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## Assessment of social acceptance of caged fish culture for improvement and sustainability: A study on Volta Lake, Ghana

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### Abstract

Acceptance of cage fish farming within Volta Lake in Ghana, was assessed in the lake's riparian sub-communities by estimating opinion case of community members generally and specifically on issues including Interference of fish culture with fishing; Cage culture interference with local boat transportation activities; Integration level of cage fish culture into other lake activities; Awareness of lake's community of the lake as a multipurpose resource; Primary occupation of community members; Co-existence level of fish farm operators and communities and cumulative acceptance of fish culture compared to other lake uses and users currently and in the future when the lake is zoned. Methods used were Formal survey and Focus Group Discussions (FGD) in two conceptualized zones (Afram Plains and Asuogyaman) of the lake and data was analyzed by SPSS. A study was undertaken to enhance integration and acceptance of cage fish culture into activities on the Volta Lake and by extension on potential other water bodies where cage fish culture might be practiced. Results indicated that several mutually beneficial situations existed between cage fish farming operators and lake communities. However, there were also conflict flashpoints between cage fish farming practices and livelihood activities of communities at some places as well as fish culture-related outcomes, such as effluents of the culture on lake water quality for communities. The benefits of cage fish farming to communities observed in the results confirm some previous reports. Suggestions of communities to the resolution of conflict flashpoints of operations with operators of cage fish farming provide avenues for enhanced integration thus acceptance and sustainability of cage culture in riparian communities of the lake and other water bodies that could be found suitable for cage fish culture.

**Keywords:** Volta Lake, Fish, Fish culture, Sustainability, Ghana

### 1. Introduction

Fish culture, defined as inclusively as possible started during the early 1950s in Ghana at very rudimentary levels in 'dugouts' in the Northern savanna parts of the country (Namara, 2019) [13]. From the late 1960s through the 1990s, fish culture was practiced in all parts of the country in earthen and concrete ponds/tanks in homes, back-yards and a few farms (Singh and Nath, 2020) [15]. In almost all situations, neither scale nor scheduling of practice was commercially oriented (Singh and Nath, 2020) [15]. Fish, cultured through the period included *Oreochromis*, *Sarotherodon*, *Clarias gariepinus*, *Heterotis niloticus* and *Parachanna spp* (Gbaguidi, 2016) [16]. From 2005/2007, farming of Volta strain of Nile tilapia (*Oreochromis niloticus*) in cages as shown in Plate 1, in the Volta Lake immediately started to show a positive impact. Evidence that cage fish culture would spread and grow on the Volta Lake exist and for that, there have been calls to zone the lake mainly for sustainable use of the water body (Asmah, et al., 2016) [3].

This zoning would among other determinations, suggest culture production limits for different segments of the lake based on information on the carrying capacity of the different lake areas (Asmah *et al.*, 2016) <sup>[3]</sup>. There is also evidence that conflict flashpoints have been found between aspects of cage fish culture practices and some livelihood activities of riparian communities as well as between cage fish culture operators and communities in some areas of Volta Lake (Reisman, 2020) <sup>[14]</sup>. Both situations do not support expansion, intensification and sustainability of cage fish culture which is seen as a promising industry in the Volta Lake, other potential locations in Ghana and elsewhere in Africa.

This necessitates this study aimed generally at enhancing working relationships between cage fish culture operators and riparian communities of Volta Lake as well as technically integrating fish culture practices into other activities on the lake. Specifically;

- The study assessed how current cage fish culture fits social and economic activities.
- Secondly, the study assessed the cultural situations after the lake would be zoned for cage culture and its integration with other activities
- Finally, the study sort for information on approaches to resolving conflicting interests of cage fish culture and other community concerns.

