Paragraph 1). It states that crossing transportation is transportation that functions as a bridge connecting the road network or railroad network separated by waters to transport passengers and vehicles and cargo.

According to Nasution (2008) in his book entitled Transportation Management second edition. The ferry transportation system includes means of transport, namely ferries, shipping lanes, namely ferry signs, river channel dredging, telecommunications, navigation, and inspection vessels, and ports, namely quay, terminals, warehouses, offices, fuel depots, electricity, and water. Crossing Transportation is transportation that connects two ends of a highway separated by a large river or sea that is not so far away. Ferry Transportation is transportation that functions as a bridge connecting the road network or railroad network separated by waters to transport passengers, vehicles, and their cargo. In principle, Crossing Transportation does not transport loose goods, the goods that are transported must be put into the vehicle.

According to Jiwandhono, Triatmodjo, and Priyanto (2020), a port is an area of water that is protected against waves, which is equipped with terminal facilities including a pier where ships can moor for loading and unloading of goods, sea warehouses (transito) and storage areas where ships unload their cargo, and warehouses where goods can be stored for a long time while awaiting delivery to the destination or shipment. This terminal is equipped with railroads and/or roads. Types of ports in terms of implementation are:

i. **Public Ports**, namely ports operated for the public interest are carried out by the Government and their implementation can be delegated to state-owned enterprises established for a specific purpose.
ii. **Special Ports** are organized for their interests to support certain activities. Types of Ports in terms of their use are:

   a. fish port;
   b. oil port;
   c. port of goods;
   d. passenger port;
   e. mixed port; and
   f. Military port.

Methodology:

This type of research is descriptive research in which the analysis is carried out trying to describe a symptom and event that is happening at this time. According to Sudaryono (2017), descriptive research is research on problems in the form of current facts from a population which includes the activity of evaluating attitudes or opinions towards individuals, organizations, circumstances, or procedures, the aim is to describe a situation or phenomena as they are. In this descriptive research, a quantitative approach is used, namely a study that uses statistical formulas to calculate the results of a study.

Result and Discussion:

Accessibility and Connectivity Analysis: Based on the theories that have been put forward in chapter two, it can be concluded that transportation cannot be separated from regional development. This is because, in the regional development system, there are three main components, namely, population resources, economic activities, and the transportation system. In this case, transportation plays a strategic role as a supporting facility and developer. The role of transportation is very important as a liaison, closer, and bridging between parties in need. Transportation is also as a tool to guide development in the area and infrastructure for the movement of people or goods arising from activities in the area. Transportation facilities and infrastructure will also support and support physical development. The availability of transportation has a very strong relationship with the level of regional development, which among other things is characterized by the rate of economic growth and social welfare. Therefore transportation is very important in regional development planning in an area because it can create accessibility in facilitating inter-regional connectivity to support regional development, especially in a spatial context.

Ship Load Analysis: Ferry shipload is the number of passengers and vehicles crossing using ferry transportation. In determining the ship's load factor, the vehicle load on the car deck is a reference because there is a capacity limit or temporary transportation area for passenger capacity is only limited by the number of safety equipment (Life Jackets) available on board and still low, so the vehicle load factor is used as a reference.

Table 1: Cross-Tigaras- Simalungun Vessel Loads[2]

No	Vehicle (SUP)				
	Productivity	**2018**	**2019**	**2020**	**2021**
1.	Frequency	5.265	6.446	6.965	8.280
2.	Load	129909894	18268469	204129186	26971548
3.	Tonnage	38508	38508	38508	38508
4.	Available Capacity	20274462	248222568	26820822	31884624
5.	Load Factor	64.08%	73.60%	76.11%	84.59%

Based on the table above, it can be seen that the load factor for the Tigaras – Simanindo crossing in 2021 is 84.59%. Where there was an increase of about 8% from the previous year. Meanwhile, shiploads at the Ajibata - Tomok crossing can be seen in the following table:

Table 2: Ajibata-Tomok Cross Ship Loads[3]

[2] Source: Authors' analysis during 2022
[3] Source : Authors' analysis during 2022

No	Vehicles (SUP)				
	Productivity	2018	2019	2020	2021
1.	Frequency	2.619	672	2.458	4.573
2.	Load	184885751	52978218	199315163	391538552
3.	Tonnage	89852	89852	89852	89852
4.	Available Capacity	235322388	60380544	220856216	410893196
5.	Load Factor	78.57%	87.74%	90.25%	95.29%

Based on the table above, it can be seen that the load factor for the Ajibata - Tomok crossing in 2021 is 95.29 %. Where there was an increase of about 5% from the previous year.

