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Illegal, Unreported and Unregulated (IUU) fishing activities on fisheries sustainability: Evidence from Lake Volta, Ghana

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Abstract

The high demand for inland fish in the domestic market makes it an important subsector in the Ghanaian fisheries industry. This, however, poses a challenge for the sustainable management of the inland fishery due to its open-access nature. The present study was conducted at an important inland community along the Volta Lake (Yeji) to identify the key activities carried out on the Lake, examine how sustainable these activities are and finally assess their impact on the harvested fish stocks. Sixty (60) fisher folks were selected from three communities in the Yeji fishing enclave and interviewed using a stratified sampling technique. Additionally, data on Ghana's inland fish catch including that from the Volta Lake was obtained from FAO dataset and Fisheries Commission, Ghana and computed. Findings of the study showed that two-thirds (67%) of major fishing activities carried out on Lake Volta are unsustainable. These include the use of unapproved fishing nets, use of mesh size below the approved size of 2.5 cm, absence of off-day fishing and open-access regime. However, none of the fishers practised light fishing. Trend analysis also revealed that the Lake Volta accounts for about 80%-90% of inland fish production. There has been a decline in the quantity of harvested fish stock in the last decade (an average of 7%). The study noted that the gradual reduction in fish catch is largely attributed to the unsustainable fishing practices carried out on the Lake. The study recommended that co-management approach should be adopted to regulate and monitor inland fishery resources as well as enforcement of the fisheries regulations. Additionally, a national fisheries management plan should be drawn up for the inland fisheries subsector similar to that pertaining for the marine fisheries subsector.

Keywords: inland, fishing, fishermen, fish catch, fish sustainability

Introduction

With the United Nations in full readiness to address global challenges related to poverty, hunger, production and consumption as well as conservation and sustainable use of oceans, sea and marine resources, as enshrined in the Sustainable Development Goals (SDGs), the world (especially developing countries) still face problems of food insecurity, malnutrition, aquatic resources depletion, among others. Globally, the absolute number of undernourished people has increased to nearly 821 million in 2017, from around 804 million in 2016. Africa remains the continent with the highest prevalence of undernourishment (PoU), affecting almost 21% of the population (more than 256 million people) ^[15]. The trend must be reversed.

Fisheries remain an important safety net as a source of food, nutrition, income and livelihood support for millions of people (an estimated 56.6 million people ^[13]). Globally, the value of fisheries and aquaculture is estimated at USD 362 billion ^[15]. Fisheries in marine and inland waters provided 87.2% and 12.8% of the global total catch, respectively in 2016. In Africa, inland fisheries produce more catch (57%) than marine fisheries ^[12, 15] with a gross value added of US\$6, 275 million ^[12]. The Ghanaian fisheries industry which comprises both the marine and inland fisheries contributed between 0.5% and 4.2% to the nations GDP, and 2 to 7% of agricultural GDP in the last two decades ^[18, 19, 29]. The demand for inland fish in Ghana is relatively high compared with marine fish largely because of the preservation method used (in particular smoking and salting). Inland fish catch in Ghana are taken from Lake Volta, Lake Bosomtwi, Berekese reservoir, Kpong reservoir, and other major rivers (See Table 1) as well as aquaculture (which contribute about 11% to national fish production ^[25]). The Lake Volta is the most important inland fishery resource in Ghana, contributing about 90% of the

total inland fishery production and approximately 20% of the total fish catch in Ghana. It has about 140 species of fish ^[9] and covers a total of 1,232 communities. The lake has an average depth of 19 metres and covers a surface area of 8,482 km² with 5,200 km of shoreline. About 80,000 fishers and 20,000 fish processors and traders engage in the Lake Volta fishery ^[6]. Providing livelihood support and enhancing economic development. There are about 32 landing sites

along the lake which often serves as marketing centres. These include; Yeji, Kwamekrom, Tapa-Abotoase, Kpando-Torkor, Dzemeni and Torkuroano. Yeji the capital of Pru District is the largest landing site and marketing centre along the stretch of Lake Volta. The inland fishery in Ghana is artisanal using simple fishing gears such as cast and gill nets, hook-and-line, and traps.

