



Public Perception to Communities Floating Fish Cage At Lake Toba

KEYWORDS

Lake Toba, floating fish cage, community, perception

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ABSTRACT *Lake waters have special characteristics related to the nature of the common property and multi-sectorial, and are open to the influence of the impact of various activities in the area. Lake Toba. For use with continuous as well as to maintain the ecological balance, which need the role of the community as a subject that has activities in Lake Toba. Floating fish cage activities in the waters of the lake have given a positive impact on the economy, because it adds more value to the water resources, but it is also highly vulnerable to environmental issues. The development of floating fish cage at Lake Toba must consider the carrying capacity that does not threaten the tourism activity which is the mainstay of national tourism. As part of the activity in Lake Toba, it is needed to know about the public perception about the floating fish cage attendance in Lake Toba.*

Introduction

Lake waters is a natural resources which owned by community as common property, so in utilized, people often use the water as freely as required. Over time, because of more various and more intensive the needs of the community, so, in its development and authority emerging multi-sector policies and interests (Lukman, 2011).

Generally, the function of aquatic environment of Lake Toba is reserved and utilized as the source of clean water, water for industry, water for irrigation, as a tourism resource, as an energy resource, and used for transportation, but also as the receiver for various kinds of waste. Along with the increased activity of the community around Lake Toba so will provide feedback in the form of nutrient to the lake waters body and if the self-purification process is exceeded so it will speed up the eutrophication process (Suryono et al, 2010).

Fish farming activity using Floating Fish Cage at lake waters is one of the efforts to increase the production of fish by utilize the existing water potential. Floating Fish Cage activity reap a lot of public attention because of the controversy between the social and economic needs of community and the environmental sustainability, and also between achievement of production and the carrying capacity of waters. The amount of Floating Fish Cage that already operated at Lake Toba is always increasing and planned to be developed (Ari-fin, 2004).

As many as number of Floating Fish Cage increase in Lake Toba water then also increasing the amount of feed that sown in Lake Toba waters which is one of the sources of water pollution in Lake Toba. From another research that done before gives an indication decreasing of water quality has occurred in location which is the place for community to do their activities (Barus, 2007). The quality of Lake Toba water has decreased and compounded again with the growth of Eichhornia crassipes that so lush is the indicator that water in Lake Toba is rich in organic substance (organic contamination). Types of that contamination will create negative effect for local people health.

Based on the early survey done by authors at Toba Samosir regency, show that majority of the community use lake waters as source of drinking water and household need.

Appropriate with what the government want to be done namely to decrease the number of unemployment, so the

Floating Fish Cage farmers also take a part in succeeding that program (Pontoh, 2012). But in other side, this business also will give negative impact to the lake waters ecosystem. In this case, fish farming activity using Floating Fish Cage directly will affect the quality of lake waters (Barus, 2007). Potentially, deployment of the waste that rich with nutrient and organic matter can increase sedimentation, siltation, hypoxia, hypernutrification and the changes in productivity and also the structure of benthic community (Barg, 1992).

Because of that, it is very important to study about the social and economic values of lake waters, not only from the biophysical perspective approach. Klessig (2001) in Lukman (2010) stated that lake only give optimal social advantages if the management policy acknowledge fully setting for the potential contribution of lake which can be made for community and that management policy also integrated to give balance attention to all values that can provide by the lakes.

Waste that comes from the activity which took place at the waters body derived from community and industry Floating Fish Cage activity. Loads of organic waste that derived from Floating Fish Cage such as residual feed and fish feces can decrease the quality of lake waters. Because of that, in the context of management of Floating Fish Cage at Lake Toba proposed research questions, how the public perception for the presence of Floating Fish Cage managed by the community?

The results of this research are expected can give benefit to various parties, especially for the community as the information in utilization and observation of resource at Lake Toba waters.

Literature Review

To increase the quality of life, human always utilize natural resources even in excessively way. The more limited amount of natural resources to support human, it can make humans are more difficult to maintain theirs' decent quality of life. This case means, many environmental problem happen because the process for human to increase theirs' quality of life (Soemarwoto, 2004).

With the increase of population, it means the use of natural resource will be higher, and the consequences the waste disposal to the environment will also increase.

