IJSER
ISSN: 2149-5939

**International Journal of Social Sciences and Education Research**
Online, https://dergipark.org.tr/tr/pub/ijsser
Volume: 9(3), 2023

# Investigating the fishery of Owabi fishing community in Ghana, West Africa, using traditional ecological knowledge

Samuel K.K. Amponsah[1]

[1]*Corresponding Author, Department of Fisheries and Water Resources, University of Energy and Natural Resources, Sunyani, Ghana, Email: samuel.amponsah@uenr.edu.gh, ORCID: https://orcid.org/0000-0001-5559-3139*

***Article Info***

***Research Article***

*Received: 2 May 2023*
*Revised: 20 August 2023*
*Accepted: 16 September 2023*

***Keywords:***
*Traditional ecological knowledge (TEK), Artisanal fisheries, Fisheries management, Owabi Reservoir, Ghana*

***Abstract***

*This study aimed at identifying issues confronting fishermen within the Owabi Reservoir, Ghana, West Africa using LEK. Data from twenty (20) fishermen were collected on fishing methods, fish species, and alternative livelihood using open and closed-ended questionnaires. From the study, fishers indicated that eight species are mostly harvested from the dam, with most fish species declining in abundance. The status of fish species in the reservoir is affected negatively by climate change and waste disposal. As a result, most fisherfolks are engaged in alternative livelihoods to supplement returns from fishing activities. Fisherfolks engage in illegal fishing methods, though materials for illegal fishing methods are rarely available on the open market. To sustain the fisheries of the Reservoir, management should engage fisherfolks in community awareness programs on the impact of illegal fishing activities, as it will sustain the fisheries of the Reservoir.*

## 1. Introduction

Fisheries resources have existed on earth for centuries and their management approaches have depended on the knowledge available to those entrusted with management responsibilities, including Indigenous Knowledge (Barnhardt and Kawagley, 2005). Local Ecological Knowledge mostly transcends generations through cultural transmission and can often be associated with elders within the local community (Olsson and Folke, 2001; Davis and Ruddle, 2010; Murray et al., 2006). Based on LEK, fisherfolk can provide novel information on the biology and ecology of species and aid in providing questions related to the identification of fish habitat use, nursery areas, and migrations of species where such knowledge is scarce (Le Fur et al., 2011; Begossi et al., 2016). Despite the important contribution of LEK to the management of natural resources, fisherfolk's knowledge is rarely incorporated into management policies for marine or freshwater fisheries environments (Silvano and Begossi 2010; Leite and Gasalla 2013; Allison and Badjeck 2004). This is partly because agencies and academics lack appreciation for the importance of such ethno-ichthyological data (Castillo et al., 2018). Though LEK has the propensity to complement formal science for sustainable management of fisheries resources (Dulvy and Polunin, 2004; Haggan et al., 2007, Johannes and Neis, 2007; Johannes et al. 2000), LEK is seen as dynamic. Hence, it is imperative to formally document such information for future reference about managing the fisheries resources. In Ghana, most fishermen are endowed with intensive indigenous knowledge about their fishing activities, including but not limited to when to set sail, declining fish species, how to identify fishing grounds, which waves or currents provide signals for a bumper catch, and others (Seidu et al., 2023). Studies on local ecological knowledge of inland water bodies are mostly scarce in Ghana, as recent studies are largely inclined toward the marine environment (e.g. Seidu et al., 2023). Given the paucity of information on LEK for freshwater bodies in Ghana and its importance to fisheries management, the present paper aims to assess the status of fisheries in Owabi Reservoir, Ghana, from the perspective of the fisherfolk's LEK. The information gained from this study will provide relevant authourities with the needed resources for sustainable management of the Owabi Reservoir fish species.

**All responsibility belongs to the researchers. All parties were involved in the research of their own free will. Ethics committee approval was not required because the data for this study are not related to humans.*

**To cite this article:** Amponsah, S.K.K. (2023). Investigating the fishery of Owabi fishing community in Ghana, West Africa, using traditional ecological knowledge. *International Journal of Social Sciences and Education Research*, 9 (3), 232-240. DOI: https://doi.org/10.24289/ijsser.1284817


