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DEVELOPMENT AND IMPLEMENTATION OF TOOLS TO GATHER LOCAL KNOWLEDGE ON BONGA AND CATFISH ARTISANAL FISHERIES: A PILOT STUDY AT KONAKRIDEE AND SOLIMA LANDING SITES IN SIERRA LEONE

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ABSTRACT

This study examines the current state of artisanal fisheries programs in Sierra Leone, with a focus on Konakridee in the Northwest District and Sulima in the Southern District. The method used to collect local knowledge on detailed fishing patterns was applied for the first time in Sierra Leone. The results provide a good foundation for using the method of developing and implementing questionnaire-based interviews to gather local knowledge from fishermen/boat owners, harbour masters, and enumerators for Sierra Leonean artisanal fisheries. The knowledge gaps targeted during this study provide detailed insights into where, when, and how fishing activities occur, including specific fishing grounds, techniques used, and seasonal variations. Local knowledge has revealed detailed fishing patterns and gear usage for the two main target species, *Ethmalosa fimbriata* (bonga) and *Arius* species (catfish). By understanding fishing pressure and identifying vulnerable species, valuable information was retrieved to inform the development of targeted conservation and sustainable management measures, addressing gaps in effective fisheries management strategies. Additionally, it offers insights into the social and economic dimensions of fishing in Sierra Leone, including its role in local livelihoods, cultural practices related to fishing, and the socioeconomic impacts of changing fisheries dynamics, which were previously lacking in the two regions investigated.

Keywords: Artisanal fisheries, local knowledge, fishing patterns, gear usage, *Ethmalosa fimbriata* (bonga), *Arius* species (catfish), Sierra Leone.

ACRONYMS AND ABBREVIATIONS

EEZ	Exclusive Economic Zone
GDP	Gross Domestic Product
FMP	Fisheries Management Plan
EAF	Ecosystem Approach to Fisheries
IUU	Illegal Unreported Unregulated
EU	European Union
ISFM	Institutional support for Fisheries Management
Voc	Vocational Education
Pri	Primary Education
Sec	Secondary Education
S	Standard

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Sierra Leone as a coastal region

Sierra Leone has a tropical climate and lies on the coast of West Africa between latitudes 7°N and 10°N, and between longitudes 10°W and 13°W. It is encircled on the southwest by the Atlantic Ocean, north and northeast by the Republic of Guinea, and southeast by Liberia. Sierra Leone has a total area of approximately 71,740 km2 and a coastline of approximately 560 km (Ministry of Fisheries and Marine Resources, 2008). Sierra Leone lies north of the Gulf of Guinea and at the connection between the Canary Current in the north and the Guinea Current in the south. Water movement is one of the important dynamics influencing Sierra Leonean waters and the extent of fishing activities. Sierra Leone has a continental shelf that, combined with local currents, creates a substantial upwelling that places the country within one of the world's most productive marine ecosystems (Heymans & Vakily, 2004). The continental shelf of Sierra Leone is approximately 100 km wide in the north and contracts to approximately 13 km in the south, toward Liberia. The total continental shelf area covers approximately 30,000 km2.

Fisheries play a pivotal role in the national economy and food security of Sierra Leone. They represent approximately 10% of the gross domestic product (GDP) and are the most important economic activity along the country's coastline. Fish is the largest source of animal protein for the majority of Sierra Leoneans, supplying approximately 80% of the total animal protein consumption. It is estimated that more than 600,000 people are directly or indirectly employed in the fisheries sector (Ministry of Fisheries and Marine Resources, 2017). Fisheries in Sierra Leone encompasses four sub-sectors: the artisanal fishery, the industrial fishery, the inland fishery and aquaculture, and semi-industrial fishery.

Small-scale fisheries in Sierra Leone are composed of marine artisanal and inland fisheries, in which marine artisanal fishermen target mainly small pelagic species, including *Sardinella spp*. (bonny), *Scombero scombridae* (mackerel), and *Ethmalosa fimbriata* (bonga). These species are mostly targeted with fishing canoes using ring nets, drift nets, set nets, and gill nets. In addition, industrial vessels target mostly demersal species, such as *Cynogloss cynogloss* (sole fish), *Chlorosco carangida* (kainty), *Pseudotolithus senegalensis* (ladyfish), *Arius spp.* (catfish), and others. These vessels use cast nets, beach seines, set nets, gill nets, traps, and hook-and-line gear.

Among the species that are exploited, *Ethmalosa fimbriata* (bonga) and *Arius spp.* (catfish) are the most important species for local fishermen in the southern (Sulima outstation) and northwest (Konakridee outstation) regions among the six coastal regions in Sierra Leone. *E. fimbriata* (bonga), *Arius species* (catfish), and other clupeid species constitute a major portion of the catch for small-scale coastal vessels.

1.2 Rationale

The fisheries statistics and management system of Sierra Leone's artisanal fisheries were critically reviewed by Sellu (2011). The author suggested new approaches to data collection, data analysis, and the presentation of results. The study highlighted that, although a data

collection system was established in a policy statement, it was not adequately implemented in the artisanal sector. Catch and effort assessment data were collected but not adequately and consistently, while little or no biological data were gathered, and socioeconomic information was lacking. The fisheries management plan 2020-2025 (Sheku Sie, 2020) points out that artisanal data collection has been poor since 2009. Other recommendations included banning the use of beach seines, establishing marine protected areas, and limiting the minimum mesh size to 45 mm (ISFM 2009). The new management plan also recommends setting a cap on the number of licences issued for the small pelagic fishery.

The ministry has been collecting artisanal fisheries data through enumerators. This was conducted by sampling landing sites around the six coastal regions, with 657 identified fish landing sites in total. The data collection program used in the past (Sellu 2011) was discontinued around 2020 because of a lack of funding. Although there are enumerators present at almost all landing sites, interestingly, not even half of these are on the ministry's payroll. Most of them are volunteers who are not paid for such work and end up assisting the harbour masters in their daily activities. Therefore, data are not consistently sampled from any of the sites. If any data collection is conducted, it prioritises obtaining minimum information on catch (total catch, length size, and species name). Information on effort, such as the time spent fishing (i.e., number of days at sea), type of boat and gear used, and fishing depth, is not collected. The ministry performs a rough estimate of the total artisanal landings per year based on the information it can collect.

Considering the above recommendation on co-management, it was proposed to involve fishermen/boat owners and harbour masters in the data collection process, in addition to enumerators (Sellu, 2011).

There are five main types of artisanal fishing crafts operating in Sierra Leone: the Kru canoe, Standard 1–3, Standard 3–5, Standard 5–10, and the Ghana boat. The Kru canoe is usually operated by one person using handlines, cast nets, and is propelled by a paddle or a low-horsepower engine. The Standard 1–3 boats are operated by one to three people and propelled by a paddle and a high-power engine. Standard 3–5 (Figures 1 and 2) and Standard 5–10 boats are powered by motors and have crews of three to ten people. The Ghana boat is larger and usually motorised (between 8 and 40 high-power engines). Motorised boats use various fishing gears, such as gillnets, driftnets, handlines, and longlines. Over the years, the Kru canoe and Standard 1–3 have been devolved to the local councils to manage and help some of the needs of the community people, while the Standard 3–5, Standard 5–10, and Ghana boat have been managed by the artisanal sector in the Ministry of Fisheries and Marine Resources. Therefore, the ministry does not have any data on licences paid by the Kru canoe and Standard 1–3 vessel types.

To maintain sustainable exploitation, artisanal fisheries need to evaluate, develop, and implement a system to collect reliable fisheries data. Given the complex nature of the fishery, which is estimated to comprise 12,000 boats in operation of various categories landing catch at approximately 657 landing sites, it is difficult to establish a regular monitoring program, given the lack of resources. Therefore, this study promotes the integration of local knowledge from fishermen by developing a questionnaire that aims to address the knowledge gaps identified. The study will interview fishermen, boat owners, harbour masters, and enumerators to obtain targeted information about catch and effort from the five different vessel types, gear types they

deploy, fishing areas they exploit, fishing habits, and some socioeconomic information to assess the importance of fisheries for their livelihood. It also aimed to gather information on whether recommendations from the past outlined by ISFM and in the current management plan are being followed. As a proof of concept to test this type of sampling method, one landing site will be chosen in two main regions, and data collection will focus on two main species: *Ethmalosa fimbriata* (bonga) and *Arius species* (catfish).

The expected outcome of this project was to provide detailed information about fishing behaviour at a landing site and use that information to provide recommendations for an efficient data collection system. The type of data collection depended highly on the nature of the fishery.

1.2.1 **Main objective**:

To gather information on artisanal fishing behaviour and assess the status of bonga and catfish species through local knowledge by using a questionnaire to interview fishermen, boat owners, harbour masters, and enumerators at one landing site in the northwest (Konakride) and one in the south (Sulima) of Sierra Leone.

1.2.2 Specific objective:

- Develop and deploy a tool (questionnaire) to gather the necessary information on bonga and catfish catch and effort and fishing behaviour from the selected landing sites.
- Establish baseline data on artisanal bonga and catfish fisheries at the selected fish landing sites, including key indicators such as catch amount, fishing effort, and economic aspects, to serve as a foundation for further monitoring and research efforts.
- Analyse data (from the questionnaire) with a focus on:
  - Describing and comparing catch by types of gear and boats used.
  - Document any changes in fishing techniques and adaptations over time.
  - Summarise the perceived value of artisanal catches and their socioeconomic importance.
- Based on the data gathered, identify the main challenges faced by local fishermen/boat owners in artisanal fisheries and explore potential opportunities for sustainable practices, community development, and resource management.

2 LITERATURE REVIEW

2.1 Status of marine fisheries in Sierra Leone

Marine fisheries in Sierra Leone are a major source of income and employment. The management plan for these fisheries, covering a period of five years (2020–2025), focuses on specific targeted fish stocks to establish conservation and management measures, enhance repopulation, and encourage the sustainable use of marine resources. The management plan aims to regulate fishing efforts in the industrial, semi-industrial, and artisanal subsectors to a level that will certify the sustainable exploitation of fish stocks and the preservation of the environment. Most catches are taken by small-scale vessels. Nevertheless, the sector faces challenges, such as illegal, unreported, and unregulated fishing by foreign trawlers, data deficiency, and weak enforcement of user rights (Sheku Sie, 2020).

In addition, marine fisheries in Sierra Leone have been unevenly exploited. Some fishing grounds are under heavy pressure and fishing effort levels exceed the maximum sustainable yield. Although fish are a readily available source of animal protein, poor handling and processing result in lower prices and the disposal of large quantities of fish (Misganaw & Bazezew, 2015).

Sierra Leone's fisheries resources have an anticipated capitalised economic value of USD 735 million. It provides direct employment to approximately 200,000 people and indirect employment to approximately 600,000 people (almost 10 percent of the population) along the coastlines in Western Area, Kambia, Port Loko, Moyamba, Pujehun, and Bonthe. More specifically, in coastal areas, approximately 25 percent of the male population of working age is reported to be involved in part-time fishing. The total annual production is estimated to be 228,000 tons. (Neiland & Sei, 2016). In essence, the marine artisanal subsector accounts for the bulk of the total annual fish production in Sierra Leone.

2.2 The artisanal fishery

Marine artisanal fisheries operate in estuaries, creeks, bays, and coastal waters extending from the shoreline to a depth of 15–45 m. This fishery comprises a collection of dugouts and planked canoes that employ various fishing gear, including cast nets, ring nets, driftnets, set nets, beach seines, pots and traps, fencing, and hooks and lines. Marine artisanal fisheries contribute significantly to the total national fish production. They serve as social and economic engines for national development by enhancing food security, generating revenue, and creating employment opportunities in fishing communities. A recent frame survey conducted in 2018 recorded a total of 12,000 fishing canoes actively operating in Sierra Leone (Sheku Sie, 2020). The total artisanal fleet has increased by 2,000 since the last survey in 2011. However, the artisanal fishery is not well regulated in terms of effort control. The artisanal sector has not progressed significantly over the past 30 years because fishers use the same fishing boats, engines, and fishing gear and are unable to develop owing to poor management and low investment in improved technology.

