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Morphology of Travel Routes in Lake Toba

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Abstract. Lake Toba is the largest caldera lake in the world, so its development is included in the 5 super priority areas for the development of the tourism sector. This study aims to identify and analyze the morphology that appears in the travel routes in Lake Toba. This study uses qualitative methods with a descriptive approach to explain and interpret travel routes in Lake Toba. The substance boundaries discussed in this study are components and morphological forms. The morphological component is land use, road network patterns/travel routes, and buildings (density and patterns).

Keyword: morphology, travel routes, Toba

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1 Introduction

In the province of North Sumatera there is a caldera lake which is known in the worl is Lake Toba, which is 176 km to the west of Medan City. With the length of 100 km (62 mil), the width of 30 kilometer (19 mil), and a depth of 508 meter (1.667 ft) as well as a height of 904 meter above sea level making Lake Toba the largest lake in Indonesia [1]. The Lake Toba Caldera area is one part of the Bukit Barisan range. The Toba Caldera is the caldera with the latest eruptions from the quaternary era and is the fourth youngest caldera in the world [2]. The panorama that Lake Toba has, makes anyone who enjoys it recognize the beauty that is presented. Almost every corner of Lake Toba presents stunning beauty, this can be felt when we are in various areas surrounding Lake Toba, each has its own charm that makes the area a tourist travel destination. At this time there are 8 (eight) regencies that surround Lake Toba, including: North Tapanuli, Samosir, Toba, Simalungun, Humbang Hasundutan, Dairi, Pakpak Barat and Tanah Karo. Samosir, Toba, Humbang Hasundutan and Dairi districts are areas resulting from division of North Tapanuli district. So that it can be said that before experiencing the expansion of Lake Toba, it was only surrounded by 3 districts, namely North Tapanuli, Simalungun, Tanah Karo.

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The history of the formation districts in the land of Batak, is in 1946 consisting of 5 (five) district, namely Silindung, Toba Holbung, Humbang, Samosir, and Dairi, each of which was led by a Demang. After the Dutch left Indonesia, with the ratification of sovereignty, new districts were formed in Tapanuli, namely North Tapanuli regency (formerly Batak regency), South Tapanuli regency (formerly Padang Sidempuan regency), Central Tapanuli regency (formerly Sibolga regency) and Nias regency, North Tapanuli regency was formed by Law Number 7 Drt of 1956 concerning the Formation of Autonomous Regencies within the Province of North Sumatra [3]. Given the vast area of North Tapanuli, in order to increase the effectiveness of government and the distribution of development results, in 1964 North Tapanuli regency was divided again with the formation of the Dairi Level II Regional District whose capital was located in Sidikalang. In 1998, North Tapanuli regency was split again into 2 (two) regencies for the second time, namely North Tapanuli regency and Toba Samosir regency, in accordance with law number 12 of 1998 concerning the Establishment of Toba Samosir Level II Region and Mandailing Natal District Level II Region [4]. In 2003, for the third time, North Tapanuli regency was split again into 2 (two) regencies, namely North Tapanuli regency and Humbang Hasundutan regency [5]. And then, in accordance with Law number 9 of 2003 concerning the Establishment of South Nias Regency, West Pakpak Regency, and Humbang Hasundutan Regency, in the same year the Dairi district also experienced division into Dairi and West Pakpak districts [5]; After that, in the middle of the 4 (four) year journey of Toba Samosir regency, in accordance with law number 36 of 2003 dated December 18, 2003 concerning the establishment of Samosir regency and Serdang Bedagai regency in North Sumatra Province, there was again a division of Toba Samosir regency into 2 (two) two) districts, namely Samosir regency and Toba regency [6].

In line with the expansion that occurred in the regency areas surrounding Lake Toba, Lake Toba travel routes also underwent changes because each district began to improve itself both in its economic, social and cultural sectors. Panorama of Lake Toba is a tourist spot that is the mainstay of each district to attract tourists and a source of income for the community and the region.

Since President Jokowi's administration, the development of the tourism sector has been one of the main programs. Labuhan Bajo, Mandalika (West Nusa Tenggara), Lake Toba (North Sumatra), Borobudur (Central Java), Likupang (North Sulawesi), are designated as 5 (five) super priority tourist destinations for development [7].

Lake Toba is one of the points that gets the most attention. This can be seen by the establishment of the Lake Toba Tourism Area Management Authority Board in accordance with Presidential Decree Number 49 of 2016. n 2016 - 2041, the Lake Toba Tourism Area Management Authority Board drafted a master plan that must be completed for the development

of the area [8]. The scope of the Lake Toba tourism area includes an area of at least 500 (five hundred) hectares, the management of which is the right of the Lake Toba Authority Agency.