Accessibility Analysis: Accessibility to Lake Toba crossing transportation is the capacity that can be transported from the location of origin to the destination location. The accessibility calculation uses the capacity of vessels operating from the port of origin to the port of destination multiplied by the frequency of ship departures. The following is the result of calculating the annual accessibility of the Lake Toba ferry across the Tigaras- Simalungun and Ajibata - Tomok crossings.

Table 3: Accessibility of Lake Toba Ferry Transportation between Regencies[4]

No	Regency	Vehicle (SUP)			
		2018	2019	2020	2021
1.	Simalungun - Samosir	202744620	248222568	2.68208220	318846240
2.	Toba Samosir - Samosir	235322388	60380544	2.20856216	410893196

Based on the table above, there has been an increase in accessibility in 2018 - 2021 an average of 16.45 %/year in Kab. Simalungun – Kab. Samosir and 92.49 %/ year in Kab. Toba Samosir - Kab. Samosir.

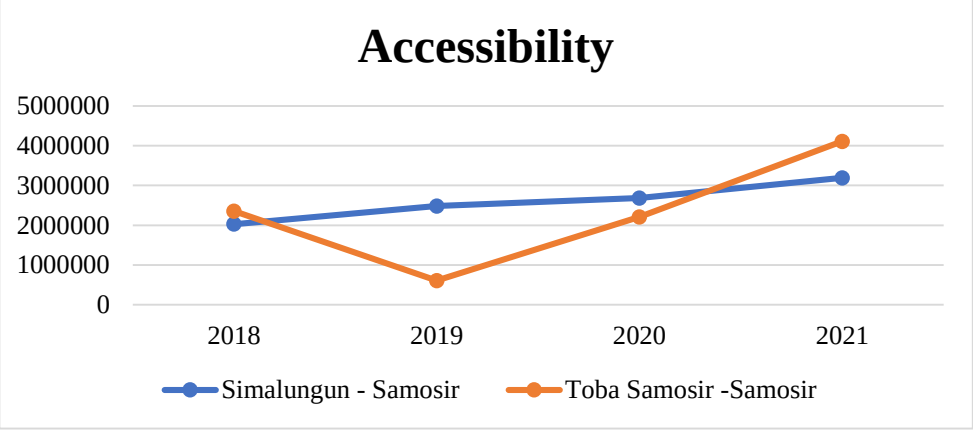

Figure 1: Accessibility between districts

The increase in accessibility that has occurred plays a very important role in the convenience of the community in reaching the origin location to the destination location. This

[4] Source : Authors' analysis during 2022

smoothness certainly helps improve community connectivity in interacting to trigger activities that can improve and develop the region both economically, socially, and physically.

Connectivity Analysis: in calculating transportation connectivity between regions, the gravity method is used, namely the interactions that occur between regions using transportation compared to the distance between regions. According to the gravity method as the theory of Daldjoeni (2016) where interaction between regions is the result of the movement of vehicle loads with SUP units from the origin location to the destination location divided by the square of the distance from the origin location to the destination location where the distance between the Tigaras - Simanindo crossing is 5 miles and Ajibata- Tomok 5.6 miles.

Table 4: Toba Ferry Transport Connectivity between Regencies[5]

No.	Regency	Vehicle (SUP)			
		2018	2019	2020	2021
1.	Simalungun - Samosir	4902725164	9714502313	12104785653	21072780281
2.	Toba Samosir - Samosir	7740650541	645756286	9100191370	35573674974

Based on the results of the analysis, it is known that the connectivity created on the Tigaras-Simanindo or Kab. Simalungun - Kab. Samosir has increased by 65.61 %/year and the Ajibata-Tomok crossing connecting Kab. Toba Samosir - Kab. Samosir of 502.8%/ year.

