Solid waste management in Lake Toba area

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Abstract. Lake Toba is a tourist area that continues to be developed, attracting local and foreign tourists. The increase in tourists visiting lake Toba affects the social and economic aspects and impacts the environment, one of which is the increase in waste generation. On the other hand, waste in the Tourist area is not well managed. This study determines the condition of existing waste management in the Lake Toba tourism area. Girsang Sipangan Bolong and Merek sub-districts were chosen as study area. This study found that waste management in both areas is not sustainable. The sources of waste come from residential and non-residential areas. The two regions manage waste independently. Some of the community's waste handling includes burning, composting, separating kitchen waste for animal feed, and recycling. The two regions' government is still trying to provide the best service in solid waste management, such as providing communal waste containers in public facilities and waste transportation to landfills. However, it was found that there are still many deficiencies that need to be fixed. Solid waste management in these two regions is still far from Indonesia’s standard.

1. Introduction
Toba is a national strategic area that is described in Presidential Regulation No. 81 of 2014. National Strategic Area is a prioritized area. It has a significant national influence on state sovereignty, national defense, security, economy, social, culture, and environment, including areas designated as world heritage.

Toba is developed as a world tourism destination. Having a positive impact on economic improvement also negatively impacts the environment, such as water pollution, air pollution, and waste. The purpose of tourists coming to tourist attractions, of course, wants to enjoy the beauty and cleanliness of the tourist attractions themselves. The beauty and cleanliness of the tourist area are reflected in the culture of a nation. In order to increase tourist attraction, of course, the Lake Toba area needs good environmental management, including solid waste management. Several researchers have conducted studies related to solid waste management around tourist areas, such as Pariaman [1]; Bromo [2]; Thailand [3]; Romania and Italy [4], and Vietnam [5]. These studies are related to the best and practical management for tourist areas.

Girsang Sipangan Bolon is a sub-district in Simalungun Regency, North Sumatra, Indonesia, with 129.89 km². This area is located on the shores of Lake Toba with Parapat as its icon and a tourist destination, which is the capital of Girsang Sipangan Bolon District. Girsang Sipangan Bolon District is geographically located at 920 above sea level, with an area of 123.56 km² and a population in 2019 of 15,023 people [6].
Merek is a sub-district in Karo Regency, North Sumatra. This sub-district is the division of the Tiga Panah sub-district into three sub-districts. It consists of Sipituhuta, Pertibi Lama, Aek Popo, Pangambat, Tongging, Situnggaling, Pertibi Tembe, Tambusan-Garingging, plus some villages resulting from the division of Tiga Panah sub-district. Merek has a hilly topography and is a center for producing Arabica coffee, vegetables, pine forest areas. It is an agribusiness terminal station to support the agropolitan national program located in Bandar Tongging. The population of Merek sub-district in 2019 is around 21,944 people with 5,149 household heads. Overall, the population can be associated based on sex, type of work, religion, age, and education level. This study aims to determine the existing conditions of solid waste management in Lake Toba's tourist area, especially in Girsang Sipangan Bolon and Merek sub-districts, North Sumatra.

2. Materials and methods

In this study, data collection was carried out by direct observation in the field, interviews, and analyzing reports related to waste in the study location. The study locations were Girsang Sipangan Bolon District, Simalungun Regency and Merek District, Karo Regency. This study was conducted in mid-2019.

3. Results and discussions

3.1. Girsang Sipangan Bolon Subdistrict

The source of waste in the Girsang Sipangan Bolon Subdistrict area comes from residential and non-residential areas such as commercial areas and public facilities. The Girsang Sipangan Bolon Subdistrict is part of Simalungun Regency. The regency does not yet have a sustainable waste management system from the source to the final processing site. Some of Simalungun Regency people still manage the waste produced independently in various ways that are considered capable of destroying the waste produced, including throwing waste into the trash, burning, composting, separating kitchen waste for animal feed, and recycling.