The catches are dominated by bonga and catfish, while the remainder are primarily various species of demersal fish. *Ethmalosa fimbriata* and *Arius species* constitute approximately 60 % of artisanal fishery production and are mainly exploited by the ring net (purse seine) fishery. The clupeids (bonga) are at increasing risk of overfishing due to the overexploitation of the juvenile stages (Seisay, 2008). It is important to note that the juvenile or immature bonga contributed up to 25% of the total artisanal fishery production between 2001 and 2005. The 2008 frame survey indicated a yearly catch of around 100,000mt of fish that contributed to food for the poor fishing communities.

According to the frame survey conducted in 2003 for the six coastal districts (Western Area, Port Loko, Kambia, Moyamba, Bonthe, and Pujehun), there were a total of 10,642 fishermen, 2,137 fishing boats, 244 engines, and 132 fish landing sites in the north/northwest, and 13,801 fishermen, 3,638 fishing crafts, 29 engines, and 342 landing sites in the south (Jalloh, 2009). There are 93 fish landing sites in Konakridee, of which one main landing site (Konakridee) was sampled by interview using questionnaires, and 45 fish landing sites in Sulima, of which one main landing site (Sulima) was also sampled.

Figure 1: Standard 3-5 vessel at Konakridee fish landing site.

Figure 2: Standard 3-5 vessel at Sulima fish landing site.

2.3 The Fisheries Management System in Sierra Leone

The fisheries management plan (FMP) establishes management measures for each fishery – shrimp trawlers, demersal trawlers, small pelagic, and tuna species – seeking to "restore the stocks as a whole and the ecosystem wellbeing of the marine environment." Such measures include reducing fishing effort, reducing bycatch and discards, promoting fisheries observers' programs, and promoting control on fishing methods. In relation to the management measures for shrimp trawlers, for instance, the FMP promotes the use of selective gears to reduce the volume of bycatch, the development of marine protected areas (MPAs), and the reduction of conflict between the industrial and artisanal sectors.

In 2003, the Ministry, in consultation with stakeholders, developed its first Fisheries Policy (Ministry of Fisheries and Marine Resources, 2010). The Fisheries and Aquaculture Act 2017 created provisions for the management, conservation, and development of the fisheries of Sierra Leone. The Fisheries Policy 2016, Fisheries Development Strategy 2016, and the National Plan of Action to Deter, Prevent, and Eliminate Illegal Unreported and Unregulated (IUU) Fishing. All these fisheries management instruments are geared towards the implementation of biological control measures by implementing area restriction, promoting closed seasons and economic control measures, limiting the number of licences issued, implementing input control through gear restriction and mesh size regulation, and subsequently enforcing fisheries regulation enforcing penalties for violation of the laws.

2.4 The Artisanal Fisheries Management Measures

To promote community management of fisheries, stakeholder consultations are held at the national level to discuss fisheries management issues. The following recommendations were agreed upon during two consultative meetings (ISFM 2009):

- The proposed mesh size from the consultative meeting was 45 mm, which is slightly higher than the current mesh size for the gill net (43 mm).
- A marine protected area has been proposed for Yawri Bay, Sierra Leone River Estuary, Sherbro River, and Scarcies River; however, further research is required for its implementation.
- Community management was proposed from consultative meetings involving fisher organisations, local councils, village headmen, the Ministry of Fisheries extension staff, Sierra Leone Navy, and Maritime Police. This management requires stakeholder analysis and implementation as a policy instrument.
- The banning of beach seine fishing nets for small-scale fishermen was proposed and implemented, but with caveats between the ministry and fishing communities.

These measures have not been successful in the artisanal fisheries sector, which remains an open-access fishery characterised by destructive fishing methods (Sellu, 2011). With the enactment of the Local Government Act of 2004, the management and development of the artisanal fishery sector in Sierra Leone was devolved to the local councils. In 2004, the Local Government Act gave authority to the councils to collect licence fees for fishing canoes (Krue canoes and Standard 1–3) (Jalloh, 2009). Within the same Act, Standard 3–5, Standard 5–10, and Ghana boats were classified as semi-industrial fishing vessels, and supervision of these

remains the responsibility of the central government through the Ministry of Fisheries and Marine Resources under the artisanal unit.

2.5 Utilising local knowledge for fisheries assessment.

Interview-based data collection has proven to be highly effective for gathering fishery data and conducting assessments, particularly for examining human interactions with marine ecosystems. This serves as a valuable means to tap into the rich local ecological knowledge (LEK) held by fishermen (Sáenz-Arroyo & Revollo-Fernández, 2016).

Sáenz-Arroyo & Revollo (2016) used this method of data collection to gather local ecological knowledge from the abalone fishery in Baja California, Mexico. They found that by using survey questionnaires, fishers' recollections are one of the most accurate tools available to understand how abundant populations were in the recent past, at the regional level. Abalone populations were diminishing in Mexico at that time.

Jones et al. (2008) used interviews as a tool to monitor the trends in the harvesting of wild species. The author found that rapid assessment interviews with local fishermen offered an attractive and relatively inexpensive method for collecting information. This shows that rapid interviews can detect meaningful changes in harvesting patterns. By doing so, it suggests that well-designed interviews have a role to play in conservation monitoring.

To assess data-poor small-scale fisheries in the Congo River (Castello et al. 2023), interviews were conducted to collect local knowledge about fisheries in the past and in the future. Furthermore, Castello et al. (2023) used interview types to monitor biological data over time and space.

This provides a good foundation for the current study on the use of questionnaire-based interviews to gather local knowledge from fishermen/boat owners, harbour masters, and enumerators, and to test it as a proof of concept for Sierra Leonean artisanal fisheries.

2.6 Biology of the two important species

2.6.1 Biology of *Ethmalosa fimbriata* (bonga)

Bonga fish, also known as *Ethmalosa fimbriata*, is a pelagic fish found in the coastal waters of the ocean, particularly along the west African coast of Sierra Leone (Figure 3). This species is relatively small, typically reaching lengths of approximately 20–25 cm (Baldé, et al., 2018), although they can grow larger. They have a streamlined and elongated body that is well suited for their pelagic (open water) habitat and often move from coastal areas to estuaries and vice versa. The species breeds in both environments and exhibits migratory behaviour.

The timing and location of spawning are influenced by environmental factors, such as temperature and salinity (Charles-Dominique and Albaret, 2003). They are primarily planktivorous and their diet includes small crustaceans, zooplankton, and other tiny organisms found in the water column. The species distribution shows two main areas of concentration: one from the mouth of the Senegal River to the coast of Sierra Leone, and the other along the coast of Nigeria and Cameroon to the mouth of the Congo River (Bainbridge, 1963). They are restricted to shallow waters (< 20 m depth) (Durand et al., 2013). They are caught for human consumption and for commercial purposes and provide a valuable source of protein for local communities.

Figure 3: Ethmalosa fimbriata (bonga) from Sulima fish landing site.

2.6.2 Biology of Arius spp.(catfish)

Catfish comprise a diverse group of freshwater and marine fish species belonging to the order *Siluriformes.* They are usually demersal fish found in coastal marine waters, particularly along the west African coast. They can reach 90 cm or more (Teugels et al., 1994) and are characterised by a sleek and often cylindrical body shape with an atypical, flattened head and a long flexible body. One of their distinctive features is the presence of sensory organs that help them locate food in dark or murky waters and on the bottom, for example, barbels around their mouth. The catfish diet consists of small fish, insects, crustaceans, worms, and plant material. These fish are nocturnal, which means that they are more active and feed during the night. *Arius spp.* exhibit diverse reproductive strategies; some build nests for their eggs, whereas others scatter their eggs among plants in crevices (Figure 4).

Figure 4: Arius spp. (catfish) from Konakridee fish landing site.

3 METHODOLOGY

3.1 Study area.

This study focuses on two major areas in Sierra Leone, namely, Konakridee in the northwest and Sulima in the southern region (Figure 5). Primary data and information were collected from fishermen/boat owners, harbour masters, and enumerators in two fish landing sites across Sierra Leone, as shown on the map below.

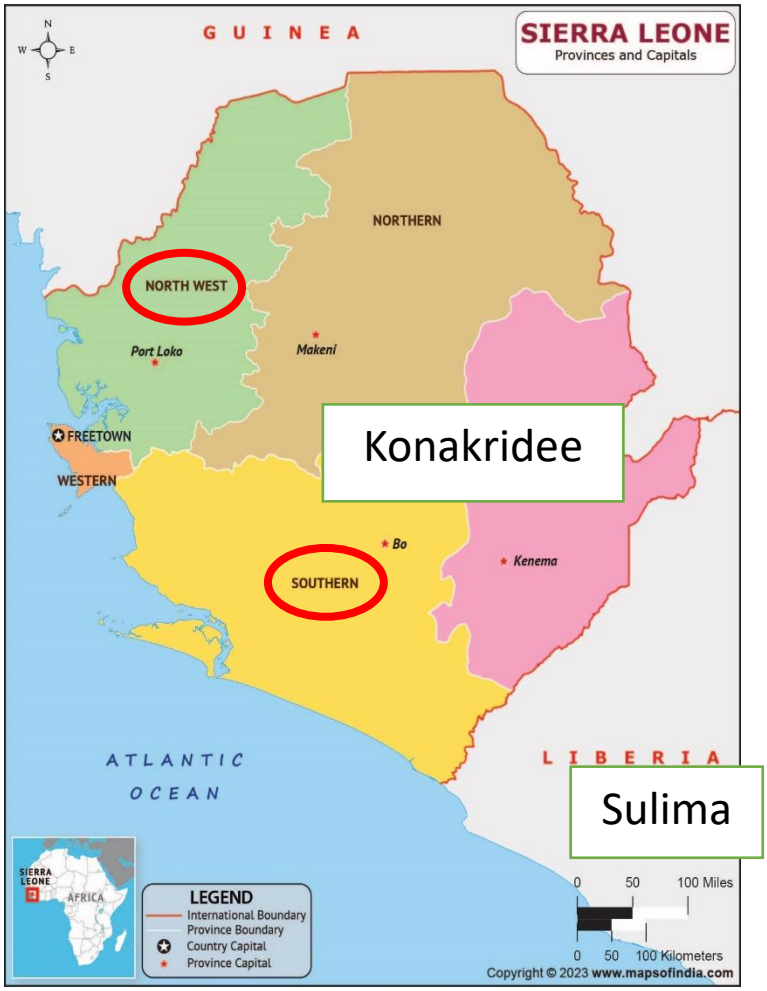


Figure 5: Map showing study areas in the northwest and southern regions with the targeted major fish landing sites.

3.2 Structure of the two study areas

3.2.1 Konakridee

The Konakridee landing site, located in the northwest district of Sierra Leone, is an important hub for fishing in the region. It is located on the coast and offers direct access to the rich marine resources of the Atlantic Ocean, making an important contribution to the local economy and the livelihoods of coastal communities. The jetty in Konakridee is equipped with the necessary infrastructure to support the fishing industry. This includes berths for fishing vessels, storage facilities for the catch, and basic amenities for fishermen, such as shelters and rest areas. In addition, there are processing facilities to sort and prepare the catch for sale and distribution. The landing site is a focal point of community activities and serves as a meeting place for

fishermen, traders, and other stakeholders involved in the fishing sector. It is a hub of social interaction where people come together to do business, share knowledge, and engage in cultural exchange. The management of the Konakridee landing site is overseen by local authorities or community-based organisations responsible for regulating fishing activities, ensuring compliance with fishing regulations, and maintaining order at the site. Traditional leaders or village councils also play a role in the decision-making processes related to the management of the landing site. Given its proximity to sensitive coastal ecosystems, the Konakridee landing site is subject to environmental considerations and conservation measures aimed at preserving biodiversity and mitigating the impact of fishing activities on marine habitats. These include habitat restoration, marine protected areas, and sustainable fishing practices. Like many fishing communities, the Konakridee landing site faces several challenges, including overfishing, habitat degradation, and inadequate infrastructure. However, there are also opportunities for sustainable development and resource management, including initiatives to build capacity, improve infrastructure, and promote alternative livelihoods. Effective management of landing sites often requires collaboration and partnerships between government agencies, local communities, non-governmental organisations, and other stakeholders. By working together, these entities can leverage their respective strengths and resources to address common challenges and achieve shared goals for the sustainable management of fisheries resources and the well-being of Konakridee.