ISSN: 2149-5939

## 2. Literature review

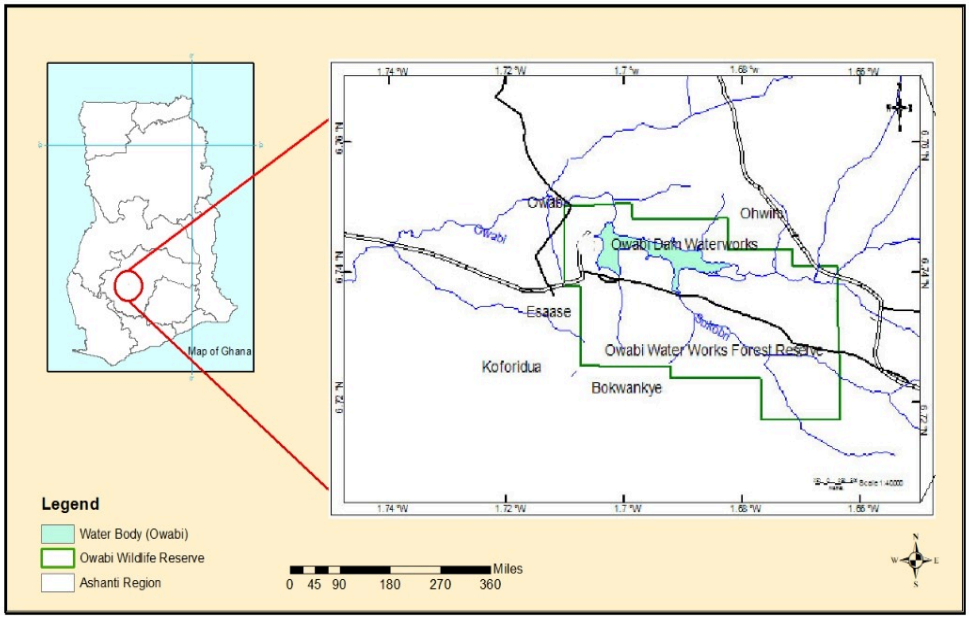
In the past, people relied heavily on indigenous knowledge to regulate their livelihoods, enabling them to be in harmony with their environment. As natural resources become increasingly managed globally, and these management systems constrain the way fishermen interact with the marine environment, understanding their impact on local ecological knowledge (LEK) is essential for management (Feldstein and Poats, 1989). LEK contributes to place-based, fine-scale spatial and temporal information, management techniques, and institutions (Tawake et al. 2001; Johannes and Hickey 2004; Drew 2005; Cinner and Aswani 2007; Vierros et al. 2010). Such information, if interpreted using a biological sciences framework, may provide better insights for biologists (Johannes 1993). However, the poor level of understanding of biological folk knowledge is problematic, as such information faces extinction due to the disappearance of indigenous people and their customs (Johannes 1978; Posey 1983; Wester and Yongvanit 1995). The absence of such information may lead to poor experimental design and incorrect conclusions by agencies responsible for fisheries management ((Johannes et al. 2000). As a result, many fisheries appear to be failing to achieve yields or conservation goals, and improving livelihoods is prioritized (Karr et al., 2017; Unsworth et al., 2018). Given this, it is clear that LEK improves decision-making (Bergmann et al., 2004; Berkes et al., 2001) and enhances conservation and management strategies for small-scale fisheries.

From indigenous studies by Seidu et al. (2023) on marine fishermen, it has been documented that fishermen use the lunar cycle to determine the appropriate period to embark on any fishing activities. Furthermore, many artisanal fishermen can detect shoals of fish using the paddle as a medium, while others know which currents bring more or less catch. Fishers are even aware of the feeding relationships associated with their target species' predators as they keenly observe the specialized feeding and breeding patterns of targeted fish species (Seidu et al., 2023). However, little information exists on local ecological knowledge for freshwater bodies in Ghana. In developing countries, where data and resources are often lacking due to certain challenges, there is a need to embrace LEK. This will aid in the attainment of useful information for the management of natural resources, whereas disregarding local knowledge will adversely affect their enforcement (Taylor et al., 2011; Silvano and Begossi, 2012; Thornton and Scheer, 2012; Anoliefo et al., 2003). It is, therefore, pertinent that these traditions be included in conservation and management strategies, as they have tacitly proven effective (Dudley et al., 2009).

## 3. Materials and methods

All responsibility belongs to the researchers. All parties were involved in the research of their own free will. Ethics committee approval was not required because the data for this study are not related to humans.

Figure 1. The map of the Owabi reservoir with its tributaries




### *3.1. Study area*

The catchment of the Owabi Lake is recognized as a wetland of national and international importance located in Atwima Nwabiagya Northern District in the Ashanti Region of Ghana (Banunle et al., 2021; Nunoo et al., 2012).


ISSN: 2149-5939

It was established in 1926 in the Ashanti Region of Ghana, in the Kumasi Metropolis. It has a depth of 7.4 m along its spillway and 11.5 m across the embankment (Akoto and Abankwa, 2014). Akoto and Abankwa (2014) indicated that the lake covers an area of about 69 $km^2$ with an approximate volume of 26,000,000 $m^3$ and is surrounded by a forest reserve. It serves as a source of fish, water supply, recreation or tourism, a wetland habitat for animals, maintenance of water tables, floods, and erosion prevention. The Reservoir, besides its primary function of water supply, also serves as an inland capture fishery resort. The local communities near and around depend on it as fish sources for their livelihood. In all, less than thirty (30) small-scale fishermen use dugout canoes and wooden paddles for fishing activities on the main dam. The Reservoir has several surrounding rivers and streams that serve as the lake with water, including the Rivers Owabi, Sukobri, Akyeampomene, Pumpunase, and Atafua (Boadi, 2018). The Owabi River, the main tributary of the Reservoir, with its quality affected by agrochemicals and fertilizers used by farmers within the Reservoir's catchment, are source of pollution to the Reservoir (Boadi et al., 2018).