We can interpret Environmental management as conscious

effort in keeping and repairing the quality of the environment so that the basic human needs can be fulfilled as well as possible. Because of perception of basic human needs, especially for the necessities of human life, it is also not same for all segments of society and always changes from time to time, so the environmental management must be flexible. With that flexibility we are trying to close options for specific community groups to get their basic needs or also to early close our options in the future (Soemarwoto, 2004).

There were 2 concepts in that definition. First is needs concepts, especially the basic needs of today's generation, and the second is the idea of limitations which is based on consideration of technological advances and social organization to establish the carrying capacity of the environment that have capability to sustain the life of the current generation and also future generation.

Lake Toba Area

Lake Toba area is a national strategic area (area with priority spatial planning because that area has very important effect nationally for state sovereignty) which has established in Peraturan Pemerintah No. 26 Year 2098 about national spatial planning.

Lake Toba located in Bukit Barisan highlands in North Sumatera Province, in government administration is part of 7 regency areas, namely; Karo regency, Simalugun, Dairi, Toba Samosir, Samosir, Humbang Hasundutan, and North Tapanuli. Geographically, Toba Lake ecosystem area located in coordinates $98^{\circ} 31' 2'' E - 98^{\circ} 09' 14'' E$ and $2^{\circ} 19' 15'' N - 2^{\circ} 54' 02'' N$, with height 903 m from sea level. Lake Lake is the widest lake in Indonesia with total area is 1124 km^2 ; maximum depth reaches 508 m and the total volume of water around $256, 8 \times 10^3 \text{ m}^3$.

Lake Toba is inland waters that have multi sector role, for the benefit of local community, national and even international. Lake Toba area is the tourism center at North Sumatera, with the main appeal is panoramic expanse of Lake Toba waters and the area around the lake is tourism objects which are well known to the foreign countries. It has become a national policy that Lake Toba areas become one of the mainstay's potential for national tourism development master plan (RIP-NAS) (Ardika, 1999 in Lukman et al, 2010). A huge potential from Lake Toba waters is water flowing through its outlet which has been utilized for power plants at Sigura-gura hydropower which has a large enough capacity (286 Megawatt) and has been operating since 1982, compare with Maninjau hydropower that only 68 MW (Lukman, 2010).

Lake Toba and the catchment area is a large natural landscape. The total catchment area is 369.824 ha consisting of 190.314 ha land in Sumatera Island, 69.280 ha land in Samosir Island and 110.260 ha the total surface of Lake Toba. Lake Toba area is an upstream of some regency/city at North Sumatera. The condition of this area will give direct and indirect effect for downstream areas.

Lake and Floating Fish Cage

Lake is one shape of the ecosystem which relatively occupies smaller area on the surface of the earth than sea or land. For human its importance is bigger than the area. To fulfill the human interest, the environment around the lake changed to match with the human way of life and living. Space and land around the lake is converted to accommodate various human activities like settlement, road, sewer line, farmland, recreation, etc. (Connell & Miller, 1995).

According to Connell & Miller (1995), two things that offered by lake are: 1) As the most practical and the cheapest source of water for domestic and industry purpose. 2) As an adequate and cheapest landfill.

Kumurur (2002), lake area need an integrated management

so that the ecologic and economic functions that come from these natural resources can be preserved to sustain life in future generation.

Floating Fish Cage method increasingly conducted by community to do fish farming, especially in freshwater. The development of this technology is rapidly growing. In terms of effectiveness and efficiency, Floating Fish Cage method is very good to use. By utilizing the breadth of lake waters and coupled with the suitability between lakes' climate and fish growth, it makes the use of Floating Fish Cage is rapidly growing.

But in its development, the used of Floating Fish Cage method at lake waters has caused many problem. Started from, sudden death of fish until to the disruption issue of lakes' ecosystem.

Generally, inland water ecosystems can be divided into two parts namely, lentic water and lotic water. Lentic water also called still waters because it has a slow flow speed, so it causing the accumulation of water mass in a long period of time. Examples: lake, ponds, swamps, reservoirs. Meanwhile, lotic waters have flowing waters because it has a fast flow speed with fast mass transfer of water. Examples: river and canal.