Along with the expansion that occurred with the districts that surround Lake Toba, starting with the division of North Tapanuli Regency into North Tapanuli Regency and Dairi Regency until finally President Jokowi made Lake Toba a super priority tourism, the travel routes on Lake Toba of course underwent changes. For this reason, this study aims to see how the physical appearance of travel routes on Lake Toba looks like today.

James and Bound said that morphology comes from the word morph which means form, so morphology is also interpreted as the physical appearance of an area [9]. Changes that manifest in the physical form of the area arise as a result of social changes over time [9]. The results of social changes that are formed in the physical area of this area are known as morphology [9]. According Dahal et al 2017, morphology is the appearance/physical appearance/outer form of an area in terms of the structures that make up a certain appearance. And it's not just the form that is the physical appearance of morphology but also the relationship between regions [9].

According to Soetomo (2019), in examining the physical condition of the area, there are three components of morphology [9]. The components in question are land use areas that describe activities that occur in the area in question, road network patterns or circulation patterns that link between areas and building patterns and their functions [9]. Structurally, the morphological components are divided into road networks, plots, and buildings [9]. Morphological forms are divided into compact and non-compact forms. Compact shapes include square, rectangle, round, fan, ribbon and octopus. Uncompact forms include split, chain, split, and stellar forms [10].

The morphology of travel routes is shaped by the city's spatial patterns (land use and road topology) in relation to dynamic factors such as congestion, accessibility, and travel demands, which are related to various accompanying socio-economic factors [11]. The most basic concept of transportation studies is the relationship between the spatial distribution of trips and the spatial distribution of land use in an urban area [11]. Trips are made to carry out a certain activity, while the location of the activity is determined by the pattern of land use [12].

2 Methodology

Descriptive research method was chosen to be applied in this research. By using this method, it is expected to be able to explain the facts that appear or are in accordance with what they are . The substance boundaries discussed in this study are components and morphological forms. Morphological components include land use, road network patterns/travel routes, and buildings (density and pattern) [9]. Primary and secondary data collection is needed in this study. Primary data was collected by using a 1 : 1000 scale map from satellite imagery as a survey form.

Secondary data collection was obtained by conducting literature and document reviews from related agencies.

3 Result and Discusion

The morphological component of the travel route consists of 3 (three) elements, namely land use, soil network pattern, and buildings (pattern and density). Identification aims to determine the characteristics of each component forming the morphology in the Lake Toba Region. The analysis technique used is identification of morphological components and analysis of morphological forms.

3.1 Land Use

The land component is one of the components in morphology. Apart from being an open area, the shores of Lake Toba have also developed into residential, tourist and business places such as food stalls, vehicle washing and others. The use of Lake Toba for the surrounding community includes the primary function and secondary function. As a primary function, Lake Toba serves as a source of drinking water. Of the 147 residential locations on the outskirts of Lake Toba, 88% use Lake Toba water as a raw material for drinks without further processing. Several drinking water companies known with the name Perusahaan Daerah Air minum (PDAM) Tirtanadi, around them using water from lake toba as a source of raw material like PDAM Tirtanadi Pangururan, PDAM Tirtanadi Laguboti and PDAM Tirtanadi Balige [13]. As a second function, used for utilization as a power generator, in the downstream part, the Asahan river which drains Lake Toba water is used for electricity generation, which is divided into 5 (five) generation groups, with a potential of around 1,056MV [13]. Aquaculture with floating net cages started in 1996 and with a total of more than 4,922 units spread across 51 locations; utilization as a tourist attraction.

Land use in the area is divided into built and unbuilt land use. The spatial pattern direction in the Lake Toba DSK area is dominated by Non-Development Areas (Protected Areas and Production Forest Areas) [13]. Protected forest areas consist of nature reserve forests and protected forests. Meanwhile, cultivation areas consist of water bodies/lakes, pond, dryland agriculture, wetland agriculture, plantations, settlements, conversion forests, production forests and limited production forests [13].

The high and low, the movement/gravity of the population between districts can be seen from the total population of each district (Table 1). From the table below it can be seen that Karo and Simalungun districts have the highest connectivity among other districts around Lake Toba.