### *3.2. Data collection*

Data was collected on 25th January, 2022 at the dam and downstream of the Owabi reservoir. Close and open-ended questionnaires were administered to 20 fisherfolks who fish at both sections of the ReservoirThe selection of respondents for the study was done using random and snowball sampling techniques. The questionnaire was section into three categories, namely i) demographics of respondents, ii) fishing practices, iii) illegal fishing methods, and iv) threats facing fisheries.

### *3.3. Data analysis*

Statistical Package for the Social Sciences (SPSS 25.0) was used to analyze the data retrieved from the respondents. Descriptive analyses, including the frequencies and percentages, were estimated using the SPSS. One One-way analysis of variance (ANOVA) was applied to non-categorical variables at a confidence interval of p = 0.05. Charts were developed using Microsoft Excel Tool Pac.

## 4. Results

### *4.1. Fishing activities*

From Figure 2, the most harvested species from the Owabi Reservoir reported by respondents were *Coptodon zillii, Parachanna obscura, Chrysichthys nigrodigitatus, Sarotherodon galilaeus, Heterotis niloticus, Hemichromis fasciatus,* and *Clarias gariepinus*. Among these, the dominant species were *C. zillii* and *P. obscura* (Figure 2). From Figure 3, the main fishing gears identified were set gillnet, traps and & line. The most employed fishing gear by fishermen at the Owabi Reservoir was set gillnet (46%).

Figure 2. Respondent's response on fish caught from the Owabi reservoir

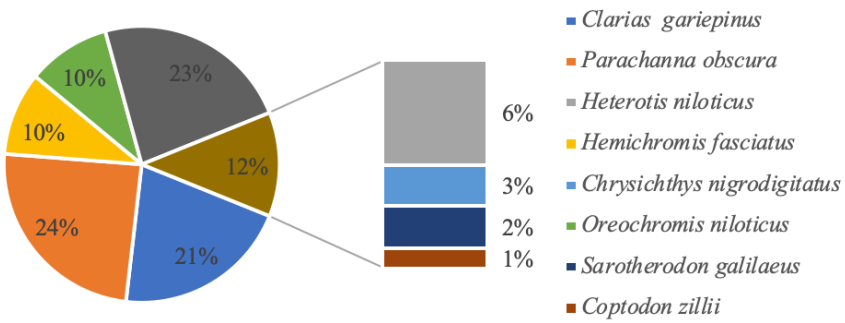



Figure 4 reports the different mesh sizes of fishing gear used by fishermen at the Owabi Reservoir. Respondents at the Owabi Reservoir reported eleven (11) different mesh sizes, with 2.5 and 3-inch mesh sizes being the most common. The most popular fishing locations are shown in Figure 5. The majority of fishermen acknowledged fishing in the lake's lower reaches (i.e. downstream), while a small number mentioned the dam portion as their favoured fishing grounds.