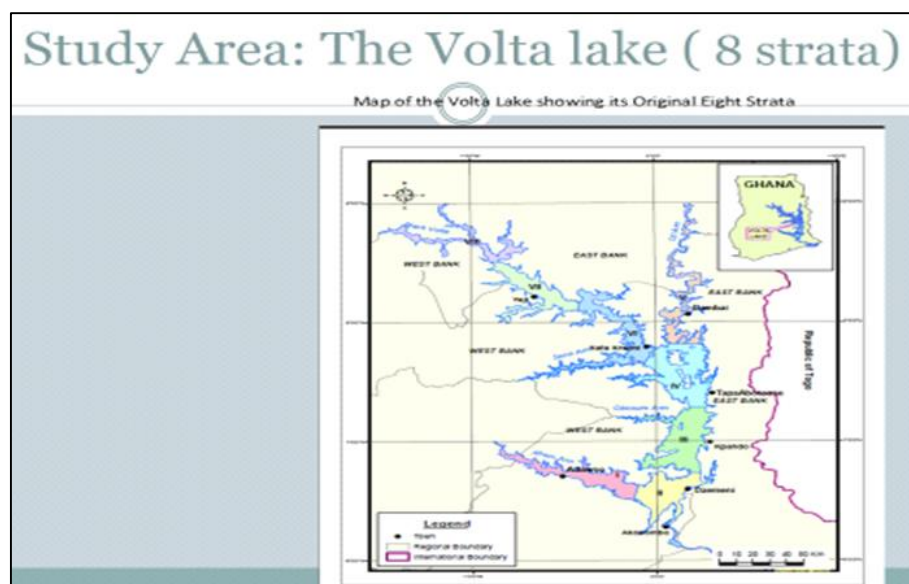
## 2. Materials and Methods

### Study Area

The study area was Volta Lake, created as a result of the

construction of a dam across the Volta River System in West Africa at Akosombo in Ghana. The dam was closed in 1965 to initiate the creation of an 8,500 Km<sup>2</sup> surface area reservoir behind it (Dankwa *et al.*, 2017) <sup>[7]</sup> which has been referred to as Volta Lake from its inception (Fig. 1). The reservoir was created primarily for the generation of hydroelectric power. However, it has continued to be a resource base for other activities of social and economic importance to first, lake's riparian community of the country and other West African countries. Activities on the lake include Fishing & Culture-based fisheries activities; Local & long distant commercial boat transport for goods, services and humans; Tourism and recreation of new activities, such as commercial water transport of goods from Burkina Faso. In 2005/2006, cage fish culture initiated on the Volta Lake quickly established and have become enterprises since about 2007 with some international involvement.

The lake covers all agro-ecological zones in Ghana from a Southern Coastal savanna area through Coastal savanna - forest transitional zone, a forest zone, a Forest - Equatorial-Guinean-savanna transitional zone to a northern Guinean tropical savanna zone at the North end of Ghana into Burkina Faso. At creation, the lake was shown to have eight principal sections or strata, I to VIII (Fig. 1) based on morph-edaphic characteristics including, depth and flow rate (Obeng, 1969) <sup>[10]</sup>. For example, Entz (1969) <sup>[10]</sup> studying the limnological conditions of areas of the Southern part of the lake at different depths recorded varying conditions.



**Fig 1:** The Volta Lake shows eight main divisions or strata by color-coding

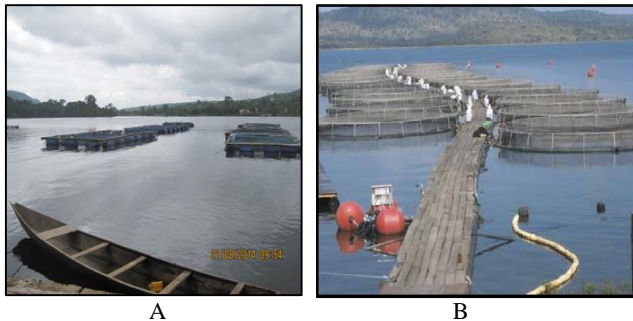
### Methods

For this study, the lake with its riparian community was divided into two major zones: Southern (Asuogyaman) and Middle (Afram Plains) The study team prepared, tested and amended a semi-structured questionnaire for formal survey in principal communities per zone. The team also did the same for guiding questions and issues for focus group (FGDs) discussions in the zones as indicated in Table 1 Four main FGDs were held, two in the Asuogyaman zone, mainly due to the spread of area covered and one each for Afram Plains

