Waters Utilization of Toba Lake for Fish Cultivation and Tourism

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Abstract: Lake Toba is one of the 15 priority lakes of the government program to save the lake ecosystem in Indonesia from extinction due to damage. The role of Lake Toba as the largest lake in Indonesia is undeniably very important to support human life, especially for local communities. Utilization of the waters of Lake Toba is as a source of raw water for the community. Most of the villages / hamlets around the lake use lake water directly, both for bathing and washing and drinking. Many of these villages / hamlets are highly dependent on lake water for domestic needs, because water sources from the mountains are not available. Lake Toba is used by the local community as a fish farming and tourist destination. These two aspects provide great benefits for the surrounding community and local government. In this case, it needs the support and participation of stakeholders in the future so that Lake Toba becomes a pilot area for lakes in Indonesia for fish cultivation and as a means of tourism.

1 INTRODUCTION

North Sumatera is one of ten leading tourist destinations in Indonesia. The province has 339 tourist attractions spread throughout its 33 municipalities. Until today 120 of them have been promoted and marketed. One attraction that is promoted for its natural beauty is Lake Toba. It is indeed the mainstay tourist attraction of the province. There are 8 regencies having administrative territories around the lake. Each has tourist sites with their respective unique characteristics. (Jaya, 2019).

Lake Toba is one of the largest lakes in Indonesia with the type of volcano-tectonic lake. The explosion of Toba volcano (tumor Batak) formed Lake Toba. It located in the coordinates of 2010'N-300'N and 98020" E-99050"E or in the Bukit Barisan mountains of North Sumatra Province. The Lake Toba area consisted of seven districts, namely North Tapanuli Regency, Humbang Hasundutan, Toba Samosir, Samosir, Simalungun, Karo, and Dairi. The area of Lake Toba is 1,124 km2 with a maximum depth in the northern concave section (508 m) while the southern concave maximum depth is 420 m. (Lubis, 2019).

The huge potential of the waters of Lake Toba is water that flows through the *inlet* and has been used for the Sigura-gura Hydro Power Plant (PLTA). The capacity is quite large, reaching 286 Megawatts (MW), compared to the Maninjau PLTA which is only 68 MW, and has been operating since 1982. Another activity that has developed in the waters of Lake Toba is the aquaculture business of the floating net cage system (KJA), which is the first time tried in 1988 (Dharma, 1988). The level of total fish production from KJA in Lake Toba waters in 2010 was recorded at 47,478 tons and the dominant production areas are Samosir Regency (24,420 tons), Toba Samosir Regency (10,372 tons), and Simalungun Regency (9,807 tons). (Afonina, 2018).

In the utilization of the waters of Lake Toba, need a variety of careful consideration for the sake of balance that refers to the use of the waters of sustainable development (*sustainable development*). The Lake Toba area, which is located in 7 districts, needs to implement a one-hand management policy (*One lake one management*), to accommodate various interests and maintain the sustainability of the lake's ecological system itself. Understanding of the limnological conditions of the waters of a lake is very important in the development of today's society. This is related to the lake's vulnerability to environmental threats which is getting higher in line with the intensity of its use. (Hanson, 2012).

The pollution of Lake Toba waters was caused by the large amount of sediment deposits and other

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chemical factors. This will result in disruption of fish habitat and can affect the function of organisms in the ecosystem. As explained by Shuai et al. (2017) chemical factors such as DO, water clarity, NH4- N concentration and TDS will influence fish to find food. Consistent habitat will affect the role of organisms in the ecosystem.

Based on the review above, the waters of Lake Toba are also used as a means of fish farming by the local community. This is a form of concern for the Regional Government, in this case the Provincial Government of North Sumatra in improving the standard of living of local communities, as well as serving as a means of tourism for domestic and foreign tourists. (Kartamihardja, 2012).