ISSN: 2149-5939

Figure 3. Fishing gears used by fishermen at Owabi reservoir

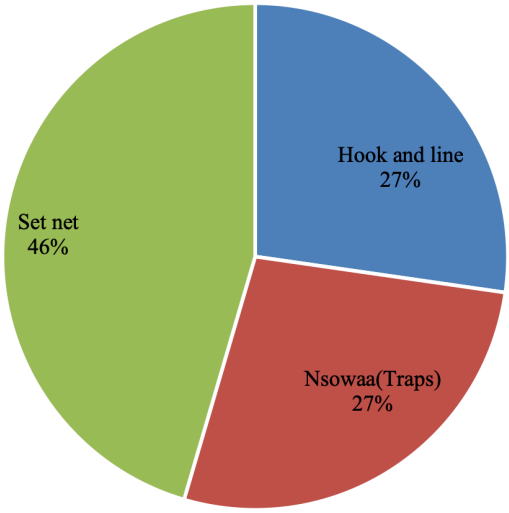



Figure 4. Mesh size of fishing gears used by fishermen at Owabi reservoir

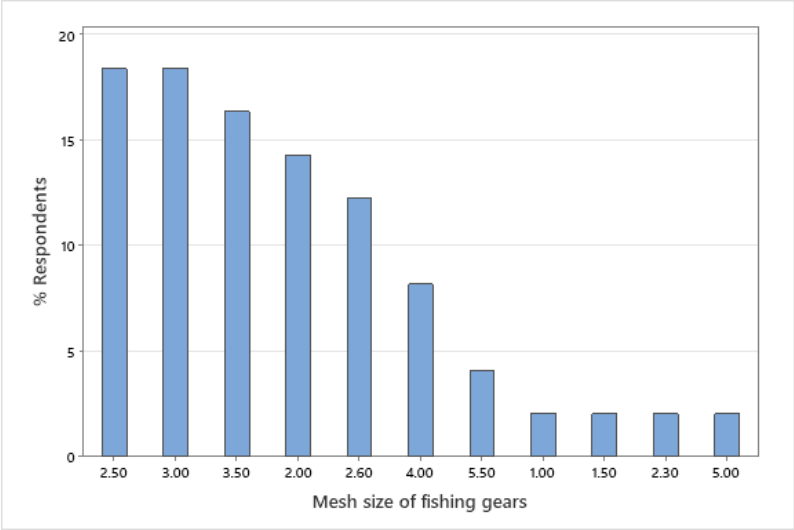
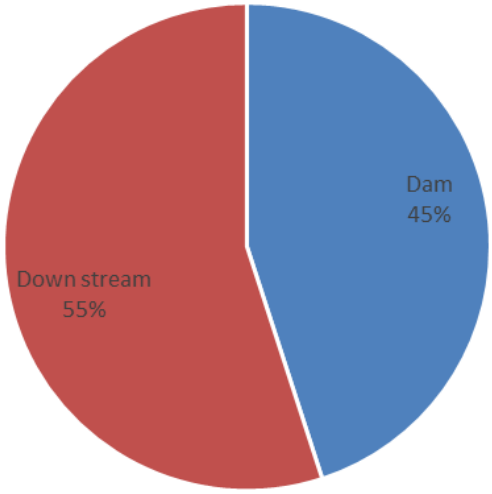



Figure 5. Preferred fishing area by fishermen at Owabi reservoir





ISSN: 2149-5939

Table 1.Cross tabulation of fishing area and factors influencing the choice of fishing area

| Fishing area | Factors influencing choice of fishing area | | | | | |
|---|---|---|---|---|---|---|
| | Avoid the scent | Fear of security | Legitimate work | More fish | Open access | Security reasons |
| Dam | 3 | 0 | 1 | 4 | 0 | 1 |
| Downstream | 0 | 1 | 0 | 0 | 10 | 0 |
| Total | 3 | 1 | 1 | 4 | 10 | 1 |

Table 1 lists factors influencing respondents' preferred fishing location. The avoidance of odour, the validity of the job, greater catch, and security considerations were cited by respondents who preferred fishing near the dam. Other respondents cited their concerns about security vulnerabilities and the downstream section's open access policy as their justifications for fishing in downstream section.

The frequency of fishing trips made by fishermen at the Owabi Reservoir is depicted in Figure 6. The majority of fishermen fish twice daily, with a small percentage (25%) fishing just once. At Owabi Reservoir, fishermen travel to the fishing grounds for an average of 53±46.6 minutes, ranging from 3 – 180 minutes. Fishermen spend averagely 141±72 minutes at the fishing grounds. They spend, on average, 57 minutes getting back to shore. Time spent getting to the fishing grounds, time at the fishing grounds, and time from the fishing grounds to the shore differed significantly [One-Way ANOVA, $F(2, 20) = 16.47$, p-value = 0.001]. There was a significant difference between time spent at fishing grounds and time spent in getting to the fishing grounds, according to a post-hoc analysis employing the Tukey test. Respondents reported that in 2010, the average daily catches was 2.5±1.15 pans and in 2021, it was 1.16±0.65 pans., suggesting a decline in catches since 2010 (Table 2).