and the Yeji zones. The main focus groups engaged were: Fishers; Community elders & opinion leaders; Fish handlers; Fish processors; Fish traders; local canoe and boat builders & operators for transportation of fish, other goods, services and humans on the lake; fish farmers were available and others. At each main FGD, participating community members were divided into respective Focus Groups for their Group discussions. The results of the survey were analyzed using SPSS using descriptive and frequencies as well as content analysis for qualitative data.

**Table 1:** Segmentation of Volta Lake for study involvement of segments

	General reference area of Volta Lake.	Indication of cage fish culture practiced	Communities studied in the zone.	Number of respondents
1	<b>Southern zone</b> Asuogyaman zone	1. All large-scale caged fish farms on the lake. 2. Majority of medium-scale caged fish farms. 3. Majority of small-scale caged fish farms.	13	63
2	<b>Middle zone</b> (Afram Plains zone).	A few small-scale caged fish farms.	4	31

**Fig 1:** Principal models of cages for fish culture on Volta Lake, Ghana

**Rectangular cages usually 5m x 5m x 3m. (b) Circular cages**

### 3. Results and Discussion

#### Parameters Assessed

The two zones into which the lake was divided for this study coincided with deferent intensities of fish culture practice on the lake as 'High' Asuogyaman and 'Low' in Afram Plains. Situations leading to different levels of fish culture in the zones are outlined (Table 1). The different levels of cage culture practice in the different zones gave different exposure level experiences to corresponding communities, which was observed to reflect in responses of community members to a formal survey and FGDs questions and discussions. Generally, issues studied and reported on here have been presented individually and commented on mostly as such for their relevance to study. However, where issues are easily related, appropriate discussions have been made.

The age range of individuals surveyed in Asuogyaman and Afram Plains zones respectively are presented in Table 2. The respondent's ages ranged from 15 to 60 years old. A few over 60 years were recorded in the Afram plains (Table 2). The age group between 31 to 50 years was predominant (44%). Age groups 51 to 60 were accounted for 23% and the age group, 15 to 30 accounted for 19% of the respondents as in Table 2. Data obtained showed that about 70% of the surveyed population were between ages 31 and 60 years old. The age group 31 to 60 years constitutes the majority of active workers, creators of wealth and opinion leaders in

typical Ghanaian communities (Tamako *et al.*, 2022) <sup>[16]</sup>. The situation thus provided that information generated from the survey could be depended on as a true reflection of the critically valid opinion of the riparian community of Volta Lake.

An estimate of percentages educational background of surveyed population in the Asuogyaman and Afram Plains zones are presented in Table 1. 'JHS (52%), SHS (19.95%) and Tertiary (2.4%) and None (25.7%)'. First, it was deduced that the general educational background observed in sub-communities of the Volta Lake was higher, compared to what would have been expected for rural Ghana, as the areas studied were typical of rural Ghana. This is similar to the research of Bene *et al.*, (2009) <sup>[5]</sup>, where similar trends of educational levels were reported. Bene *et al.* (2009) <sup>[5]</sup>, was similarly on engaging local human resources in generating research data on the Volta Lake. This study also suggests a higher general educational level of communities around Volta Lake to be more than expected.

Compared to the result of Golo and Eshun (2019) <sup>[11]</sup>, in addition to the principal age group of respondents and their assumed traditional knowledge. Through discussions, respondents suggested that, reasonable discussions could be held between their representatives and fish farmers, as of late entrants of the lake's users, to settle differences. Finally, the respondents having tertiary education indicated that the community could provide personnel to negotiation or discussion at any level should there be a need. Between zones differences in the relative proportion of educational levels were attributed to differences in the availability of infrastructure.