3.2.2 Sulima

Sulima, located in the southern district of Sierra Leone, has a rich maritime environment along the Atlantic coast with diverse ecosystems such as coastal plains, estuaries, and mangrove forests. Fishing has been a cornerstone of Sulima's livelihood for generations, with artisanal fishermen relying on traditional methods passed down from family to family. Wooden canoes or pirogues equipped with nets, traps, and lines are often used for fishing expeditions. Bonga, also known as shad, is the main target species of fishermen in Sulima. This species, which is abundant in the coastal waters of Sierra Leone, has great cultural and economic value and is an important source of protein for local communities. The choice of fishing gear depends on factors such as the target species, fishing environment, and local fishing traditions. Fishing communities in Sulima are usually organised into local chiefdoms or village councils, which play a central role in decision-making regarding fisheries management and resource allocation. Traditional leaders often work with government agencies and non-governmental organisations to address challenges and implement conservation measures. Despite the abundance of marine resources, fisheries in Sulima face challenges such as overfishing, habitat degradation, and limited market access. However, there are opportunities for sustainable development through improved management practices, community involvement, and investment in infrastructure and alternative livelihoods. The Government of Sierra Leone, in collaboration with international organisations and non-governmental organisations, has implemented initiatives to strengthen fisheries management in Sulima. These efforts include measures to improve monitoring and enforcement, promote sustainable fishing practices, and support the socioeconomic well-being of fishing communities. The future of fisheries in Sulima depends on concerted efforts to address existing challenges and capitalise on opportunities for sustainable development. By prioritising ecosystem-based management, strengthening governance structures, and promoting community ownership, Sulima can ensure the long-term viability of its fisheries resources while promoting the socioeconomic resilience of its inhabitants.

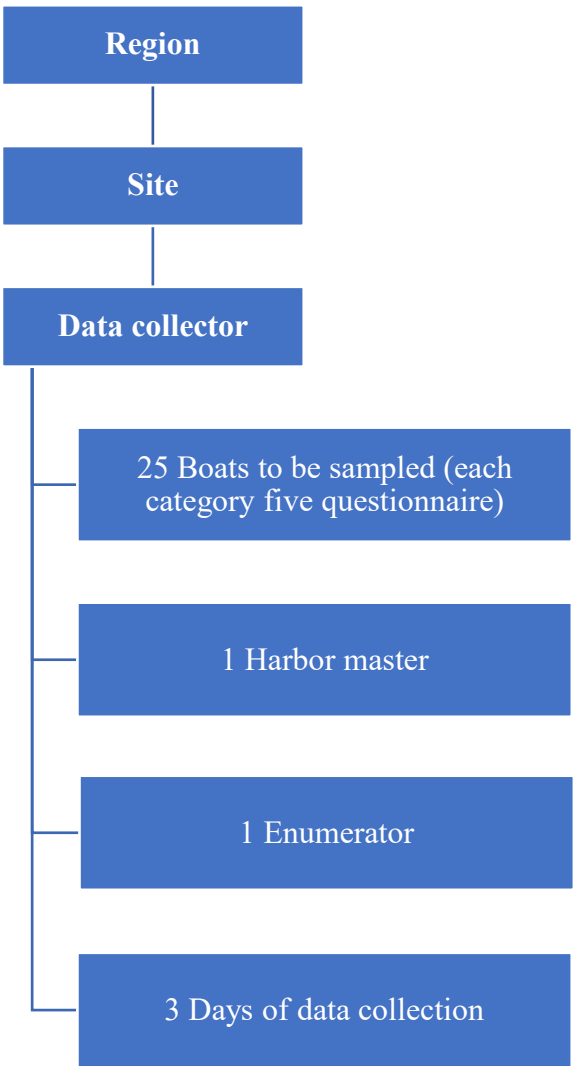
3.2.3 Selection of the two study areas

Konakridee and Sulima were selected because of the importance of fishing activities in their respective regions. Konakridee's artisanal fishing practices, which are deeply rooted in local

traditions, emphasise the importance of artisanal fishing in the northwestern district. Similarly, the fishing community of Sulima plays an important role in the economy of the southern region, contributing to local livelihoods and food security through its fisheries. The selection of Konakridee and Sulima as study sites allows for a holistic examination of fisheries management issues, resource use patterns, and community dynamics, contributing to the overall goal of promoting sustainable fishing practices and improving the well-being of coastal communities in Sierra Leone. This comparative approach allows for the identification of common trends as well as unique characteristics specific to each region, helping to develop targeted management strategies and interventions tailored to the needs of local stakeholders.

3.3 Questionnaire development

Primary data for this project were collected using three newly developed questionnaires (Appendix 1) structured to obtain detailed information from three categories of stakeholders: fishermen/boat owners, harbour masters, and enumerators. These questionnaires addressed information relevant to fisheries management. The targeted stakeholders should be resource users directly involved in fishing activities, as they are well-equipped to understand the reality of the situation. Fishermen/boat owners' knowledge was the main source for estimating the total catch, effort, and income gain. The information collected from the catch included the species name, total catch per trip in kg, average length in cm, amount of catch per month in kg, low season of catch, and the challenges faced in fishing. For the effort data, the information gathered included boat types, engine types, number of fishing trips per day, number of crew, distance of the fishing activity from shore, gear types, and the most important month for fishing. In addition, information gathered on income included the value of catch in Le, number of licences paid, vessels registered, challenges faced, and financial support. The three questionnaires (Appendix 1) provided information on the two main commercial species. On the other hand, harbour masters can provide information on total effort (number of vessels and gears) and income gain at fish landing sites (Appendix 2). Lastly, enumerators provided estimates of the catch, which were compared with fishermen/boat owners' information (Appendix 3). The data were collected using the following sampling design (Figure 6).



- Northwest region
  - Konakridee
- South region
  - Sulima
- Summary for one region:

1 data collector per region

3 days of data collecting

27 respondents per region

Figure 6. Data collection sampling design.

3.4 Interviews

Two data collectors, one targeting Konakridee and the other targeting Sulima, embarked on a crucial data collection journey within the fishing community. Upon arrival, they first sought permission from the community chief to engage with the stakeholders, including fishermen, the harbour master, and enumerators. The chief convened a brief meeting to understand the purpose of their visit. After explaining the significance of their presence, the data collectors received approval to proceed to the fish landing site to interact with the respondents. Permission was granted to conduct interviews, which commenced slowly on the first day because of a late start, but eventually involved eight respondents in Sulima and seven in Konakridee. Each interview lasted 40 minutes. The pace increased on subsequent days, with nine interviews conducted on the second day in Sulima and 11 in Konakridee, and finally, 10 on the third day in Sulima and seven in Konakridee. The interviews were conducted on subsequent days, facilitated by the cooperative nature of the respondents. Over the course of three days, the data collectors successfully gathered all the necessary information from the respondents.

Figure 7: Interview at Konakridee fish landing site.

Figure 8: Interview at Sulima fish landing site.

3.5 Data processing and analysis

The interview data collection system, which occurred in March, contained key information required for catch per unit effort (CPUE) analysis. The data collectors were willing to take over their tasks in collecting information from fishermen, harbour masters, and enumerators. After collecting the data, all information was recorded from the structured interviews. This information was centralised into a Microsoft Excel sheet with a specific reusable format and was specifically coded for further "easy-to-go" analyses, which will facilitate the understanding of the gathered information and may promote more effective management of artisanal fishing patterns for bonga and catfish in these regions.

4 RESULTS

4.1 Fishermen interviews

The data collected from the interviews comprised a random sample from the population. The trends from the sample are described below. Only men fish from both landing sites, and they usually conduct one trip per day regardless of boat type. Fishermen reported travelling to the southeast to fish for bonga in Sulima and northwest to fish for catfish in Konakridee. In both regions, fishing activities are conducted six days a week, with specific days designated as non-fishing days in each community. In Sulima, fishermen abstain from fishing on Sundays, whereas in Konakridee, Fridays are non-fishing days. Additionally, there are variations in the most active fishing months between the two regions. March is recognised as the peak fishing month in Sulima, reflecting heightened fishing activities during this period. Conversely, in Konakridee, July, October, and November are identified as the most active fishing months, indicating increased fishing efforts. This pattern is likely due to the different fish species targeted by the fleet. For all the figures the boat types are abbreviated as follows: Kru canoe (Kru), Standard 1-3 (S 1-3), Standard 3-5 (S 3-5), Standard 5-10 (S 5-10).

The age composition of fishermen (Figure 9) reveals that, among all boat types, the median age of Ghanaian fishermen is the highest in both Konakridee and Sulima (>50 years in both regions). Overall, the age of the fishermen varied greatly, ranging from 21 to 75 years. The Standard 5-10 boat category in Konakridee displayed the widest variability.

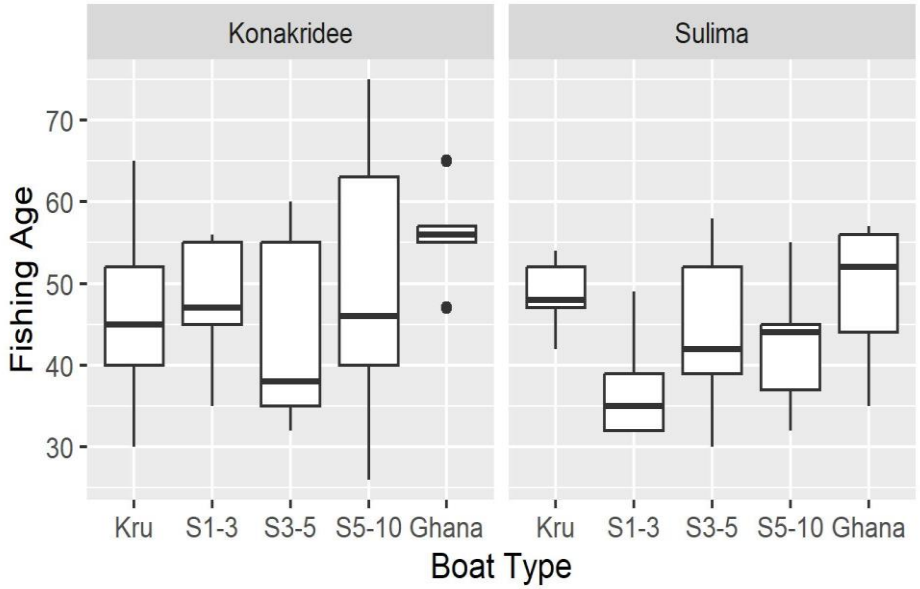


Figure 9. Variation in age composition of fishermen by boat type in Konakridee and Sulima landing sites. Boxes represent interquartile range; the lower lines represent the lower median while the upper lines represent the higher median. Dots represent outliers.

Fishermen in Konakridee who operate the Standard 5-10 category have accumulated more years of fishing experience than their counterparts in Sulima (Figure 10). For instance, in Konakridee, this spans from 15 to 50 years, with a median fishing experience of 25 years. Conversely, in Sulima, the range is narrower, with an upper outlier of 30 years, a lower outlier of 5 years, and a median of 12 years. The median years fishing using Ghana boats is also higher in Konakridee than in Sulima. Interestingly, one fisherman spent up to 52 years fishing using a Kru canoe in Konakridee. Overall, there are varying levels of fishing experience within the fishing communities of Konakridee and Sulima.

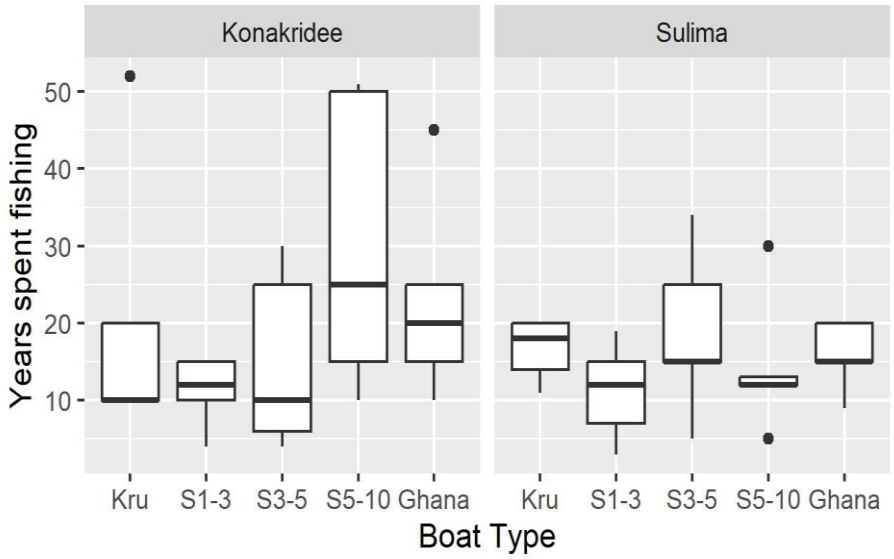


Figure 9: Variation in years spent fishing across boat types in Konakridee and Sulima landing sites. Boxes represent interquartile range; the lower lines represent the lower median while the upper lines represent the higher median. Dots represent outliers.