Figure 6. Fishing trip per day by fishermen at Owabi Reservoir

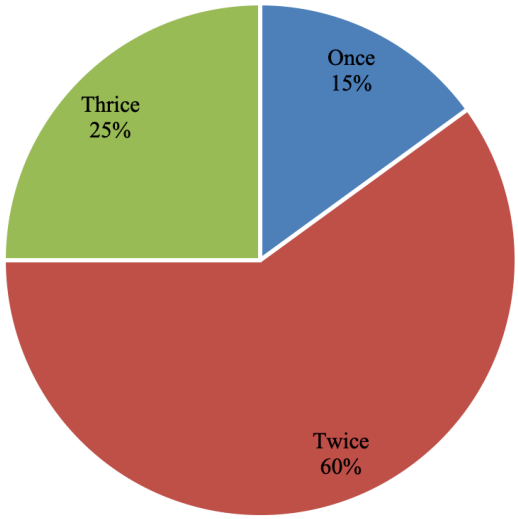



Table 2. Fishing characteristics at Owabi Reservoir

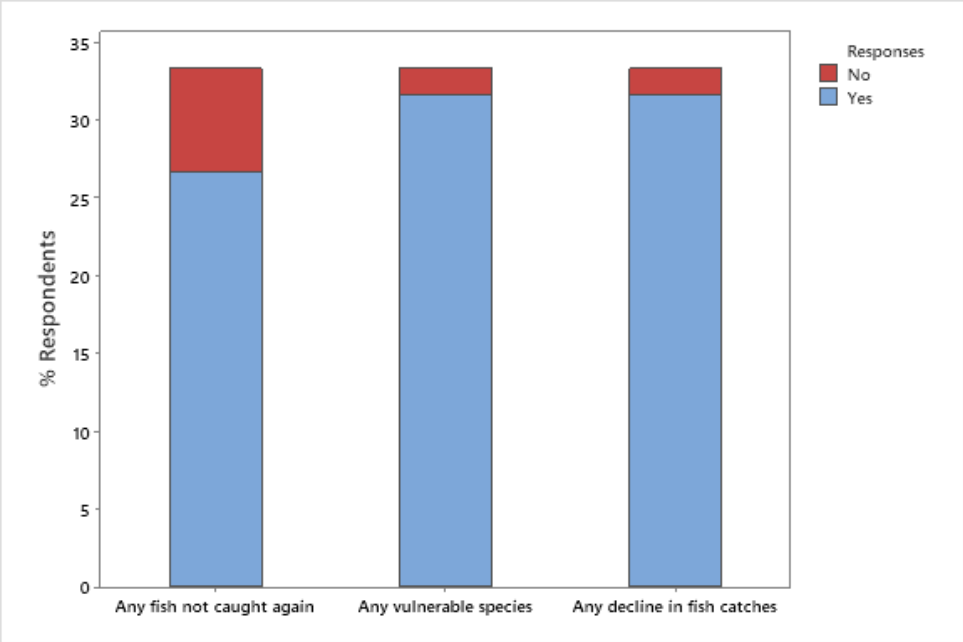
| Fishing characteristics | n | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Time spent to fishing grounds (mins) | 20 | 3.00 | 180.00 | 53.15 | 46.60 |
| Time spent at fishing grounds (mins) | 20 | 1.00 | 240.00 | 141.35 | 72.85 |
| Time from fishing grounds to shore (mins) | 20 | 20.00 | 120.00 | 57.50 | 39.02 |
| Quantity of fish caught per day in 2021 (pans) | 19 | 0.50 | 3.00 | 1.16 | 0.65 |
| Quantity of fish caught per day in 2010 (pans) | 17 | 1.00 | 4.00 | 2.50 | 1.15 |

*4.2. Conservation statutes of fish species*

According to the majority of respondents (Figure 7), specific fish species such as *H. niloticus* and *S. galilaeus* are no longer seen in the Reservoir. The majority of respondents substantially claimed that the population status of some species has collapsed [$X^2$ (1, N= 20) = 7.20, p = 0.007]. Again, most of the respondents agreed that the population of some species including *C. zillii, H. fasciatus, C. obscura*, *H. niloticus*, and *C. gariepinus* are presently in a vulnerable state (Figure 7).

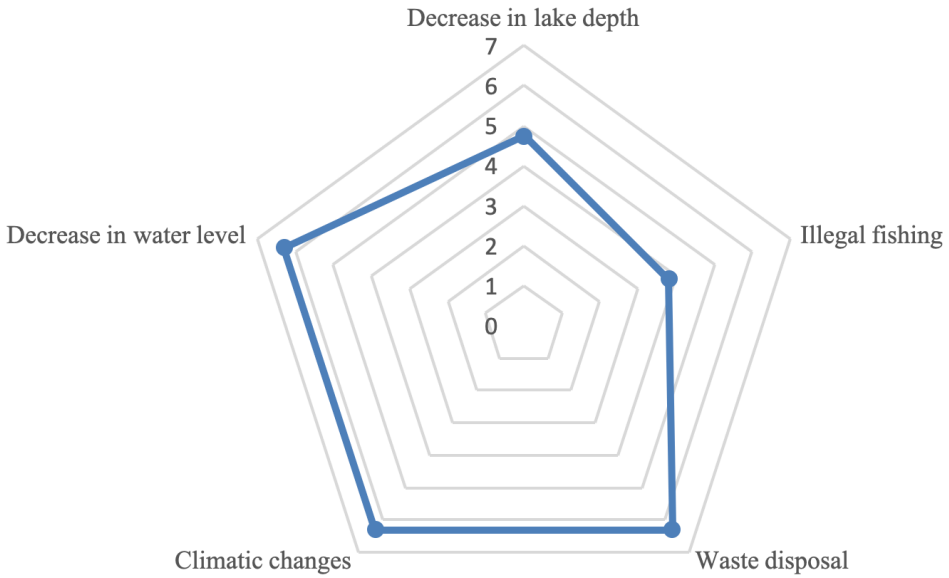

ISSN: 2149-5939

Figure 7. Responses on status of fish species at Owabi reservoir




The most frequent causes of fish species decline at Owabi Reservoir were the disposal of waste, shifts in the climate, and a decrease in water level. Illegal fishing practices and a decrease in lake level are of further concerns (Figure 8). Many of the respondents firmly agreed that trash disposal, climate change, a decrease in lake depth, and a drop in water level were the primary factors causing the decline in fish species. However, most of the respondents did notindicate that illegal fishing practices play a role in the decline of fish populations in the Owabi Reservoir.

