UiT
THE ARCTIC
UNIVERSITY
OF NORWAY

Faculty of Bioscience, Fisheries and Economics

Survey of Artisanal Fishing Gear and Craft

A case study of Kainji Lake lower basin, Nigeria.

—

Damilare Ibukun Ogundiwin

Master Thesis in International Fisheries Management
August, 2014.

DECLARATION

I hereby declare that this thesis is the result of my own original research and no part of it has been submitted anywhere. All references have been duly acknowledged and I therefore bear a sole responsibility for any shortcomings.

Damilare Ibukun Ogundiwin

I hereby certify that this thesis was supervised in accordance with the procedures laid down by The Artic University of Norway, Faculty of Biosciences, Fisheries and Economics

Associate Professor Jorge dos Santos

Supervisor

DEDICATION

This thesis is dedicated to Almighty God for His provision, protection and guidance throughout this study.

ACKNOWLEDGEMENT

First and foremost, all my gratitude goes to Almighty God for the strength given unto me to complete this work and strength throughout my studies.

My profound gratitude goes to my supervisor, Associate professor Jorge dos Santos for his time, sound advice, direction and suggestion towards the success of this study. I also want to thank him for his constructive criticisms, support, patience and encouragement towards this thesis. His suggestion helped to improve this work significantly.

I would like to express my love to my parent Mr. Oluwakayode Ogundiwin and Mrs. Felicia Ogundiwin for their love, care, daily prayers and their support. I am grateful to my uncle, Akin Adeyemo for always given me word of encouragement and always being there for me and not to forget my only biological brother, Babatunde ogundiwin God bless you.

To you Kehinde Adelakun, I say, you are indeed a friend among friends. A unique friend, your immense contribution to this work will never be forgotten. I also acknowledged the effort of Musbaudeen Bello and Femi Oyeyemi for their contribution and input in this study. Also not to forget Nicholas Sobang for his involvement

And last but not the least, all my thanks to all the people i met during the course of this programme. I extend my greetings to Village leaders in kainji Lake lower basin for their support to this study by encouraging the fishers to participate during field study.

I have no words to thank you enough. God bless u all!

ABSTRACT

Despite the considerable importance of artisanal fishing in Kainji Lake lower basin, knowledge about gear and craft being used is deficient and outdated. Little is also known as to why fishermen adopted the diverse fishing gear and craft they use in the Lake, as well as the relationship of these input factors to the socio-economic status of the fishermen and ecology of the lake. To address these issues, a survey of sixty (60) artisanal fishers and twelve (12) village leaders drawn from 12 selected communities was undertaken. The survey was performed as a structured questionnaire to the fishers, and as unstructured interviews with the heads of the fishing villages (*Maigari*). The data collected were analyzed in a dual way: as general statistics of the population of fishers (aggregate analysis), and as multi-dimensional statistics of the individual respondents (respondent analysis). The survey showed that the commonest gear are gill nets, cast nets, hooks and line, traps, surrounding nets, beach seines and lift nets. The kind of craft used in the region is planked canoe (paddle and mechanized) with flat bottom hull, and ownership varies across fishermen. Fish diversity is high, and along this survey # species (# families) were detected. There was a trend for association of species to types of fishing gear, and each fisher could own a number of gear types in different amounts. The most frequent species in the catches is x, but in terms of biomass y seems to be the most important, while Nile perch (*Lates niloticus*) is relevant for fishers is because of its commercial value. The Hausa ethnic group is dominant in number among the resident fishers. Relationship between gear types and socio-economic status of the fishers revealed *inter alia* that fishermen that use gill nets, cast nets and hook & line tend to have larger households, belong to a cooperative society, married and older than their counterparts. Settled older fishers are often members of the local cooperative group (*fadama*), an organization that seems to be less interesting or inclusive for young fishers or outsiders. This seems to exclude these workers from access to credit. The fishers generated a relatively good (gross) income compared to e.g. civil servants in of the state. The majority of the fishers, particularly the settled older men, are part-time in fishing with the possibility of pursuing other activities to generate income. There was contradiction in the opinions of most fishers and village leaders concerning the status and trends of the fisheries in the basin. Further research is needed to provide a better understanding on: (i) dynamics of change of gear with respects to daily or seasonal occurrence; (ii) social dynamics of the fishery.

Keywords: artisanal fishers; Kainji Lake lower basin; fishing gear and craft; socio-economic status; fisheries status.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

CHAPTER ONE

1.0 Introduction

Nigeria is blessed with over 14 million of hectares of reservoirs, lakes, ponds and major rivers capable of producing over 980,000 metric tons of fish annually (FDF, 2007). However, production from inland waters, including man-made reservoirs, is of great significance as it contributes nearly one third (over 30%) of the total fish production with an estimated 60% to the total domestic supply (Abiodun *et al.*, 2005). Not all reservoirs are equally important. The majority of these reservoirs are built on seasonal rivers with paucity of fish species composition and low fish productivity (*Ita et al.*, 1982). Kainji Lake is the largest man-made reservoir in Nigeria (du Feu, 2003). It offers fishing opportunities for artisanal fisherfolk around the region (Omojowo *et al.*, 2010), using different kinds of fishing methods (du Feu, 2003).

The fishery in the Nigerian reservoirs can be characterized as tropical, artisanal multi species and multi-gears activities (Abiodun and Niworu, 2004). Fishing gear can be described as any kind of equipment used in harvesting, cropping, or capturing fish from any water body (Nuhu and Yaro, 2005), while fishing method is how the gear is used. According to Moses (1992), fishing gears has generally undergone many modifications and improvements in consonance with advances in modern technology. Although, the basic principle of wounding, hooking, trapping, encircling, scooping and filtering can still be found. The types, designs and mode of operations of the traditional and modern fishing gear employed in Kainji Lake have been fairly described (NIFFR, 2002; Abiodun and Niworu, 2004). The list include among others, gill nets, cast nets, long line and traps.

Efficient and effective use of any gear on a water body with success, the fisher needs a kind of mobility to enable him/her reach both near and distant fishing grounds or markets. This necessitates the acquisition of a craft. Diversity in fish species habit and habitats has led to the use of different fishing equipment peculiar to water bodies. Seasonal variations in species composition and abundance also necessitate the use of specific fishing gear and craft at a

particular fishing site within a particular period of time. Hence, fishers employ various fishing methods, depending on the season and period of operation (NIFFR, 2002).

Like fishing gear, craft have also passed through many development stages, from trunk of wood, floating calabash and papyrus raft to woody dugout crafts, planked crafts and canoes made up of fiber glass. All these are attempts to increase the efficiency, match water condition and types of gear engaged in fishing (Ambrose *et al.*, 2001). Consequently, craft are designed to match water crossing, shore landing, ability to keep afloat and stabilize on the water. The mobility of employed craft may also depend on the type and size.

Artisanal fisheries accounts for the major fish supply in the developing countries (FAO, 1991). The fisheries are normally characterized by low technology, lack of modern equipment and capital, resulting in labour intensive activities, with little or no opportunities to expand (Ibrahim and Balogun, 2009). Abiodun and Ayanda (2008), reported that profitability of artisanal fishing is directly related to available capital invested on fishing equipment and fishing method. Artisanal fishers are, in general low income earners and their insufficient investment capital in turn affect their net profit.

The present work was first designed as a survey of artisanal fishing gear and craft used nowadays in Kainji Lake lower basin, because updated information was missing. Later it developed into a survey of the fisheries, gear and craft used in that area, as well as the socio-economic characteristics of the fishers.

1.1 Justification

Several studies have surveyed the fishing gears and crafts in Nigeria inland water (Ambrose *et al*., 2001; Agbelege, 2003; du Feu, 2003; Emmanuel, 2009; Kingdom and Kwen, 2009; Kwen *et al*., 2013). Few studies have focused on the fishing gears in Kainji Lake (Yisa et al., 1994; du Feu and kasali, 1996; du Feu *et al*., 1997; NIFFR, 2002), and the last study is already more than 10 years old. But, ultimately the choice of fishing gear relates to the fish stock (resources), fishing communities and socio economic characteristics of the fishers. However, no work has

dealt with the specific linkages between the targeted fish, the craft and gear, the markets and the socio-economic status of the fisheries in the lake. These are the main justification of the present study.

1.2 Objectives

The objectives of this study are;

- To identify the types of craft and gears used by fishers in the study area
- To access the impact of the craft and gears in use on the socio-economic status of the fishers, and vice-versa.
- To investigate the general perception of the fishers and village leaders about the present state of the fisheries in the lake

1.3 Research Questions

Some relevant questions to help accomplish these objectives are;

- Is there any gear type that is significant to fishers? Are the fishers tied to one particular gear (specialists) or mix of gears (generalists) for their fishing activities? What kind of craft do they use, do they also change craft often? If No, what are the reasons for using either motorized craft or paddle craft?
- Is there any relationship between the fishing gear and socio-economic status of the fishers? If so, what are the major determinant factors for choosing both gear and craft types?
- Does species diversity leads to the use of different kind of gear in Kainji Lake lower basin? Does the fishers have preference for particular species? If they do, what are the factor responsible?
- Is there any evidence to suggest that the fisher's level of income determine the type of gear and craft used? How does the fish marketing operation look like?

- What are the understanding of the fishers on the present state of fisheries in the lake and challenges facing fishers at the study area?

1.4 Outline of the Study

The thesis was organized into six chapters;

Chapter one is the introduction to the study. It gives indication of what is to come in the study.

Chapter two presents the review of previous research activities undertaken on Nigeria inland waters. A description of the inland water artisanal fishery in Nigeria is made, giving emphasis to the diversity of fish species, classification of gear and craft and the livelihood of the fishers. A short account is also made of the usual design of fishery surveys in tropical water. Such as how to collect data and challenges faced during fieldwork.

Chapter three describes the approaches used to reach the objectives of the study. This includes, the development of structured questionnaire to be used with the fishers and unstructured interview with the head of the fishing villages. Further, a description is made for the examination of the data collected by means of general analyses (aggregate statistics) and multivariate analyses (respondent analysis).

Chapter four contains the key findings of the study. A data set collected from the survey conducted are explained using graphs and tables. This includes the identification of the trends in the structure of the fishery (fishers and number of gears and craft used), as well as estimate of fisher's weekly income.

Chapter five discusses these key findings, their scientific consonance with the previous researches is undertaken.

Chapter six presents the conclusion drawn from the study and recommendation with further future study towards Kainji Lake lower basin fisheries is developed.

CHAPTER TWO

2.0 Literature review

2.1 Artisanal fisheries in Nigeria

Many artisanal fisheries along shoreline areas in most places in the world are of the "S" type: Small-scale, Spatial-structured and catching Sedentary stocks (Orensanz *et al*., 2005). It may be a native fisheries for sustenance or commercial fishing using indigenous or small scale fishing gear like nets, traps and also using motorized or non-motorized fishing boat during fishing activities (Mustapha, 2013). Artisanal fisheries use proportionally little amount of monetary capital for fishing activities by covering short distances close to the coastal shore of the water. The harvested fish are sold in their locality and consumed by fisher's families (Mustapha, 2013).

Like in many other places, artisanal fisheries in Nigeria (Figure 1) are characterized by low scientific knowledge, deficiency of modern equipment and modest investment. These usually result into intensivity of labour utilization, and little or no prospect of expansion (Ibrahim *et al*., 2009). Statistics has shown that fish demand exceeds supply (Ibrahim *et al*., (2009). Tsadu *et al.*, (2006) and Ibrahim *et al*., (2009) estimated fish demand in Nigeria to be about 1.3 million metric tons, but the annual fish consumption was estimated to be 2.6 million metric tons (Clement, 2013; Oyakhilomen and Zibah, 2013). The inadequate in fish supply may have transformed to high price of fish (Ita, 1993). Local production of fish is dominated by artisanal fisheries, accounting for almost 85% of total fish productions (Mustapha 2013). In spite of this small scale operation, artisanal fisheries contribute significantly to sustainable livelihoods of people in several ways.

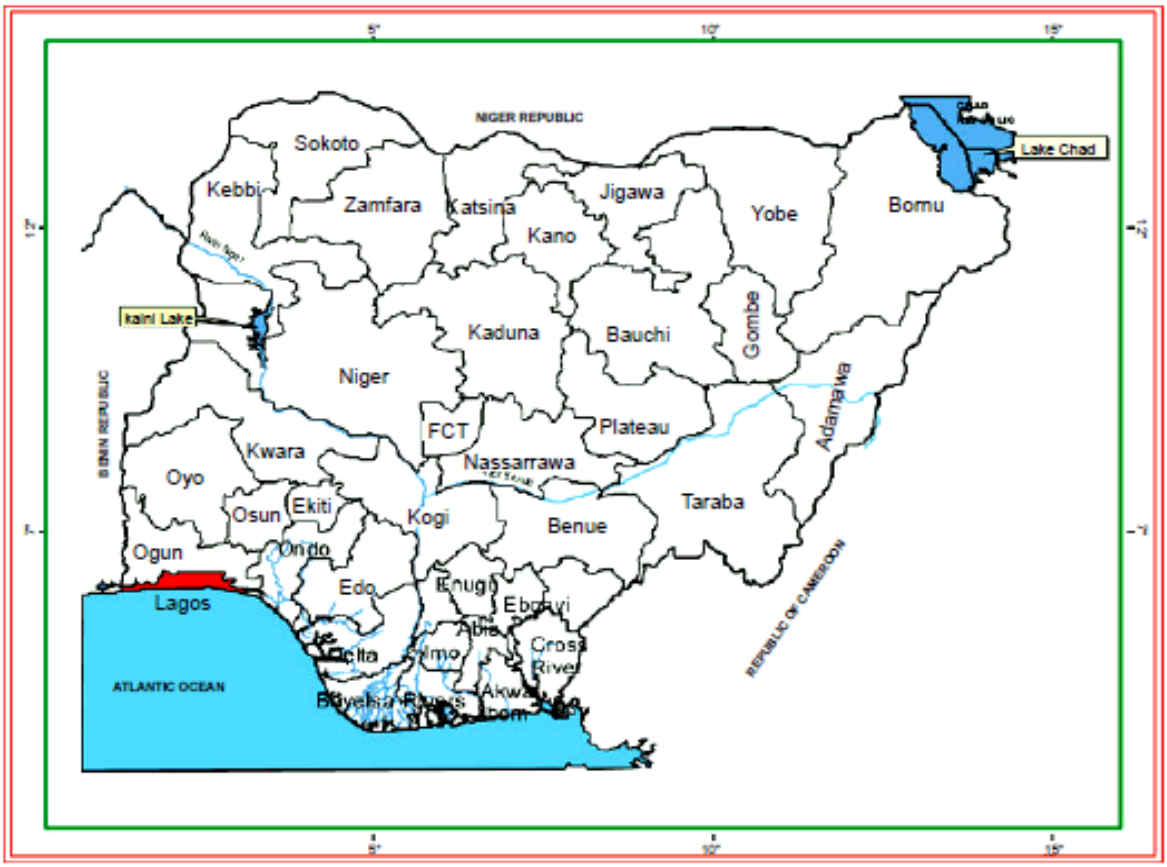


Figure 1: Map of Nigeria with blue line showing the State where Artisanal Fisheries takes place (Adapted from Mustapha, 2013). Kainji Lake, in western central Nigeria, is marked.