Table 1: Ghana Inland Water Bodies and their Fishery Potential

Lakes and Reservoirs	Area (km ²)	Fishery Potential (Metric tonnes /year)
Volta	8 482	40 000
Lake Bosumtwi (Ghana's only natural lake)	49.0	600
We ija	37.0	420
Kpong	36.5	-
Tano	18.6	22.5
Bare kese	6.4	80
Others	117.0	145
Total	8 746.5	41 267.5

Source: Adapted from Bank of Ghana (2008) ^[7]. The Fishing subsector and Ghana's Economy. <https://www.bog.gov.gh/privatecontent/Research/Sector>

The fisheries industry in Ghana is regulated by the government currently through the Ministry of Fisheries and Aquaculture Development (MoFAD) and Fisheries Commission (FC). Recent management measures such as the fishing closed season, as well as the scientific and technical working group (STWG) on sustainable fisheries management, have focused more on the marine subsector than the inland subsector. This has led to national fisheries policy and interventions skewed toward the marine subsector. Similarly, at the global level, attention on the depletion of fisheries and illegal, unreported and unregulated (IUU) fishing have focused predominately on marine fish stocks despite the importance of freshwater fisheries around the world. Inland fisheries are often underappreciated and undervalued in resource planning and decision-making ^[14]. Which is not different in the case of Ghana.

Fishing activities such as light fishing, open-access regime, the use of monofilament nets, and non-recommended mesh size are well documented as unsustainable practices (broadly fall under IUU fishing) pertaining in the marine fisheries subsector. However, there is a knowledge gap in terms of such practises taking place in inland waters. Moreover, the high demand for inland fish in the Ghanaian market (with over 600,000 mt annual fish production deficit) ^[25] against its access limitations raises sustainability concerns on inland fishery resources. The present study seeks to bridge the gap by identifying the key fisheries activities carried out on inland waters particularly on Lake Volta (the most important inland fishery resource in Ghana and the largest artificial reservoir in the world), examining how sustainable these activities are and their impact on fish stocks. The outcome of the study will provide information on inland fisheries sustainability, thereby, enriching the discourse on IUU and sustainable fisheries management.

Materials and Methods

The study was conducted in Yeji which is an important inland fishing community in Ghana (Fig. 1). Yeji has the largest fish landing site along Lake Volta and also has the largest marketing centre for both fish and other commodities. The study utilized both primary and secondary data. Primary data were collected by means of an interview-based questionnaire administered to respondents from the fishing communities.

The questions were structured into the following sections: socio-economic information (gender, age, marital status, household size and economic activities, level of education and number of years of fishing); key fishing activities (canoe size, crew size, fishing gear types, marketing, number of days for fishing expeditions); and sustainability (mesh size, formal training on sustainable fishing practices, lightening system, fishery system). Using stratified sampling technique, three (3) fishing communities namely; Jaklai, Fante Akura and Nsuano Pentecost were selected. With the aid of Fisheries Technical Assistants at the Zonal Fisheries Commission's Office, sixty (60) Respondents mainly household heads were randomly selected and interviewed. The randomisation was done with the use of GraphPad software ^[20]. The interview was conducted in the local language (Twi) and responses recorded on both paper and voice recorder. Verbal consent was obtained from respondents prior to the interview. The number of registered fishermen in the area was 120. The sample size was deduced using the formula below:

$$n = \frac{N}{1+N(\alpha)^2}$$

Sample size for fishermen was calculated as;

$$N = \frac{120}{1+120(0.09)^2} n = 60$$

Additionally, key informants such as chief fishermen, community chiefs, opinion leaders and Station Manager of Zonal Fisheries Commission were also interviewed. Secondary data on canoe numbers, the quantity of fish landed in Yeji for the last decade (2005-2015) were obtained from the District Fisheries Commission at Yeji. Lake Volta and inland fish catch for Ghana (2005-2015) was retrieved from FAO Dataset Global Capture Production (Online query) and FAO 2018 yearbook. Fishery and Aquaculture Statistics ^[16]. The data was verified from the Fisheries Commission. Overall, the data obtained were both qualitative and quantitative associated with fishing activities and harvested fish stock on Lake Volta and Ghana.