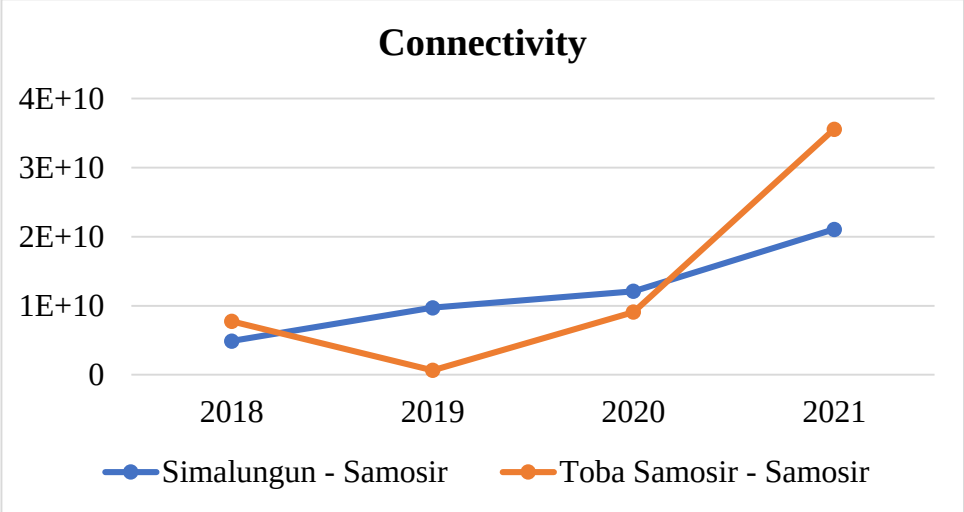

Figure 2: Connectivity between Regencies

Increasing connectivity between regions in Kab. Simalungun, Kab. Toba Samosir and Kab. Samosir shows every year that there is an increase in interaction between districts through ferry transportation in mobilizing the community to carry out activities that support regional development both physically, economically, and socially. Based on the results of the analysis that

[5] Authors' analysis in 2022

has been done, in an effort to increase accessibility and inter-regional connectivity of Lake Toba through development ferry transport obtained the following results.

Table 5: Description of Existing Conditions and Track Plans Tigaras – Simanindo

No	Indicator	Tigaras - Simanindo	
		Existing	**Planned**
1.	Means	2 Ships	7 Ships
2.	**Infrastructure**		
	Dock	2 Docks	3 Docks
	Parking Lot Ready to Load	410.4 m^2	600 m^2
	Passenger Lounge	54 m^2	168 m^2
3.	Operation Pattern	- 2 Ships/ day	- 7 Ships/ day
		- 26 Trips/ day	- 71 Trips/ day
		- 1 Dock/ day	- 3 Docks/ day
		- Headway 1,5 hours	- Headway 1 hour
		- 14 Operational hours	- 24 Operational hours
4.	**Accessibility**		
	Capacity/ Year	31884624 SUP	99793482 SUP
	Vehicle Capacity/hour	20 Vehicles/ hour	48 Vehicles/ hour
	Headway	1.5 hours	1 hour
	Freqhour	26 Trips/ day	71 Trips/ day
5.	Connectivity	21072780281 SUP	209736529936 SUP

On the Tigaras- Simanindo route, it is indispensable to add facilities from 2 ships /day to 7 ships/day assuming the ship dimensions are the same as the existing conditions, namely the Ferry Motor Boat (KMP) with a capacity of 246 GRT with a car deck capacity of 12 goal vehicles. IV. If ships are added above 200 GRT with a car deck capacity of > 12 vehicles, the number of ships can be reduced according to the transport capacity of the ships. Infrastructure improvement by adding 1 new ferry wharf with a movable bridge type with a capacity of 30 tons.

The addition of a movable bridge pier is very suitable for the type of ferry transportation mode because it has a ramp which height adjusts to the height of the tides so that the movable bridge pier type, in which the floor height is dynamic or can be raised and lowered, is ideal for the characteristics of ferry boats that carry vehicles. Expansion of the parking lot to 600 m2 or can accommodate 24 passenger vehicles/2 ton trucks with a concrete structure to make it sturdier in holding goods vehicles and their loads. The expansion of the passenger waiting room to 168 m2 which is equipped with seating facilities for 140 seats with a recline angle of 400, and manual/digital information boards and entertainment facilities. Additional facilities are at the terminal building in the form of a kiosk/canteen covering an area of 25.2 m2, a prayer room/*musholah*, toilets and others covering an area of 54.6 m2.