Generally, larger boats accommodate more crew members, whereas smaller boats have fewer crew members (Figure 11). Specifically, in Konakridee, Ghana boats utilise a considerably higher number of crew members than Sulima boats, with approximately 20–25 crew members. However, in Sulima, the number of crew members gradually increases with boat size category.

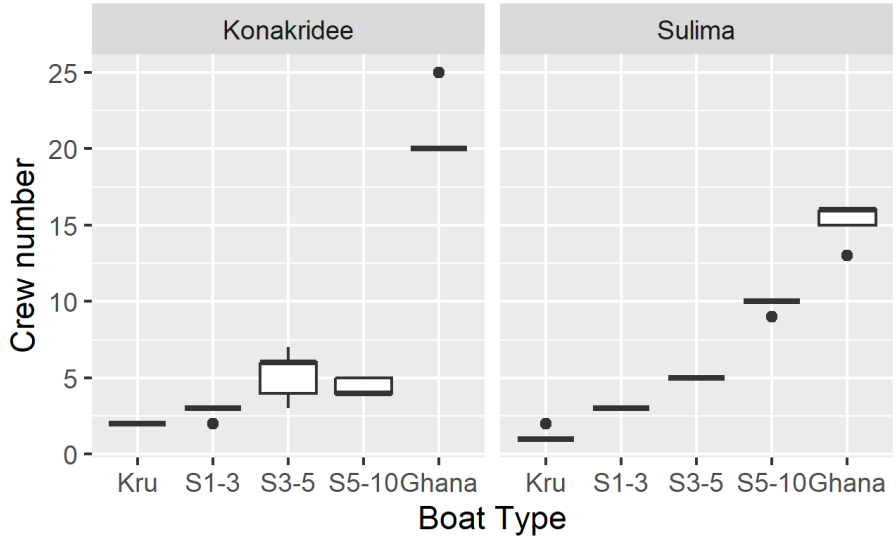


Figure 10: Number of crew by boat type in Konakridee and Sulima.

A clear correlation exists between the size of the boat and the horsepower of the engine predominantly used for fishing (Figure 12). Larger boats tend to utilise higher-horsepower engines, whereas smaller boats opt for engines with lower horsepower. Interestingly, even among Ghana boats, which typically belong to the largest size category, a small number of fishermen use engines with lower horsepower, such as 25 horsepower, to minimise fuel consumption. Additionally, it is noteworthy that a significant portion of Kru canoes rely on paddle fishing in Sulima while using 4 or 8 horsepower engines in Konakridee.

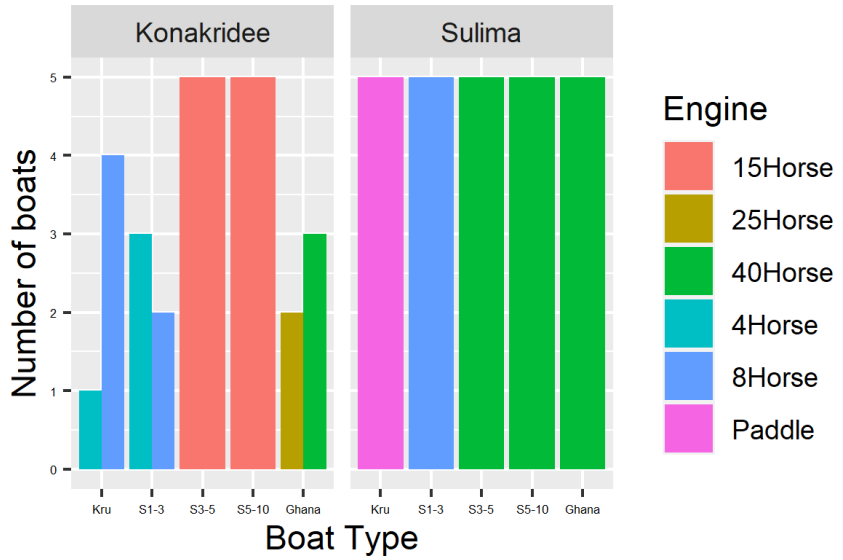


Figure 11: Use of engine power per boat in the fishing community of Konakridee and Sulima.

The differences in fishing distances travelled to reach fishing grounds seem to be related once again to the size of the boat and its horsepower (Figure 13). It is evident that the distance covered by fishermen correlates with the horsepower of the engine used. Fishermen using higher horsepower engines can cover greater distances, whereas those with smaller engines cover less distance. However, it is worth mentioning that Kru canoes in Konakridee travel even longer distances to fish than Kru canoes in Sulima. This is attributed to the fact that all Kru canoes in Sulima rely on paddling for fishing, whereas in Konakridee, fishermen using Kru canoes employ engines with 4 and 8 horsepower.

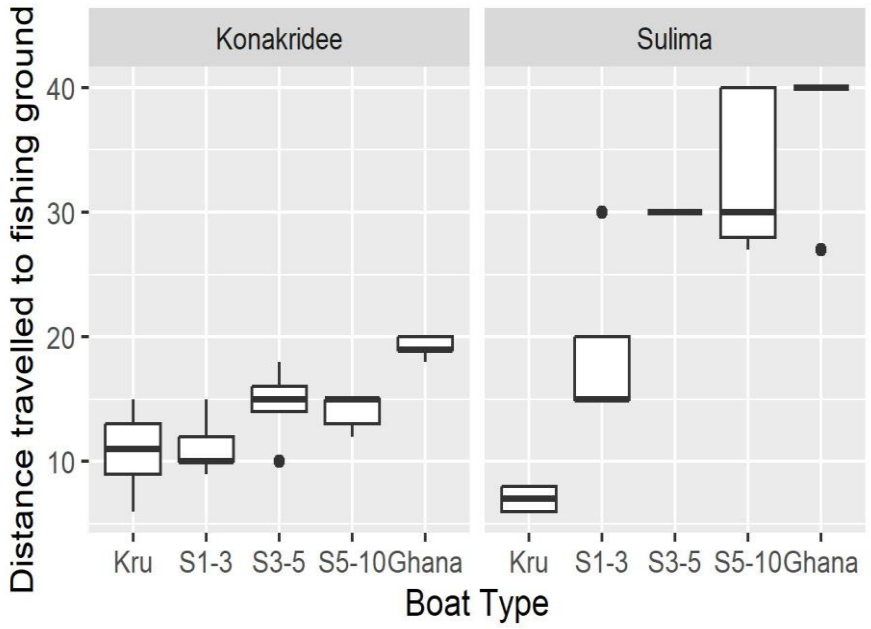


Figure 12. Distance travelled to fishing ground across boat types in Konakridee and Sulima landing sites.

There is a difference in the amount of time spent fishing between Konakridee and Sulima fishermen (Figure 14). Sulima fishermen travel much longer distances to reach their fishing grounds, as indicated in (Figure 13). Those in Konakridee display an interesting trend: the shorter the distance travelled to fish, the more time they spend fishing, in contrast to Sulima, where fishermen cover longer distances but spend less time fishing. The Kru canoes in Konakridee travel higher distances to fish than those in Sulima because of the use of 4 and 8 horsepower engines.

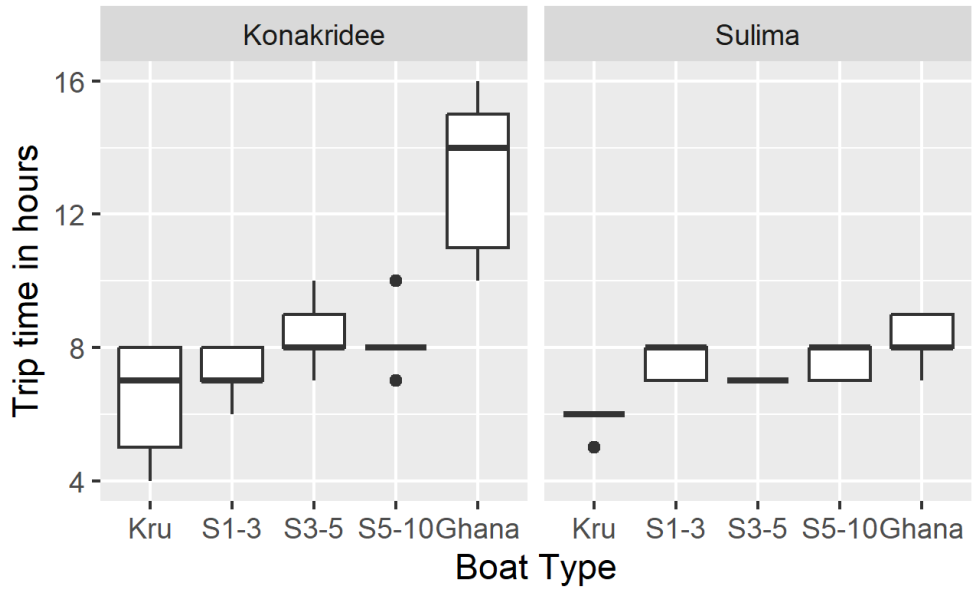


Figure 13: Variation in time spent fishing across boat types at Konakridee and Sulima landing sites.

Three different gear types are mainly used in the bonga fishery in Sulima: set net, surface drift net, and bottom drift net (Figure 15). The catfish fishery in Konakridee employs a broader range of gear types. An intriguing observation is that fishermen in Konakridee utilising the Kru canoe employ four distinct gear types for fishing: hook and line, long line, mid-drift net, and surface drift net. Kru canoe fishermen in Sulima solely rely on one gear type, specifically the set net to target bonga. Additionally, among fishermen using Standard 3-5, those in Sulima utilise only one gear type, the surface drift net, whereas their counterparts in Konakridee utilise both surface drift nets and hook and line for fishing. This indicates more diversified gear usage for the catfish fishery than for the bonga fishery. However, in general, fishermen might use different gear types based on the species they are targeting, the location where they are fishing, and various other factors. Catfish and bonga are different species with potentially different behaviours and habitat preferences.

For example, catfish may be more easily caught using bottom-set gillnets or other gear that targets fish near the bottom of the water column, as they are often found in or near the substrate. In contrast, bonga may be caught using different types of nets or gear that target pelagic or surface-dwelling fish.

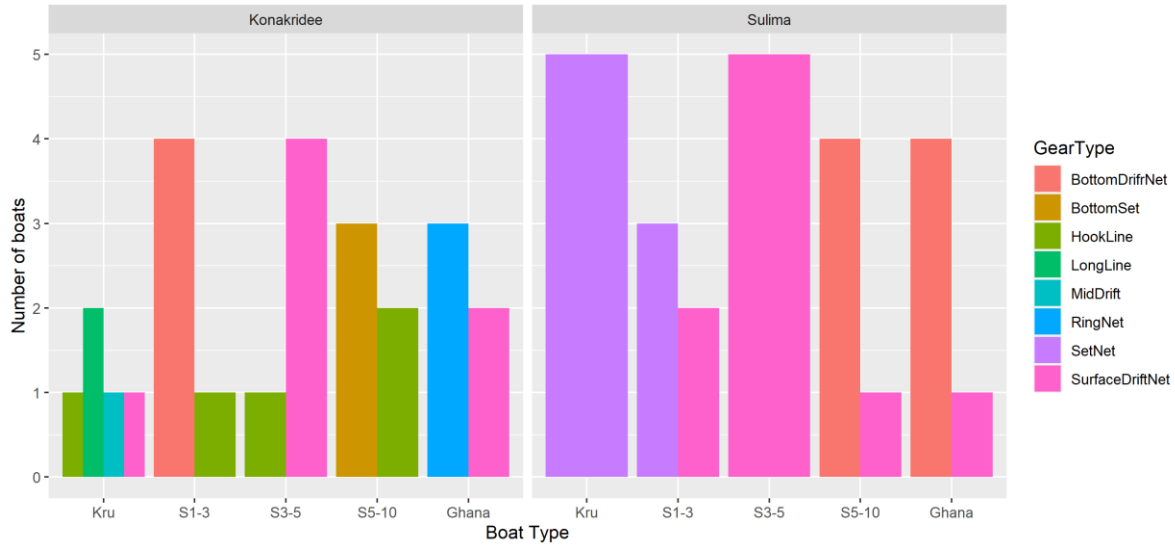


Figure 14. Types of gear used by fishermen in Konakridee to target catfish, and Sulima to catch bonga by boat type.