2.1.1. Fish Diversity in Inland Water of Nigeria

Nigeria has large natural aquatic ecosystem that provide spawning and feeding habitats for a large number of freshwater and brackish water fish species (Meye and Ikomi, 2008; Emmanuel, 2009). These aquatic ecosystems with more than 270 fish species varieties are outstanding in terms of richness in West Africa (Meye and Ikomi, 2008). The diversity and conservation of fish in inland water has attracted the attention of many researchers over the years. Teugels and Powell, (1993) reported about 243 species and 36 families mainly freshwater, in Niger basin, a region of high abundance in Nigeria. Ita, (1993) revealed 268 diverse fish species in 34 well recognized Nigeria freshwater Lakes, rivers and reservoirs, with a surface of about 98,185, kilometer square are equivalent to 12% of the Nigeria entire area. In Kainji Lake alone, about 30

fish families have been described (Beadle, 1974; Lowe-McConnell, 1999) and these includes *Centropomidae*, *Citharinidae*, *Cichlidae* and *Characidae* family (du Feu, 2003)

Food accessibility, rate of breeding, spawning grounds, availability of water current, vegetation, water depth, migration of the fish as well as low predation have been previously suggested as major factors responsible for the distribution of fish families in the lake (Akintunde, 1976; Olatunde, 1977; Ita, 1978). However, Lawson (2010) pointed out that external drivers like habitat degradation could affect biomass of inland species. The human impacts, resulting from extraction of water for irrigation and industrialization could also cause burden of inorganic and organic pollutants in water (Lawson, 2010).

2.1.2 Classification of craft and gear in inland water of Nigeria

Fishermen who are involved in artisanal fisheries in Nigeria make use of boats and gears made up of both natural and synthetic materials. Fishers use planked canoe, dugout canoe and half dugout canoe for fishing and each of them has different constructional characteristics (Ambrose *et al*., 2001; NIFFR, 2002). The planked canoes are made up of timbers, usually with flat bottom (Solarin, 1998). They are fully constructed with planks joined together with frames, U-shaped metal closures and nailing strip of galvanized iron aluminum pluck caulking over the plank joints (Solarin, 1998).

The dugout canoe which is propelled with paddle, mostly provides minute space to contain fishers, gear and harvested fish during fishing operation. The dugout canoe has quite small free board and thus, shows low reserved buoyancy and less stability in comparison to any other kinds of canoe (Solarin 1998). However, Emmanuel (2010) reviewed that half dugout canoe combines characteristics of planked canoe and dugout canoe. The round bottom body shape of the dugout craft is built up with planks on each side to increase the size or cubic quantity of the canoe.
With regard to propulsion, craft can be operated by paddle or controlled with outboard engine. The attachment of outboard engine to craft in Nigeria has been reported by Udolisa *et al.*, (1994). NIFFR (2002) reported that majority of the craft used in inland water of Nigeria are generally non-motorized, due to high cost of outboard engine.

Nigerian fishermen use about twenty seven (27) different types of fishing gear (Udolisa *et al*., 1994). NIFFR, (2002) revealed the gear commonly employed by the fishers in Nigeria: these include gill nets, lift nets, cast nets, beach seine nets, long lines and traps (Malian or gura traps, bamboo traps, cane, wire or barrier traps). Considerable literature reviewed gill nets as the most important gear used by indigenous fishers followed by long lines and cast nets (Emmanuel, 2010). According to Abdul (2005), the various type of fishing gear and the way they are used on Nigerian water depend on fisher's financial status, water depth, shoreline patterns, targeted fish species and seasons of the year.

2.1.3 Livelihood strategies of fishermen in Kainji Lake

Nigerian fishing communities are far from developed, and many fishermen are poor and can only afford the most basic needs (Araoye, 2002; Williams, 2007). The World Bank, (1996) reported that, the occurrence of poverty is extremely noticeable in Nigeria, particularly in the rural environs where greater number of people live on income from agricultural activities that are insufficient to support them. Majority of the fishing communities are remote and members of the community rely mostly on natural resources for their survival and well-being.

Notable academic papers already agreed with the deteriorating change of the fish stock over the years (Abiodun and Niworu, 2004; Ovie and Raji, 2006). This has affected numerous fishers livelihood in Kainji Lake and the whole of Nigeria. According to Abiodun, (2003) fishermen in Kainji Lake face the challenges of decline fish species and, ultimately, in the fisher's income (Tafida *et al*., 2011).

The majority of the fishers in Kainji lake communities are part-time actively involved in fishing, crop production, livestock production and other economic activities (Tafida *et a*l., 2011). In their study, Tafida *et al*., (2011), revealed that 98.8% of the communities in Kainji Lake are involved in fishing, 86.7% in Livestock production, 86.3% in crop production, while 53.3% and 13.3% are involved in fish processing and trading respectively.

2.2 Fisheries survey

Statistics of fishery are the main methods to quantify the accomplishment of a fishery within biological, environmental, social and economic structure in which it is conducted (FAO, 2002). The fishery survey can be performed to estimate the fish catch, fishing effort, economic expenses and revenues of fishing and the occurrence of these at a particular period of time. This provides statistical information on the status of fish catch, effort and socio economic characteristics (FAO, 1985). Fishery survey can be cost effective and the costs are made up of field operation and maintenance expenses connected to the operations (FAO, 2002). In various developing nations, these entire expenses may create a major limitations to the required effect of developing of fisheries statistic. According to du Feu (2003), another way in which cost of the fishery survey can be reduced is by enhancing effective sampling strategies.

2.2.1 Survey standard and sampling survey

Standardization method in data collection and production has contributed to the developments of science (Bonar and Hubert 2002). Survey standard is the process of arranging field operations, and producing reliable results. The importance of survey standard is the structure of the method used and effective framework of the sample based fisheries survey (FAO, 2002). The two important component of survey standard are stratification and classification. Stratification refers to the area to be covered during the research work, such as, landing site while classification is the method that will ascertain or discover the kind boat, gear, fish species and effort units used by the fishers (FAO, 2002). Sampling Survey gives detailed account of the selection procedure of a sample component from a target population. The three main components of sampling survey are frame survey, fisheries catch assessment survey and quality survey (FAO, 1985).

2.2.2 Frame survey and catch assessment survey

Frame survey is the sample-based or census-based methodology describing all fishing craft and gear which might be “potentially operating” within the evaluation context (FAO, 2002). Frame survey can be defined as the physical counts of gears obtainable in a fishing communities and a

whole lake count of fishing canoes (du Feu, 2003). This author also stated that it involved annual record of all the fishing communities, fishers, fishing supporters and fishing equipment owned by the fishers. Before frame survey is taken into consideration, ones must decide a general structure of landing sites, and boat and gear to be included. After frame survey has been completed, the next obligation is to complete the list of landing site, boat and gear types which can later be used as the foundation to conduct future survey research (FAO, 2002).

Catch assessment survey (CAS) is the detailed inspection and recording of the fish species that are contained in a canoe, landed from a fishing trip (Moses *et al*., 2002). For the collection of current items, information of the input and output features of operating fisheries such as fishing effort, fish catch and catch assessment are designed and executed to allow data collection and sampling in both space and time (FAO, 1985).

2.3 Methods of data collection in a fishery

The basic information requirements for fisheries management are long time series of data set that precisely reflects the sociological, environmental and fisheries features and trends (du Feu, 2003). The selection of many methods for gathering fishery data will rely on the variables to be determined, as well as the source and availability of resources (FAO, 1999). According to Food and Agriculture Organization (FAO, 1999), there are five main methods of data collection and these are; Registration, Questionnaire, Interviews, Direct Observations and Reporting. The most prominent among these methods of data collection are questionnaire and interviews which are used for quantitative and qualitative research respectively.

Questionnaire is the most commonly used tool in educational research and this is obvious in published studies as reiterated by (Nworgu, 2006). According to Fife-Schaw (2001), questionnaire is perhaps the simplest common research instrument that is quite well understood and has the benefits of being simple, adaptable and required little expenses. Interview on the other hand, can be more time-demanding than questionnaire method, but could be more flexible and more suitable for complex questions (FAO, 1999). Interviews can be described as structured, semi-structured and unstructured (Fontana and Frey, 2005). The structured interviews can be

accomplished by using survey methods. However, in unstructured interviews, jotting of notes while talking to the respondents is recommended (FAO, 1999). Opdenakker, (2006) enumerated four type of interviews, thus: the face-to-face interview, telephone interview, MSN messenger and E-mail interview of which, the most common is face-to-face. Face-to-face interview, help greatly in producing quality data or information.

2.4 The problem of data collection

Undertaking qualitative interview can pose many challenges for researchers (Birch and Miller, 2000). Some of the problems identified include issue related to maintaining the boundaries between researchers and respondents (Dickson-Swift *et al*., 2006; gale, 1992), developing friendly relationship (Liamputtong and Ezzy, 2005), managing feelings (Dunn, 1991) and biased ideas or reflexivity among the respondents (Ellingson, 1998). The problems of data collection can be lack of cooperation to sensitive questions, increase or reduction of actual data, traditional relations towards answering questions and non-response of the respondents (Adeyemi, 2010). The challenges of obtaining good quality data in a reservoir fishery has been reported by de Feu, (2003). These are;

- High cost of fisheries survey and the effort required for collection of data.
- Problems of evaluating precise assessments of the status and trends of lake's fisheries.
- Interrupted data collection due to the implementation of management measures such as ban of fishing gear types.
- Non-appreciation and uncooperative behavior of the fishers during data collection.

CHAPTER THREE

3.0 Materials and Methods

3.1 The Study Area

Lake Kainji is the second largest in West Africa after Lake Volta (Imevbore, 1970; El- Zarka, 1973) and largest man - made lake in Nigeria (du Feu, 2003). It is situated between latitudes 9^{o} 50' – 10^{o} 57' North and longitudes 4^{o} 25' – 4^{o} 45' East. The lake was impounded in August 1968, it is now 134 km in length and 24 km in width. Its surface area has been variously quoted as approximately 1,270 km^2 (du Feu and Abiodun, 1998), a volume of 13 × 109 m^3, and catchment's area of 1.6 x 106 km^2 (Obot, 1989). The climate of the study area usually alternates between dry and rainy season. The area has total annual rainfall of between 1,270 mm and 1,524 mm and spread over the month of April to October (McCurry, 1976). The highest amount of rainfall is observed in August. Monthly temperature is highest in March at about 30^{0}C and lowest in August at about 25^{0}C (Ajibade, 1982). The number of fishing settlements in Kainji Lake is now 314 (Abiodun and Ayanda, 2008). The Lake is situated in the southern portion of river Niger extending through the Guinea and Sudan savanna, which is characterized by grasses and fire resistant trees and shrub (Richard *et al*., 2010). The main purpose of making the impoundment was the generation of Hydro-electric power. The lake opened, however, massive opportunities for different kinds of developmental projects such as fisheries, irrigation, and improved the navigation on the Niger River (FAO, 1995).

3.2 Sampling procedure

Stratified sampling procedure was used to collect data for the study. Kainji Lake is divided into three main basin (upper, middle and lower). Kainji Lake lower basin is the deepest part of the Lake, having average depth of 18.5m and covers 20% of the surface area of the Lake (FAO, 1995). Fishing activities in Kainji Lake lower basin are carried out throughout the year because this part of the lake is deepest and the fish and fisheries are thereby less affected by the seasonal fluctuation in the water level. Therefore, this is allegedly also the important fishing area in the

lake because the other parts (Upper and middle basin) of the lake are shallow with little or no fishing (FAO, 1985). The present visit was during the dry season when the fishing in the upper basin is probably stopped, and therefore only the lower basin was covered.

According to the map elaborated by Fisheries Statistical Bulletin, (1997), Kainji Lake lower basin has in excess of 70 fishing villages. None of these fishing villages listed in the map are observable or detectable from the main road: many of them may have only 2 or 3 fishing huts. About 21 villages have considerable fishing activities with noticeable landing sites (Plate 1 & 2). Out of these 21 fishing villages, 12 were selected through a convenience (non-probability) sampling procedure but it was attempted to ensure a good and even coverage of the lower basin.

Plate 1: Fakun landing site with set gillnets observable on the water (right)

3.3 Data collection

The data for this study were collected through the use of questionnaire (see Appendix 1) and unstructured interviews. A structure questionnaire was used to obtain information from sixty (60) artisanal fishermen who were drawn from twelve (12) selected fishing communities along the lower Basin of Kainji Lake, Nigeria. The unstructured interviews were made to extract information from the heads of each fishing village selected. The selection of fishing communities was determined by the following criteria;

- Survey area limited to villages not further away more than 50 km from the base station (New Bussa Town), a limit set by difficulties of access to good roads (Plate 3 and 4). A day trip started and ended in the base station.
- Uniform sampling of the survey area in the southern basin was desirable
- Focus on larger villages in order to maximize the number of respondents in a work day and possibility to meet a "main informant", usually the head of the village (*Maigari*). Many small villages or landing sites are not visible from the road.
- The overall survey time was limited to 28 days (four weeks). Identification of the sample (12 villages) from the overall population (21 villages) of large settlements took several days of scouting time to find appropriate landing sites for the survey. Getting an overview of the activities and a complete sampling in any single village took two days on average.

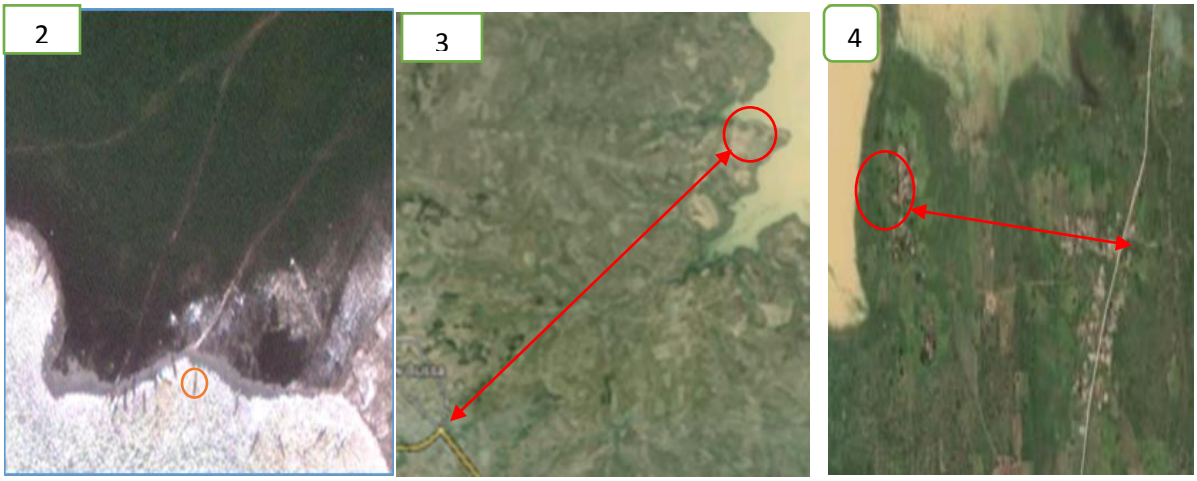


Plate 2: Lake Kainji, lower basin: landing site with boats (one canoe encircled)

Plate 3: Example of fishing village probably not visible from the main road

Plate 4: Fishing village accessible through tarred undulating road

Source: Google Earth

The following communities were visited (marked in figure 2): Malale, Tunga Kuta, Tunga Alhaji Danbaba, Yuna, Monai, Cover dam (Sarki), Fakun, Garafinni Auna, Tunga Alhaji Ibrahim, Anfani, Kaya and Tunga Danladi.