The study used the IBM Statistical Package for Social Scientist (SPSS Version 19) and Microsoft Excel to analyse trends in response to the research questions. Where there were gaps in the FAO data for the inland and Lake Volta catch,

extrapolation was done using 25% of the national fish catch and 90% of the inland catch, respectively. Data was processed and expressed in percentages.

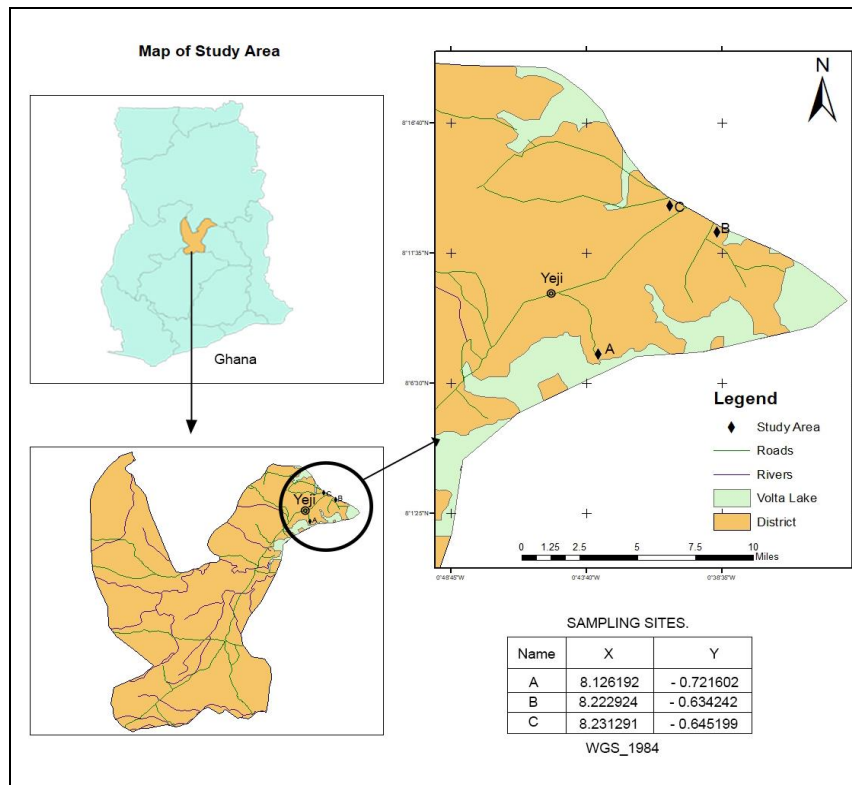


Fig 1: Map of study sites

Results and Discussion

Demographic characteristics of the fisheries

Findings of the survey showed that fishing expeditions were undertaken by males (100%) as indicated in Table 2. Fishing trips involve a lot of physical exertion which is generally considered to be beyond female capabilities (males have high energy requirements than females). In Ghana, fishing is largely gender specific with men catching and landing fish. In terms of age distribution, 40% were within the age range of 25 to 35 years. More than half (53%) of respondents were within the age 36 and above with an average of 20 years' experience in fishing. This attests that people with requisite skills, experience and energy actively engage in fishing expeditions. Marital status of respondents showed that majority of respondents (77%) were married as a result, have an average household size of nine (9), which is higher than the national household size of 4.4 [17]. This means that the inland fishers have relatively large family size they cater for, hence, they will be compelled to use all available means whether legal or illegal to increase fish catch in order to feed and support their families. The large family size may also have economic implications, especially, when the majority are

males and can provide helping hands in strenuous fishing operations. This agrees with the findings that fishers, especially, those in the artisanal sector have large family sizes [22, 27]. Moreover, a greater number of respondents have attained either primary (40%) or no formal education (33%) depicting a low level of literacy among fishers. This has implications on decision-making process particularly their eagerness to comply with sustainable fishing practices. The fishers believed that qualification may not be necessary because fishing is their way of life and the skills for fishing are acquired through their forefathers.

Knowledge about the socio-economic conditions under which fishers operate is important for the development of a more prudent and effective fisheries resource management [26]. Ghana is currently facing a lot of challenges in the fisheries sector *viz-a-viz* IUU, over-exploitation, high fishing pressure, declining CPUE, dwindling stocks, *etc.* which need to be addressed with comprehensive programmes. However, many fisheries programmes rarely turn out to be successful, including those in Ghana and elsewhere [23] because of the inadequacy of relevant socio-economic information.