Table 6: Overview of Existing Conditions and Planned Ajibata-Tomok Tracks[6]

No	Indicator	Ajibata- Tomok	
		Existing	**Planned**
1.	Means	1 Ship	6 Ships
2.	**Infrascructure**		
	Dock	1 Dock	2 Docks
	Parking Lot Ready to Load	685.08 m^2	1400 m^2
	Passenger Lounge	25.3 m^2	470.4 m^2
3.	Operation Pattern	- 1 Ship/ day	- 6 Ships/ day
		- 10 Trips/ day	- 53 Trips/ day
		- 1 Dock/ day	- 2 Docks/ day
		- Headway 2,5 hours	- Headway 1 hour
		- 14 Operational Hours	- 14 Operational Hours
4.	**Accesibility**		
	Capacity/ Year	**4.108.931,96 SUP**	**17.381.869,4 SUP**
	Vehicle Capacity/ hour	24 Vehicles/ hour	112 Kendaraan/jam
	Headway	2.5 hours	1 hour
	Frequency	10 Trips/ day	53 Trips/ day
5.	Connectivity	**35573674974 SUP**	**507175388610 SUP**

On the Ajibata-Tomok route, additional facilities are needed from 1 ship /day to 6 ships /day assuming the dimensions of the ship are the same as the existing conditions. It is namely the Ferry Motor Boat (KMP) with a capacity of 445 GRT with a car deck capacity of 28 goal vehicles. If ships are added above 445 GRT with a car deck capacity of > 28 vehicles, the number of ships can be reduced according to the transport capacity of the ships. Infrastructure improvement is by adding 1 new ferry wharf with a movable bridge type with a capacity of 30 tons. The addition of a movable bridge pier is fitting for the type of ferry transportation mode because it has a ramp which height adjusts to the height of the tides so that the movable bridge pier type, in which the floor height is dynamic or can be raised and lowered, is ideal for the characteristics of ferry boats that carry vehicles. Expansion of the parking lot to 1,400 m2 or can accommodate 56 passengers vehicles/2 ton trucks with a concrete structure to make it sturdier in holding goods vehicles and their loads. The expansion of the passenger waiting room to 470.4 m2 is equipped with seating facilities for 392 seats with a reclined angle of 400, and manual/digital information boards and entertainment facilities. Additional facilities are built at the terminal building in the form of a kiosk/canteen covering an area of 70.56 m2, a prayer room/*musholah*, toilets, and others covering an area of 152.88 m2.

Conclusion:

The conclusions from the analytical research on the development of crossing transport in increasing accessibility and inter-regional connectivity of Lake Toba, include: solving problems with the existing conditions on the Tigaras- Simanindo and Ajibata- Tomok crossings can be carried out by implementing a new crossing transport operating pattern, namely, on the Tigaras-Simalungun crossing adding operating vessels to 4 ships/day with a frequency of 28 trips/day and utilizing the two existing piers (movable bridge and plengsengan), while on the Ajibata-Tomok

[6] Source: Analysis results, 2022

route the number of ships operating has increased to 2 ships/day with a frequency of 12 trips/day and using 1 existing piers.

Recommendations:

To increase connectivity between Lake Toba regions and solve accessibility problems that cause bottlenecks/bottlenecks of ferry transport on the Tigaras-Simanindo and Ajibata-Tomok lines, the researchers recommend the following:

i. The Ministry of Transportation as the regulator may carry out the construction and improvement of crossing transportation infrastructure on the Tigaras- Simanindo and Ajibata- Tomok routes to increase the capacity of the crossing transportation modes;
ii. Ship operators may add more ships operating on the Tigars- Simanindo and Ajibata- Tomok crossings to serve the increasing demand for existing ferry transportation services, so that there are no too long headways and cause congestion due to accumulation of vehicles;
iii. The Simanindo, Toba Samosir, and Samosir Regency Governments may assist in coordinating and preparing land for the development and construction of crossing transportation facilities and infrastructure;
iv. This study analyzes the needs for facilities and infrastructure as well as patterns of operation of ferry transport based on current and future demand so that in the consummation of this research further research is needed regarding technical studies on shipbuilding and port infrastructure improvement to find out the detailed technical specifications of the improvement carried out facilities and infrastructure. After that, it can be continued with research on the effect of the construction and improvement of crossing facilities and infrastructure carried out on regional development in Lake Toba.

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