Table 1 Gravity Based on Population [13]

	West Pakpak	Samosir	Humbang Hasundutan	Karo	Dairi	Simalungun	Toba	North Tapanuli
West Pakpak	0	363.796	437.682	1.158.918	4.431.468	1.761.842	227.397	368.173
Samosir	363.796	0	4.863.520	3.486.679	6.064.221	520	1.536.485	2.472.631
Humbang Hasundutan	437.682	4.863.520	0	4.145.905	6.463.374	4.931.426	10.106.021	16.082.685
Karo	1.158.918	3.486.679	4.145.905	0	19.523.594	65.372.035	2.093.875	2.873.236
Dairi	4.431.468	6.064.221	6.463.374	19.523.594	0	24.268.160	2.514.607	4.056.529
Simalungun	1.761.842	520	4.931.426	65.372.035	24.268.160	0	8.347.807	525
Toba	227.397	1.536.485	10.106.021	2.093.875	2.514.607	8.347.807	0	17.278.963
North Tapanuli	368.173	2.472.631	16.082.685	2.873.236	4.056.529	525	17.278.963	0

	West Pakpak	Samosir	Humbang Hasundutan	Karo	Dairi	Simalungun	Toba	North Tapanuli
West Pakpak		low	low	low	low	low	low	low
Samosir	low		low	low	low	low	low	low
Humbang Hasundutan	low	low		low	low	low	low	low
Karo	low	low	low		low	high	low	low
Dairi	low	low	low	low		medium	low	low
Simalungun	low	low	low	high	medium		low	low
Toba	low	low	low	low	low	low		low
North Tapanuli	low	low	low	low	low	low	low	

From the pattern of inter-district connectivity above, it is found that Simalungun district is the center of gravity of the Lake Toba area and its surroundings (Figure 1).

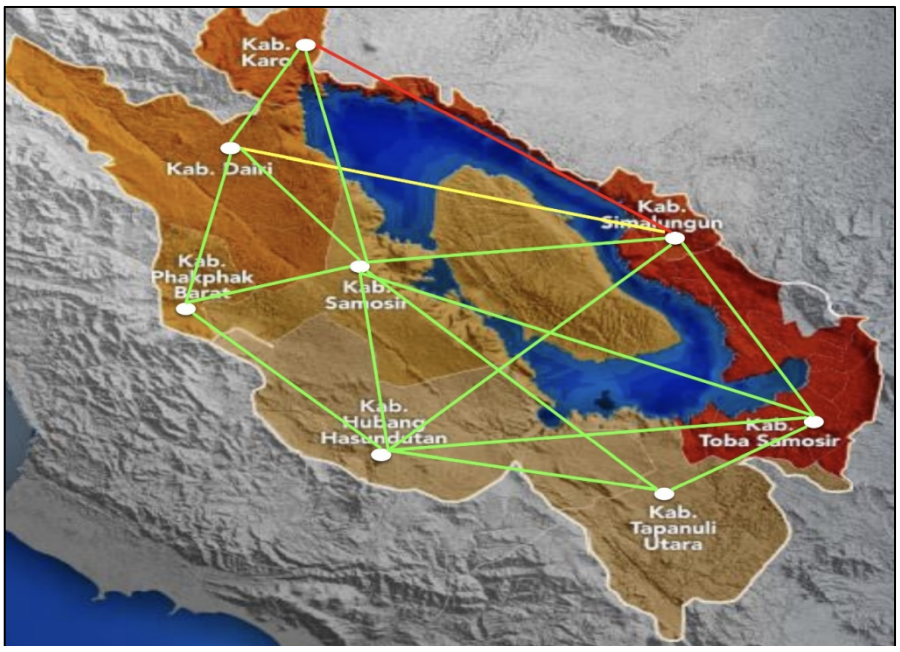

Figure 1 Pattern of Inter-District Connectivity

3.2 Road Network

A collection of road networks that are interconnected to form a model is a road network pattern. According to Morlock, 1978 there are 6 (six) road network patterns namely, grid pattern, radial pattern, radial ring pattern, spinal pattern, hexagonal pattern, and delta pattern [14].

Lake Toba is surrounded by 8 (eight) districts, namely: Simalungun, Tanah Karo, Dairi, West Pakpak, North Tapanuli, Toba, Humbang Hasundutan and Samosir regencies [4]. There are 3 (three) types of existing transportation facilities, namely: (1) Land transportation, ground transportation can be reached from: Tele – Tano Ponggol (Pangururan) and Samosir island ring road. (2) Air Transportation, Sisingamangaraja XII Airport in Siborongborong, North Tapanuli, then proceed by land trip and Sibisa Airport, Parapat [15]. (3) Water transportation, ferry fleet dan wooden boats. There is a network of fixed routes for ferry (Table 2) and wooden boats (Table 3) and in Samosir district, which are used daily by the community and tourists [6].