Primary occupations recorded were: Fishers; Fish farmers; Fish mongers, including fish handlers and traders; Boat builders, owners and-operators; Fish processors; Crop farmers; Teachers and Others including General goods traders; Petty traders; Clothes makers and hospitality industry operators (Table 2).

Estimation of proportion of community whose livelihood relates to fish and fisheries (78%) suggested critical importance of the sector to riparian communities of the Volta Lake and thus the need to consider their opinion on issues that could influence the fisheries sector positively or negatively. For example, zoning cage fish culture on the lake.

**Table 2:** Demographic characteristics of Respondents

	Communities	
Variables	Asuogyaman (%)	Afram Plains (%)
<b>Age of Respondent</b>		
15 – 30 yrs	19.4	19
31 – 50 yrs	61.2	47.6
51 – 60 yrs	19.4	27
>60 yrs	0.0	6.4
Total	100	100
<b>Educational level of Respondent</b>		
Basic	20.6	19.4
JHS	31.7	32.3

SHS	30.2	9.7
Tertiary	1.6	3.2
None	15.9	35.4
Total	100	100
<b>Primary Occupation of Respondent</b>		
Fishers	52.4	41.9
Fish farmer	9.5	4.1
Fish monger	7.9	15.4
Crop farmers	12.7	16.1
Fish processors	6.3	3.2
Teachers	1.6	6.5
Boat owners	8.0	3.2
Others	1.6	9.6
Total	100	100

**Awareness and acceptance of Volta Lake as a multipurpose resource**  
Cage fish farming has become the latest economic activity claiming space on the Volta Lake to expand as a promising industry (Akuffo and Quagrainie, 2019) <sup>[1]</sup>. Before the anticipated expansion, it has been advocated that the expansion should be undertaken based on zonation of the lake for the sustainability of the culture activity (Asmah, *et al.* 2016) <sup>[3]</sup>. Due to a situation that the acceptability of the cage culture was initially not promoted and there have been some issues with pockets of riparian communities of the lake, the necessity to assess the acceptance level of the activity and improve it before the potential expansion under zoned lake conditions is critical. Associated with the acceptance of new development activities on the Volta Lake calls for the assurance that stakeholders are aware of this and reminded that the Lake as a resource, has always been intended to be a multipurpose resource (Delaney *et al.*, 2020) <sup>[8]</sup>.

Reference to the issue of the lake's riparian communities (Asuogyaman and Afram) being aware or not, that the lake was a multipurpose resource are indicated in Considering the total study, 81% of respondents at Asuogyaman were aware of the multiple functions of the lake but the 18% of the respondents were not. About 93.5% of respondents at Afram Plains knew about multiple functions of the lake while 6.5% were not aware. The data and information obtained provided that a majority of the riparian community were aware and accepted that new entrants, such as cage fish culture operators could claim operational space on the lake. The result reveals that there were members of the lake's riparian community who were not aware of the lake either being meant to be a multipurpose resource or not concerned about who uses the lake. They suggested that some sensitization and education on the issue was required among communities around the lake.

#### **Potential of Community Perceptions of Cage fish culture interference with fishing.**

Cage fish farming on the Volta Lake, as elsewhere, involves the installation of cages in the main water body, where fishing also often takes place. It is, therefore, reasonable to anticipate some conflict situation(s) between operators of the two activities. The general situation from the study was that 64.5% of the riparian community considered that cage fish culture interfered with fishing, 31.65% considered that fishing had no interference from cage fish culture while about 3.3% of the community did not know if the culture interfered or not with fishing.