Physically, lake is a spacious place which has still water, clear or various with specific flow and presence of aquatic plants is only at surrounding area (Jorgensen and Vollenweiden, 1989; Barus, 2004).

According to Ruttner (1977), lake is natural body of water that always stagnant year-round and has specific quality of water that different between: one lake to other lakes, and also has high biological productivities.

As lentic water ecosystem, lake has a very slow speed of water flow (0.001-0.001 m/second) or even no flow at all, so it has a long time of water's residence time. Because of the lake has a very slow speed of water flow, so it not gives a big effect to the organism inside the lake. The very important factor at lakes' ecosystem is vertical stratification of water's quality that depends on depth. The difference in water's characteristics especially that connected with the difference intensity of absorbed light, which in further can make the difference of waters' temperature at every depth.

Fish farming using Floating Fish Cage system is fish farming activity which can be developed intensively with the high density of fish, so it cannot use only natural sources of food in waters, but also used fish feed from outside the waters, such as pellets.

Economically, fish farming using Floating Fish Cage system has some advantages, such as: a) increase efficiency of resource utilization; b) can increase fish production; c) provide more regular income than fishing effort. But, excessive amount of fish farming using floating fish cage system can caused serious affect for aquatic environment, both biotic environment and abiotic environment. According to Beveridge (1984) Floating Fish Cage activities will give effect to four basic things such as: a) need a lot of space in waters surface; b) impede the flow of water and also the flow to transport oxygen, sediment, plankton and fish larvae; c) degrade the aesthetic quality of lake; d) degrade environmental quality of lake. Furthermore, Floating Fish Cage activity give affect significantly to aquatic environment, such as change of nutrient water, change in dissolved oxygen concentration, and cause development of toxic organisms, so the waters become no longer feasible as source for drinking waters, recreation facilities, and for fishery itself.

Generally, the waste of Floating Fish Cage is organic waste that derived from the remnants of unconsumed feed by fish farming and the discharge of metabolic waste such as feces

and urine. The amount of unconsumed feed and feces produced by fish in Floating Fish Cage is depends on some factors, such as: a) type of feed; b) fish density in a cage; c) health of farmed fish; d) frequency of feeding; e) method of feeding and food conversion ratio. McDonald et al (1996); Boyd (1999) stated that from the total amount of feed that given to fish farming, the unconsumed feeds are around 30%. Furthermore, from the total amount of consumed feed by fish, the total feces are around 25%-30%. It means, continually, a sizeable amount of organic waste will be wasted to the waters.

If the sedimentation of waste particle is bigger than the flow velocity, so, the organic particles will settle to the bottom of the lake where the Floating Fish Cage exist (Barg, 1992). Phillips et al (1985) in Beveridge (1996) stated that solid organic waste will settle to the bottom of the lake and eventually form sedimentary. During the sedimentation process, some of the organic waste will be consumed by other aquatic biota like wild fish, and some of that organic waste will break into more subtle particles. If the organic is waste not eaten by other aquatic fauna, like fish, crab, benthos, and others, so that organic waste will decompose by microbe, either by aerobic microbe, anaerobic microbe, and elective microbe (Garno, 2004).

Research Methodology

This research was done in July-Desember 2012. Sampling was done at Toba Lake with the research sites are at 3 administration areas such as: Onan Runggu Sub District (Samosir Regency), Haranggaol Horison Sub District (Simalungun Regency), and Pangururan Sub District (Samosir Regency).

The data used in this research were consists of primary and secondary data. Primary data were in the form of physic, chemical condition of Toba Lake and partly from the laboratory test result. Secondary data were obtained from results of previous research, literature review, report, and documents from various related institution.

Collecting data to know the public perception for Floating Fish Cage in Lake Toba waters use Questionnaire that distributed to the respondent. Determination of sample size in social research is done by using SLOVIN formula (Sevilla, 1993).

From the secondary data which are the population and the amount of Floating Fish Cage entrepreneurs that obtained from headmen, specified number of the sample by using the SLOVIN equation:

$$n_{\text{sample}} = \frac{NPK}{NPK (d)^2 + 1}$$

Where the n_{sample} is the minimum amount of the analysis sample to be selected, and NPK is the amount of population (entrepreneur and non-entrepreneur) and $d = 0.1$ (level of confidence).