The household waste container system in Simalungun Regency consists of individual and communal containers. Individual containers are provided independently by the community, while the government provides communal containers at several public facilities. The individual containers provided independently by the community are generally in the form of rattan sacks and baskets. Communal storage can be made of drums and made permanent from concrete provided by the Sanitation and Gardening Service along the main road. Many communal containers are in a damaged condition, so waste is scattered in several public facilities. For market waste in Kecamatan Raya, there is no adequate container. The resulting waste is thrown away and collected just like that around the place where the traders sell, which the next day, the piles of waste will be transported by waste trucks. Meanwhile, markets located in tourism areas such as Parapat, which operate every day, already have their communal complexes.

Meanwhile, the pattern of waste collection in Simalungun Regency is divided into two, namely [7]:

1. Direct individual collection
   Waste from the source is directly transported to the landfill without any transfer process. This pattern is applied around protocol roads where a 6 m$^3$ dump truck can still pass through.

2. Direct communal collection
   Waste from several points of communal containers is collected to be transported to the landfill. The community brings waste into communal containers independently.

The number of fleets operating every day is 13 units of dump trucks measuring 6 m$^3$ and 100 units of motorbikes that carry waste with an average operation of 2 trips/day. The distance traveled from the waste centroid to the landfill is about 70 km, with a distance of about 2 hours.
Figure 1. Waste collection and transportation in Girsang Sipangan Bolon

The Sanitation and Gardening Agency manages the waste system of Simalungun Regency under Regional Regulation No. 3 of 2014 concerning the Organization and Administration of the Regional Apparatus of Simalungun Regency. Waste management on the protocol road of Girsang Sipangan Bolon District is carried out by a third party in collaboration with the local government of Girsang Sipangan Bolon. Waste handling on protocol roads is collected and transported using a truck to the temporary disposal site as seen in figure 1. The Girsang Sipangan Bolon sub-district transports the waste collected at the temporary disposal site within two weeks before being transported to the landfill. The local government manages the waste generated by households, offices, restaurants, grocery stores, and hotels. It is subject to a fee of IDR 80,000/month. However, some households do not collect this levy so that waste management is carried out independently by how to dispose of directly to the temporary disposal site.
Figure 2. Chart of Waste Management Process in Girsang Sipangan Bolon District

As seen in figure 2, the waste management system in Girsang Sipangan Bolon still uses the old paradigm of collect-transport-dispose. There is a landfill in Girsang Sipangan Bolon District. The landfill is still implementing an open dumping system and there are waste burning activities. Girsang Sipangan Bolon landfill has a land area of about 4 Ha and serves 23 sub-districts in Simalungun Regency. Its location which is more than 25 km from several transportation service areas has resulted in the transportation service to the TPA not running optimally. The available land does not meet long-term needs.

3.2. Merek Subdistrict
Waste management that is carried out in Merek District, which is part of the Karo Regency area, tends to be carried out independently and conventionally. Waste processing is still carried out individually, namely by collecting it in the home yard. Organic waste is brought to the field and then piled up while inorganic waste is burned/dumped in a place without any handling. Besides, waste collection activities are carried out by putting waste into bags/sacks or throwing them directly into the temporary site. The government's lack of attention towards waste management in the Merek District resulted in a low public awareness level.

The household waste container system in Karo Regency consists of individual and communal containers as seen in figure 3. Generally, the container is not equipped with a lid, and no sorting is done, causing unpleasant odors and aesthetic problems. This condition becomes a breeding ground for vectors such as flies, mice, and cockroaches, making it easier for disease transmission to occur. For instance, it can be seen at a pile of waste, pets roaming along the road will scavenge for food scraps to eat, which causes the trash to shatter even more.