Table 2 Fixed Route Network of Ferry

No	Ship Type	Name ofTrayek/Rute	
1	Ferry Sumut I and II	Simanindo	Tiga Ras
		Sipinggan	Muara
2	Ferry Tao Toba I and II	Tomok	Ajibata
3	KMP Ihan Batak	Ambarita	Ajibata
4	KMP Kaldera Toba	Sipinggan	Balige
5	KMP Muara Putih I	Muara	Sipinggan
6	KMP SUMUT I	Tigaras	Simanindo
7	KMP SUMUT II	Onanrunggu	Balige

Table 3 Fixed Route Network of Wooden Ships

No	Name of Trayek/Rute	
1	Tomok	Ajibata
2	Tomok	Tigaraja
3	Tuktuk	Tigaraja
4	Simanindo	Tigaras
5	Simanindo	Haranggaol
6	Onanrunggu	Balige
7	Onanrunggu	Ajibata
8	Nainggolan	Ajibata
9	Nainggolan	Balige
10	Nainggolan	Bakkara
11	Nainggolan	Muara
12	Tarabunga	Tamba
13	Pintu Batu	Sihotang
14	Pangururan	Tamba
15		Sabulan
16		Sihotang
17		Harian
18		Tulas
19		Janji Raja
20		Balige
21		Bonan Dolok
22		Ransang Bosi
23		Hasinggaan
24		Binangara
25	Mogang Urat Pandiangan	Balige
26		Ransang Bosi - Dolok Martahan- Tamba
27		Tamba
28		Dolok Martahan

No	Name of Trayek/Rute	
29		Holbung
30		Ajibata
31		Sitio-tio - Sabulan
32		Janji Raja
33	Sipoltongon	Balige
34	Sihotang	Pintu Batu
35	Tamba	Simbolon

The road pattern in the regency area itself is irregular, this can be seen from the various road widths and road directions, as shown in Figure 2,3,4.

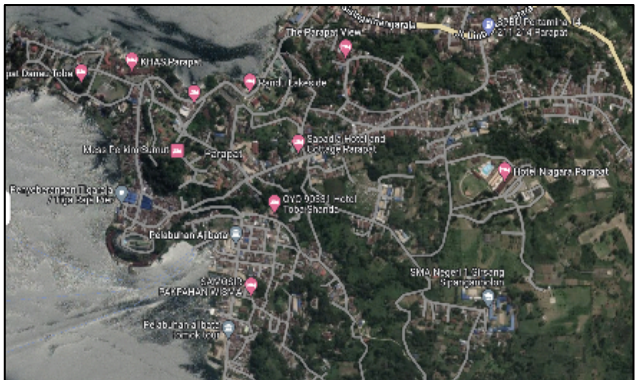

Figure 2 Road Patterns in the city of Parapat

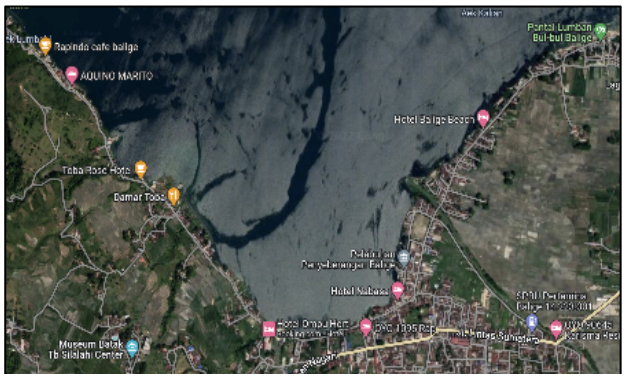

Figure 3 Road Patterns in the city Balige

Figure 4 Road Patterns in the city Pangururan

3.3 Building (Density and Pattern)

From the results of observations, it was found that the residential areas around the Lake Toba area form a spreading pattern, a linear spatial structure that follows the direction of the main road (Figure 5 and 6) and clusters that are still found in traditional settlements/traditional settlements (Figure 7). The pattern of the building is heterogeneous, as seen from the appearance of the shape of the building which has a basic square and rectangular shape.