Result and discussion

The research was done at three locations such as Onan Runggu Sub District (Samosir Regency), Haranggaol Horison Sub District (Simalungun Regency), and Pangururan Sub District (Samosir Regency).

According to GPS, Floating Fish Cage at Onan Runggu Sub District is situated at Sitamiang village located at coordinate 020 29' 93.4" Northern Latitudes and 0980 58' 62.8" East Longitude, Floating Fish Cage at Haranggaol Horison Sub District is situated at Haranggaol village located at coordinate 020 52' 05.4" Northern Latitudes and 0980 40' 61.3" East Longitude and Floating Fish Cage at Pangururan Sub District is situated at Tanjung Bunga village located at 020 06' 00.8" Northern Latitudes and 0980 41' East Longitude.

The analysis of community perception about Lake Toba and

Floating Fish Cage conducted on the Floating Fish Cage entrepreneur and non-entrepreneur and also to the local government about the advantage of Floating Fish Cage to the community.

From the secondary data which is the population (KK) and the amount of Floating Fish Cage entrepreneur (KK) that gained from headman, as in Table 1.

Table 1 KK amount as the Floating Fish Cage (FFC) entrepreneur or non-entrepreneur

No	Location	Amount KK	Amount KK Entrepreneur FFC (NPK)	Amount KK Non-Entrepreneur KJA (NNK)
1	Desa Sitamiang Kec. Onan Runggu	176	20	156
2	Desa Haranggaol Kec. Haranggaol Horison	400	34	336
3	Desa Tanjung Bunga Kec. Pangururan	417	20	397

So, has been decided that the number of opinion samples by using SLOVIN equation, as in Table 2

No	Location	Amount KK	Amount KK Entrepreneur FFC (NPK)	Amount KK Non-Entrepreneur KJA (NNK)
1	Desa Sitamiang Kec. Onan Runggu	176	17	61
2	Desa Haranggaol Kec. Haranggaol Horison	400	26	78
3	Desa Tanjung Bunga Kec. Pangururan	417	17	80

By looking the data of public perception of Floating Fish Cage entrepreneur and non-entrepreneur in general, generally the communities at Samosir regency (85.8%) use the lake water for daily needs such as bathing, washing until the primary needs like for drinking. This thing cause the quality of Lake Toba waters need better attention by refers to the standard of waters quality I appropriate with the attachments of government regulation no. 82 year 2001, while the communities in Simalungun regency do not use the lake water for daily needs. The communities also feel the changes in water quality that they use, in terms of color, taste, and smell, where from the total of 219 questionnaires, 46.6% said that they feel the changes of waters quality in term of color, 98.08% said that they feel the changes of waters quality in term of taste, and 85.8% said that the feel the changes in term of smell.

96.7% of communities Floating Fish Cage entrepreneur in Samosir regency and Simalungun regency are the direct owner of Floating Fish Cage. The communities Floating Fish Cage entrepreneur at Samosir regency only 80% utilize Floating Fish Cage as their main income, and the rest still works as farmers and as civil servants, while all the communities Floating Fish Cage entrepreneur at Simalungun regency utilize Floating Fish Cage as their main income.

While for the non-entrepreneur communities at Samosir regency, no one from their family members working at the communities Floating Fish Cage, while at Simalungun regency almost 60.5% of their family members working at the communities Floating Fish Cage with the range income between Rp.50,000.00 – Rp.75,000.00 per day.

53.85% of communities Floating Fish Cage entrepreneur at Simalungun regency use pellets as fish food around 50-55 kg for one meal, 26.9% use pellets around 55-60 kg for one meal, even almost 15.4% use pellets more than 60 kg for one meal. While almost all the communities Floating Fish Cage

entrepreneur at Simalungun regency use pellets as the food fish around 2-4 kg for one meal. The average outcome of the Floating Fish Cage at Simalungun regency is around 1300 kg for each fish harvest. While the average outcome of Floating Fish Cage at Samosir regency is around 250 kg for each fish harvest.