Based on various publications, the recorded Lake Toba fish community reaches 18 species, whereas Kartamihardja found 13 species and several new introduced fish. Introduced species such as tilapia and goldfish were introduced to Lake Toba in 1940 and 1937, respectively. (Sarnita, 1999).

Currently, the Lake Toba area is the center of tourism in North Sumatra. The main attraction is the panoramic view of the blue expanse of water, which makes this lake the largest lake tourist attraction in Indonesia. Data on tourist visits between 1990 and 1995, about 500 thousand people per year, and 20 percent of them are foreign tourists (Dinas Pariwisata DT II Simalungun, 1996, *unpublished*).

The low diversity index and the uniformity index of living things in the Lake Toba waters were caused by waste in the environment. Environmental waste in lake waters is influenced by physical-chemical properties, such as temperature, pH, organic matter, inorganic substances, salinity, and others. Afonina & Tashlykova (2018) stated the temperature of water, minerals, and pH, the main factors for determining the abiotic and biotic components of a waters, greatly influences the structure of the plankton community. Plankton play a role in the nitrogen cycle and its response to changes in environmental factors in freshwater ecosystems.

With regard to tourism development, of the 147 hamlets / villages scattered around Lake Toba, 15 of which are tourism and business areas that also support tourism such as Parapat, Balige, and Panguruan; 12 locations have undeveloped tourism potential; and others are villages / hamlets not related to tourism. Overall, there are 27 locations that need to be given attention in the utilization of their area, especially water areas, to maintain natural conditions. Thus, tourism activities and their development can continue to be supported.

In order to synergize various government policies with the existence of floating net cages (KJA) in Lake Toba, which was originally based on the lack of agricultural produce there, KJA is the answer to various problems.

Lake Toba in North Sumatra is a popular destination for local and foreign tourists. The government of Indonesia expects foreign arrivals to Lake Toba to increase from 250,000 to 1 million people over the next four years (The Jakarta Post, 2017). There are many development projects, as well as promotional efforts carried out by the Ministry of Tourism Indonesia, aiming to welcome the international tourists to Lake Toba, thus, generating tourism revenue for the country. Therefore, in supporting the ministry's efforts, this study attempts to explore and analyze tourists' experiences in Lake Toba as a tourism destination.

In Indonesia, the tourism sector has become the center of attention of the government today and is a mainstay of state revenue. Jokowi's government has determined tourism as a priority sector that can boost the economy. Tourism is an important job creator, employing millions of people around the world. (Manurung, et.al. 2020).

Lake Toba has the potential to attribute tourist destinations on the 5A system. In terms of the level of local community participation, the community response to its involvement in tourism-destination attributes in Lake Toba can be categorized in the "partnership" phase. (Wiweka, et. al., 2020).

One of the developing tourism areas in the North Sumatera is the Lake Toba. The government has set this area as one of the main national tourism destination Samosir, Toba Samosir, Simalungun, North Tapanuli, Humbang Hasundan, Karo, and Dairi, and is located in the center of Batak culture with several of subethnic, including Simalungun, Tapanuli, Karo, and Pakpak, and also various traditions.

This sub-ethnic cluster possesses various cultural resources which are mainly reserved in rural areas. It also owns a large topographic and lake surface potential for various economic and noneconomic activities. From the perspective of tourism development, the existence of these resources is valuable assets to force the development of tourism.

Extensively, lakes are identified by many countries and destinations in tourism promotional campaigns, whether it provides a key image of destination or an attractive backdrop for other leisure activities. Due to that, attention should be given to lake tourism as it falls under natural environment that promotes both tourism and recreational

activities. There are many beautiful lakes in the world, such as Lake Como in Northern Italy, Maligne Lake in Canada, and Lake Pichola in India. Besides that, one of the largest volcanoes-tectonic lakes in the world are Lake Toba. The lake is located in the province of North Sumatra, 176km to the west of the provincial capital, Medan. Lake Toba can be reached by car from Medan within three hours. By plane, Medan is 40 minutes away from Singapore and two hours from Jakarta, the capital city of Indonesia. The lake is one of the country's important tourist destinations with its position not only as one of the largest volcanic lakes in the world, but also as one of the biggest lakes in Southeast Asia. (Azmi et.al, 2018).