Table 2: Demographic characteristics of respondents

Variable	Frequency	Percentage (%)
Age of Fishers: 18-24; 25-35; 36 and above	4; 24; 32	6.7; 40.0; 53.3
Marital Status: Single; Married; Divorced; Widowed	5; 46; 6; 3	8.3; 76.7; 10.0; 5.0
Household size: Maximum; Mean; Minimum	20; 9; 2	
Level of Education: None; Primary; Secondary; Tertiary	20; 24; 12; 4	33.3; 40.0; 20.0; 6.7
Years of Fishing: Maximum; Mean; Minimum	43; 20; 4	
Type of Ownership: Sole-proprietorship; Partnership; Limited Liability Company	54; 6; 0	90.0; 10.0; 0.0

Fishing activities

The key fishing activities carried out by fishers on Lake Volta is presented in Table 3. With respect to crafts used by fishers, all respondents used canoes and basins/baskets. The number of fishing canoes estimated was 11,000. The canoes are planked flat bottom in design and ranges from 6 to 12 metres in size. In addition, about two-thirds of respondents propelled their canoes with outboard motors whilst a third used wooden paddles indicating that fishers are sensitive in adopting innovations that aim to enhance efficiency in their fishing business. With the introduction of outboard motors since the 1950s, fishermen are able to increase their catching efficiency. Outboard motors are being continuously subsidized by the Government (to an amount of \$4.5 million annually) [32]. This is a form of bad subsidy [31], and can collapse the fishing industry and increase poverty (up to 80%) [5] in the inland subsector, thus, bringing individual losses and economic hardship. In the area of sources of light for fishing, almost (90%) of respondents used torchlight. The remaining 10% used lamp. However, none of the fishers practiced light-on-vessel fishing. This observation is contrary to the marine subsector where light fishing is noted to be a common practice [2,8]. Light for fishing (which usually attract fish for easy capture) has been the bane of artisanal fisheries in Ghana. Though light fishing is prohibited in Ghana, fishermen are permitted to carry approved light [1] (such as torch light, and a flare which may be made of a piece of cloth soaked in kerosene or other inflammable oil) on their vessels at night to

avoid collision.

The study also revealed that close to half (47%) of respondents used purse seine fishing net whilst about a third (30%) used gill net. About 16% and 7% used cast and trap nets, respectively. The study showed that majority (83%) of respondents used mesh size below the minimum approved size of 2.5 cm (25 mm) meaning the fishers are overexploiting the fishery resources and this has sustainability implications. A World Bank report [34] suggested that up to 70% of the Lake Volta catch could be taken by illegal methods. Therefore, it would be prudent to register and undertake complete canoe frame survey of all the freshwater fishing gears for effective monitoring and controlling of the freshwater fisheries.

The average number of days for fishing per week was five (5) indicating limited resting period for fishing. In most fishing communities in Ghana, a day is set aside during the week as a non-fishing day. Fishermen use the day to mend their nets, repair canoes and resolve any work-related conflict. However, it was revealed that there were no recommended off days for fishing so fishermen chose any day of their choice within the week to rest. This is a form of traditional fisheries management measure to reduce fishing pressure.

Majority (77%) of respondents confirmed receiving formal training on sustainable fishing practices by the Fisheries Commission and other management institutions in the past one year indicating that fishers benefit from extension services provided by fisheries regulatory bodies.

Table 3: Key Activities carried out by Fishers on Volta Lake

Variable	Frequency	Percentage (%)
Fishing crafts: Canoe; Basins/Baskets	60; 60	100.0; 100.0
Propulsion: Outboard Motors; Paddles	40; 20	66.7; 33.3
Type of Net: cast; trap; Purse seine; Gill	10; 4; 28; 18	16.7; 6.7; 46.7; 30.0
Mesh Size: Below 2.5 cm; 2.5 cm and above	50; 10	83.3; 16.7
Crew Size: Maximum; Mean; Minimum	12; 4; 1	
Source of Light: Torch light; Lamp; Light on vessel	54; 6; 0	90.0; 10.0; 0.0
Number of days for fishing per week: Maximum; Mean; Minimum	7; 5; 1	
Recommended days for Fishing: Yes; No	0 60	0.0 100.0
Formal Training: Yes; No	46 14	76.7 23.3