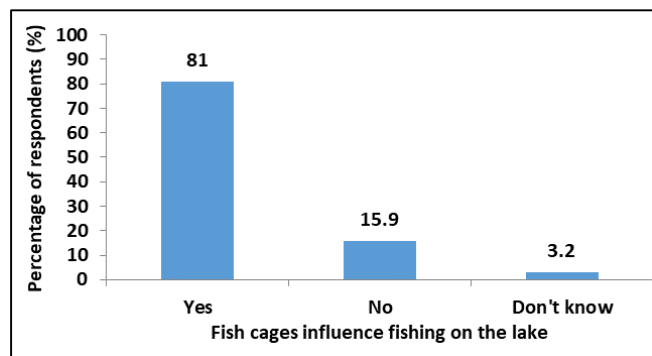
All respondents in Asuogyaman knew about the interference of cage culture with fishing while those in the Afram Plains were unaware of the interference of cage culture with fish. The situation that some community members considered cage fish culture an interference to fishing while others saw no interference was attributed mostly to different operational strategies of cage fish farmers in different locations. Some farmers, according to fishers, did not clearly or appropriately mark out their farm areas on the water but had occasions to accuse fishers of fishing within their farm areas. The situation often resulted in farmers accusing fishers of operating too close to their cages, giving room for suspicion of fishers harvesting fish from cages. Both situations would potentially degenerate into confrontations because fishing is not generally expected within declared fish farming areas. There were also situations where some fish farmers did not have onshore operations exemplified is hatcheries. Thus have no occasion to possibly contest for shore space with nearby communities, which fish farmers with shore operations may have.

Major zonal differences, especially concerning the presence of respondents of the Afram Plains community not being aware of whether cage culture could be interference with fishing was also attributed to lower numbers and smaller sizes of farms in the Afram Plains zone compared to the Asuogyaman area. Thus, there was less interaction between farmers and fishers in the Afram Plains area

#### **Assessment of Interference of Cage fish Culture in Zoned Volta Lake on Fishing**

The study solicited respondents' opinions on the possible interference of cage fish culture on fishing in the lake, situation(s) following the zone of the lake for aquaculture, was considered. Respondents shared their opinions on a zoned lake, a situation that required concentration of cages in demarcated extended areas requiring no-fishing in the extended areas was considered. Consideration of level of anticipated interference of cage fish culture with fishing when the lake is zoned is shown in (Fig. 2). The result of 81% of the community indicating that cage fish culture would constitute an interference to fishing when the lake is zoned was higher compared to the 64.6% indicating the same while the lake was not zoned. The situation suggested that implementation of zoning the lake should factor maximum areas to be blocked for cages even where carrying capacity of water could allow for more culture.





**Fig 2:** Cage fish Culture anticipated interference with fishing in Zoned Volta Lake in both zones.

### Interference of local transport boats to fish cages in zoned Volta Lake

The potential of fish culture cages in zoned Volta Lake interfering with the lake's local transport boat routes was assessed because boats may have to detour to avoid sailing too close to cages under the lake's zoned conditions. In general, cages are not expected to sail close to fish culture cages for good reasons such as consumption of fish, declining stocks of wild fishes and poor farm (Jónsdóttir *et al.*, 2021)<sup>[12]</sup>. However, if because of zoning, cages could be 'stringed' for longer than usual distances, boats would have to detour to reach some communities. Responses from the respondents show the results of interrogation of the issue with a riparian community of the lake whether zoned cage culture will interfere with increase lake transport. About 58.1% of the respondents said No, 38.7% said Yes and only 3.2% did not have an idea whether zoned cage culture will interfere with increased lake transport or not. Results of consideration by the community if zoning the lake would negatively influence local boat transportation indicated that more than half of the community did not anticipate zoning of the lake to interfere with local transport boats on the lake. This could be considered a positive consideration for zoning by the community about other activities on the lake.