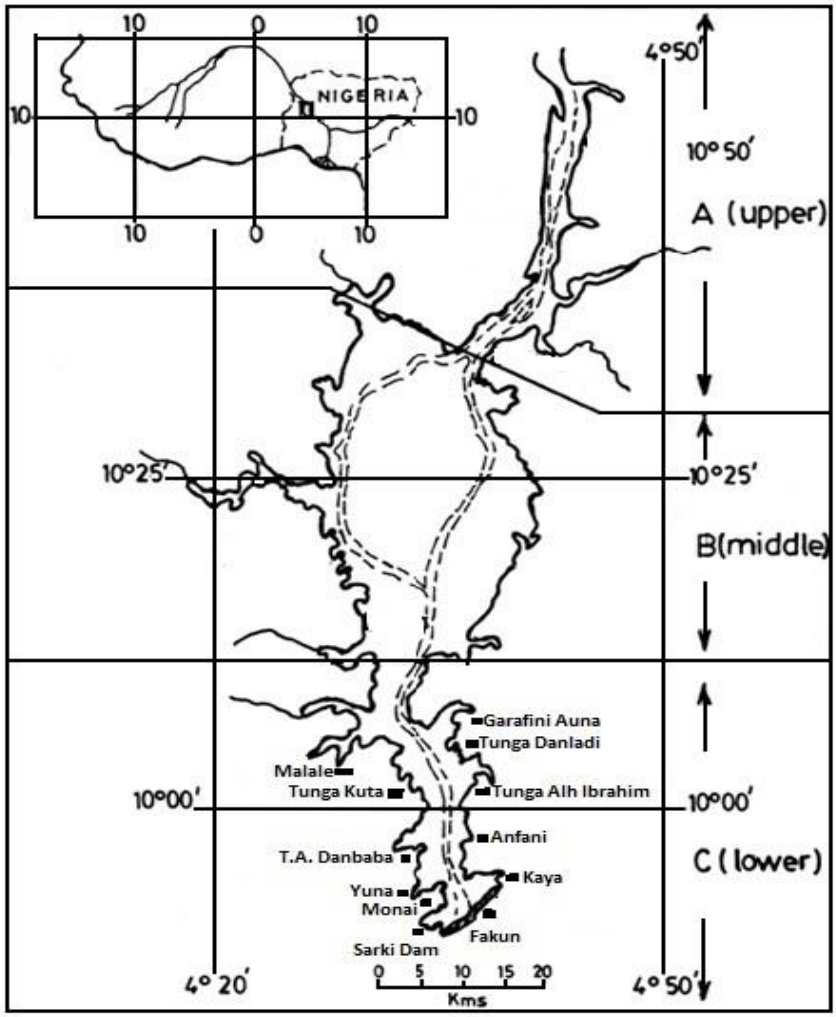


Figure 2: Map of Kainji Lake showing location of fishing villages visited (12 small black squares) Map adapted from (FAO, 1995).

3.4 Interview process and methods

A typical interview session started with general introduction to the fishers about the purpose of the visit as well as other important information related to the study. The study was well received by the heads of each village visited and the fishermen found in those communities, with a few

exceptions. Many head of fishing villages complained that interviewer surveys of this type had been performed before with little feedback or benefit for the fishing villages. Also, some fishermen requested for money before participating in the study. Other fishermen that were using illegal gear types (Lift nets and Beach seines) refused to participate in the study entirely. Their fear was that the information they provided could be used against them by exposing their activities. At the end of the day all respondents were encouraged to provide their personal and independent opinions and their anonymity was assured.

There are about 250 registered languages in Nigeria. The residents of Kainji Lake and its environs often speak Hausa language, which is one of the important local languages in Nigeria. A translator was hired to translate Hausa language to English, and to spell Hausa words that are considered important for the study. Five (5) fishers were selected from each community often through snow ball sampling: the respondent indicated other fishermen for inclusion in the study. The structured interview questionnaire (Appendix 1) targeted information on socio demographic features of fisher, fishing gear specification, fishing craft specification, common and target fish species, fishing effort, costs and income, as well as general challenges faced by fishermen together with their perceptions towards fishery law and regulations. Answering of each questionnaire took one to one and half hours (1-1½h), partly owing to the language barrier and translation. After filling the questionnaire, fishers were also asked for their informal opinions about the sustainability of the fisheries in the lake.

Unstructured oral interviews with each head of the village were also undertaken. In this case, there were no defined lists of questions. The established plan was to follow a range of themes, namely the current state of the fishery, the driving factors regarding choice of boats and fishing methods, main challenges facing the fishers and the existence of local fisheries management institutions in general. It was considered that interview approach will provide more information based on the experience of different fishing gear and craft used and fish catch by the head of the fishing communities because they are also fishermen. Oral interview were recorded using tablet (IPad) with the permission of the respondents and later translated.

3.5 Data analysis

The data collected through structured interview were extracted and recorded into Microsoft (MS) Excel sheet. Missing observations were considered, when the respondents had problems to recall given facts (e.g. fish catch or income) or straight refusal to answer given questions. Data analysis was performed following two approaches.

Firstly, the descriptive analysis (using tables and graphs) in which average characteristics of the population (respondents) with respect to gear and craft types, and social and economic variables was performed. This roughly corresponded to an analysis of the columns in a matrix of characteristics (columns) by respondents (rows). This type of analysis coarsely corresponded to the statement that "x% of the fishers utilized gear y, or had z years of fishing experience. This is called the "aggregated data analysis".

The second type of analysis, often performed with multivariate techniques, corresponds to an analysis of the rows: how were the different respondents characterized by their socio-economic traits and how these traits were associated to craft, gear and species captured. This would correspond to a statement of the type: "fishers that used gear y tended to have level z of education". Thus, the focus of the first type of analysis is the population interviewed, and the emphasis of the second type of analysis is on the individual respondents.

The fish specie's names, which were originally given in local name by the fishers, were translated to English and Latin names with the support of taxonomic guide (Raji *et al*., 2008). The pictures taken during data collection were also useful for fish identification. However, some local species names were not clearly distinguishable and these fish were classified to the genus level only. Fish species names were given four letter code using the first two letters from the genus and the last two letters from the species name (Appendix 2). Six (6) matrices table data were generated for the analysis of:

- Fisher's socio-economic characteristics and Organization membership (9 rows X 60 columns for main/response variables and 3 rows X 60 columns for supplementary/environmental variables).
- Gear use and social features relationship (Response variables: 5 rows X 60 columns and supplementary variables: 7 rows X 60 columns).

- Targeted fish species and gear types relationship (8 rows X 26 columns), to analyze the variation in aggregated species occurrence with gears owned by each fisher.
- Gear and craft propulsion relationship (5 rows X 60 columns for main variables and 3 rows X 60 columns for environmental variables) to analyze variation in most gear used and craft found in the study area.
- Gear use, input factors and economic output relationship (4 rows X 60 columns for main variables and 4 rows X 55 columns for environmental variables).
- Craft propulsion, input factors and output factor association (3 rows X 60 columns and 5 rows X 60 columns for main and environmental variables respectively).

3.5.1 Multivariate data analysis

There are four important ordination techniques based on whether weighted averaging or linear methods are used and if or not the ordination is constrained or unconstrained (Leps and Smilauer, 1999). These four ordination methods are Principal Component Analysis (PCA) and Redundancy Analysis (RDA), which are both linear methods, and Correspondence Analysis (CA) and Canonical Correspondence Analysis (CCA) which assume a uni-modal response (Leps and Smilauer, 1999). The table matrices were subjected to PCA using statistical package for Canonical Community Ordination (CANOCO) for windows package, version 4.5 (CANOCO 4.5) (Ter Braak and smilauer, 2002).

Detrended Correspondence Analysis (DCA) was initially performed to check whether or not the length of statistical gradients are less than four standard deviation (4 sd). According to Ter Braak and Šmilauer, (2002) if the gradient size is less than 4 sd, the data shows an approximately linear response and models of the PCA-RDA family are recommended. When the gradient is greater than 4 sd, a CA-CCA model should be utilized. In the present analyses, gradients were normally less than 4 sd and the linear methods of PCA were thus selected. In CANODRAW, one can make a deliberate decision between mainly interpreting relationships between group of samples (respondents) and group of species (any other biological, technological or socio-economic variable of interest) from the ordination diagram, or both simultaneously as a bi-plot (Van den Brink *et al.*, 2003).

As a routine in the present work, a third type of variables was superimposed on the bi-plots to disclose other interesting relationships. In Canoco terminology these are called supplementary variables and have absolutely no influence on the underlying PCA. As an example, the major species declared by each given respondent were plotted in a bi-plot, and this was followed by the superimposition of the fishing gear variables. This allows a visualization of which respondents and fish species are more associated to a given gear or craft. Standard procedures in the treatment of the variables were, otherwise, followed in multivariate analyses with CANOCO. The abundance of species caught with gear types data were log-transformed [log10(y+1)], and their distributions rescaled after standardization to a mean of zero and a standard deviation of one. This was necessary because there were large discrepancies in the occurrence of the different species, and this can affect the interpretation of the ordination plot.

In the respondent analysis, it is important to keep in mind that the unit of sampling was the individual fisher, not his craft or gear, of which each fisher could own different amounts and combinations. In other words, any fisher interviewed often had more than one gear type and boat and provided aggregated information about catch and income with the different gear and craft that he owned. It was therefore not possible to associate a particular gear to a particular species or craft on a one-to-one basis. The results give only coarse trends across respondents. This can be exemplified in a statement of the type: “fishers of group f tended to have a gear combination of type g and craft of type c and target or catch species of group g, make large investments on fishery inputs and were often placed in the high income group".

CHAPTER FOUR

4.0 Result

4.1 Description of fishing gear and craft used in lower basin, Kainji Lake

The type of fishing gear used by the fishers in the Kainji Lake lower basin of Nigeria are represented in Figure 3. A total of 7 different gear types were identified and the commonest ones used by fishers at the study area were Gill net (*Taro*), Cast net (*Birigi*) and Hooks & line (*Kujiya*). The other gears included Traps (*Gura*), surrounding net, Beach seine and lift net (*Atala*). Gill net is the most important gear type used by the fishers with the percentage of almost 40%. The beach seine and lift nets fishing gear were only used by one or a few respondents.

Individual fisher claimed that gill net are more efficient, followed by cast net and hook & line respectively. Cast net and hook & line had quite similar trends among the fishers: the percentage usage of these gears are very close. Unlike gill net, trap made lower contribution to fisher's catch, but respondents clarified that they got good quality catch from the trap. Beach seine and lift net type utilization were few among the fishers because they are banned gear, but some respondents reported using it.

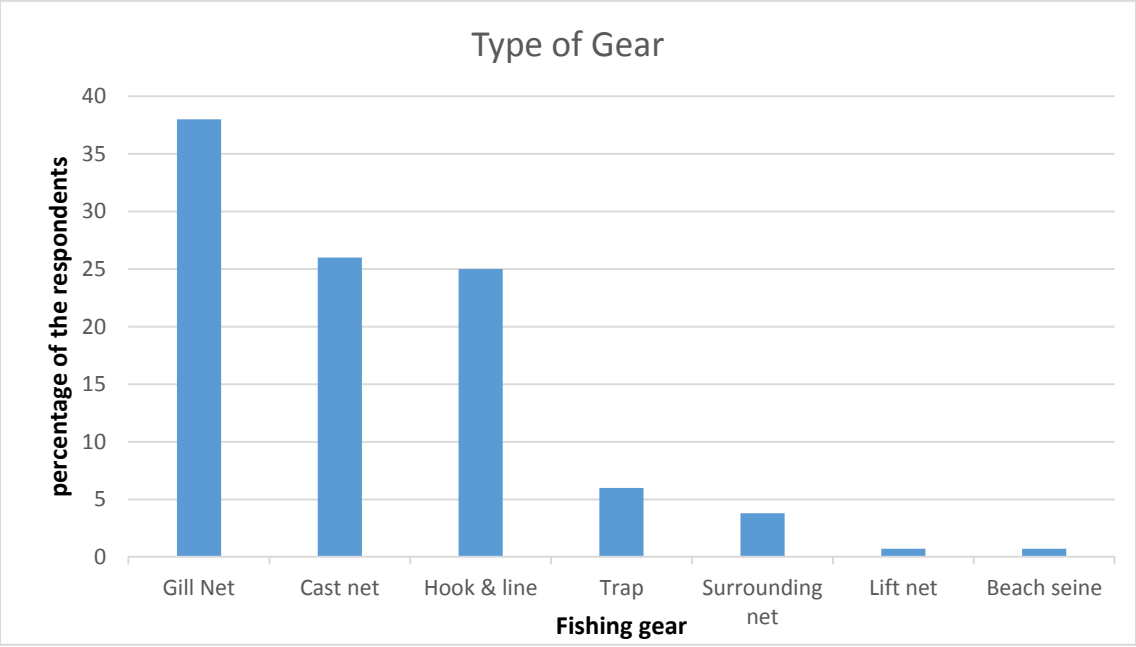


Figure 3: Type of gear found in Kainji Lake lower basin, Nigeria (n=60)

The majority of the fishers had more than one gear. More than 70% of the respondents had between 1 and 5 gears (Figure 4) and these were often of different types.

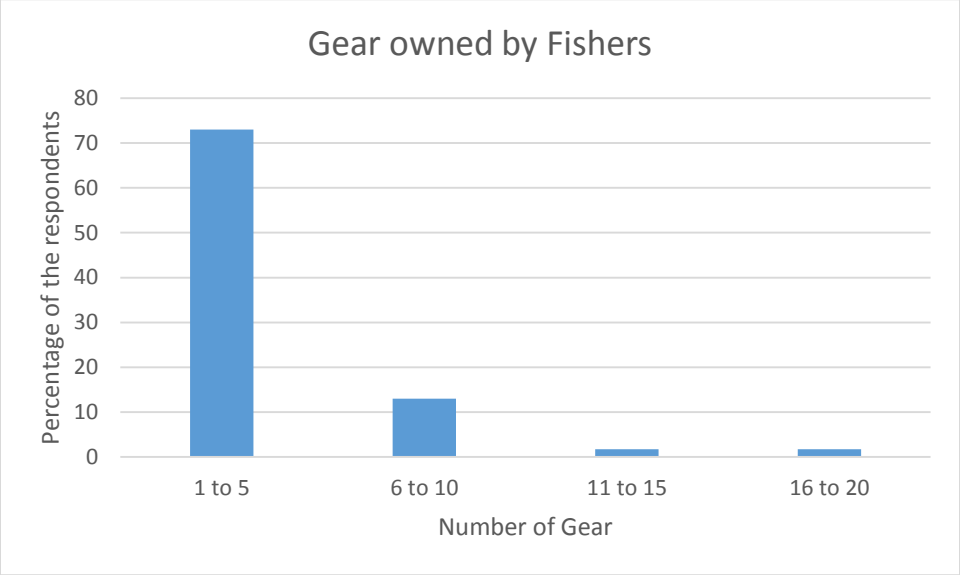


Figure 4: Number of gear per fisher in Kainji Lake lower basin (n=60)

For instance, a fisher could own one gill net, one cast net, one set of hook & line, as well as some traps. Fewer other fishers owned between 6-10 gear, 11-15 gear and 16-20 gear. In total, the average number of gear per fishers was 6.1. Many of the fishers in Kainji lake lower basin fabricated their own gear. They claimed that self-fabrication gear is cheaper than buying.

Different reasons were indicated for the use of fishing gear in the lower basin. The most important reason the respondents considered when choosing their gear is its efficiency (41% of the respondents) which is expressed in terms of numbers of fish caught by a fishing gear, followed by suitability of gear to catch fish species that the fisher desired (32%), fishing season (20%). Others are ability to catch fresh fish species (5%) and cost of fabricating fishing gear (2%).