Government have important role in managing the communities Floating Fish Cage. In this case, the governments are Camat and Lurah/headman, and note that all Camat at the research location do not mind with the presence of Floating Fish Cage because it has important role in increase the public economy, with hope that the Floating Fish Cage placed at the right location. In other side, headman at the research location was disagreeing with the presence of Floating Fish Cage because according to their opinion Floating Fish Cage causes waters pollution at Lake Toba. The reason of disagreement is because generally, almost all villagers use the lake water as their daily needs especially for drinking.

Both Camat and headman realize that no growth of local revenue from the presence of this communities Floating Fish Cage. Even in other side give negative effect for the tourism activity which is marked by the decreasing number of newcomers or tourists that come to Lake Toba since the presence of Floating Fish Cage. Nevertheless, the government hope after the Floating Fish Cage localized later, the tourism activity will also evolve.

Conclusion

The communities at the location of Floating Fish Cage in general realize the impact of Floating Fish Cage to the waters quality for public and individual interests such as the use of lake waters for drinking, for household needs, moreover, communities also want to keep the preservation of Lake Toba considering the communities have felt the changes of waters quality in terms of physical such as smell, taste and color.

In other side, the communities Floating Fish Cage activities plays very important role to increase the public economy, both for the owner of the Floating Fish Cage and not the owner at Haranggaol sub-district. But at Onan Runggu sub-district and Pangururan sub-district, the presence of Floating Fish Cage does not have a lot of role in economic activity of non-entrepreneur communities of Floating Fish Cage.

The headman at research location hope that the Floating Fish Cage placed at the location that does not interfere tourism and no too close to people settlement, so not cause water pollution that needed by the communities for daily needs.

Suggestion

Need to be research all Floating Fish Cage locations at Lake Toba to get research result of public perception to the presence of communities Floating Fish Cage. Then also need to do research for the public perception to the presence of companies Floating Fish Cage in large-scale.

Attachment 1: Communities of FFC non-entrepreneur at Onan Runggu

Variable	Explanation	Point
Gender	Men	58
	Women	3
Education	Below SHS	34
	SHS	20
	Above SHS	7
Job	Farmer	42
	Civil Servants	5
	Entrepreneur	4
	Others (Merchant-Pedidriver)	10

Are there any of their family member works at other communities FFC?	Yes	Seed dispersers	0
		FFC maker	0
		Boat Driver	0
		FFC guard	0
		Others	0
	No		61
Daily wage of family members		25000	0
		50000	0
		75000	0
		100000	0
		>100000	0
Use Lake Toba waters for daily use	Yes		52
	No		9
Distance of waters source from FFC		101	55
	m	101 – 200	6
		>201	0
Feel the changes of lake waters quality	Yes	Color	
		Taste	46
		Smell	7
	No		0
Understand about FFC	Yes		57
	No		4
Realize the FFC effect for environment	Yes		57
	No		4
Want to keep environmental sustainability	Yes		61
	No		0
Transportation by ship is disturbed by FFC	Yes		57
	No		4

Attachment 2: Communities of FFC entrepreneur at Onan Runggu

Variable	Explanation	Point
Gender	Men	16
	Women	1
Education	Below SHS	4
	SHS	10
	Above SHS	2
Job	Farmer	3
	Fish Farmer	3
	Farmer and Fish Farmer	3
	Private employee	2
	PrivateemployeesandFishFarmer	0
	CivilservantsandFishFarmer	4
	Merchant	2
Ownership of FFC	Own Property	16
	Not Own Property	1
Quantity of fish harvest/year	Never	2
	1 kali	9
	2 kali	6

Amount / fish harvest (kg)	0 – 200	3
	201 – 300	7
	301 – 400	3
	401 – 500	3
	>500	1
FFC is main income	Yes	10
	No	7
How long did their have FFC	Newly created	3
	3 years	2
	2 years	8
	1.5 years	1
	1 year	3

Using pellet for fish feed	Yes	16
	No	1
Realize FFC effect for environment	Yes	16
	No	1
Want to keep environment sustainability	Yes	16
	No	1