### Community perceptions of least wanted the user of the lake by communities

A cumulative 'status of acceptance' of cage fish culture activities and involvement was compared to other often not

acceptable common operations-cum operators in the Volta Lake such as: 'Atidza' operations; Industrial transport vessels; Fishing with chemicals and others listed below and shown in Fig. 4. The activities and their major concerns are summarised as follows:

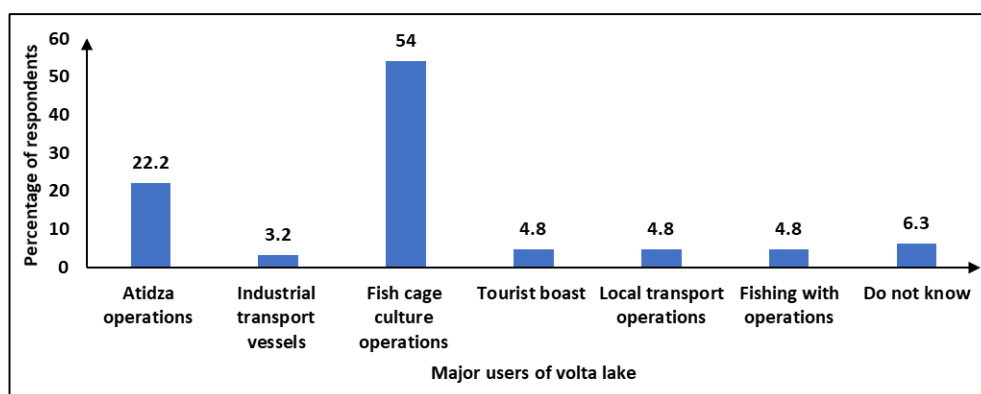
**Atidza** – a culture-based fisheries activity that involves the use of sticks and branches of trees in the lake that may entangle fishers' nets when their locations are not clearly and appropriately shown.

**Industrial transport vessels:** These are larger vessels compared to local canoes and transport boats that ferry mainly agricultural goods produced in northern parts of Ghana, e. g. cotton, fish and yams to the southern part of the country; it also includes bulk movement of items such as fuel to the northern part of the country. During the study, Issues of concern regarding these vessels were very few. To some other operators are mainly high waves that cause smaller boats and cages as well as spilling of oil into the lake as pollutants-pollution of the lake through oil spillage.

**Fishing with chemicals:** The use of poisonous chemicals to fish contributes to general pollution of the lake water resulting in fish kills and killing off other organisms not targeted by the users. Thus, concern for the general health of an aquatic ecosystem. A major concern of chemical fishing is that operators remain generally anonymous.

**Tourists and Local transport boats:** These may raise some waves for fish cages if they got too close to the cages

**Fish cage culture:** Issues include: Operator's attitudes; Declaration of cage areas as 'no-go-areas' to fishers while fish in open waters are attracted to cage areas by fish feed aroma; Outcomes of fish feeding such as remains of feed; Fish droppings and other effluents of culture on lake water quality which is the source of potable water for the majority of the lake community. Furthermore, open defecation of cage workers into the lake water becomes a pollutant and has health implications to communities and perhaps, finally, declaration of some shore areas by some cage operators (farmers) as part of their operational area with a posture or attitudes considered intolerant by communities. The percentage of respondents indicated which activity was least wanted in the lake among those listed. Cage fish culture was outstandingly the least wanted activity by community members (Fig. 3).



**Fig 3:** Community perceptions of least wanted the user of the lake by communities

Lake Community had some measure of unwontedness with all activities. This could have been expected. However, the percentage of the community who disliked Atidza and cage

fish culture suggests attention especially because these two actively contribute to fish production and thus availability. A study of Atidza (unpublished) suggested that a deliberate

explanation of involvements of activity, its value chain and its economic importance to the community could enhance acceptance to the community. Similarly, more than 50% of the community who were against cage fish culture could be reduced through deliberate discussions and compromise to enhance acceptance and sustainability of the cage culture.

### Conclusion

Several mutually beneficial situations exist between cage fish farming operations and lake communities, probably more obviously for the communities. There were conflict flashpoints between some cage fish farming practices at some places and major livelihood activities of some communities. Considering the implementation of cage fish culture, zoning should consider a minimum distance to be blocked for cages and thus no fishing and perhaps no local boats transport activities.

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