Catches of bonga in Sulima reach approximately 100 kg per trip, sometimes above 300 kg per trip for the largest boat types (S5-10 & Ghana), except Kru canoes, where the catches are less than 100 kg (Figure 16). While catches of catfish in Konakridee reach 200 kg for Standard 5-10, catches were less than 100 kg for Kru canoes. Although Ghana boats are the largest and employ more crew, this is not reflected in the catches of catfish. This could be mainly due to the effectiveness of the gear used by each vessel type.

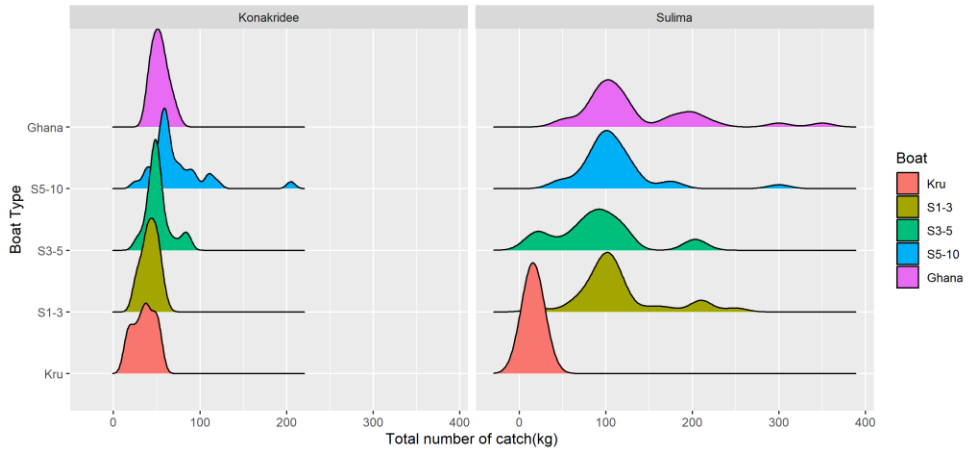


Figure 15. Catch distribution by boat type in the two regions, Konakridee (catfish), and Sulima (bonga).

The catfish fishery in Konakridee employs various gear types, as illustrated in Figure 15. Among these gear types, the catch range can differ considerably (Figure 17). For instance, when utilising the hook and line gear type, the amount of catch per trip can vary greatly from 30 to 230 kg for Standard 5-10. Similarly, the catch range for bottom set gear on the same vessels ranges from 20 to 110 kg. This suggests that Standard 5-10 vessels exhibit a broader catch range than other vessel types employing hook and line gear (Figure 17). This variation in catch range

emphasises the importance of both gear type and vessel type in influencing fishing outcomes within the Konakridee fishing community.

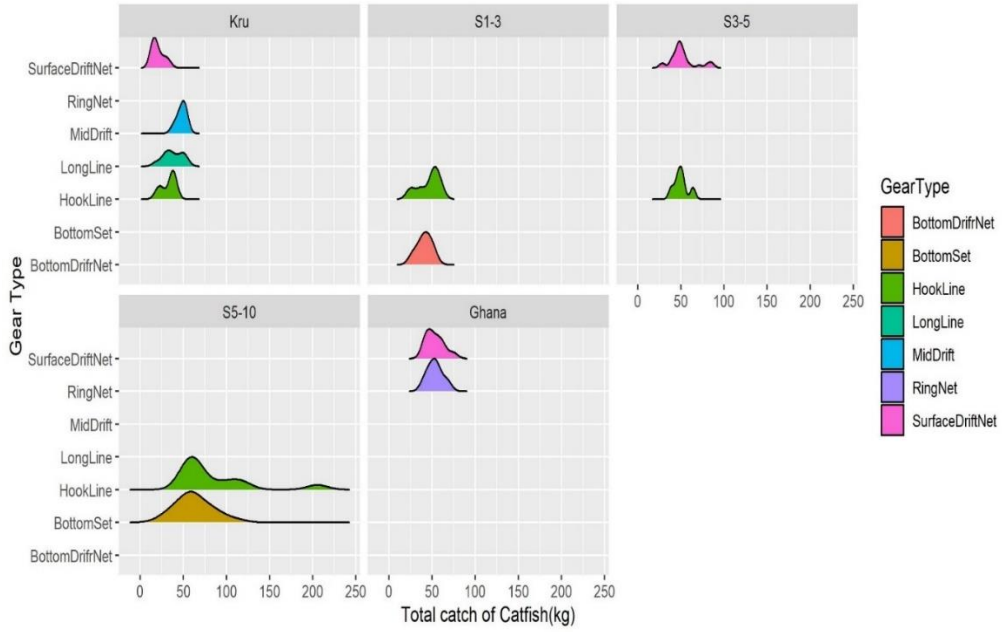


Figure 16. Total catch of catfish species (kg) in Konakridee by boat and gear type.

Sulima utilizes three distinct gear types as depicted in (Figure 15). Notably, the surface drift net is employed across all four types of fishing vessels, except for the Kru canoes. Interestingly, catches have a wider range in Standard 3-5, Standard 5-10, and Ghana boats than in Standard 1-3 vessels. (Figure 18). Furthermore, while the set net is utilised in Kru canoes, it demonstrates a greater catch range in Standard 1–3 vessels. Kru canoes which use paddling catch considerably lower amounts of fish.

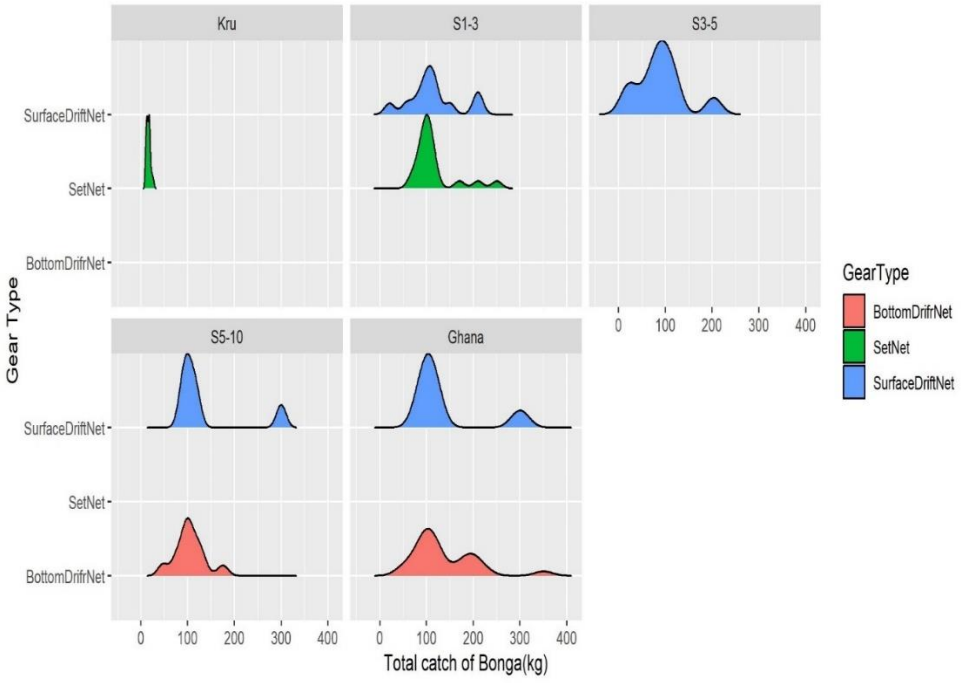


Figure 17. Total catch (in kg) of bonga species in Sulima by boat and gear type.

Different gear types yield varying lengths of catfish catches: long-line fishing captures a wide range of lengths, bottom-set nets target larger fish, and mid-drift nets focus on smaller fish, as depicted in (Figure 19). Additionally, the average length of catfish caught by Standard 3-5 vessels (42.2 cm) differs from that caught by Ghanaian boats (36.2 cm), suggesting potential influences from differences in fishing techniques, gear types, or targeted fish species between the two vessel categories.

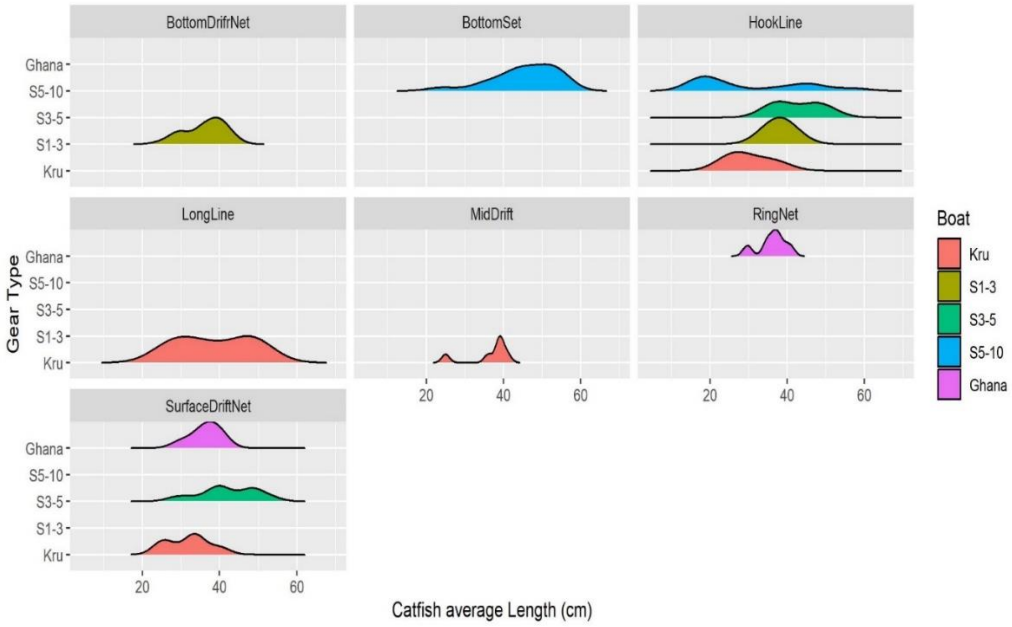


Figure 18. Length distribution of the average estimated length (cm) of catfish species caught by fishermen in Konakridee using boats and gear type.

The length range of bonga caught by gear/boat type shows that larger boats using surface drift nets estimate catching fish between the sizes of 10–15 cm (Figure 20). Kru canoes that exclusively utilize set nets, estimate a broad range of catch lengths. These observations highlight the nuanced interplay between gear types and catch lengths in the fishing practices of the Sulima, demonstrating variations in catch outcomes across different vessel categories and gear selections.