Figure 8. Factors affecting the decline in fish at Owabi reservoir

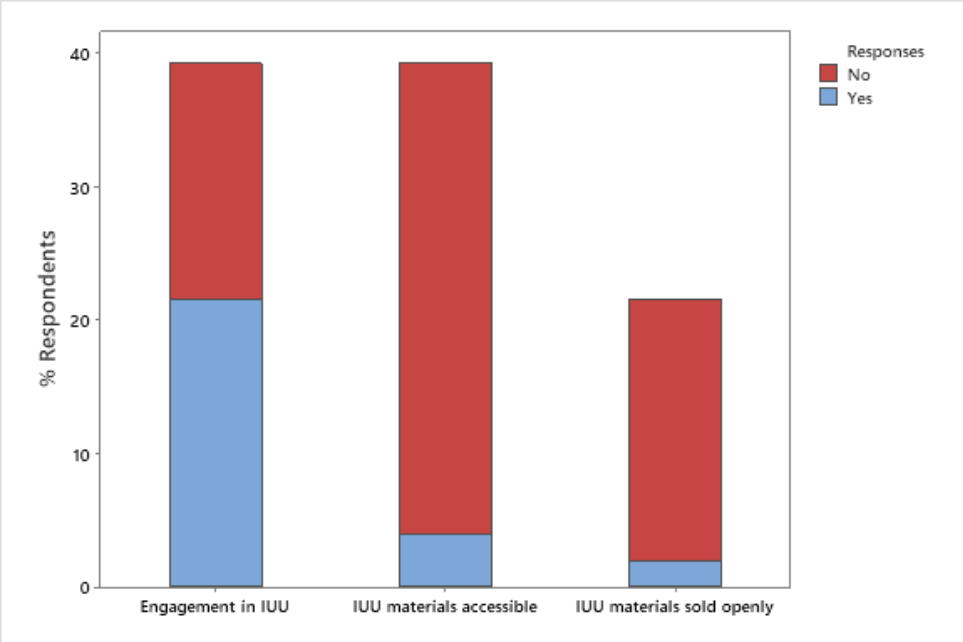



*4.3. Illegal unreported unregulated fishing methods*

It is well known that most of the fishermen at Owabi Reservoir use IUU fishing techniques (Figure 9). Most of respondents substantially stated that it was difficult to obtain materials for IUU fishing activities (Figure 9). Again, many fishermen claimed that materials for carrying out IUU fishing activities are barely sold openly at the market (Figure 9).


ISSN: 2149-5939

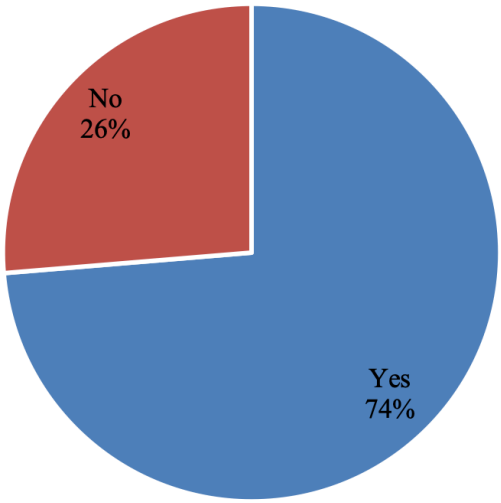
Figure 9. Issues on illegal unregulated unreported (IUU) fishing activities at Owabi reservoir




*4.4. Alternative livelihoods*

Figure 10 shows that most respondents indicated their participation in other kinds of employment, while only a small percentage (26%) said they did not. The alternative livelihoods that the respondents pursued included plumbing, farming, farming, and water treatment.

Figure 10. Engagement in alternative livelihoods by fishermen at Owabi reservoir




**5. Discussion**

The fish species that live in the Owabi Reservoir are recognized to resemble those in Lake Volta (Nunoo *et al.*, 2012). Nunoo *et al.* (2012) reported nineteen species from the Owabi Reservoir which was comparatively more than the number of species reported by respondents from the current study. Variations in the depth and extent of the catchment area, differences in fishing gears, or physiological differences among the species could have accounted for the fluctuation in species composition. The study by El-Far *et al.* (2020) claimed that the sort of fish species that fishermen harvest depend on the selectivity of the fishing gears, hence understanding gear selectivity is crucial for fisheries management. Fish migration to the downstream in reaction to low water levels reduces the


ISSN: 2149-5939

catch composition in the reservoir. The mesh sizes used by fisherman in the reservoir from the study were consistent with those reported by Nunoo *et al.* (2012). However, the majority of the mesh sizes employed by these fishermen were illegal according to Ghana's Fisheries Act 625. For instance, any mesh size less than 2.9 inches in a freshwater system is prohibited by Ghana's Fisheries Regulations LI 1968 (Fisheries Regulations, 2010). The types of fishing gears seen in the study region were consistent with research conducted by Akongyuure et al. (2015) on the Oti River. However, the absence of a dragnet may be measures instituted by the management of the Owabi Ghana Water Company. Preference for a particular fishing ground depends on various circumstances, including better catches, increased protection against theft of fishing gear, and others. From the study, increased catch and profitability were the main drivers for fishing in the reservoir. This finding aligned with studies by Sultan (2020) and Hallwass (2016), who reported that financial gains mostly influence fishers' preferred fishing areas. Expected fish capture explains the choice of fishing place, according to Hunt et al. (2019).