The main type of fishing craft used in Kainji lake lower basin is the planked canoe. All canoes have flat bottom, and can be motorized or not (paddled). From the results gathered 10% of the respondents used motorized canoe, 71% of the fishers used paddle canoe and 19% owned both paddle and motorized canoes. Fishers with motorized craft agreed on its cost–effectiveness,

efficiency and ability to cover long distance during fishing. On the other hand, fishers with paddle craft established that it is affordable and readily available. There exists a belief among many fishers that utilization of motorized canoe scare fish away from the gear.

The majority of the fishers (54%) owned only one craft (Figure 5). Respondents with more than one fishing craft also had different sizes of the craft, in terms of length overall (LOA, in meter). Nearly all the paddle canoes observed in the study area were between 4.5m - 7m. The respondents claimed that the reason for these small sizes is to allow them to propel their canoe easily whenever they are out for fishing. The lengths of motorized canoe found were 8m and above.

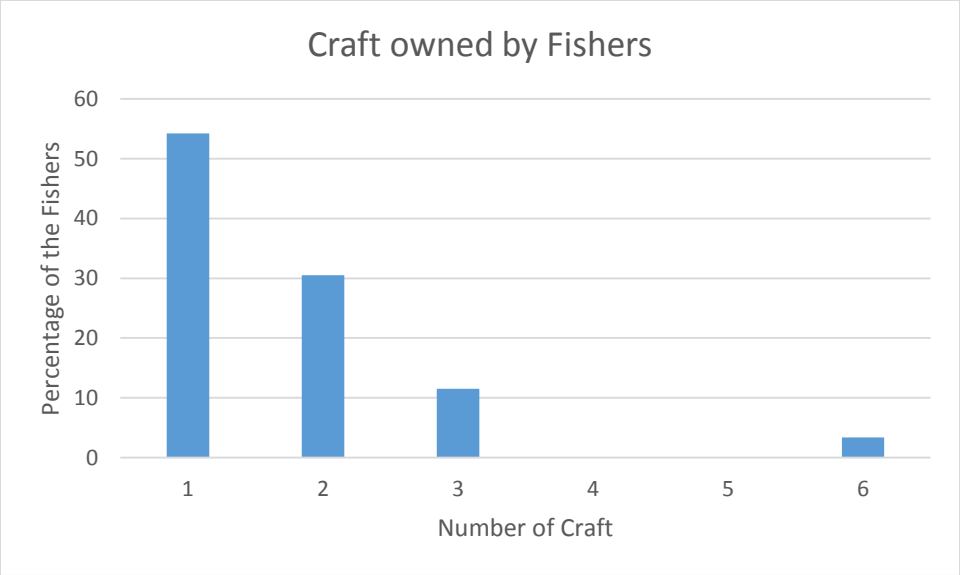


Figure 5: Craft owned by the fishers at Kainji Lake lower basin, Nigeria (n=60)

According to the fishers at the basin, durability of the craft varied. Sixty-nine percent (69%) of the respondents assumed durability of between 1 and 5 years while others claimed between 6-10 years, 11-20 years and above 20 years respectively (Figure 6). Almost all respondents revealed that durability of the craft depends on the maintenance and the kind of wood used for the construction of the craft. Fishers protect their craft from excessive sunlight by covering it with leather bag after use.

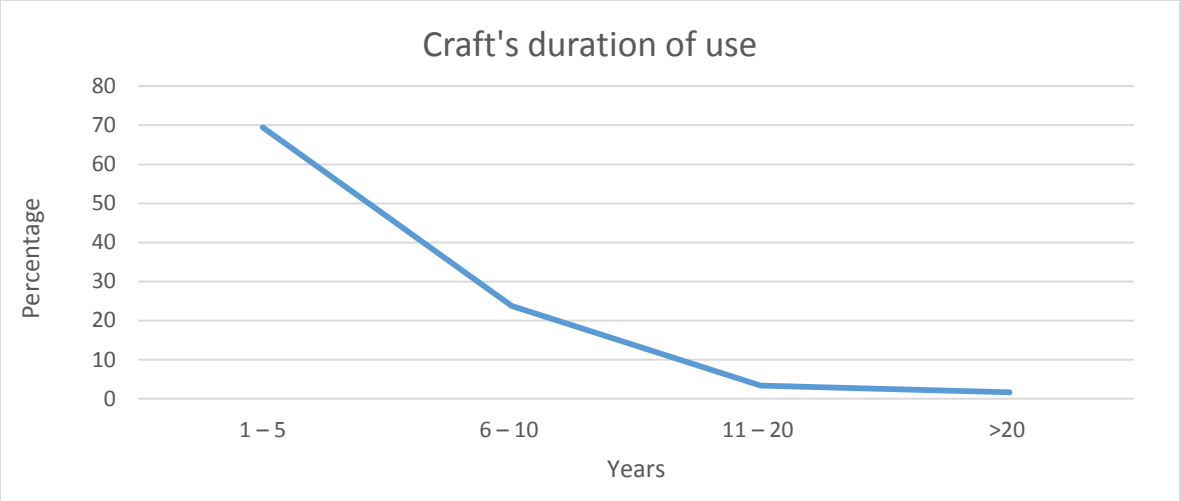


Figure 6: Fishers perspective towards craft's durability (years) at Kainji Lake lower basin (n=60).

4.1.1 Socio-economic characteristics of the fishers

It is likely that there are patterns in the utilization of gear and craft that are related to the background of the respondents. The socio-economic characteristics of the respondents in relation to gear and craft used are presented in Table 1.

The majority (96%) of the respondents in Kainji lake basin belonged to the Hausa, ethnic group. Only men are active fishers in Lake Kainji, and the largest age-group (23%) fell within the age brackets 41-50 years. The younger age groups of 21-30 and 31-40 years were equally represented (22%) each. The great majority (93.3%) of respondents were married. The largest number of households of the respondents (35%) ranges between 1 and 5 people in a family. All fishers interviewed claimed to have other household members involved in fishery related activities. Their roles are related to fishing, selling or both.

Table 1: Socio-economic characteristics of the respondents and relationship with the use of gear and craft in the lower basin of Kainji Lake, Nigeria

Characteristics		Percent (%)	Gill net	Cast net	Hooks & line	Trap	S.net	B. seine	Lift net	Paddle Craft	Motorize Craft
Sex	Male	100	145	45	42	129	5	1	1	75	20
Age	≤20	5	2	0	2	0	0	0	1	2	0
	21-30	21.7	24	6	5	47	3	0	0	15	0
	31-40	21.7	30	6	9	40	1	0	0	16	2
	41-50	23.3	39	8	10	18	0	0	0	9	8
	51-60	11	17	4	6	25	0	0	0	9	3
	61-70	10	13	11	4	0	0	1	0	8	3
	>70	8.3	16	9	5	14	0	0	0	13	3
Marital status	Married	93.3	145	44	41	129	3	1	0	71	19
	Single	6.7	0	1	1	0	2	0	1	4	1
Educational Level	FSLC	8.3	15	8	2	15	0	0	0	4	1
	Q.Edu.	73.3	132	40	35	47	4	1	0	66	19
	SSSC	16.7	12	4	6	82	0	0	1	8	0
	T.Edu.	1.7	1	1	1	0	0	0	0	1	0
Number of Household	1-5	35	33	9	10	95	4	0	1	12	4
	6-10	25	28	14	10	10	1	0	0	17	2
	11-15	23.3	54	16	14	24	0	1	0	20	12
	16-20	11.7	17	3	6	0	0	0	0	12	0
	21-25	1.7	5	1	0	0	0	0	0	1	1
	26-30	00	0	0	0	0	0	0	0	0	0
	31-35	1.7	1	1	1	0	0	0	0	2	1
	>35	1.7	7	1	1	0	0	0	0	1	0
Fisher's status	Fulltime	20	19	14	9	15	1	0	0	12	2
	Part-time	80	126	31	33	114	4	1	1	63	18
Fishing experience	6-10	11.6	10	1	5	15	1	0	1	5	2
	11-15	23.3	24	9	7	47	1	0	0	14	2
	>15	63	121	35	30	82	3	1	0	61	18
Membership Of cooperative	member	66.6	114	31	35	104	5	1	0	54	16
	Non member	31.6	31	14	7	25	0	0	1	21	4
Ethnic Group	Hausa	96	145	38	42	129	5	1	0	73	19
	Igbo	2	0	7	0	0	0	0	0	1	0
	Ijaw	2	0		0	0	0	0	1	1	1

With respect to education 73% of the respondents had Quranic education (Figure 7) indicating that they were Muslim, and can read and write Arabic text while a small number of respondents had different levels of secular education.

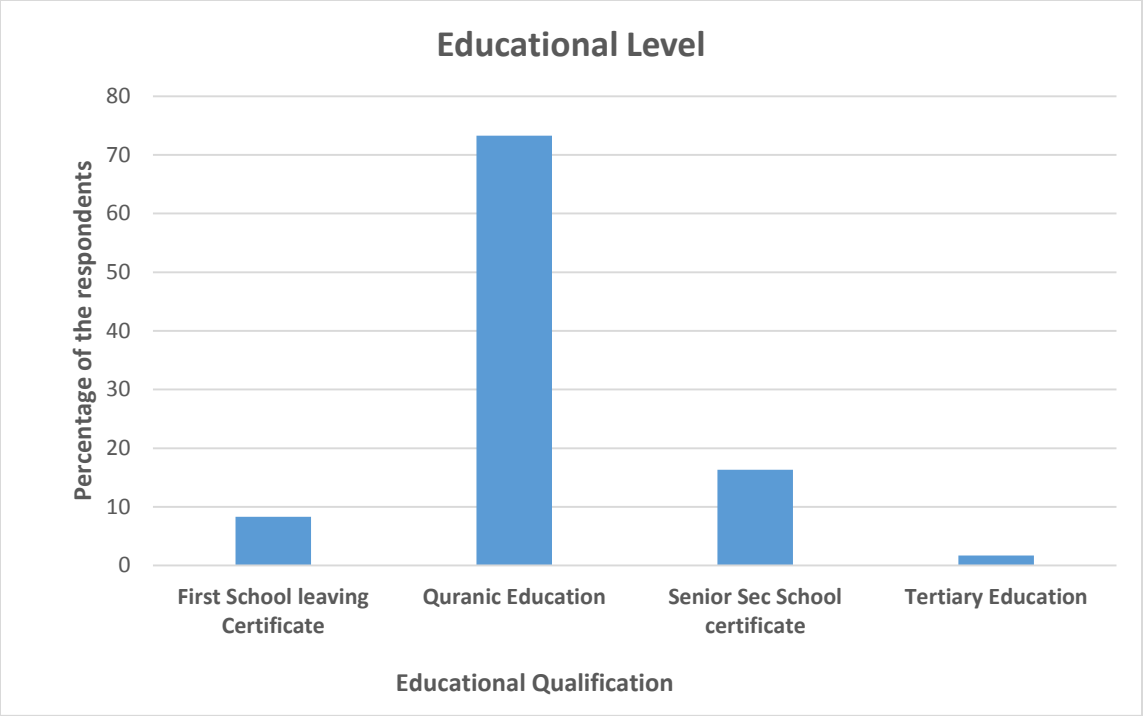


Figure 7: Educational qualification of fishers in the lower basin of Kainji Lake (n=60).

The majority of the respondents (80%) had part-time involvement in fishing, usually in association with other occupations, especially farming. Also according to most (90%) fishers, there has been declining individual catches in the region and this encouraged diversion into other activities and businesses. Most fishers had good familiarity with their profession, and 63% of the respondents had more than 15 years fishing experience. Furthermore, about 67% of the respondents were member of *Fadama* a cooperative project supported by the World Bank.

4.1.2 Species composition and fisher's preference in Kainji Lake lower Basin

The fishers from Kainji Lake lower basin were asked to characterized fish species according to three criteria: i) those that are frequently/consistently caught (even if in low quantities), ii) those species that are abundant in the catches, and, iii) their preferred catch. Tilapia species (*Tilapiine*) are the most consistently represented species (Figure 8). Although not very important in terms of biomass or number, the probability of finding at least one *Tilapiine* fish in every landing is high compared to other species. Other species that were also consistently were Moonfish (*Citharinus*

citharus), Upside down catfish (*Synodontis species*), Nile perch (*Lates niloticus*), African catfish (*Clarias gariepinus*) and a Clupeid (*Pelonula afzeliusi*) respectively. In terms of abundance, the Upside down catfish was reported to be the most abundance by number, followed by *Tilapiine* species. The majority of the respondents indicated Nile perch to be their favorite or choice catch, followed by Moonfish and Upside down catfish in order of preference.

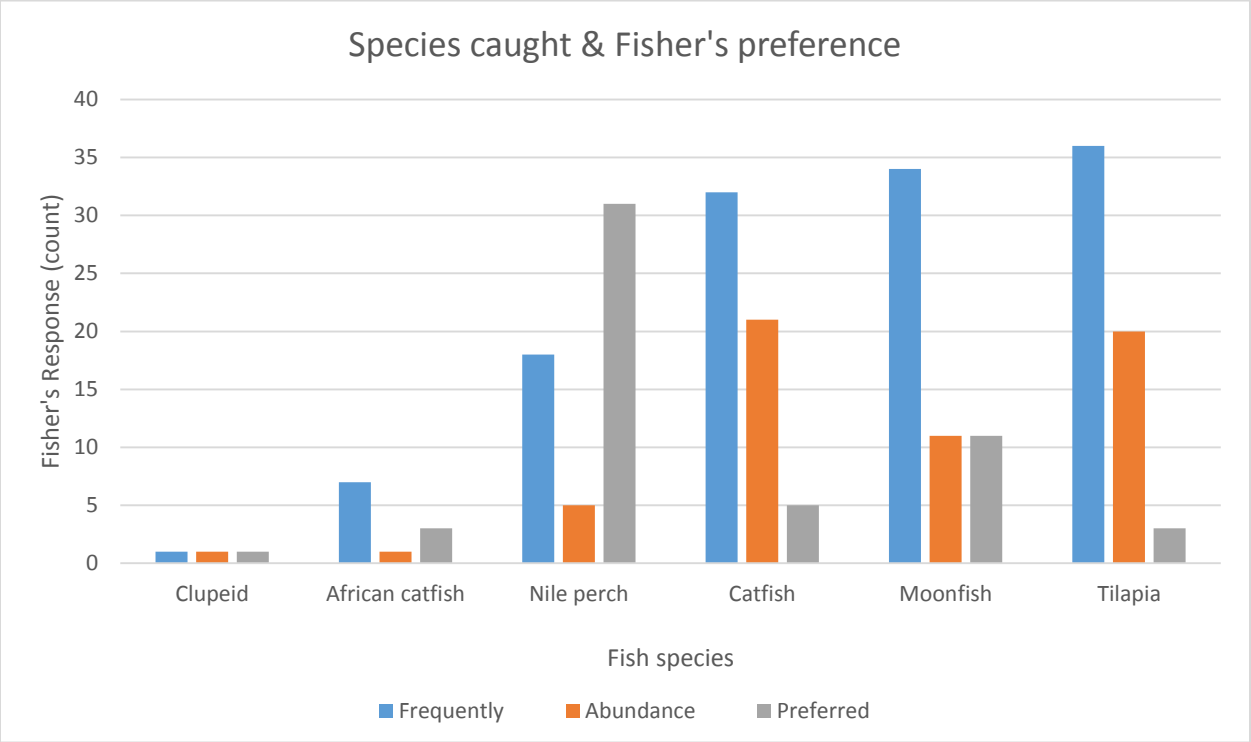


Figure 8: Fishers perception towards frequently, abundance and preferred species in Kainji lake lower basin

(n=60)

4.1.3 Fishing effort, Marketing and Income

There were large variations in the effort dedicated to fishing among the respondents. About half (48%) of the fishers interviewed claimed to spend between 4 and 6 hours fishing every day, 7 days a week (Figure 9). The respondents revealed that their fishing time was that devoted to setting and retrieving gear from the water since most of the gears used in Kainji Lake are passive. It was difficult to elicit fishers to provide good measurements of fishing distance: some

would claim to fish far away, while other said they do closer to shore. However, it was not possible to discern and quantify "far" from "very far" or "not so far".