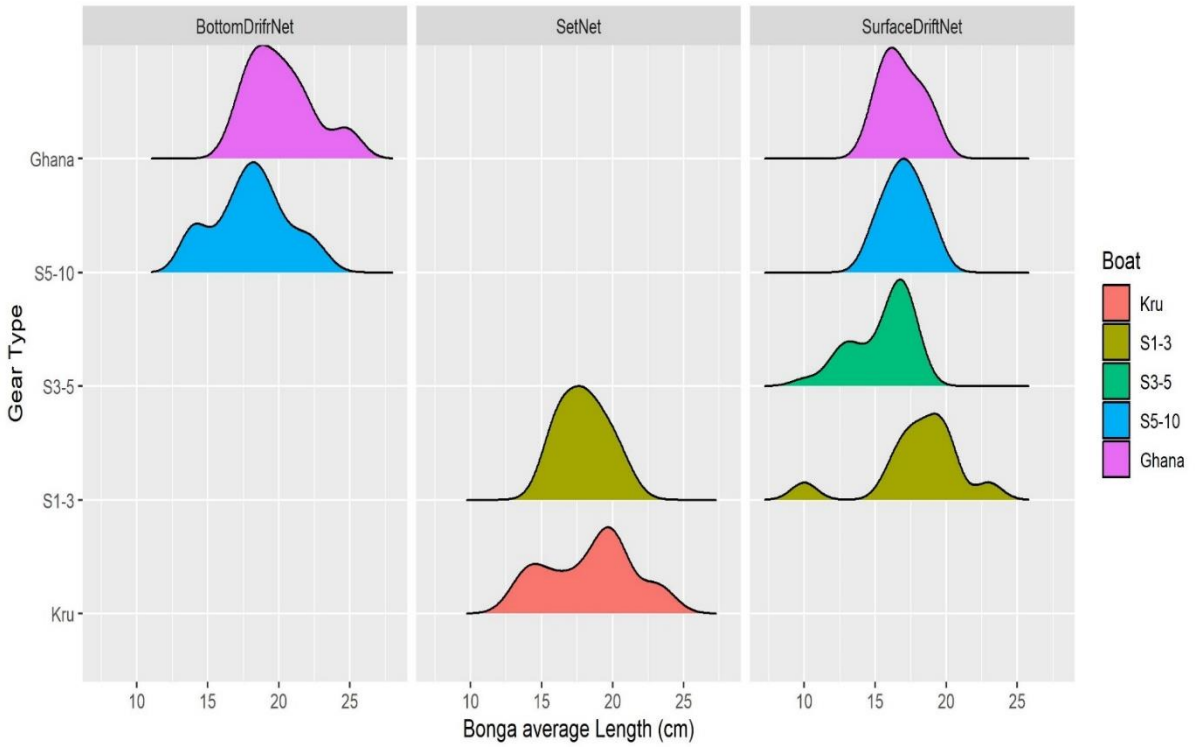


Figure 19. Length distribution of the average estimated length (cm) of bonga fish caught by fishermen in Sulima by boat and gear type.

The catch values of bonga at the Sulima landing site and catfish at the Konakridee landing site showed distinct patterns based on boat type and fishing practices (Table 1). At Sulima, the value of the bonga catch appears to be driven by the quantity of catch and freshness. Conversely, at Konakridee, the value of the catfish catch may depend on the length of the catch rather than the size of the vessels. The handling of the catches by vessels also seems to be important, as well as the freshness of the catch. Fishermen in Konakridee employ varying mesh sizes for fishing, indicating a more diverse approach to gear selection. This variability in mesh size usage may contribute to differences in catch, highlighting the importance of considering fishing practices alongside boat type when analysing catch data.

Table 1. Value of catch by boat types across Sulima and Konakridee.

Site	Boat	Specie	CatchValue
Sulima	Kru	Bonga	500
Sulima	S1-3	Bonga	700
Sulima	S3-5	Bonga	700
Sulima	S5-10	Bonga	900
Sulima	Ghana	Bonga	900
Konakridee	Kru	Catfish	700
Konakridee	S1-3	Catfish	500
Konakridee	S3-5	Catfish	600
Konakridee	S5-10	Catfish	600
Konakridee	Ghana	Catfish	600

4.2 Harbour master interviews

The data collected from the interviews with the harbour masters are considered a random sample and provide valuable insights into fishing activities in Konakridee and Sulima. These harbour masters were selected by community members and endorsed by the Ministry of Fisheries and Marine Resources to oversee fishing operations and ensure compliance with the rules and regulations. Their input sheds light on various trends and practices within fishing communities, offering a comprehensive understanding of the dynamics at play. Through their roles, harbour masters play a crucial role in facilitating fishing activities, maintaining order, and upholding regulatory standards to promote sustainable fishing.

Notably, Konakridee has fewer Ghana boats for fishing, whereas in Sulima, the Ghana boat is the most used vessel type according to the harbour masters (Figure 21). Potential factors contributing to this difference may include differences in fishing grounds and targeted fish species. Additionally, standard 5–10 vessels are reported to be the most prevalent boat type for fishing in Konakridee, whereas Kru canoes and standard 1–3 are fewer in number and less frequently used for fishing in Sulima.

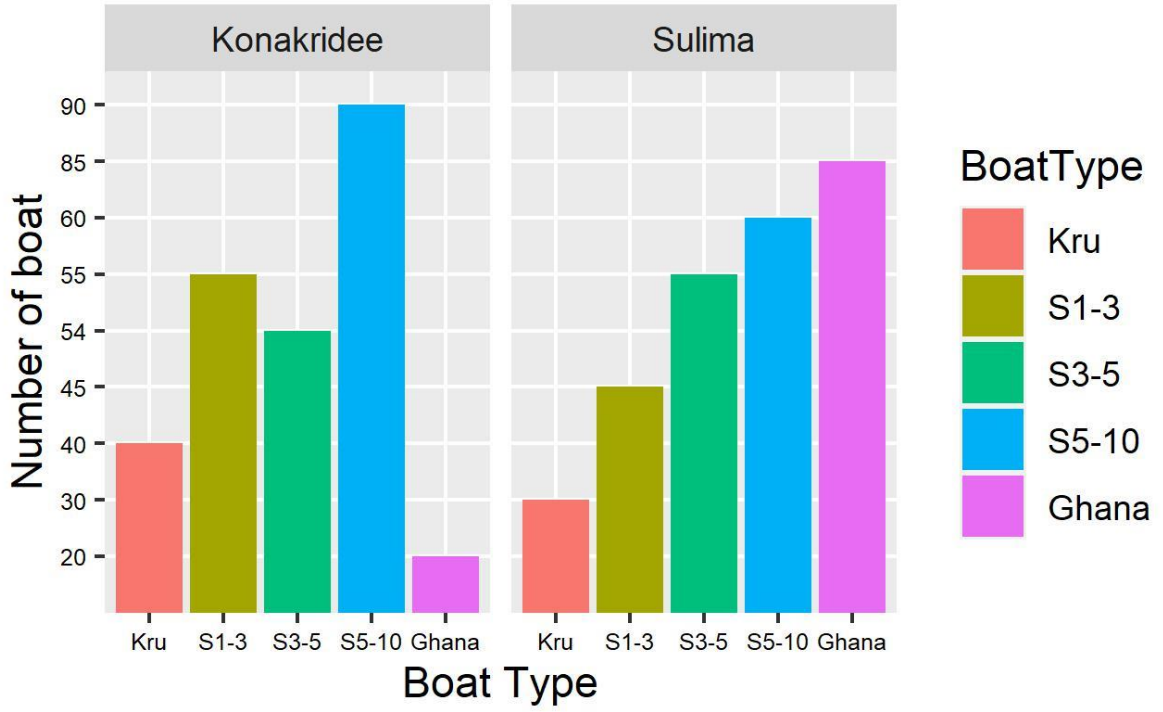


Figure 20. Estimated number of boats activity fishing in Konakridee and Sulima by boat type, according to harbour masters.

4.3 Enumerator interviews

The data collected from the interviews with the enumerators represent a random sample and offer valuable insights into fishing activities in Konakridee and Sulima. Enumerators are deployed to landing sites in both regions to ensure accurate and comprehensive reporting of fishing data to the Ministry of Fisheries and Marine Resources. Their role is pivotal in maintaining a proper dataset documenting all ongoing fishing activities, thereby facilitating informed decision-making and resource management. By meticulously recording and reporting fishing data, enumerators contribute to the creation of a robust information framework essential for monitoring and regulating fishing practices. Their efforts play a crucial role in promoting transparency, accountability, and sustainability in the fisheries sector.

Enumerators estimated that they sampled more Standard 1–3, Standard 1–5, and Standard 5–10 boats in Konakridee than Sulima (Figure 22). Ghana boats were reported to have the fewest samples. Conversely, in Sulima, Kru canoes were identified as the most sampled boats at the landing sites. Interestingly, although Ghana boats were the most prevalent vessel type at the Sulima landing site, they were least frequently sampled by the enumerators.

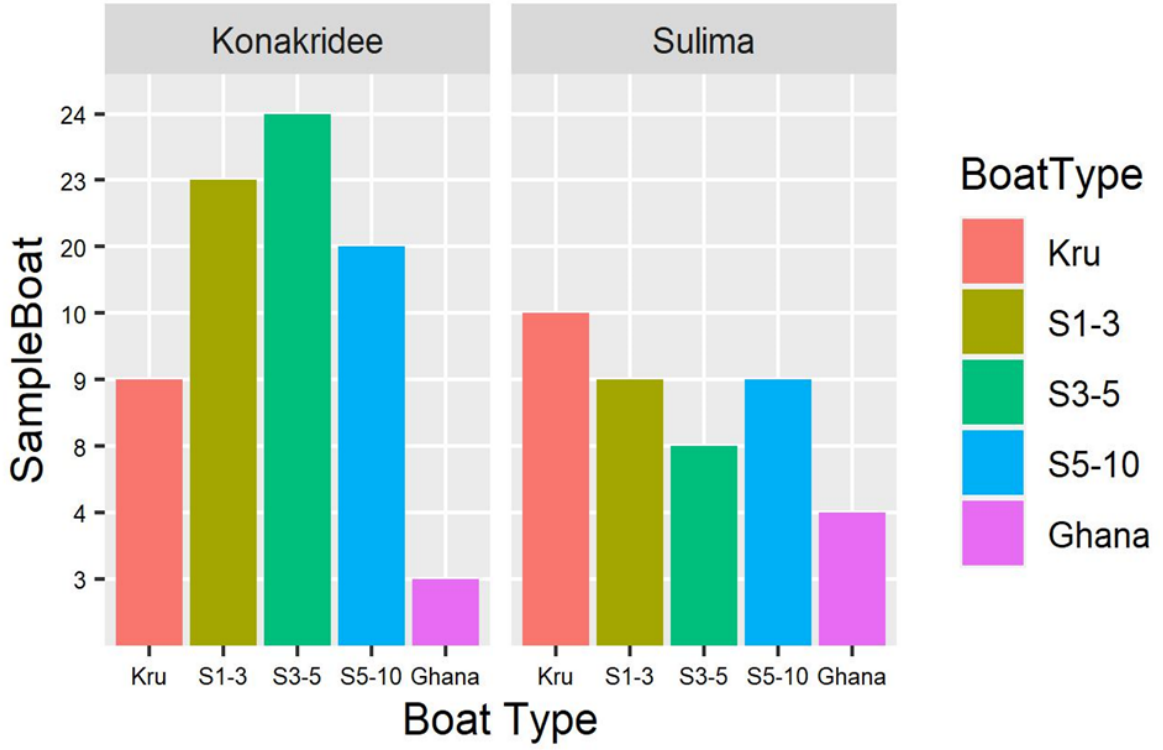


Figure 21. Number of boats sampled by enumerators in Konakridee and Sulima by boat type.

4.4 CPUE on bonga and catfish fishing

4.4.1 Bonga fishing

The catch per unit effort (CPUE) analysis revealed different trends in bonga fishing efficiency across different gear types and vessels (Figure 23). The median CPUE was slightly higher when utilising a bottom drift net compared to a surface net, indicating that bottom nets can be more efficient. Interestingly, both bottom and surface drift nets exhibited high outliers in CPUE, suggesting occasional instances of exceptionally successful fishing trips. In contrast, CPUE values were considerably lower when utilising a set net with Kru canoes, indicating lower catch rates compared to standard 1–3-boat types that utilised the same gear. This suggests that the catch efficiency of Kru canoes is lower because they are non-motorised. These differences in CPUE underscore the variability in fishing efficiency across different gear types and vessel types, highlighting the importance of gear selection in optimising catch rates for bonga fishing.