The low presence of fishermen in the reservoir, however, could be due to their inability to provide the necessary documents needed by the Owabi Ghana Company to grant access to the resources. This management action may have played a key role in limiting fishing access and consequently ensuring sustainable management of the stocks. The huge amount of time spent by fishermen in getting to or from the fishing grounds may be due to the use of non-motorized dugout canoes, which largely utilize paddles for locomotion. Similarly, the huge amount of time expended in setting or hauling in the net may be due to the low number of crew onboard. Mostly these canoes accommodate only one fisherman and, at most, two fishermen. The setting aside a day's rest from fishing activities resonates with fishermen along the coast of Ghana. This non-fishing day is mostly for reducing fishing efforts on these fish stocks. During this non-fishing day, most fishermen repair their worn-out fishing gear and attend family gatherings and other activities (Akongyuure et al., 2017). The contribution of drop in water level and change in climatic conditions lends credence to the impact of climate change on fish abundance (Pabi et al., 2015). Furthermore, the high presence of waste within the reservoir may not have only reduce the abundance of catch but also affect the health of dependent households (Ameyaw, 2017). The presence of illegal fishing activities among fishermen in Owabi Reservoir is widely practiced in Ghana (Nahuelhual et al., 2020; Nunoo et al., 2015; Okrah and Agyeman, 2012). However, the existence of stringent management measures and the unavailability of materials for illegal fishing activities could have led to the low involvement of fishermen in such unsustainable fishing practices. Engaging fisherfolks in alternative livelihoods, such as masonry, plumbing, and petty trades, could be an economic solution to the low returns from fishing activities, especially in the wake of declining fish populations. Recently, many fishing households, especially women are engaged in supplementary livelihoods to enhance their economic well-being (Francisco et al., 2021; Funge Smith, 2019).

## 6. Conclusion

The aim of the study was to evaluate the status of fisheries in the Owabi Reservoir from the perspective of local ecological knowledge. From the study, fishermen indicated the absence and presence of some vulnerable fish species. In addition, fishermen demonstrated knowledge on factors accounting for the decline in fish species. Furthermore, most fisherfolks were engaged in alternative livelihoods due to declining fish catch. From the study, is it essential that management of the reservoir conduct an awareness program on the impact of illegal fishing activities. In addition, climate change mitigation strategies should be developed by management to ensure sustainable fishing practice.

## References

Afoakwah, R., Osei, M. B. D., & Effah, E. (2018). A guide on illegal fishing activities in Ghana. *USAID/Ghana Sustainable Fisheries Management Project. Narragansett, RI: Coastal Resources Center, Graduate School of Oceanography, University of Rhode Island. Prepared by the University of Cape Coast, Ghana. GH2014_SCI048_UCC*, *64*.

Agyeman, N. A., Blanco-Fernandez, C., Steinhaussen, S. L., Garcia-Vazquez, E., & Machado-Schiaffino, G. (2021). Illegal, Unreported, and Unregulated Fisheries Threatening Shark Conservation in African Waters Revealed from High Levels of Shark Mislabelling in Ghana. *Genes*, *12*(7), 1002.

Akongyuure, D. N., Amisah, S., & Agyemang, T. K. (2017). Gillnet selectivity estimates for five commercially important fish species in Tono Reservoir, Northern Ghana. *Lakes & Reservoirs: Research & Management*, *22*(3), 278-289.

Akongyuure, D. N., Amisah, S., Agyemang, T. K., & Edziyie, R. E. (2017). Tono Reservoir fishery contribution to poverty reduction among fishers in northern Ghana. *African Journal of Aquatic Science*, *42*(2), 143-154.

Antwi-Agyei, P., Kpenekuu, F., Hogarh, J. N., Obiri-Danso, K., Abaidoo, R. C., Jeppesen, E., & Andersen, M. N. (2019). Land use and land cover changes in the owabi reservoir catchment, Ghana: implications for livelihoods and management. *Geosciences*, *9*(7), 286-296.


ISSN: 2149-5939

Awuah, G. K. (2016). *Assessment of heavy metal concentrations in sediment, water and fish from the Ankobra and Tano River basins In Ghana* (Doctoral dissertation, University of Ghana).