Source: Field Survey, 2018

Sustainable and unsustainable fishing practices

The study further categorised fishing activities carried out by fishers into sustainable and unsustainable practices (based on Fisheries Regulation 2010). As shown in Figure 2, two (2) out of six (6) key practices namely; formal training on fishing activities and sources of light for fishing were found to be sustainable whilst the remaining 4 (four) which comprised of fishing net type, mesh size, recognition of fishing off days and open access fishing regime were considered to be unsustainable practices.

The recommended types of fishing nets and gears on Lake Volta were made up of gill net, cast net, line fishing, traps, bamboo pipes and spears. However, purse seine net dominated the fishing gear used (47%) on the Lake and this confirms that purse seines and other forms of encircling fishing gears are supposedly illegal on Lake Volta but currently contribute about 65 to 70% of total fish landings from the Lake. With reference to the Fisheries Act 2002, Act 625 Section 85, "the Minister acting in accordance with the advice of the Commission shall by regulations prescribe the type and sizes of gears or devices that may be used for fishing including prohibited nets and relevant fishing activities". Moreover, from the Fisheries Regulation 2010, section 12,

subsection 2, the minimum mesh size for small pelagic purse seine net is 2.5 cm. About 80% of fishers were aware of these regulations, yet they were flaunting the laws by using fishing nets with mesh size below 2.5 cm. According to the fishermen, they are compelled to fish throughout the week due to lack of alternative livelihoods. The lack of alternative livelihood options in the fishery sector is one of the reasons why there is too much pressure on fishery resources [4].

Meanwhile, from the Fisheries Act 2002, Act 625 Section 84, the Commission may by notice in the Gazette declare closed seasons, including their duration, for fishing in specified means of the coastal waters or the riverine system. According to the Chief Fisherman of Fante Akura Nana Kojo Ntei, "there are no off-days or closed seasons for fishermen as far as they are capable of fishing".

There was also open-access on the Lake where fishing is not coordinated, and anyone can fish (free entry). The poor performance and over-capacity of Lake Volta fishery is due to the open-access nature since there is no limit on the number of canoes entering the fishery. The Government has recognized that the Volta Lake is confronted with overexploitation and overcapitalization phenomena that inhibit the optimum use of the available fisheries resources [24].

Open-access fisheries with inadequate compliance with management rules lead to overcapacity and overfishing and diminishing returns [3]. The inland fishery sector of Ghana operates an open-access, leading to higher fishing effort. Open-access regime no individual fisherman considers the effect on the fish stock when making decisions. Vessels with

high autonomy and economic rent will increase harvest rates by exerting their fishing effort on distant fishing grounds [30]. This could lead to conflicts and non-sustainability of the fisheries which is detrimental to a developing country such as Ghana.