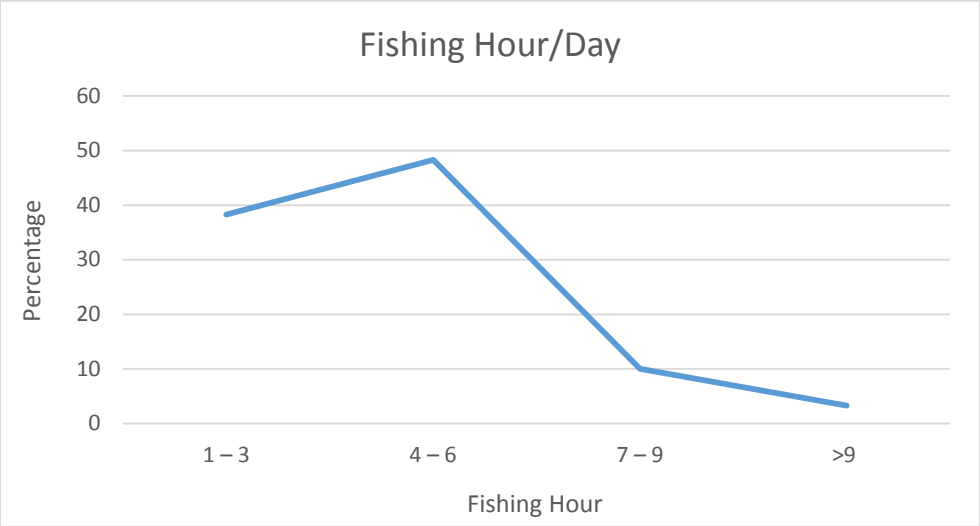


Figure 9: Fishing hours spent per day fishing (n= 60).

Fish caught can be transformed into different product through processing. However, about 78% of the respondents sold their catch to fish monger, apparently as fresh, un-processed fish (Figure 10). The transaction took place upon visual inspection of the catch, and balances were never utilized. Further, mongers were also reluctant to disclose the quantity bought and amount paid.

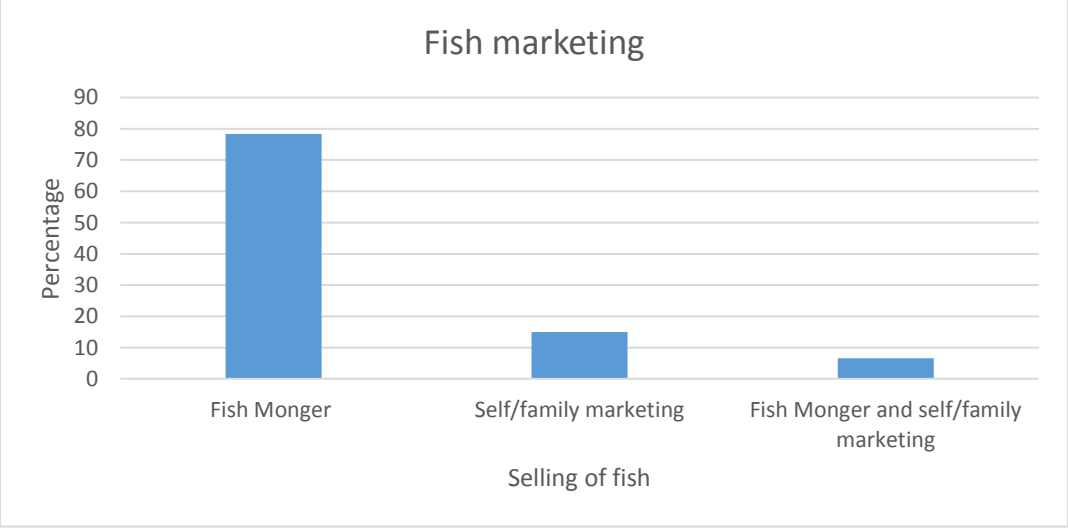


Figure 10: Market distribution channels for fishers in Kainji Lake lower basin Nigeria (n=60).

The distribution of the reported weekly income among the fishers interviewed is shown in Figure 11. About 60% of the fishers in the study area derived between 10 and 25 (in thousand naira (₦), approximately, $155) weekly income, and only 2% fetched more than ₦40,000 (approximately, $250).

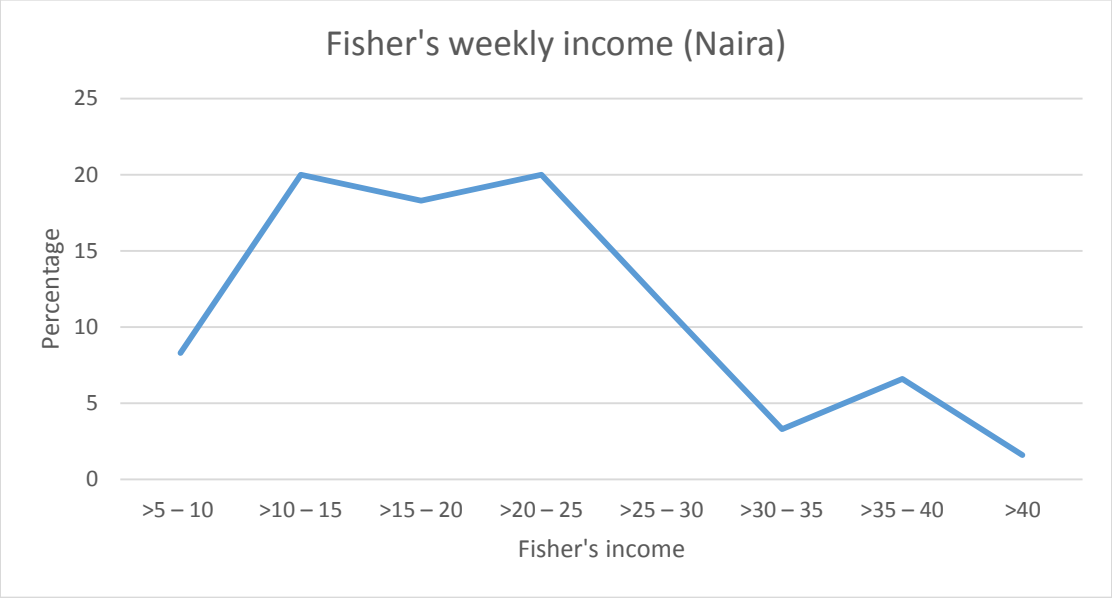


Figure 11: Distribution of the weekly income among the respondents in Kainji Lake lower basin (units in x-axis, ₦'000:00k). Note: Current Exchange rate 1.00 USD = 161.800 NGN where NGN is Nigerian naira.

4.2 Individual respondent analysis

The six sets of multivariate data were explored to describe the relationship among gear types, craft type, species caught by the fishers, fishing effort, fishers economic outputs and socio-economic characteristics of individual fishers in lower basin of Kainji Lake, Nigeria.

4.2.1 Fisher's socio-economic features with organization membership

The analysis provided a good relationship between fisher's socio-economic characteristics and organization membership in Kainji Lake lower basin. The PCA triplot of respondents ("sample"), socio-economic features ("species"), and organization member (Cooperative membership with non-cooperative group, the supplementary environmental variables in capital letters) is shown in figure 12. Axis 1 (horizontal) explained 95% of the total variation in the socio-economic data and together with Axis 2 (vertical), accounted for nearly 100% of the total variation (100%).The supplementary data, organization member explained 96% of the explainable overall (100%) variation in the first two axes.

The main contrasts in the data, which are those explained along the horizontal axis, seem to be well associated with organization form and contrast the coop-member group (right side of the graph) with non-cooperative member (left side) . Fishers that belonged to the cooperative society also tended to involve in part-time fishing activities, marry with more than one wife, and have larger households. They are often older fishermen than the others and tend to belong to the Hausa ethnic group. A few respondents of non-cooperative group participated in full-time fishing activities, but few of them belonged to Igbo/Ijaw ethnicity. Many of them were young, single, and had thereby smaller households to sustain. This contrast in household situation is more clearly illustrated along the vertical axis of the graph.

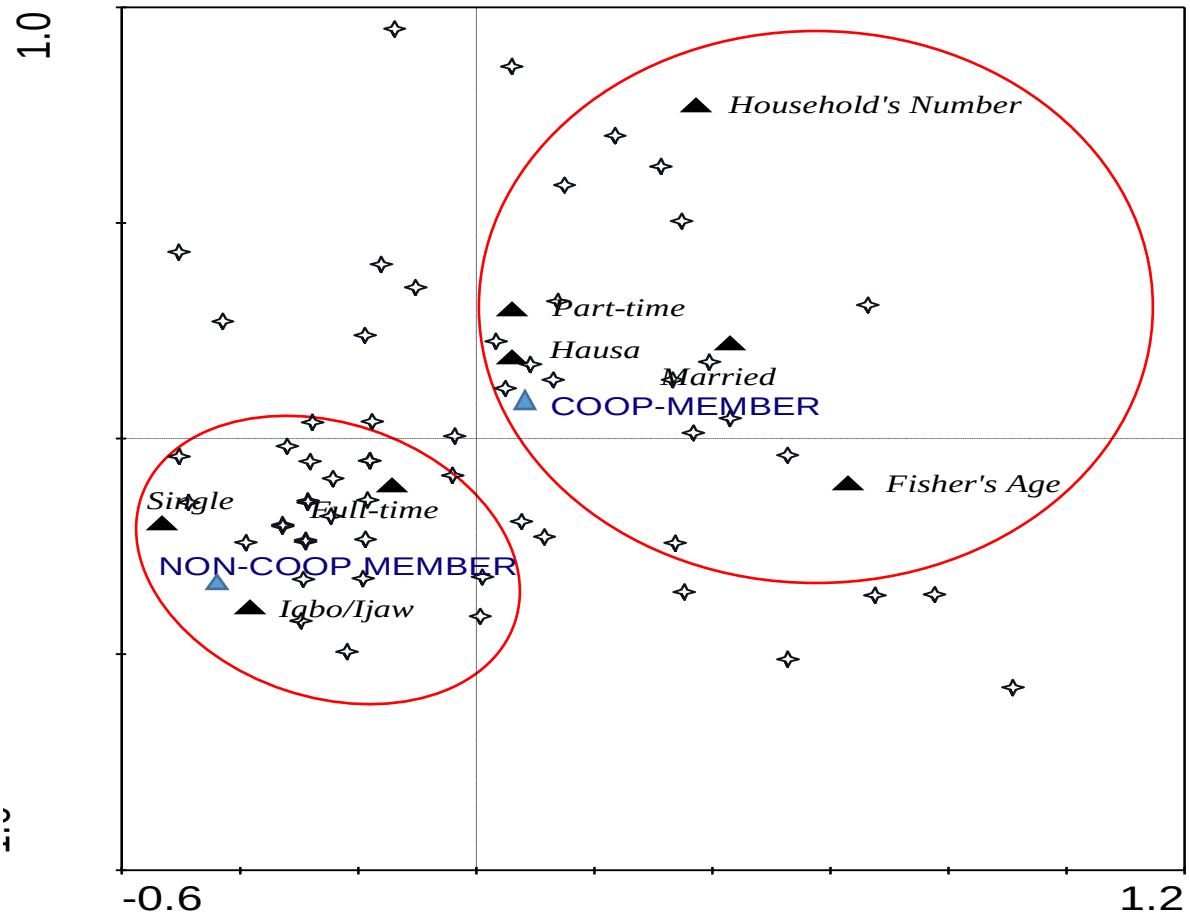


Figure 12: A triplot of PCA, accounting for socio-economic characteristics of the fishers in Kainji Lake lower basin with organization membership.

The response (main) variables were: marital status, occupational status, fisher's ethnicity, number of households and fishers age. The predictor (supplementary environmental) variables were the organization membership: Cooperative and non-cooperative member (blue capital letter). Fishers that belonged to cooperative society tended to be involved in part-time fishing activities and non-cooperative membership involved in full time fishing activities.

4.2.2 Gear use and social features relationship

There was a good association between gear use and socio-economic characteristics of the fishers in Kainji Lake lower basin. The PCA triplot of respondents, fishing gear and socio-economic characteristics is shown in Figure 13. Axis 1 explained 70% of the total variation in the fishing gear data, and together, the two axes account for about 87% of the total variation. This analysis

was performed with the removal of beach seine, lift net and Trap's variables (response variables), because only a few fishers operated these gears and their presence dominated the outcome of the PCA and provided very little information of general interest.

The different fishermen interviewed spread well in the graph shown in Figure 13. The main contrast, which is depicted in the horizontal axis 1, opposes fishers that rely strongly on gill nets (right side) to those that tend to rely more on surrounding nets. Respondents that showed some specialization in hook & line tended to have large amount of cast nets as well, and these fishers contrasted vertically along axis 2. However, most fishers that reported to use a suite of gear tended to use gill nets, hook & line and cast nets and a fewer using surrounding net. The supplementary socio-economic variables explained 93% of the explainable 87% variation in the first two axes. In this regard, fishermen that reported specialization in gill nets, cast nets and hook & line often had larger households, belonged to a cooperative society, and were married and older than their counterparts. This corresponds more closely to the description of the old Hausa fishers that belonged to the cooperative society given above. Contrastingly, fishers that relied more on surrounding nets were more seldom members of a cooperative society, and tended to be younger, single and sustain smaller households.

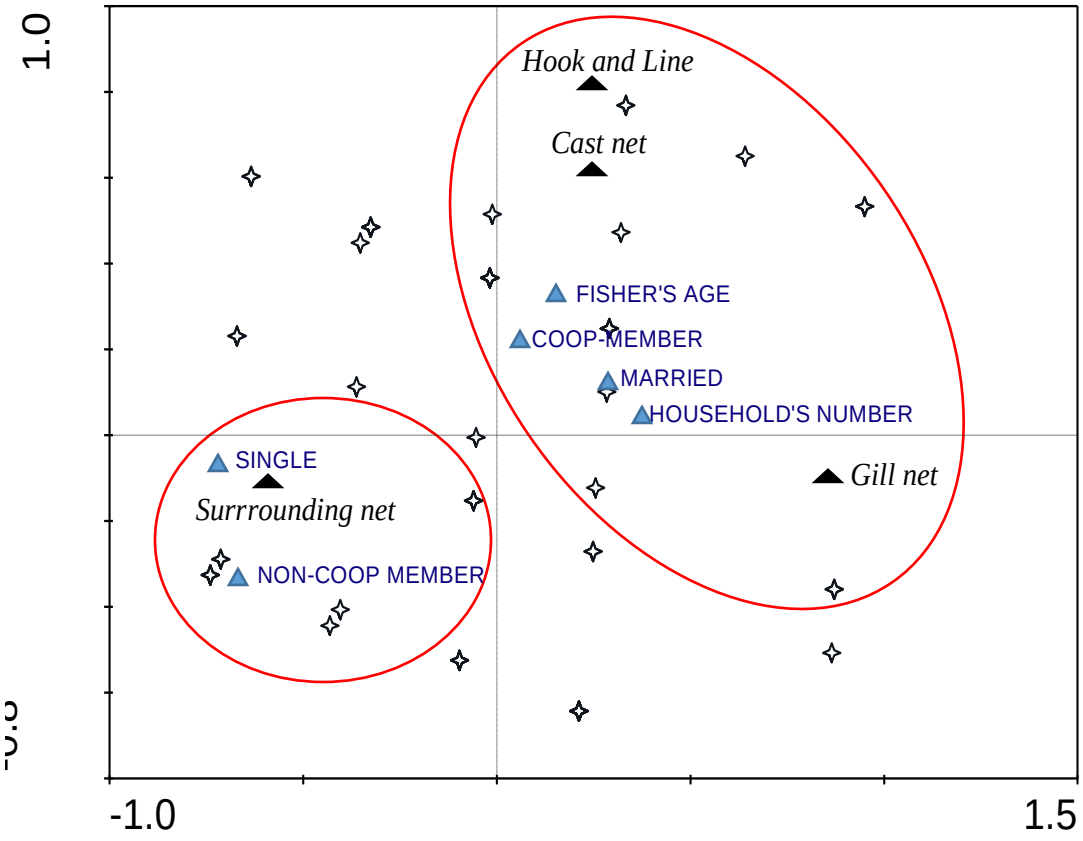


Figure 13: A triplot of PCA, of the gear use and main social-economic characteristics of fishers in Kainji Lake lower basin.