Boadi, N. O., Borquaye, L. S., Darko, G., Wemegah, D. D., Agorsor, D., & Akrofi, R. (2018). Assessment of the quality of the Owabi reservoir and its tributaries. *Cogent Food & Agriculture*, *4*(1), 1492360.

Boonstra, W. J., & Hentati-Sundberg, J. (2016). Classifying fishers' behaviour. An invitation to fishing styles. *Fish and Fisheries*, *17*(1), 78-100.

El-Far, A., Aly, W., El-Haweet, A. E. D., Nasr-Allah, A., & Karisa, H. (2020). Fisheries management based on gear selectivity of a tropical reservoir, Lake Nasser, Egypt. *The Egyptian Journal of Aquatic Research*, *46*(1), 71-77.

Food and Agriculture Organization. (1995). *Code of conduct for responsible fisheries*. Food & Agriculture Org..

Francisco, R. P., Hoguane, A. M., Simbine, R. L., & Mabota, H. S. (2021). Household dependence on fish-based farming systems in the Bons Sinais Estuary in Mozambique. *Western Indian Ocean Journal of Marine Science*, (1/2021), 29-41.

Funge-Smith, S., & Bennett, A. (2019). A fresh look at inland fisheries and their role in food security and livelihoods. *Fish and Fisheries*, *20*(6), 1176-1195.

Hallwass, G., & Silvano, R. A. (2016). Patterns of selectiveness in the Amazonian freshwater fisheries: implications for management. *Journal of environmental planning and management*, *59*(9), 1537-1559.

Hilborn, R., Amoroso, R. O., Anderson, C. M., Baum, J. K., Branch, T. A., ... & Ye, Y. (2020). Effective fisheries management instrumental in improving fish stock status. *Proceedings of the National Academy of Sciences*, *117*(4), 2218-2224.

Hunt, L. M., Camp, E., van Poorten, B., & Arlinghaus, R. (2019). Catch and non-catch-related determinants of where anglers fish: a review of three decades of site choice research in recreational fisheries. *Reviews in Fisheries Science & Aquaculture*, *27*(3), 261-286.

Keppeler, F. W., Hallwass, G., Santos, F., da Silva, L. H. T., & Silvano, R. A. M. (2020). What makes a good catch? Effects of variables from individual to regional scales on tropical small-scale fisheries. *Fisheries Research*, *229*, 105571.

MoFA (2003). Ghana: Post Harvest Fisheries Overview. Directorate of Fisheries, Ministry of Food and Agriculture, Ghana. 70 pp.

Mustapha, U. F., Akongyuure, D. N., Abagale, F. K., Alhassan, E. H., & Abarike, E. D. Fish and fisheries of the Sisili-Kulpawn river basin in the Northern region, Ghana.

Nahuelhual, L., Saavedra, G., Mellado, M. A., Vergara, X. V., & Vallejos, T. (2020). A social-ecological trap perspective to explain the emergence and persistence of illegal fishing in small-scale fisheries. *Maritime Studies*, *19*(1), 105-117.

Nunoo, F. K. E., Asiedu, B., Olauson, J., & Intsiful, G. (2015). Achieving sustainable fisheries management: A critical look at traditional fisheries management in the marine artisanal fisheries of Ghana, West Africa. *Journal of Energy and Natural Resource Management (JENRM)*, *2*(1).

Nunoo, F. K., & Asiedu, B. (2013). An investigation of fish catch data and its implications for management of small-scale fisheries of Ghana. *International Journal of Fisheries and Aquatic Sciences*, *2*(3), 46-57.

Nunoo, J., Agbo, N., & Ackah, M. (2012). Fish fauna of the Owabi Dam reservoir in Ghana. *Proceedings of the International Academy of Ecology and Environmental Sciences*, *2*(1), 21.

Saldaña, A., Salas, S., Arce-Ibarra, A. M., & Torres-Irineo, E. (2017). Fishing operations and adaptive strategies of small-scale fishers: insights for fisheries management in data-poor situations. *Fisheries Management and Ecology*, *24*(1), 19-32.

Sultan, R. (2020). Fishing location choice and risk preferences among small fishers–Implications for fisheries management policies. *African Journal of Agricultural and Resource Economics*, *15*(311-2020-1786), 140-156.

Varol, M., & Şen, B. (2012). Assessment of nutrient and heavy metal contamination in surface water and sediments of the upper Tigris River, Turkey. Catena, 92, 1-10.

Walters, C. J., & Martell, S. J. (2020). *Fisheries ecology and management*. Princeton University Press.

***Acknowledgments***

Sincere thanks go to the fishermen at the Owabi Reservoir for the assistance they provided during the study period. Furthermore, appreciation goes to the management of Owabi Water Company for permitting us access to their facility.

***Disclosure statement***

The author reported no potential competing interest.

***Ethics committee approval***

All responsibility belongs to the researchers. All parties were involved in the research of their own free will. Ethics committee approval was not required because the data for this study are not related to humans.


ISSN: 2149-5939