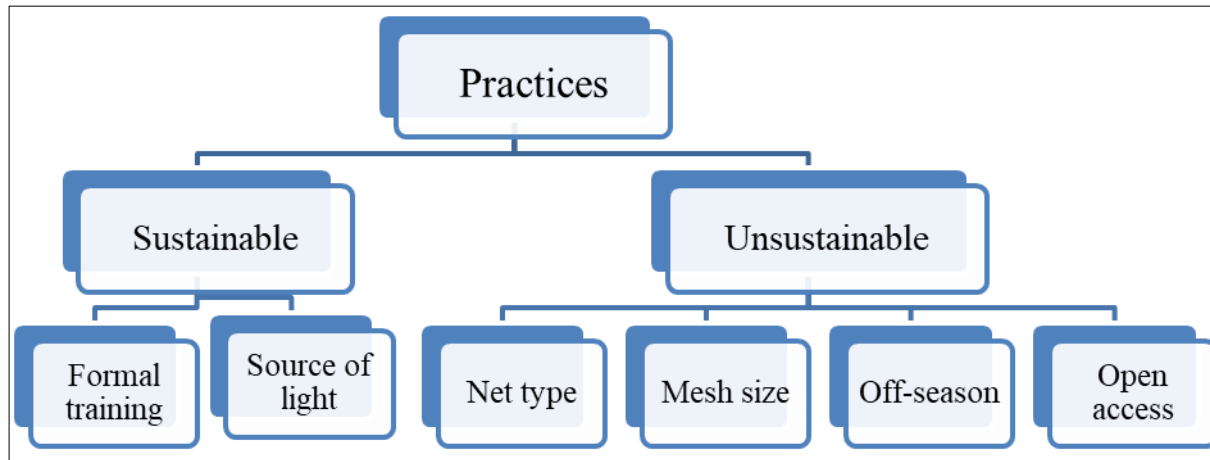
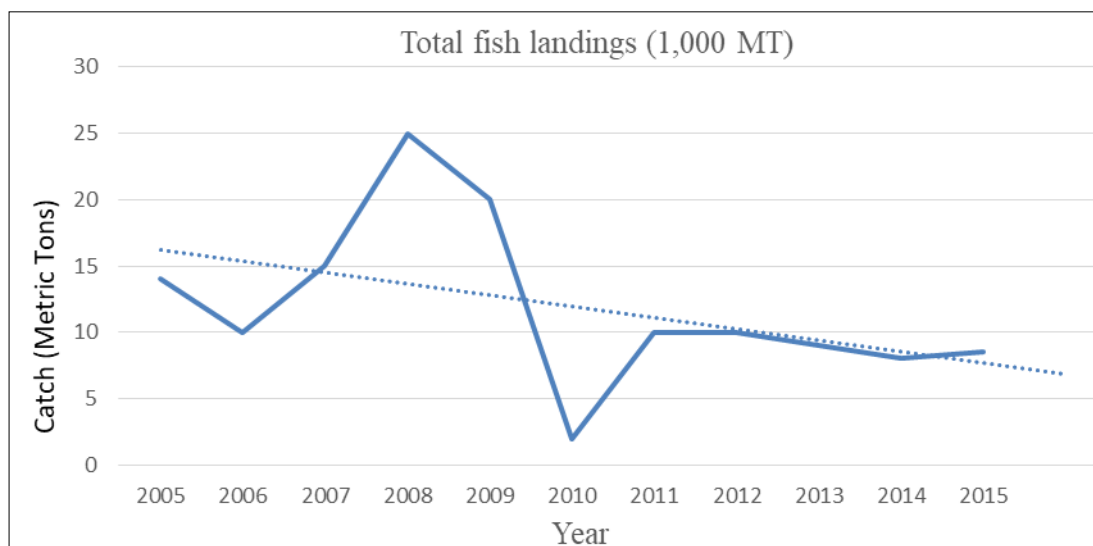


Fig 2: Sustainable and Unsustainable practices on Lake Volta (Source: authors)

Trends in fish harvested (2005-2016)

Trends in quantity of fish stocks harvested were examined in order to ascertain the impact of fishing practices on fish stock in the past decade. As illustrated in Figure 3, the quantity of fish stock harvested from the Yeji part of the Volta Lake in the year 2005 was 14,000 t reducing to 10,000 t in the year 2006. Within the years of 2007 and 2008, there was a sharp increase in fish harvested thus 15,000 t and 25,000 t, respectively. In 2010, there was a sharp decline in the harvest with as low as 2,000 t. This was mainly because of the construction of the Bui hydroelectric dam on the White Volta which affected water volume and water quality for the aquatic

life. However, in the year 2011, the quantity began to rise to 10,000 t and maintained in 2012. There was a slight fall in 2013 to 9,000 t. It declined further to 8,000 t in 2014 and finally increased slightly to 8,500 t in 2015. Overall, trend analysis showed a gradual decline in stock from the year 2005 to 2015. This corroborated with the findings that fish stock in Lake Volta has declined in the last 40 years [10, 11, 21]. The study attributed the gradual fall in quantity of harvested fish stock to the illegal and unsustainable fishing practices carried out by fisher folks on Lake Volta and this also confirms the findings [9, 10, 28]. That the decline in fish stock is as a result of unsustainable fishing practices carried out on the Volta Lake.