The response variables: Cast net, Hook & Line, Gill net and surrounding net and the supplementary variables are fisher's age, number of households, marital status and membership of cooperative society (blue capital letter). Fishers that use gill nets, cast nets and hook & line tended to belong to a cooperative society, be older, married and with larger households.

4.2.3 Targeted species and gear types association

The respondent analysis showed a good association between the species caught and the dominant gear types used by artisanal fishermen in Kainji Lake lower basin. The PCA bi-plot of targeted species and fishing gear use is shown in Figure 14. Axis 1 explained 65% of the total variation in the targeted species and gear types data, and taken together the two axes accounted for about 85% of the total variation. The species more often associated with gill nets, surrounding nets,

cast nets, beach seine, and traps tended to contrast with those reported by fishers that relied on lift nets. This contrast appears from left to right along the horizontal axis. Respondents that used many gill nets and/or cast nets tended to report as their main targets *Citharinus citharus* (Cici), *Synodontis species* (Sysp) and *Tilapiine spp.* (Tisp), and to a lesser degree of *Lates niloticus* (Lase), *Heterotis niloticus* (Heni), *Marcusenius senegalensis* (Mase), *Hydrocynus forskalii* (Hyfo), *Alestes baromoze* (Alba) and *Distichodus rostratus* (Diro). Fishers that used Beach seine and surrounding nets often reported catching *Hydrocynus forskalii* (Hyfo), and *Alestes macrolepiditus* (Alba). Moreover, beach seine fishers also caught some *Heterotis niloticus* (Heni). Respondents that used traps tended to catch *Citharinus citharus* (Cici) most, as well as *Labeo senegalensis* (Lase) and *Heterotis niloticus* (Heni). The fish species more associated with the Lift net appear in the third quadrant of the graph. These respondents tended to report *Pelonula afzeliusi* (Peaf), a fresh water clupeid, as their main catch. A few respondents that showed some specialization in hook & line tended to catch *Bagrus bayad* (Baba), *Lates niloticus* (Lani) and *Clarias gariepinus* (Clga), as depicted in the vertical contrast along Axis 2. Hook and line fishers also relied largely on the catches of *Clarotes laticeps* (Clla), *Heterobranchus bidorsalis* (Hebi), and *Malapterurus electricus* (Mael).

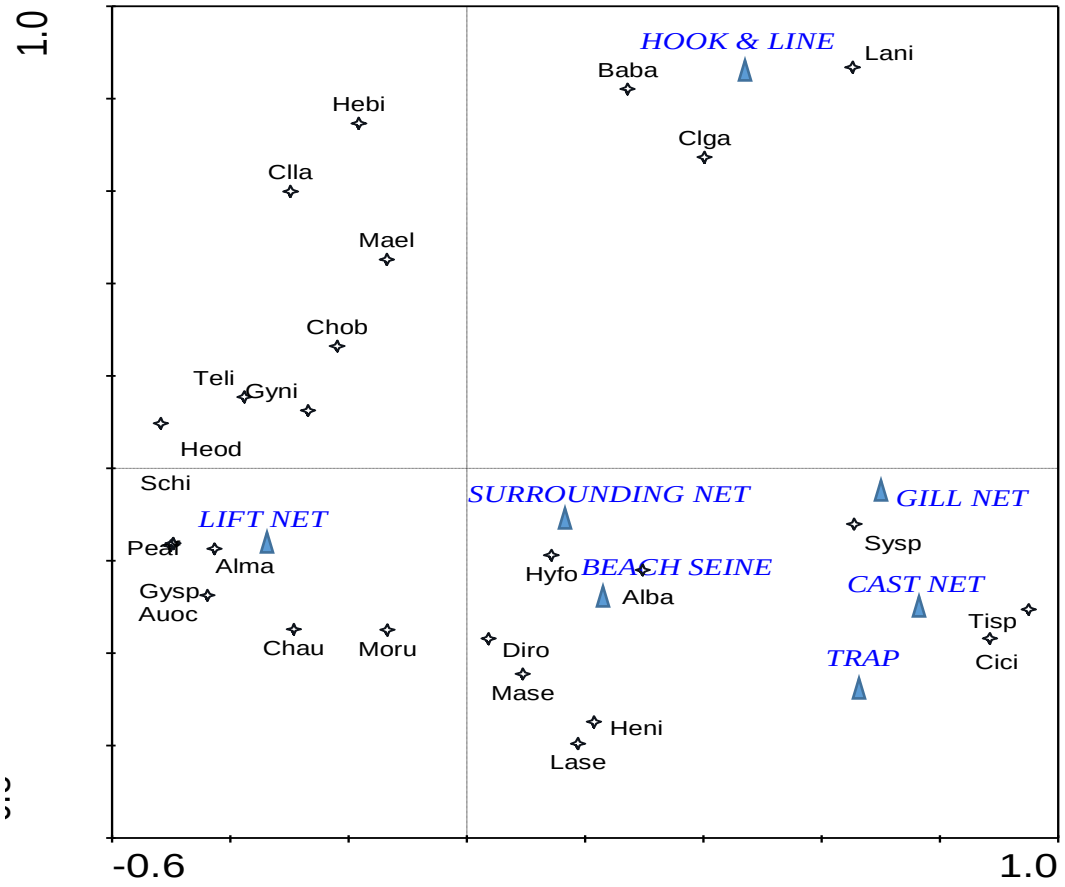


Figure 14: Biplot of a PCA of the species caught in Kainji Lake lower basin by different fishers interviewed.

The species type is the main variables (response) in the analysis. The gear types (blue capital letters) are supplementary variables in the analysis. The main species in the catches are Nile perch (Lani), *Citharinus citharus* (Cici), *Synodontis species* (Sysp) and *Tilapia species* (Tisp) See (Appendix 2) for a full description of species and abbreviations.

4.2.4 Gear and craft propulsion relationship

There was a general relationship between the gear and craft propulsion types used in the lake. The PCA triplot of respondents (observations), fishing gear ("species") and fishing craft (supplementary variables) is shown (Figure 15). Axis 1 explained about 71% of the total variation in the fishing gear data, and simultaneously, the two axes accounted for about 87% of the total variation. This analysis was performed after exclusion of the trap, beach seine and lift

net variables. Only a few fishers operated these gears and they strongly affected overall result of the PCA, and this made the general trends for all other gear types and craft types difficult to interpret. The reason seems to be that trap fishers normally declared to operate between 10 – 40 traps, and this high number of gear tended to dominate all other trends.

There was a good spread in the observations of gear and propulsion types. The variables paddle craft and motorized craft explained 82% of the explainable 87% variation in the first two axes. Fishers that operated gill net used both forms of propulsion but a number of them relied primarily on motorized craft. In contrast, respondents that operated surrounding net usually do from paddle craft. A few respondents that showed some specialization in hook & line tended to have cast nets as well, and to use paddle craft more than motorized craft.

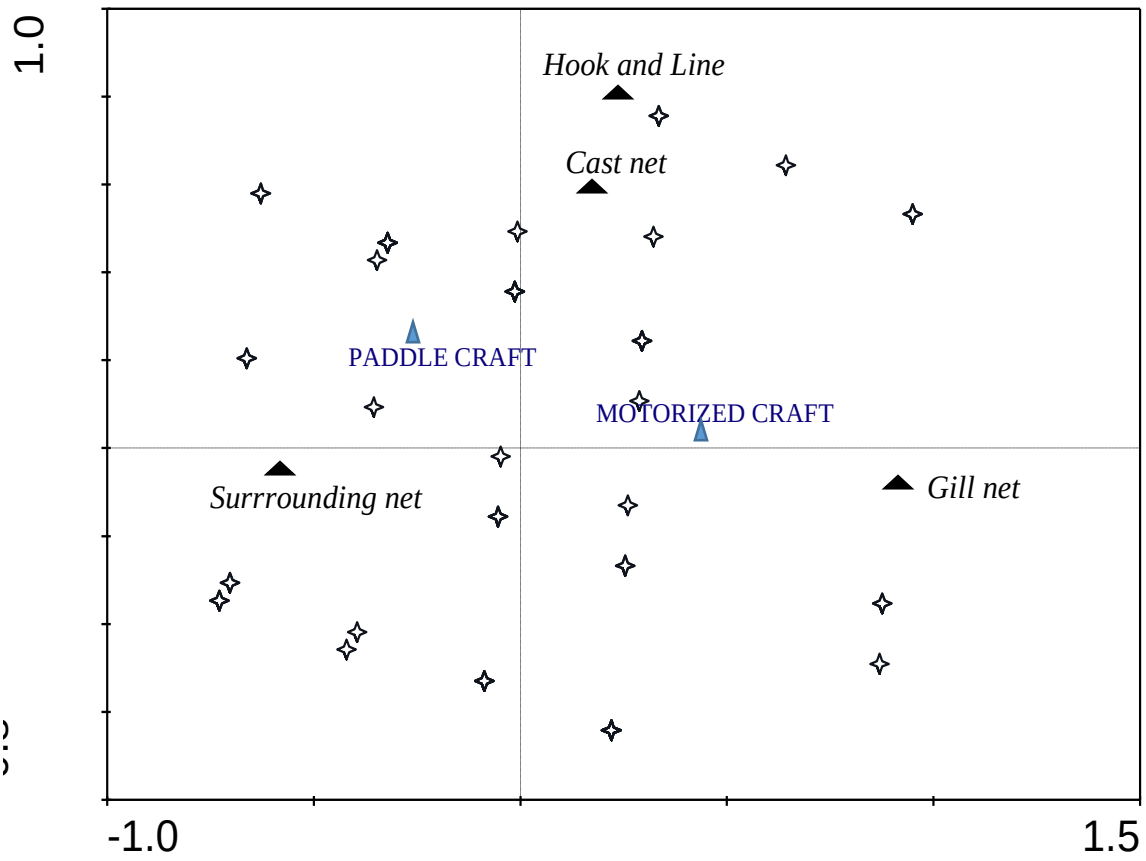


Figure 15: A triplot of PCA, of the gear types and craft types used in Kainji Lake lower basin.

The response variables were the gear: Cast net, Hook & Line, Gill net and surrounding net. The predictor variables were the type of propulsion: Paddle and Motorized (blue capital letter). Fishermen with gill nets, cast nets and hook and line reported using both paddle and motorized craft.

4.2.5 Gear use, input factors and economic output relationship

The analysis provided a suitable association between gear use, input factors and economic output. The PCA triplot of respondents, most utilized fishing gear, and input factors and output is shown in Figure 16. Axis 1 explained 72% of the total variation in the fishing gear data, and taken together the two first axes accounted for about 89% of the total variation. In this analysis, eight observations (respondents) were removed. Four respondents that neither use gill nets nor hook & line and cast nets, three respondents with extremely high number of gill nets without

disclosing their weekly income and, finally, one respondent with large number of cast nets that did not disclose his economic output also. These were removed because they either were missing observations or represented extremely cases and interfered with general trends of the graph.

Fishermen that use a suite of fishing gear and those that concentrate on gill nets (right side of the graph) appear to form the main contrast in the data and spread from left to right along axis 1. A few respondents that showed some specialization in hook & line tended to accumulate large number of cast nets as well, and these fishers contrasted vertically along axis 2 (top) with the pool of non-specialized fishers (close to the origin). Taken together the input factors and economic output explained 87% of the explainable (89%) variation in the first two axes. Hence, fishers that reported concentration on gill nets, hook & line and cast nets, often reported the high expenditures of fishing gear. Contrastingly, the highest economic output, as measured by the variable weekly income (in the second quadrant of the graph), seemed to be associated with gill net fishers. A large input to fishing in the form of fishing hours (position close to the origin of the axes), does not seem to be particularly associated with any gear types. Thus, cost of the gear may be more important than its efficiency (volume caught per time) in the selection of fishing gear.

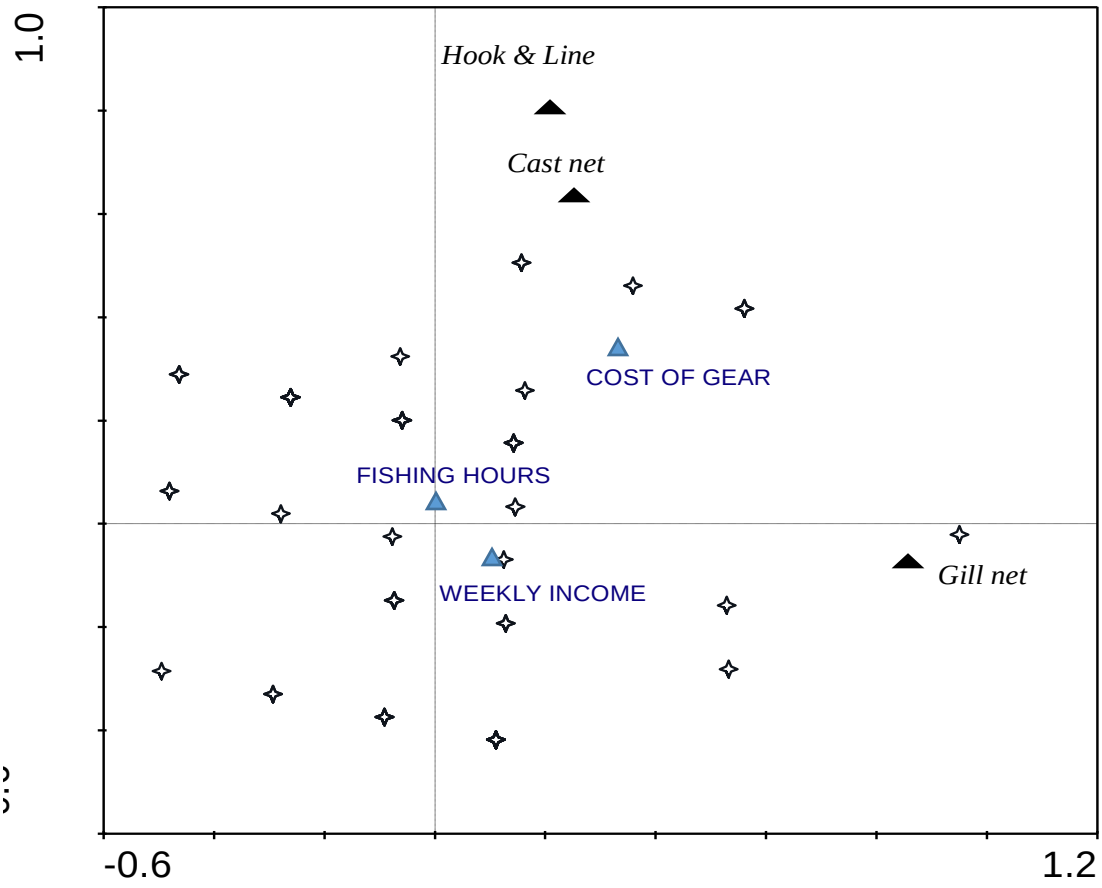


Figure 16: A triplot of PCA, of the gear use, input factors and economic output in Kainji Lake lower basin.