Lake Toba functioned as a water transportation infrastructure, community water source and the main one as a hydroelectric power station to supply electrical energy needs.

The research method used in this research is qualitative research methods. Research is used to examine the conditions of natural objects, where the researcher is the key instrument. And also the quantitative research that is by looking for information about existing symptoms, clearly defined objectives to be achieved, to plan his approach, collect data as ingredients to make a report related to the utilization of waters of Lake Toba to cultivation of Fish and Tourism.

This research was conducted through literature study and direct observation in the field and supported by interviews with related parties.

2 LIBRARY

2.1 Concept about Tourists

According to the World Tourism Organization in Marpaung (2002), tourists are every four people living in a country regardless of nationality, visiting a place in the same country for a period of more than 24 hours whose purpose of travel can be classified as: utilizing free time to be creative, vacation, health, education, religion, and sports or business and visiting family. (Maksimovic, 2019).

The development of tourist open space in the form of tourist image, tourist satisfaction, interest and loyalty of influential visitors and supporting regional development.

2.2 Concept of Tourist Attraction

Based on the Republic of Indonesia Law No.10 of 2009, Tourist Attraction is described as anything that has uniqueness, convenience, and value in the form of a diversity of natural, cultural and man-made wealth that is the target or tourist visit. A tourist attraction is based on several important points, namely: the existence of resources that can create a feeling of pleasure, beauty, comfort and cleanliness; there is high accessibility to be able to visit it; the presence of special characteristics that are rare; the existence of supporting facilities and infrastructure; has high attractiveness due to inner beauty; and there is a special value because it has an appeal in the arts, traditional ceremonies or the existence of values that form objects of past works.

2.3 The Concept of Tourism Potential

Tourism potential is the various resources found in a certain area that can be developed into tourist attractions (Pendit, 1999).

2.4 Concept about Management

In a broader sense, management can be defined as: the process of how to make it manage; the process helps formulate policies and organizational goals, the process provides oversight on all matters involved in its implementation and policies in achieving goals (Kamus Besar Bahasa Indonesia III (2001; 470).

2.5 The Concept of Nature Tourism

Nature tourism can be interpreted as a form of recreation and tourism that utilizes the potential of natural resources and their ecosystems, both in their original form and after a combination of human creativity, according to Fandeli (2001).

3 RESEARCH METHODS

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report related to the utilization of waters of Lake Toba to cultivation of Fish and Tourism.

This research was conducted through literature study and direct observation in the field and supported by interviews with related parties (see Table 1).

Table 1: Data Sources and Collection Techniques.

No	Activity Description	Type of Data	Sources of Data	Data Collection Techniques
1.	Water quality data			
	Physical parameters include temperature, dissolved solids, conductivity and turbidity, while chemical parameters include pH, ammonia, nitrate, phosphate and chloride.	Primary and secondary	Agency for Environmental Living, Research and Development of the Provincial Government North Sumatera.	Laboratory analysis, document study
2.	Data precipitation rain	Secondary	Department of Agriculture, Fisheries and Livestock of the Provincial Government North Sumatera.	Document study
3.	Fish farming strategy model	Primary	Survey, observation, NGOs, local government.	Interviews in depth (in-depth interviews)

Based on the table above, it is clear that this study comes from primary and secondary data, primary data, data obtained by conducting field surveys, while secondary data is data obtained from various literature related to the topic that the author raises.

4 DISCUSSIONS

Prior to the discussion, the author first explains about the use of Lake Toba for the use of fish farming and tourism.