Source: Fisheries Commission

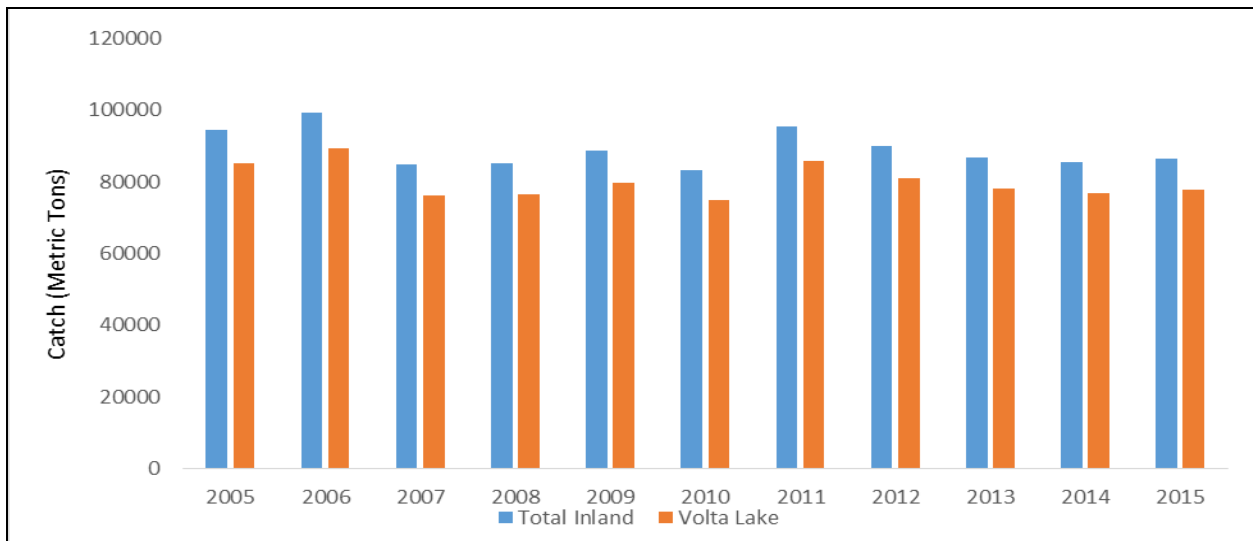
Fig 3: Trends in fish catch at Volta Lake (Yeji) 2005-2015 (y= -0.85x+17.01; r²=0.20)

The Volta Lake continues to be an important fishery resource to Ghana contributing over 80% to inland fish catch (Figure 4). Between 2005 and 2015, the Volta Lake and inland fishery sector declined by 7% and 8%, respectively. This is due to a number of factors including pollution, agriculture intensification, climate change and IUU fishing. The inland

subsector is wholly artisanal and contributes about 18% to national fish production [25]. With a population of about 29.5 million, Ghana’s estimated national fish consumption is at approximately 775,000 MT (with only 43% in fish self-sufficiency) [33]. Imports must be done to supplement consumption. Fish import continues to drain on Ghana’s

resource (US\$131 million in 2016). Fish provides approximately 60% of the animal protein consumed in the average Ghanaian diet and accounts for 22% of household food expenditures. The decline capture fisheries (both marine

and inland) is been cushioned from aquaculture, albeit its own challenges in order to ensure food security, nutritional needs and sustainable livelihood.



Sources: FAO Dataset, FAO 2018 yearbook and Fisheries Commission

Fig 5: Fish stocks harvested in Inland and Volta Lake, 2005-2015

Conclusion and Recommendation

The study was conducted to examine IUU fishing activities on Lake Volta and their impact on fisheries sustainability. From the findings, two-thirds of fishing activities carried out on Lake Volta were unsustainable. These included; the use of unapproved fishing nets, use of mesh size below the approved 2.5 cm, not practicing off fishing days and the presence of open-access regime. However, none of the fishers practiced light-on-vessel fishing. Trend analysis from the year 2005 and 2015 also revealed a significant decline in the quantity of fish harvested (an average of 5%). This is largely due to the unsustainable fishing practices carried out on the Lake. The challenges in the inland fishery subsector are complex and require multiple solutions.

To ensure sustainable management of the fishery resources, the following are being recommended

1. Co-management approach (a combination of traditional and formal management measures) should be adopted to monitor and safeguard the inland fishery resources.
2. A national fisheries management plan should be drawn up for the inland fisheries subsector

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