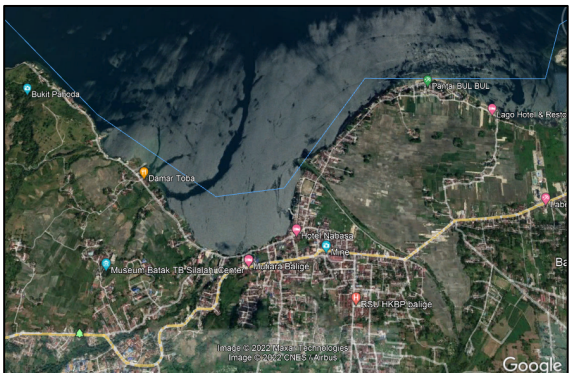

Figure 5 Settlement patterns follow the direction of the highway (Balige)

Figure 6 Settlement patterns follow the direction of the main road (Estuary)

Figure 7 Residential clusters that still exist in Samosir

3.4 Morphological Shape Analysis

Morphological form, in terms of 3 components, namely, land use, road network patterns, and building patterns. The results of the identification of the characteristics of the 3 morphological forming components show that the shape of the travel route in the Lake Toba area is fan-shaped.

4 Conclusion

The morphology of the travel route area on Lake Toba is formed from 3 (three) components. These components are mixed land use, irregular road patterns, density centered on the center of gravity and heterogeneous building patterns. The appearance shows the morphological shape of the fan.

REFERENCES

[1] Dinas Komunikasi dan Informatika Provsu. (2022, Juni) Pemerintah Provinsi Sumatera Utara. [Online]. www.sumutprov.go.id

[2] (2022) Wikipedia. [Online]. id.wikipedia.org/wiki/Danau_Toba

[3] Diskominfo Kab. Tapanuli Utara. (2022) Portal Kabupaten Tapanuli Utara. [Online]. www.taputkab.go.id

[4] ITMP Toba. (2020, April) Program Pembangunan Pariwisata Terintegrasi, dan Berkelanjutan. [Online]. https://p3tb.pu.go.id/in/main/project_location/toba/121/171/175#:~:text=Lokasi%20Program%20Toba&text=Merujuk%20pada%20peraturan%20tersebut%2C%20Kawasan,%2C%20Pakpak%20Bharat%2C%20dan%20Dairi.

[5] Dinas Komunikasi dan Informatika Kabupaten Humbang Hasundutan. (2022) Humbanghasundutankab.go.id. [Online]. https://humbanghasundutankab.go.id/main/index.php/read/page/121

[6] Diskominfo Kab. Samosir. (2022) Kabupaten Samosir, Satahi Saoloan. [Online]. samosirkab.go.id

[7] Erlangga Satya Darmawan. (2022, Mei) Kompas.com. [Online]. travel.kompas.com

[8] JDIH BPK RI. (2017) JDIH BPK RI Database Peraturan. [Online]. peraturan.bpk.go.id

[9] Mentari Adhika Putri, Murtanti Jani Rahayu, and Rufia Adisetyana Putri, "Bentuk Kenampakan Fisik (Morfologi) Kawasan Permukiman di Wilayah Pinggiran Selatan Kota Surakarta," *Jurnal Pengembangan Kota*, vol. 2, no. 4, pp. 120-128, 2016.

[10] Hadi Sabari Yunus, *Struktur Tata Ruang Kota*. Yogyakarta: Pustaka Pelajar Offset, 2019.

[11] Hugo Barbosa, Hyejin Youn, Petter Holme, and Gourab Ghoshal, "Morphology of travel routes and the organization of cities," *Nature communications*, vol. 2229, no. 8, 2017.

[12] R Aditantri, N A Krisnaputri, and A Oktaviyani, "Morphological Study of Planned Human Settlement Affectedby Service Trade Activities," *IOP Conference Series : Earth and Environmental Science*, no. 328, 2019.

[13] Pusat Perencanaan dan Pengembangan Kepariwisataan Institut Teknologi Bandung. (2019) Badan Pengembangan Infrastruktur Wilayah Kementerian Pekerjaan Umum dan Perumahan Rakyat. [Online]. https://bpiw.pu.go.id/uploads/itmp/Konsep_Pengembangan_Wilayah_dan_Infrastruktur_KSPN_Danau_Toba.pdf

[14] RD Rusmiadi. (2021, July) Metro Sulawesi.id. [Online]. https://metrosulawesi.id/2021/07/09/jaringan-jalan-urat-nadi-percepatan-pembangunan-dan-investasi/

[15] Budi Sitorus, "Peran Transportasi Dalam Mendukung Kawasan Strategis Pariwisata Nasional Danau Toba," *Jurnal Manajemen Transportasi dan Logistik*, vol. 01, no. 04, 2017.