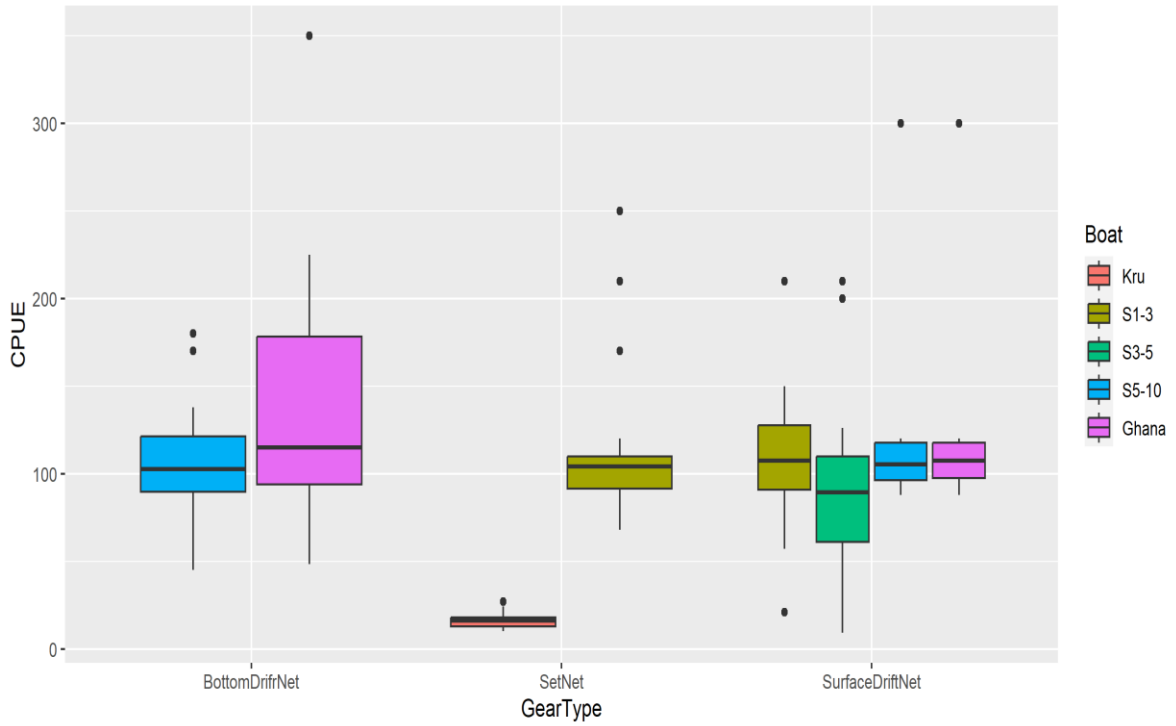


Figure 22: Variation in catch per unit effort (CPUE) by gear type in bonga fishing.

4.4.2 Catfish fishing

The analysis of CPUE values for catfish reflects several trends that emerge across different fishing gears and vessel types (Figure 23). Specifically, for Ghanaian boats employing ring nets and surface drift nets, there is a notable low CPUE, indicating lower catch efficiency for these gear types. Conversely, CPUE values are higher for mid nets and long lines, suggesting that these methods are more effective for catfish capture. Interestingly, Kru canoes have high catch efficiency for mid drift nets and long lines; however, a lower CPUE is observed with surface drift nets. This variation suggests differential efficacy among gear types employed by Kru canoes. Furthermore, for vessels categorised as Standard 3–5, there is a stable low CPUE associated with hook lines and surface drift nets. These findings underscore the importance of understanding the effectiveness of various fishing gears and vessel types in relation to CPUE, offering insights into optimising fishing strategies for catfish capture across different fishing fleets.

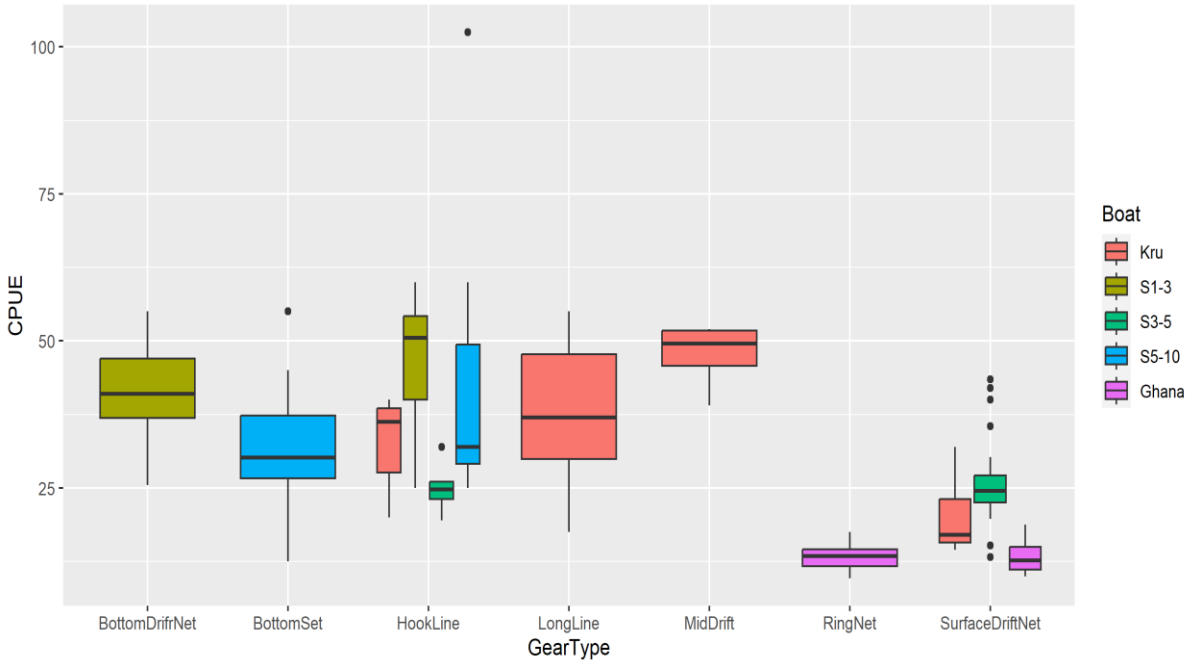


Figure 23. Variation in catch per unit effort (CPUE) by gear type in catfish fishing.

5 DISCUSSION

5.1 The current artisanal fishery program in Sierra Leone

The method developed and implemented in the current study to collect data by targeting local knowledge to gather information about detailed fishing patterns is an innovative approach for Sierra Leone. This provided a good foundation for the current study to develop and implement the use of questionnaire-based interviews to gather local knowledge from fishermen/boat owners, harbour masters, and enumerators as a concept for Sierra Leonean artisanal fisheries. These knowledge gaps filled detailed insights into where, when, and how fishing activities occur, including specific fishing grounds, techniques used, and seasonal variations. Local knowledge has unveiled the variety of fish species pursued by fishermen and documented shifts in their populations over time, a realm that was previously lacking comprehensive documentation. It helped to understand the status of artisanal fisheries and to fill gaps in understanding the ecological dynamics of Sierra Leone's coastal and marine ecosystems. By understanding fishing pressure and identifying vulnerable species, it has provided valuable information to inform the development of targeted conservation and sustainable management measures, addressing gaps in effective fisheries management strategies. Additionally, it has offered insights into the social and economic dimensions of fishing in Sierra Leone, including its role in local livelihoods, cultural practices related to fishing, and the socioeconomic impacts of changing fisheries dynamics in the two regions investigated.

The government should allocate resources, including funding and personnel, to support the collection and analysis of data using local knowledge. This may involve investing in training

local researchers or partnering with organisations experienced in working with local communities.

They can also engage with local fishing communities which is essential for the success of local knowledge initiatives. Building trust, respecting local knowledge systems, and involving communities in the design and implementation of research projects can enhance the quality and relevance of the data collected.

The current artisanal fisheries program in Sierra Leone aims to support small-scale fishers in securing their livelihoods while promoting the conservation of fish stocks and marine ecosystems. This program typically includes initiatives such as capacity-building workshops, access to improved fishing gear, and community-based management approaches. However, despite these efforts, there are still some shortcomings and knowledge gaps.

One major shortcoming is the lack of comprehensive data on artisanal fishing, including catch statistics, fishing effort, and species composition. Limited control and monitoring infrastructure makes it difficult to accurately assess fish stocks and the effectiveness of management measures. There is also a lack of coordination and collaboration between government agencies, non-governmental organisations (NGOs), and local fishing communities, leading to fragmented efforts and suboptimal results.

Knowledge gaps exist regarding the socioeconomic dynamics of artisanal fishing communities, including their livelihood strategies, access to markets, and vulnerability to external shocks, such as climate change and economic volatility. Understanding these factors is critical to developing targeted interventions that address the specific needs and challenges of fishers and their communities.

In addition, research and data collection are needed to assess the impact of artisanal fishing on marine ecosystems, including habitat destruction, bycatch, and overfishing. Without this information, it is difficult to develop science-based management strategies that balance conservation goals with the socioeconomic needs of fishing communities.

Improving data collection, fostering collaboration among stakeholders, and conducting targeted research are essential steps toward more effective and inclusive fisheries management in the country. The current study only focuses on two sites as a case in point to illustrate the use of local knowledge. If a study like this is conducted on a full scale, with multiple sites within the region, the data can be used to increase the catch samples to total catches by landing sites and regions. This level of information is currently missing for the artisanal fisheries.

5.2 Patterns in local knowledge data

5.2.1 Fishermen

The data obtained from the interviews with the fishermen provided valuable insights into fishing practices and dynamics in Konakridee and Sulima. In Konakridee, fishing is primarily focused on catfish, whereas in Sulima, it is mainly focused on bonga. Despite this difference, both regions have similar fishing seasons, which take place six days a week, with separate non-fishing days in each community. Sundays in Sulima and Fridays in Konakridee. In addition, the

most active fishing months differ in the two regions. In Sulima, March is the peak fishing season, and in Konakridee, July, October, and November are the busiest.

In terms of demographics, the fishermen in Konakridee generally have more fishing experience than those in Sulima, and this is particularly evident among the Kru canoe fishermen. The activities they do for a living also differ. Most fishermen in Sulima are exclusively engaged in fisheries, whereas fishermen in Konakridee often pursue additional activities.

Educational levels also differ, with more non-formal education prevalent in Sulima, while Konakridee has a more diverse educational landscape, including some fishermen with secondary education. The size of fishing vessels correlates with engine power and the number of crew members in both regions; larger boats have more powerful engines and more crew members.

Fishing gear differed between the regions, with Sulima mainly using three types, while Konakridee had a wider choice. There were also differences in the choice of mesh size: Sulima fishermen used a uniform size of 37 for all gears, while Konakridee fishermen used different mesh sizes, such as 30, 32, 35, 40, and 45.

Within the Konakridee fishing community, diversity relates to the adaptability and ingenuity of Konakridee fishermen, who use a range of gears tailored to specific fishing needs and conditions. The use of hook-and-line methods with different hook sizes reflects a nuanced approach to gear selection, potentially influenced by factors such as target species, fishing location, and seasonal variations. In contrast to the more standardised or limited gear options seen in other fishing communities, the diverse techniques used in Konakridee reflect a rich tradition of knowledge and experience.

In terms of licencing and registration of vessels, compliance is better in Sulima, as all vessels are registered and all licences are paid. In contrast, Konakridee faces challenges, including a significant proportion of unregistered boats and unpaid licences, especially for Ghanaian boats and Standard 3-5 vessels. While Sulima also faces issues such as poor road infrastructure, which affects income, Konakridee faces obstacles such as high equipment and repair costs and rocky fishing grounds.

These differences underline the complex socioeconomic dynamics in fishing communities and highlight the need for tailored measures to address the specific challenges faced by fishermen in different regions.

5.2.2 Enumerators

The data obtained from interviews with enumerators provide crucial insights into fishing activities in Konakridee and Sulima. Enumerators play a central role in ensuring the accuracy and completeness of fishing data reported to the Ministry of Fisheries and Marine Resources. By deploying enumerators at landing sites, both regions seek to maintain a comprehensive dataset that is essential for effective decision-making and resource management in the fisheries sector. Through careful record-keeping and reporting, enumerators contribute to transparency, accountability, and sustainability in the industry.

During the interviews at the landing site in Sulima, discrepancies were found in the information provided by the enumerators on mesh size. While the fishermen reported that a mesh size of 37

mm was used consistently on all vessels, the enumerators reported different mesh sizes, specifically 44 mm for Standard 5-10 and Ghana boats. It was also found that the average catch in Sulima tended to increase with boat size. However, in Konakridee, the average catch was not determined by boat size alone but rather by the catches of individual vessels.