Attachment 3: Communities of FFC non-entrepreneur at Haranggaol

Variable	Explanation	Point	
Gender	Men	76	
	Women	2	
Education	Below SHS	2	
	SHS	76	
	Above SHS	0	
Job	Farmer	44	
	Civil Servants	6	
	Entrepreneur	5	
	Others (Merchant-Pedical driver)	23	
Are there any of their family member works at other communities FFC?	Yes	Seed dispersers	0
		FFC maker	0
		Boat Driver	0
		FFC guard	6
		Others	40
		No	32
	Daily wage of family members	25000	0
50000		6	
75000		40	
100000		0	
>100000		0	
Use Lake Toba waters for daily use	Yes	0	
	No	78	

Distance of waters source from FFC	m	101	0
		101 – 200	0
		>201	78
Feel the changes of lake waters quality	Yes	Color	65
		Taste	70
		Smell	42
		No	0
		Yes	78
Understand about FFC		No	0
		Yes	78
Realize the FFC effect for environment		No	0
		Yes	78
Want to keep environmental sustainability		No	0
		Yes	78
Transportation by ship is disturbed by FFC		No	0
		Yes	78

Attachment 4: Communities of FFC entrepreneur at Haranggaol

Variable	Explanation	Point
Gender	Men	26
	Women	0
Education	Below SHS	0
	SHS	23
	Above SHS	3
Job	Farmer	0
	Fish Farmer	22
	Farmer and Fish Farmer	4
	Private employee	0
	Private employees and Fish Farmer	0
	Civil servants and Fish Farmer	0
Ownership of FFC	Own Property	26
	Not Own Property	0
Quantity of fish harvest/year	Never	0
	1 kali	0
	2 kali	26
Amount / fish harvest (kg)	1200	7
	1300	13
	1400	3
	1500	3
	>1500	0
FFC is main income	Yes	26
	No	0
How long did their have FFC	<8 years	0
	8-10 years	3
	11-12 years	15
	13-14 years	5
	15-16 years	3

Using pellet for fish feed	Yes	16
	No	1
Realize FFC effect for environment	Yes	17
	No	0
Want to keep environment sustainability	Yes	17
	No	0

Variable	Explanation	Point	
Gender	Men	64	
	Women	16	
Education	Below SHS	46	
	SHS	25	
	Above SHS	9	
Job	Farmer	54	
	Civil Servants	10	
	Entrepreneur	9	
	Others (Merchant-Pedidriver)	7	
Are there any of their family member works at other communities FFC?	Yes	Seed dispersers	0
		FFC maker	0
		Boat Driver	0
		FFC guard	0
		Others	0
	No	80	
Daily wage of family members	25000	0	
	50000	0	
	75000	0	
	100000	0	
Use Lake Toba waters for daily use	Yes	69	
	No	11	
Distance of waters source from FFC	101	80	
	>201	0	
Feel the changes of lake waters quality	Yes	Color	84
		Taste	85
		Smell	19
	No	0	
Understand about FFC	Yes	80	
	No	0	
Realize the FFC effect for environment	Yes	80	
	No	0	
Want to keep environmental sustainability	Yes	80	
	No	0	
Transportation by ship is disturbed by FFC	Yes	80	
	No	0	

Job	Farmer	7
	Fish Farmer	4
	Farmer and Fish Farmer	2
	Private employee	2
	Private employees and Fish Farmer	0
	Civil servants and Fish Farmer	1
	Merchant	1
Ownership of FFC	Own Property	17
	Not Own Property	1
Quantity of fish harvest/year	Never	1
	1 kali	2
	2 kali	14
Amount / fish harvest (kg)	0-200	2
	201-300	11
	301-400	3
	401-500	1
	>500	0
FFC is main income	Yes	14
	No	3
How long did their have FFC	Newly created	1
	3 years	12
	2 years	2
	1.5 years	1
	1 year	1

Using pellet for fish feed	Yes	16
	No	1
Realize FFC effect for environment	Yes	17
	No	0
Want to keep environment sustainability	Yes	17
	No	0

Attachment 6: Communities of FFC entrepreneur at Pangururan

Variable	Explanation	Point
Gender	Men	17
	Women	0
Education	Below SHS	2
	SHS	13
	Above SHS	2

REFERENCE

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