4.1 Fish Cultivation

The utilization of the waters of Lake Toba is very diverse, well that water, reserves, objects travel, hydropower, transport media in the area of Lake Toba, cultivation of agriculture and fish farming. In this paper, the author focuses on the use of Lake Toba for fish farming, especially floating net cages (KJA) and tourism. For capture fisheries business, it has been recorded since the 1950s (Soerjani *et al*. 1979). The dominant catch rate before the introduction of bilih fish was mujaer (69.1%), followed by tilapia (22.4%), nilem (months) (3.0%), goldfish (2.4%), and shoes (3.0%). (Tajhjo, 1998) Based on 2005 data, total fish catch production in Lake Toba is 4,462 tonnes, with *tilapia* (*Oreochromis mossambicus*) and tilapia (*O. Niloticus*) as the most dominant fish caught. (Poernomo, 2005) Capture fisheries business which is currently quite dominant is fishing bilih (*Mystacoleucus padangensis*). The production rate in 2010 is estimated at 30,000 tonnes and the fishing gear that is commonly used is the lift net chart. (Koeshendrajana, 2010)

Fish farming activities in KJA in the waters of Lake Toba were first tried in 1988, currently the KJA activities are quite widespread. It is recorded that 50 villages / hamlets have KJA, owned by the community, 5,158 units and 4 locations are owned by large foreign capital companies (PMA) and 1 location with 72 small KJA units). Total fish production from KJA in Lake Toba in 2010 reached 47,478 tons, mainly from three districts, namely Samosir Regency (24,420 tons), Toba Samosir (10,372 tons), and Simalungun (9,807 tons). By taking the most logical data, namely the level of fish production in Simalungun Regency and assuming that the size of all KJA is the same (5 x 5 x 3 m3), the average production per cage is 2.995 (≈ 3) tons / year.

It should be noted that fish farming using floating net cages (KJA) is the main source of income for residents around Lake Toba. It seems

that the KJA reduction policy should be reviewed. Although accused of being the main cause of Lake Toba's pollution, in fact many other factors influence this pollution, such as pig farm waste, household activities and hotels, as well as logging in the lake's catchment area.

Location of tourism in the region of Lake Toba almost scattered along the lake, both of which come into contact with water or not. There are 15 hamlets / villages that support tourism. In fact, apart from tourism locations, Parapat, Balige, and Panguruan are also business centers. There are 12 tourism potential locations that have not been developed. Thus, in total, there are 27 locations that must be protected and it is not possible to use them as KJA. In business and port areas, the condition of the marine environment in general is not supportive of the marine cage due to high domestic pollution and discharges from ferry boats. Meanwhile, marine cage in tourist areas will interfere with tourist activities because it reduces the aesthetic value of the waters.

Regarding fish farming through floating net cages in Lake Toba, of course there are several things that must be considered, namely in relation to the management strategy. In order to realize the management of fish farming in a lake/ reservoir in a productive and sustainable manner, it is necessary to support all parties who synergize with each other. A number of strategic steps that should be taken by the government, business actors, and all other components of society, including:

1. Spatial planning for public waters according to its designation. The aquaculture zone is prioritized for water conditions that are not too fertile (oligotrophic-mesotrophic) with adequate accessibility.
2. Rasionalism biomass of fish in cage appropriate environmental carrying capacity (carrying capacity), by limiting the number and arrangement of KJA equitably between the public and private sectors.
3. Spread of plankton feeder fish (for example: milkfish, tilapia) in the lake / reservoir environment to cope with high plankton abundance.
4. Use of floating fish feed which has a minimal phosphorus content. High levels of phosphorus in waters are known to increase water fertility (eutrophication) which is bad for fish farming activities.
5. Application of an early warning system against upwelling events to prevent losses due to mass mortality of fish. Upwelling usually occurs when the rainfall is high, which causes the surface temperature of the waters to drop, so that the activities carried out should be harvesting or reducing the stocking density of fish and raising fish that are resistant to poor water quality conditions (eg catfish, tilapia).
6. Modification KJA eco able to accommodate the rest of the feed in order not to precipitate and cause water pollution. The KJA models that are built must have improved water quality through physical and biological filters, up to 20% of the remaining feed to the surface, and provide additional benefits such as from the maintenance of kale plants.
7. Aeration in the marine cage area in anticipation of low Dissolve Oxygen concentrations for fish.
8. Excessive water hyacinth weed control physically, biologically, and chemically.