The waste collection schedule is carried out once a week using a dump truck. The transported waste is waste that has been collected at the temporary disposal location, not directly from each household/non-household. The conditions for this temporary are also very minimal, where the location is far from residential areas. The infrastructure facilities are also inadequate so that the collection and transportation of waste are delayed to the landfill location. The shape of the land in Merek District, which is physically hilly and the landfill location, is relatively far away, makes it difficult for waste trucks to reach it.

Figure 3. Individual and communal waste container system in Merek

The legal basis for waste management in Karo District still refers to government regulations and regulations issued by the Ministry of Environment. There is no regional regulation that specifically
regulates waste management. However, regarding the waste/cleaning service fees, it refers to the Karo Level II Regional Regulation No 14 of 2006. The tariff structure is classified based on the services provided, the type and volume of waste produced, and the community capacity. Meanwhile, under the Karo Regency Regional Regulation Number 6 of 2008 concerning the Organization and Work Procedure of Regional Technical Institutions, solid waste management, especially those dealing with cleaning staff, is carried out by the Karo Regency Sanitation and Gardening Office. The coverage of waste services is currently still limited to the Karo area and Market. Meanwhile, the waste in the sub-district capital and the village market is not well managed and is still dumped into rivers/ravines/hillside [8].

![Figure 4. Chart of Waste Management Process in Merek District](image)

Karo Regency has a landfill, and it is located in Nang Belawan, Kabanjahe District, Karo Regency, with ± 4 Ha with a load capacity ± 750,000,000 m³. Besides that, Karo Regency also has ± 72 places of temporary waste disposal. Each has a ± 1.5 m³ capacity, located in Kabanjahe City, Berastagi City, and the District Capital. Karo District also has 18 bin container units with a capacity of 6 m³, which are in each of the subdistrict capitals. The intensity of transportation once a day by two dump trucks. In practice, waste management at the Nang Belawan landfill is still using an open dumping system. Nang Belawan, apart from not having professional management staff, also does not have supporting facilities and infrastructure for sanitary landfill patterns such as bulldozers, excavators, scales, workshops, and a management office. Waste management process in Merek Subdistrict described as figure 4.

4. Conclusion
This study found that the two regions are still trying to provide the best service in solid waste management to the community. However, it was found that there are still many deficiencies that need to be fixed. Solid waste management in these two regions is still far from Indonesia’s standard. Both of them are where the open dumping landfill is still in operation. Also, both regions still lack professionals in solid waste management.

Acknowledgments
The authors gratefully acknowledge that the present research is a collaboration between the Environmental Service of North Sumatra Province and the author as part of the experts of the Integrated Waste Management System Planning in the Lake Toba Area in 2019.
References

[1] Aziz R and Mira 2019 Study of recycling potential of solid waste of tourist area in Pariaman City IOP Conf. Ser. Mater. Sci. Eng. 602 012059

[2] Chrisdianti 2017 Alternatif Pengelolaan Sampah Di Kawasan Wisata Laut Pasir Taman Nasional Bromo Tengger Semeru (Institut Pertanian Bogor)

[3] Manomaiviboob P 2018 Tourism and Municipal Solid Waste Management in Developing Economies: Challenges and Opportunities Open Access J. Waste Manag. Xenobiotics 1

[4] Giurea R, Precazzini I, Ragazzi M, Achim M, Cioca L-I, Conti F, Torretta V and Rada E 2018 Good Practices and Actions for Sustainable Municipal Solid Waste Management in the Tourist Sector Resources 7 51

[5] Hoang M G, Fujiwara T and Phu S T P 2017 Municipal Waste Generation and Composition in a Tourist City - Hoi An, Vietnam J. JSCE 5 123–32

[6] Badan Pusat Statistik Kabupaten Simalungun 2018 Kecamatan Girsang Sipangan Bolon dalam Angka 2018

[7] Dinas Lingkungan Hidup Kabupaten Simalungun 2018 Rencana Induk Sistem Pengelolaan Sampah Kabupaten Simalungun

[8] Pemerintah Kabupaten Karo 2011 Buku Putih Kabupaten Karo