The response variables: Cast net, Hook & Line and Gill net. The supplementary variables: fishing hours, cost of gear and weekly income (blue capital letter). There is a good association between gear use, input factors and economic factor.

4.2.6 Craft propulsion, Input factors and Output factor

The analysis provided a suitable association between craft compulsion, input factor and economic output. Figure 17 shows the PCA triplot of respondents, fishing craft, and input factors and output factors (supplementary variables). This analysis was performed with the removal of four observations. A respondent who did not provide sufficient detail about his craft and three respondents with more than two crafts without disclosing their weekly income. The axis 1 alone accounted for 60% of the variability in the data and taken together, the two axes explain close to

all the variability in the data (100%). The analysis contrasted fishermen that used paddle craft (right side of the graph), and normally have lower weekly income, to those that use motorized craft and have larger incomes. The latter group was also normally associated with larger and more costly craft (along axis 2). These input and output factors explained all the variability (100%) of the overall explainable (100%) variation in the first two axes.

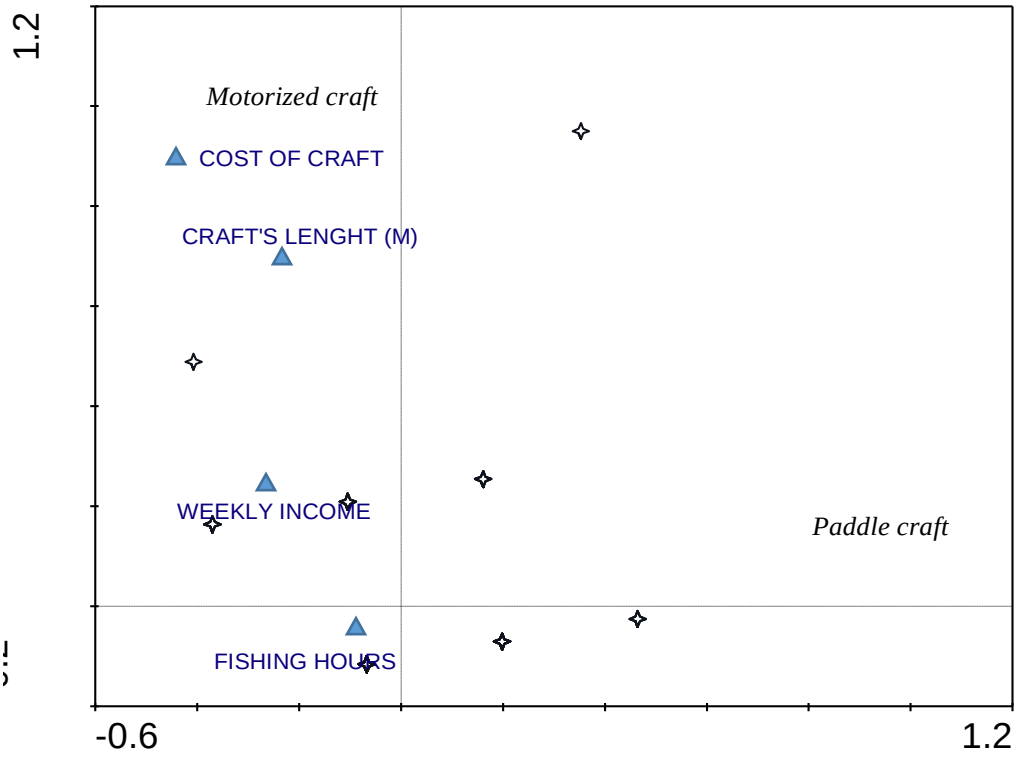


Figure 17: A triplot of PCA, of the craft propulsion type and other input and output factors of fishers in Kainji Lake lower basin.

The response variables: Motorized craft and Paddle craft. The supplementary variables: fishing hours, cost of craft, length of the craft and weekly income (blue capital letter). Cost of the craft and length of the canoe are the major determinant factors in the selection of craft type.

4.3 Challenges identified by the fishers

Fishermen in the lower basin of Kainji lake identified a number of challenges to their occupation, but for the vast majority (88%) lack of access to credit facilities, followed by high costs of

fishing materials and theft of gear were the most important. Others include decline fish caught in recent time, lack of good fishing materials and inability to repair craft and gear (Table 2).

Table 2: Challenges facing fishers and Fisheries management practice in the study area

Challenges	Frequency	Percentage (%)
Lack of access to credit facilities	53	88
High cost of fishing materials	43	72
Stealing of fishing equipment/catches	28	47
Catch decline	19	32
Inadequate of fishing materials	18	30
Inability to repair craft and gear	17	28
Flood	15	25
Water current	11	18
Problem of water plant	10	17
Fish spoilage	8	13
Tearing of nets by engine boat	6	10
Poor durability of fishing materials	3	5
Gear inefficiency	2	3

4.4 Fisheries Trends according to the *Maigari*

All of the twelve village heads (*Maigari*) interviewed claimed that catches had declined in recent years due to much lower catch every time a fisher goes out. They revealed that there is always demand for fish, but the fishers have not been able to meet owing to the declining catches as well as the seasonal fluctuations. These has made majority of the fishermen to involve in part-time fishing activities compared to the past. The problem was attributed to non-monitoring of fishing activities, inadequate regulation, and both these factors plus poor management. A majority of

maigari reported that major changes had occurred in their villages in recent time. Village head indicated that they had observed a continuous decrease in the number of fishermen in their fisheries because of the dwindling fisheries resources. It was often (10 *Maigari)* reported that fishers have started moving to farming practice and any other occupation where they can more easily meet their needs.

The opinions with regard to the future of fishing expressed by *Maigari* were not positive. Most (8 *Maigari*) of the head of the villages stated that the future of the fisheries is not promising because there is no effective law and regulation. They accused government for neglecting the fisheries and not involved in the provision of alternative means of livelihood/skill acquisition training. Some (5 *Maigari*) reported that things will turn out well if government fully committed in the improvement and management of Kainji Lake fisheries. Whereby four out of five *Maigari* emphasized on the enforcement and restriction of lift nets (*Atala* nets).

CHAPTER FIVE

5.0 Discussion

The conduction of the present survey followed the general directives identified by FAO (1995) for the collection of basic information required to know, or manage in small-scale inland fisheries. Whilst specific details about the fish biology, gear selectivity and vessel technology could not be captured in a rapid survey, a strength of the study are the findings about gear and craft utilization, as well as the ecological and socio-economic linkages in the fishery.

There was problem of acquiring historical information relating to survey of fishing craft and gear in the study area, but these had little or no effects on the present study. Fisheries data from Kainji lake only exists from 1969 to 1978 (Abiodun 2003; du-feu, 2003). After this period, consistent collection of data stopped. This corresponded to non-availability of sufficient and good quality data. For instance, there are no current record of fishermen fishing in Lake Kainji because fisher's registration and licensing has stopped long time ago. The last record of fishermen in Kainji Lake was reported by Abiodun, (2003). Language barrier in terms of communication was also an obstacle the researcher confronted at the study area. The majority of the respondents spoke Hausa language only (few speaks Pidgin English which is another general language spoken in Nigeria): this made the survey practically demanding in terms of time and may have led to some imprecisions in translation.

Regardless of these shortfalls, the general descriptive analyses and individual respondent analyses revealed patterns in gear use and craft utilization, species composition and socio-economical traits of the fishers in Kainji Lake lower basin. These have not been fully described before in this and many other areas of Nigeria.

5.1 Fishing gear and craft

The gear types gear found in this present study are gill nets, cast nets, hook and line (Long line), Traps (Malian or *Gura* trap), surrounding nets, beach seine nets and lift nets (See Appendix 3 for pictures). All these gear types have been acknowledged by du Feu *et al*., (1997) and NIFFR, (2002) during previous surveys of the inland water bodies in Nigeria. These gears are the

commonest gear in Kainji Lake (Yisa *et al.*, 1995; du Feu *et al*., 1997), Lake Alau (Bankole *et al*., 2003) and Lake Chad basin (Bene and Neiland, 2003), all in Nigeria.

Gill net is ranked as the most important and the most used fishing gear among the fishers. The dominance of gill net followed by cast net can be traced back to the mid 70's as it has been earlier reported by Seisay, (1998). Gill nets are widely used in artisanal fisheries in developing countries because they are efficient, relatively inexpensive and capable of catching higher amount of economically valuable fish than other artisanal gears (Valdez-Pizzini, 1992). Despite acceptance of gill nets in Kainji Lake, fishers at the lower basin switch gear during fishing activities, a practice that is in consonance with Neiland *et al*., (2000). For instance, a fisherman could own one gill net, one cast net, one set of hook & line as well as some traps and any of them can be use anytime the fisher want. This may be as a result of fishing patterns (mixed fisheries) of the region, but is also a reflection of the flexibility in nature utilization and lack of rigid fishing regulations. As has been reported by Tagago *et al*., (2011), different gears are used for targeting fish because of habitat changes. According to du Feu *et al*., (1997), and Bankole (2003), fishers used different kind of fishing gear because of seasonal variations in species availability. Whilst the present study gave a static description of a fishery in the dry season, it is apparent from other publications that fishers in Lake Kainji measured seasonal variation and fish species as their main reasons for switching fishing gear (du Feu *et al*., 1997; Agbelege *et al*., 2003; Bankole *et al*., 2003).

All the craft sampled during the study were made of wood planks and are locally built (Appendix 3 for picture), as it is apparent in the literature (Udolisa et al., 1994; Solarin, 1998; NIFFR, 2002). Greater number of fishermen in Kainji Lake lower basin use paddle planked canoe and this validate NIFFR, (2002) survey of craft uses at Kainji Lake. Majority of the fishermen own only one craft and this may be attributed to the level of commitment as many of the fishers have alternate means of livelihood. However, some fishers have two, three, or more crafts based on their financial ability, and probably household size. Contrast to the primary research question on diversity of craft, the study shows that there is little or no diversity of craft use in the region. In previous studies, Ambrose *et al.* (2001) identified three types of fishing craft in Nigerian coastal water namely: dugout, half-dugout and planked canoes. Ago and Tafida, (2005), also identified dug-out type and gourd/calabash craft at the lower basin of Kainji lake. In the present survey,

only planked canoe with flat bottom shape were found in the region. Flat planked canoe has a wide acceptance by the fishermen in Kainji Lake lower basin and this is contrary to NIFFR (2002) who reported the use of some V-bottom shaped crafts. Flat bottom planked canoe may remain to be popular even if a new craft materials is introduced to the fishers because it has dominated the fishery already and fishers claimed they are always comfortable and save on it.

Canoes in river normally have flat hulls or bottom while sea going vessels normally have pronounced keels, which are handy to avoid sideways drift but less operational in calm shallow waters. According to Gilbert (2008), the sea going vessels have hulls that are long and slender with pointed ends. The reason for using flat bottom craft in Kainji Lake lower basin may be as a result of shallow water depth of the lake as indicated by Gilbert, (2008). Another reason might be that flat bottom craft gain greater stability from the bottom width and they are suitable for lake or river at lower speed. This has been reported by Stambaugh, (2010) with the additional indication that it takes relatively less time to construct flat bottom canoe compared to V-bottom shaped.

The results of the present study also revealed that craft use by the fishers in Kainji Lake lower basin are mainly not motorized probably, because of their low cost compare to the motorized ones. This was also reported by NIFFR, (2002) and Ago and Tafida, (2005) who identified the problem of not using motorized craft as a result of high price of outboard engines. The existing perception among the fishers in Kainji Lake lower basin that motorized craft scare fish away could also be another factor responsible for low number of motorized craft, or rather, accounts for the high acceptability of paddle craft. Despite the cost, motorized craft facilitate fishers to reach far and deeper fishing area from the shore, and possibly other landing sites. Apart from simplicity of planked canoe, it is also durable and could last for more than 5 years if there is proper and adequate maintenance culture (Solarin, 1998).

5.2 Gear types and Socio-economic Characteristics of fishers

The relationship between gear types and sociological together with economic status of fishermen exists in Kainji Lake lower basin. Fishermen that uses gill nets, cast nets and hook & line often had larger households, belonged to a cooperative society, and they are married, at the same time older. Fisher's households (wife or children) always have one or more contribution towards

fishing activities. They normally play roles in the fishing operation, marketing of the fish, or sometimes both. Neiland *et al.*, (2000) reported that fisher's households exhibited important variety in relations to their socio-cultural and economic features. In Kainji Lake lower basin, the cooperative (*fadama*) seems to act as an exclusive organization, especially suitable to the settled fishers that lead a combined agro-fish activity. Youngers with little capital, or outsiders, seem to be excluded from membership, and are those more often are full-time fishers. Older fishermen are active members of the cooperative which is supported by a World Bank project. This put them at an advantage of getting financial assistant from the organization. The benefit they derive include soft loan and access to subsidized fishing and farming tools. Kingdom and Kwen (2009), reported that fishers who are not members of cooperative societies have the difficulties to get support and attention from the administration (Government), non-governmental organizations and financial institutions. This raises another issue of interest for further research, which is to describe the ecological and socio-economic consequences for the lake as a whole of implementation of such cooperative and development projects.

The observed high percentage of married fishers in the lower basin of kainji Lake reflects also the findings of Olaoye *et al*., (2011) who affirmed that artisanal fisheries are dominated by married fishers. A possible reason may be linked to the fact that married people may have more pressing demands and problems to solve than singles or divorcee (Kwen *et al*., 2013), or that these are people that have managed to accumulate enough capital to both marry and purchase/inherit fishing gear and craft. The highest age group of fishers fell between 41-50 years, which may possibly indicate that youth are not fascinated by fisheries practice in Kainji Lake, or face increasing difficulties to enter the fishery. Much along the same lines, Ahmed, (2012), reported age bracket of the fisher folk in *Borgu* local government area of Niger State, Nigeria to be 30 – 49 years.

5.3 Fishing Gear and Craft Selection

It was observed that the major determinant factor responsible for choice of fishing gear in Kainji Lake lower basin is the efficiency of the gear (41% of the respondents), followed by the

suitability of gear to catch targeted fish, fishing season and cost of the craft. Gear effectiveness can be expressed in terms of numbers of fish caught by a fishing gear in a unit period. The efficiency of gear is directly associated to the possibility that a fish will encounter and be caught in the gear. According to Portt *et al.,* (2006), efficiency varies among gear types. There is variation in efficiency of the fishing gear use by the fishers in Kainji Lake lower basin, this efficiency variation may be influenced by the mesh size of the gear, which may invariably have greater influence on the size of species caught. This may be attributed to the behavioral pattern of the gear itself (passive or active) and even be related to materials used in the fabrication of the fishing gear.