Through the steps above, it is hoped that the management of fish farming in Lake Toba can run productively and sustainably. Furthermore, it can generate economic growth, provide employment opportunities, and improve community welfare.

The allocation of the number of KJA determined through the various scenarios above is by considering the main function of Lake Toba for the benefit of tourism, as well as paying attention to local residents who need land for their livelihoods. Development of a better fish farming system, including through increasing feed efficiency and utilizing leftover feed that is released into the waters along with waste management that can increase the number of KJA that can be planted.

4.2 Tourism Sector

The tourism sector in Indonesia is one of the sectors that plays an important role in the sustainability of the Indonesian economy. If you get good and correct management, tourism development as an industry will create prosperity through the development of transportation, accommodation and communication which creates relatively large job opportunities (Slamet Santoso, 2008).

Tourism is a new type of industry capable of accelerating economic growth and providing employment, increasing income, living standards and stimulating other productive sectors. As a complex sector, the tourism industry is also arranged classic industries such as industry- industrial crafts and souvenirs. Lodging and transportation are also viewed economically as an industry (Wahab in Pendit, 2006).

Along with this, of course there are factors that benefit from being attractive, including the tourism sector, considering that Lake Toba is the largest crater lake or volcanic lake in the world and is the largest lake in Indonesia and Southeast Asia. With an altitude of almost 1 kilometer above sea level and surrounded by a series of volcanoes which are part of the Bukit Barisan Mountains, **Lake Toba is** so cool and beautiful. Many palm and pine trees that thrive around Lake Toba add to the beauty of this lake.

To the north of Lake Toba, you can still find a variety of interesting fauna such as langurs, orangutans, and several types of monkeys. Meanwhile, in the southern part of Lake Toba there are different types of fauna such as monkeys, tapirs, and ingkir. Of course this is also unique because this lake seems to function as a dividing line for the ecology of fauna on the north and south sides of Lake Toba.

As far as the eye can see, you can see the beauty of the lake which is surrounded by a series of mountains that are so beautiful and amazing. Thick fog sometimes blankets this cool and cold lake. If there is no fog, the curves of Lake Toba are so beautiful to admire. Lake Toba is like a sea in the middle of a really cool land.

Based on this, it is clear that Lake Toba inspires the surrounding community to develop creations, both through fish farming and tourism, both making souvenirs for tourists, as guides and other things that can provide benefits to the surrounding community.

5 CONCLUSIONS

It is time for the integrated management of the waters of Lake Toba to begin, given the increasing importance of utilizing its resources so that problems and conflicts of interest are increasing. On the other hand, people's understanding of the importance of a good environment continues to develop and encourages every stakeholder to pay greater attention to lake waters which must be more preserved.

Cultivation of fish in KJA that has developed in various lakes needs attention so that the direction for its development is urgently needed. Mitigation of environmental threats from KJA development is a policy direction for the development of a cultivation system that refers to the carrying capacity with available formulations and a certain level of tropical status, as well as the determination of zoning that takes into account the various uses of lake resources by the community. This book can be used as a reference for other lakes in Indonesia, while still paying attention to the characteristics of the lake in question and aspects of its utilization.

Lake Toba has become a future tourist destination for Indonesia, so it directly and indirectly has implications for the welfare of the community. The people who benefit are the fishermen and local communities around Lake Toba. The right government policy and appropriate regulations will provide certainty for the economic improvement of the communities in Lake Toba.

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