The data collectors in both regions had similar roles and responsibilities, which emphasises the importance of their contributions to maintaining accurate and reliable fishing data. Overall, these results underline the importance of enumerators' efforts to ensure data integrity and informed decision-making in the fisheries sector.

5.2.3 Harbor master

The insights gained from the interviews with the harbour masters provide valuable information about overall fishing activities in both Konakridee and Sulima. The harbour masters, selected by the municipality and recognised by the Ministry of Fisheries and Marine Resources, oversee fishing and ensure compliance with the rules and regulations. Their contribution provides comprehensive insights into trends and practices within fishing communities and contributes to a deeper understanding of the dynamics.

Harbour masters play a central role in facilitating fishing activities, maintaining order, and ensuring compliance to promote sustainable practices. In Konakridee, the interviews revealed discrepancies between the mesh sizes for Standard 1-3 and Standard 3-5 and the information provided by the fishermen. In addition, data from the harbour masters indicate that the percentage of active boats in Sulima is 94.5%, while it is 79.9% in Konakridee.

Discussions with the harbour masters also revealed that no new fishing licences should be issued, except for those already in possession of fishing vessels. This underscores the importance of regulatory oversight and compliance in the fishing industry. Overall, the findings from the harbour masters underscore their critical role in ensuring the integrity and sustainability of fishing activities in both regions.

6 RECOMMENDATIONS

6.1 Recommendations for improving questionnaire surveys

The interview data collection system, which occurred in March, contained key information required for catch per unit effort (CPUE) analysis. The data collectors were willing to take over their tasks in collecting information from fishermen, harbour masters, and enumerators. The data were imported into the statistical software R for further analysis. After collecting the interview data, the following errors and inconsistencies were found during extraction, conversion, and analysis.

- Specifically asking whether the fishermen travel in different directions on different days.
- Collecting information on the number of crews per day.
- The values of landed catches should be collected on a daily basis.
- Duration of the travel to the fishing ground
- Time spent fishing.

6.2 General recommendations

- The sampling design should be closely followed, and the sampling frequency should be maintained to provide reliable measurements of sample-based catch estimates, which is a common practice in small-scale artisanal fisheries with multiple fishing areas.
- Fisheries management should continue to fully support data collection programs for artisanal fisheries for good fisheries management.
- Harbor masters should be involved in a better way in data collection.
- Provision should be made for both enumerators and harbour masters to promote data collection.
- A simple method should be developed for calculating catch per unit effort (CPUE) as an indicator of the status of fish stocks.
- There should be a need to collect information on the time travelled to the fishing ground and the time spent fishing.
- Gear regulations: Establish and enforce gear regulations, mesh sizes, and fishing methods to minimise habitat destruction, bycatch, and overfishing. Promote the use of selective and environmentally friendly fishing gear to reduce negative impacts on non-target species and marine habitats.
- All data should be quality checked before and after entry into the database.
- Training on database entry should be provided to staff.
- Market access and value chains: Improve market access and value chains for fishers in Konakridee and Sulima to ensure fair prices, reduce post-harvest losses, and improve economic opportunities. This can be done by supporting the development of local processing facilities and marketing cooperates.

7 CONCLUSION

In conclusion, at the Konakridee Landing Site in the northwest and the Sulima Landing Site in the south, several key observations emerge. Both landing sites represent vital hubs for fisheries activities within their respective regions, playing crucial roles in supporting local livelihoods, food security, and economic development.

Questionnaires are often a relatively inexpensive way to collect data compared with other methods, such as interviews or on-site observations. They can be widely distributed and completed remotely, reducing travel costs and time. They can be administered to many respondents simultaneously, allowing for broader data collection and potentially more representative results. Respondents may feel more comfortable providing honest answers to sensitive questions about their fishing practices through a questionnaire, especially if they can remain anonymous.

In both locations, artisanal fishing practices are deeply rooted in the community's culture and traditions.

Additionally, differences in the fish species targeted and market dynamics influence the fishing structures observed at each location. For example, Konakridee focus on species such as catfish, whereas Sulima have a different species composition based on its geographical location and ecological factors, hence the focus on species such as bonga.

Moreover, governance structures and management approaches at each landing site play a crucial role in shaping fishing activities and resource utilisation. Traditional leadership, community-based management initiatives, and government regulations have contributed to the overall structure and function of the fisheries sector in Konakridee and Sulima.

Both landing sites are important fishing communities in Sierra Leone and exhibit unique characteristics shaped by their geographical, cultural, and socioeconomic contexts. Understanding these differences is essential for developing targeted interventions and policies to promote sustainable fisheries management and support the well-being of coastal communities in both regions.

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APPENDICES

Appendix 1: Individual questionnaire for fishermen/boat owners on catch, effort, and income data.

INDIVIDUAL QUESTIONNAIRE

DEVELOPING AND IMPLEMENTING TOOLS TO GATHER LOCAL KNOWLEDGE ON BONGA AND CATFISH ARTISANAL FISHERIES IN NORTHWEST AND SOUTHERN REGION OF SIERRA LEONE.

FISHERMEN/BOAT OWNERS

DATE:

1. REGION:.....
2. FISH LANDING SITE:.....
3. TYPE:

Fishermen ☐

Boat owners ☐

DEMOGRAPHIC

4. Name:.....

5. Sex:

Male ☐

Female ☐

6. Age:.....

7. How long have you been fishing (years)? ……

8. Do you do other jobs besides fishing?

Yes ☐ No ☐

If yes, please specify……

9. What is your educational status?

A. Non formal ☐ B. Primary ☐

C. Secondary ☐ D. Vocational ☐

E. University ☐

EFFORT DATA

10. Boat type:

A. Kru canoe ☐ B. Standard 5-10 ☐

C. Standard 1-3 ☐ D. Ghana boat ☐

E. Standard 3-5 ☐

11. Engine type/s:….....

12. Number of fishing trips per day:.....

13. Number of crew:.....

Trip 1 ☐

Trip 2 ☐

14. How many miles do you fish from shore?.....

Trip 1 ☐

Trip 2 ☐

15. In which direction do you travel to reach the fishing area? …….....

Trip 1 ☐

Trip 2 ☐

16. How long is each fishing trip (in hours)?: .....

Trip 1 ☐

Trip 2 ☐

10. Gear type/s and size:

Trip	Type of Gear	Mesh size / number & size of hook
Trip 1		
Trip 2		

11. Which days of the week do you go fishing, indicate number of trips per day in the box:

	Number of trips per day
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

12. Do you fish every month of the year?

Yes ☐ No ☐

13. What month do you fish the most?.....

CATCH DATA

14. Species name:.....

15. What is the total catch per trip (kg):

	Trip 1	**Trip 2**
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

16. Average length of fish (cm):

	Trip 1	**Trip 2**
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

17. Do you catch the same amount every month?

Yes ☐ No ☐

18. Do you experience any low season of catch?

Yes ☐ No ☐

Please specify the low season (months) .....

19. What challenges do you face?.....

……

…….....

…….....

INCOME

20. Value of catch per kg (LE):

	Trip 1	**Trip 2**
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

21. Have you paid licence fees?

Yes ☐ No ☐

22. Have you registered your vessel?

Yes ☐ No ☐

23. What challenges do you face in maintaining a stable income from fishing?

.....

.....

.....

24. Do you receive any financial support from government programs? If yes, please specify.

Yes ☐ No ☐

……

……

……

Appendix 2: Individual questionnaire for harbour masters on effort, and income data.

INDIVIDUAL QUESTIONNAIRE

DEVELOPING AND IMPLEMENTING TOOLS TO GATHER LOCAL KNOWLEDGE ON BONGA AND CATFISH ARTISANAL FISHERIES IN NORTHWEST AND SOUTHERN REGION OF SIERRA LEONE.

HARBOR MASTERS

DATE:

1. REGION:.....
2. FISH LANDING SITE:.....

DEMOGRAPHIC

3. Name:.....
4. Sex:

Male ☐

Female ☐

5. Age:.....

EFFORT DATA

6. Number of boats in the harbour (fish landing site)

Kru canoe.....

Standard 1-3.....

Standard 3-5.....

Standard 5-10.....

Ghana boat.....

7. What type/s of gears do the vessels use?

Trip 1	Net type	Hooks
Kru canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boat		

Trip 2	Net type	Hooks
Kru canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boat		

8. What is the mesh size / number and size of hooks for each vessel type?

Trip 1	Mesh size	Number and size of hooks
Kru canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boat		

Trip 2	Mesh size	Number and size of hooks
Kru canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boat		

9. Are all the fishing vessels active at the landing site?

Yes ☐ No ☐

Please specify the proportion of active boats (100 boats but only 30 fishing actively for example): …….

10. Fishing days per week:

	Number of fishing days per week
Kru canoe	
Standard 1-3	
Standard 3-5	
Standard 5-10	
Ghana boat	

INCOME

11. Number of licensed boats:.....

12. Does the ministry issue new licenses to fishermen/boat owners?

Yes ☐ No ☐

13. Are there any closed fishing area being set up?

Yes ☐ No ☐

14. In your experience, have you seen a change in the numbers of boats/licences actively fishing? Please tick the box below for the corresponding changes:

Increase numbers ☐ Decrease numbers ☐

Appendix 3: Individual questionnaire for enumerators on catch, effort, and income data.

INDIVIDUAL QUESTIONNAIRE

DEVELOPING AND IMPLEMENTING TOOLS TO GATHER LOCAL KNOWLEDGE ON BONGA AND CATFISH ARTISANAL FISHERIES IN NORTHWEST AND SOUTHERN REGION OF SIERRA LEONE.

ENUMERATORS

DATE:

1. REGION:.....
2. FISH LANDING SITE:.....

DEMOGRAPHIC

3. Name:.....
4. Sex:

Male ☐

Female ☐

5. Age:.....
6. What is your role at this fish landing site?.....

EFFORT DATA

7. How many boats do you sample in a day?

	Kru canoe	**Standard 1-3**	**Standard 3-5**	**Standard 5-10**	**Ghana boat**
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

8. What type/s of gears do the vessels use?

Trip 1	Net type (please specify)	Hooks
Kru canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boat		

Trip 2	Net type (please specify)	Hooks
Kru canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boat		

9. What is the mesh size / number and size of hooks for each vessel type?

Trip 1	Mesh size	Number and size of hooks
Kru canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boat		

Trip 2	Mesh size	Number and size of hooks
Kru canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boat		

10. Number of fishing days per week:

	Number of fishing days per week
Kru canoe	
Standard 1-3	
Standard 3-5	
Standard 5-10	
Ghana boat	

CATCH DATA

11. Amount of average catch (kg) per trip:

	Trip 1	**Trip 2**
Kru Canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boats		

13. Average length of fish (cm):

	Trip 1	Trip 2
Kru Canoe		
Standard 1-3		
Standard 3-5		
Standard 5-10		
Ghana boats		

INCOME

14. Do you receive a salary?

Yes ☐ No ☐

15. Do you assist the harbour master with other duties? If yes, please specify

……..

.....

.....

16. Do you have supplementary income outside your enumerator job?

Yes ☐ No ☐

……..

.....

.....

Appendix 4: Budget

Table 2. Budget for data collectors and respondents for Konakridee and Sulima.

1 main Landing site in each region							
3 days of sampling per site							
Konakridee							
	Site	Days	Boat type	Number	Unit cost	Total	
Data collector pay (1 data collector per landing / 3 days of s	1.00	3.00			31.05	93.15	
Travel cost	1.00	3.00			15.05	45.15	
Fishermen incentive (15/site [10/boat category] * 3 sites)	1.00		5.00	5.00	15.05	376.25	
Harbour Master incentive (1/site)	1.00			1.00	15.05	15.05	
Enumerator incentive (1/site)	1.00			1.00	15.05	15.05	
Total						**544.65**	
Sulima							
	Site	Days	Boat type	Number	Unit cost	Total	
Data collector pay (1 data collector per landing / 3 days of s	1.00	3.00			31.05	93.15	
Travel cost	1.00	3.00			20.05	60.15	
Fishermen incentive (15/site [10/boat category] * 3 sites)	1.00		5.00	5.00	15.05	376.25	
Harbour Master incentive (1/site)	1.00			1.00	15.05	15.05	
Enumerator incentive (1/site)	1.00			1.00	15.05	15.05	
Total						**559.65**	
Total						**1104.3**	