Gill nets and cast nets constitute about 70% of the use by the fishers in the region. However, gill nets are the most commonly operated passive gear. They can be operated from shallow to large depth and can be used for fishing on rough bottom distinctively from cast nets. Gill nets are used to catch a large variety of fish species. Hence, majority of the fishermen believed it is more efficient (strong) and last longer when multifilament materials are used for the self-fabrication. On the other hand, fishermen revealed that paddle craft are quite small in size and affordable, while motorized craft (with outboard engine) may be bigger, but expensive. This corroborates report of NIFFR (2002), and Udolisa *et al.,* (1994). The noticeable trend from the analysis of craft propulsion (figure 17) shows that the cost of the craft and the size of the craft may be the determinant in selecting craft use for fishing activities. These two factors invariably determined the efficiency and distance covered during fishing operation. The high cost and big size of the fishing craft could fall within the reach of the rich old fishermen that may be involved in another occupation.

5.4 Species Diversity in Kainji Lake lower Basin

The present findings revealed a high species diversity of 26 fish species representing 19 families (see Appendix 2). According to du Feu (2003), fish species in Kainji Lake are linked to diverse "*Nilo-Sudanian*" fauna group that is represented about 30 families. The catch composition varied considerably in type and size and include large number of small fish, such as catfish species

(*Clarotes laticeps, Synodontis membranacea, Clarias gariepinus*) and *Cliclidae* family (*Tillapiine*).

According to the fishers interviewed, the most consistently (at least one fish present in every landing) species were *Tilapiine* from the family *Cichlidae* though not the most abundance (see Appendix 4). Among these *Oreochromis niloticus, Sarotherodon melanotheron* and *Coptodon zilli (Tilapia zilli)* are predominant. This partly substantiate the findings of Balogun (2006), who reported that majority of the fish catch in Kainji Lake belonged to the family *Cichlidae*. The frequently catch of *Tilapiine* could be attributed to their prolific breeding pattern. Bankole *et al*. (1994) reported that tilapia spawn between three to four times annually. Regardless of diversity of the species caught in this region, the catch are dominated by the upside down Catfish (*Synodontis species*, picture in Appendix 4). This was in agreement with Gell and Whitington, (2002) who reported that few species dominate fishery, despite multi-species nature of artisanal fishery.

Fishermen in the lower basin have preferences for certain fish but take any fish caught in the gear, and no fish are discarded. The premium specie in Kainji Lake lower basin is Nile perch (*Lates niloticus*). The fish is of great commercial importance as majority of the fishermen claimed they earn more money and benefit more whenever they catch Nile perch. The findings correspond to those fishers in Lake Victoria. Nile perch is of similar economic importance in Lake Victoria where the fish has brought transformation and profitability to fishing communities and local fishers (Abila, 1998).

The present observation suggest that the relatively high species diversity may lead to the use of different kind of gear in Kainji Lake lower basin. Gear types may select catch by size or species (Dalzell 1996), therefore, gear use may hence affect the catch per unit effort of targeted fish. Fishermen revealed that gear type use depend on targeted species, and the present analysis (figure 14) strongly suggests that certain combinations of gears are more prone to catch some species than others. Fishers at the basin does not use nets gear (gill nets or cast nets) for targeting catfish (*Clarias gariepinus*), rather, hook & line or traps is preferable because catfish stay closer to the grass and they believe grass will destroy the nets gear. The most common species taken by

nets gear are *Cichlidae*, *Mochokidae*, *Tilapiine*, and *Citharinidae* family. Besides, nets gear use in Kainji Lake lower basin take a wide variety of species by catching smaller fish if the size of the mesh is not selective. This has also been reported by du Feu, (2003).

5.5 Fishers Level of income

Fishing is one of the main source of income in Kainji lake lower basin and contributed to fisher's survival in terms of food supply and occupation. The fishers in the basin generated relatively good weekly income, with about 60% of them (figure 11) deriving between 10 and 25 thousand naira (approximately, $61 and $154) weekly. This translates to approximately, $246 (or more) in a month. This is higher than the monthly minimum wage (18 thousand naira, approximately, $111) pay by the Niger State Government for the workers. Similar observation has been reported by Kingdom and Kwen, (2009) that fishers in lower Taylor creek of Balyelsa State, Nigeria, earn more than the state civil servants. Kainji Lake provides outstanding and diverse income generating opportunities for the fishermen or at least those that remain in the fishery. However, only few fishers are involve in full-time fishing activity to generate income. This was reported by Omojowo *et al*., (2010) who observed that most fishermen are part-time fishers. Fishermen (80%) in the lower basin are usually involve in income generating activities by combining farming (65%) and other occupation with fishing. This corresponds to the findings of Marie-sarch (1996) who identified fishing and farming as combined activities of many fishermen in Lake Chad. Also, the fact that nearly 90% of the respondents (figure 9) fished less than six hours a day, conforms with the possibility of pursuing other activities to generate income. The remaining 10% worked apparently full time in fishing (more than seven hours per day). Contrary to previous report that fishermen in Nigeria are poor (Araoye, 2002; Williams, 2007), the present observations suggest that fishers in the basin are doing better than the poor people of Nigeria.

Tafida, (2011) reported that there is involvement of the independent variables in determining the overall income of the fishers. This implies that the variable input such as gear, craft and other factor of production have strong influence on fisher's final net income. The present findings suggests that the number of hours spend on fishing activities per week may not determine fisher's weekly income. This was also noted by Tafida (2011) that the number of activities does not determine the amount of fishermen total income. Rather, the efficiency and effectiveness of

the input variables (gear and craft) use for fishing operation. Fishers with gill nets get high weekly income than other fishers with other types (figure 16). The finding also reveals that fishers with high weekly income are able to acquire large number of gear. Agbontale (2009), reported that income of fishermen determines their ability to purchase improved fishing gears to a greater extent. In the present study, fishers with high weekly income were often those that could afford more gill nets and bigger motorized craft (figure 17). It is not clear, however, of what is the cause and consequence of this process, but given the age of the fishers and their sedentarism (agriculture) it may be as a result of a long process of accumulation of capital. Younger people and newcomers are those with low weekly income, and always go for paddle canoe probably because it is cheap. As they may also lack access to land, and thereby agriculture, their chances of entering the cooperative and getting credit to purchase input factors may be limited.

5.6 Marketing Network

Fishers operate two markets in Kainji lake lower basin: selling fresh to the fish monger and transformed into another product through processing by fisher/family. Fishermen sell most of their catch to fish mongers as earlier identified by Neiland *et al*., (2000). Transaction of fish was observed through inspection. Fishers don't usually sell in kilogram, rather, they perceive in quantity. Fishers and fish mongers use personal negotiation for the selling of the catch fish which based on species and physical perceived quantity of the fish. The exception is the bigger *Lates niloticus* which is usually weighed and has probably the status of a trophy fish. Each fisher have their own stable and permanent customers to buy their fish. The channel of fish distribution is from fishermen to fish mongers and to final consumers.

There is well defined fish marketing networks between the fishermen and middlemen where the middle men buy processed fish from the fishermen, packaged it (see Appendix 4 for picture) and sell it, normally to the markets/consumers in south eastern part of Nigeria (Onisha in Anambra State). This corresponds to what is happening in Lake Chad, upper river Benue and Nguru-Gashua wetlands as reported by Neiland *et al.,* (2000). The channel of fish distribution could not be ascertained in-depth as it is beyond the scope of this present study.

5.7 Status of the Fisheries

The finding that fish catch are declining due to much lower catch by the fishers (claimed by *Maigar*i) could not be evaluated convincingly from the present study (statistic data of catch and effort were not collected). This is not, however, an unequivocal sign of over-exploitation. FAO (1995) stated that over-exploitation within the dry hot climate fisheries is very difficult to notice because of their highly productive status, but little sign of overfishing may occur. Furthermore, FAO (1995) indicates that there can be severe fluctuations in production, dictated by seasonal variation. Welcomme, (1985) also reported that tropical inland fisheries can withstand high catch through effort increment, but a point will come when the fisheries will collapse. From the survey findings, there may be a sign to suggest that there is development of catch decline in Kainji Lake lower basin due to catching that include large number of small size fish. Already, Abiodun (2003) and Ovie and Raji, (2006) reported decline in fish catch in Kainji Lake as a result of over-exploitation. But this may be as a result of another factor like seasonal variation as well, as reported by FAO, (1995). Fish decline may also be as a result of small mesh size gear use by fishers in the region. As has been reported by Abiodun, (2003) fishermen changed from the recommended gill net mesh size (75mm) first to smaller size (52mm) and now to nylon monofilament because it catches juvenile and are extremely efficient. The use of small mesh size has led to catching small fish size which might suggest fish decline in that region. However, not all the gear identified in the present study were gill nets, and there was not a possibility to determine the common mesh sizes.

*Maigar*i opined that one of the most important problems for management is the lack of monitoring fishing activities by the government. The fishery of the Lake Kainji lower basin is a complex, open access and unregulated fishery. It is also difficult to manage and govern in a centralized way. Neiland *et al*., (2002) stated issues confronting management and sustainability of the fisheries in Lake Chad basin to be environmental factors, factors originating from outside such as (population, poverty), fisheries policy and implementation. These are not peculiar to the Lake Chad alone but common to Nigeria inland fisheries in general (Ovie and Raji, 2006). Furthermore, Ovie and Raji (2006) indicate that the management system of many inland fisheries resources in Nigeria involves the formal (government) and informal institutions (traditional head and fisherfolks). Lack of proper fishery governance in the direction of Kainji Lake fishery show

that, there are no combine effective action and true cooperation between the fishers and the government towards fishing gear use, diversity of fish species, fishermen level of income, fish market operation and management of the fishery in general. The indication of village head that they had observed a continuous decrease in the number of fishermen in their fisheries has also been reported by Abiodun, (2003). Majority of them have been using farming practice as a livelihood substitute as has been reported by Neiland *et al*., (2000). The two activities (fishing and farming) are often combined by the fishers.

However, the challenges confronting the fishers (Table 2) at the lower basin of Kainji Lake are not new, but are common to other inland water fisheries in the country and other developing countries of the world. This might suggest that these are the major problem encountered by artisanal fishers in most parts of Nigeria (Kwen *et al*., 2013). Most of these challenges has been documented, and they are well represented in the literature (Ipinjolu *et al.,* 2005; Kingdom *et al*., 2008; Kwen and Kingdom, 2009; Davies and Kwen 2012; Tagago and Ahmed, 2011; Ekpo and Essien-Ibok, 2013). Some of these challenges have been attempted to solve by the government but lack continuity (Ita, 1993). Lack of access to credit facilities to purchase fishing inputs is a problem often raised by the fishers in the region and has been highlighted by Omorinkoba *et al.,* (2011) in artisanal fisheries in Kainji Lake. However, it is not clear whether access to cheap credit would not inflate fishing effort and lead to even less profitable fisheries.

CHAPTER SIX

6.1 Conclusion

The study sought to survey fishing gear and craft in lower basin of Kainji Lake, and to study the socio-economic features of fishers regarding fishing equipment. The study also investigated the general perception of the fishers and village leaders about the present state of the fisheries with the challenges they are facing. This section presents the conclusion based on the findings of the study and suggestions for future research.

Returning to the research questions posed at the beginning of this study, it is now possible to reveal that a diversity of fishing gear, but only a single type of craft, are used by the fishers in the study area. The gear type that is important and widely used by the fishers in the study area is gill nets (38% of 368 sampled gears surveyed). However, the study also showed that most fishers are not tie to a specific gear. Fishers switch gear presumably as a result of seasonal variation and species diversity in the region. The possibility of the fishers changing gears during fishing operation was not investigated in detail. It would be interesting to study the dynamics of change of gear with respect to daily or seasonal occurrence of fish or demand for it. The kind of craft fishers used nowadays in the region is planked canoe (paddle and mechanized) with flat bottom hull. Fishers do not change craft as they do for gear types. This is apparently a classical design for this type of water bodies, and it marks an evolution in craft construction after dug-out canoes. The stated reason for the use of paddle propulsion are mainly its low cost and low disturbance of the fish prior to harvest. Motorized craft is expensive, but some fishers prefer it because it is efficient and cover long distance. It was not clear if this was a distance to more profitable fishing grounds, landing places or both.

The relationship between gear use and socio-economic features of the fishermen show that fishers using gill nets, cast nets and hook and line normally have larger households and belong to cooperative society. They are married and older than their colleagues. The major determinant factor in the selection of gear is its efficiency, which they defined as ability or competence of fishing gear to achieve a desired catch without wasting energy. Determining factors in the choice of craft are the size and cost. It would be interesting to study the social dynamics of the fishery:

how young people are recruited and how they progress along the professional ladder to finally enter the cooperative and purchase the boats and nets. These dynamics must be understood before any attempt to regulate the fishery is made.

Species diversity leads to the use of different kind of gear according to the targeted species. Hook & line are used to catch *Clarias gariepinus* and nets to catch *Cichlidae* family. Fishers have preference for *Lates niloticus* because of its size (big) and its economic value. Apparently this is not a very common catch and must be regarded as a "trophy" or bonus rather than the usual target. Fisher's level of income determine the type of gear or craft they use. Fishermen that earn high weekly income attain large number of gear (especially gill net) and could afford motorized canoe that has bigger length. But, the opposite can also be said: efficient input factors may be acquired by those with larger income. The process of capital accumulation is not totally understood, but having part-time activities in farms, larger families and membership in the fisheries cooperative are important features in the process. Fish is mostly sold fresh, and the marketing operation is mainly between fishermen and fish mongers. There are distinct marketing networks between them whereby personal negotiation without weighing the fish happened between the fishermen and the mongers. The channel of distribution could not be ascertained in details, hence, the rest of the chain should be followed in future study. Nonetheless, the levels of (gross) income reported in the questionnaire survey by the fishers were relatively high for the country.

The understanding of village leaders on the present state of the fisheries in Kainji Lake lower basin is that fish catch are declining due to low catch in recent years. Leaders attributed fish decline to non-monitoring of fishing activities and inadequate regulation by the government. This view conflicted with the opinions of most fishers who claimed that absence of credit facilities and the high cost of new fishing gear were the major challenges to fishery development in Kainji Lake lower basin. This view was mostly share by the fishermen who were not member of cooperative, and lacked probably the access to formal credit from funding institutions

REFERENCES

Abdul, W. O. (2005). Fishing Gear Design and Production lectures. In: Fishing Methods in Nigeria. Federal University of Agriculture, Abeokuta, Nigeria. 20pp.

Abiodun, J. A. (2003). Evaluation of Fisheries Catch Trend on Kainji Lake, in Nigeria. Journal of Applied Sciences and Environmental Management, Vol. 7, No. 2: 9-13

Abiodun, J. A. and Ayanda, J. O. (2008). Economics of fishing gears for sustainable fish production and development in inland water bodies in Nigeria. *Continental J. Agricultural Economics 2:* 23 – 27.

Abiodun, J .A; Alamu, S. O; Miller, J. W. (2005). Assessment of inland waters fisheries in Nigeria with implications for freshwater fish production, poverty alleviation and food security. *In proceedings of the 19th Annual Conference of Fisheries Society of Nigeria. Lagos:* FISON. Pp. 304 – 311.

Abiodun, J. A. and Niworu, A. M. (2004). Fisheries Statistical Bulletin Kainji Lake, Nigeria, 2004. Kainji Lake fisheries Management and Conservation Unit *Technical Report Series 23*. 24 pp.

Abila, R. O. 1998. The patterns and trends of marketing and consumption of the fish of Lake Victoria (Kenyan waters). African Journal of Tropical Hydrobiology and Fisheries 8:35-40.

Adeyemi M. B. (2010). Cultural Influence Militating against Effective Data Collection in the field: *The case of Two African Countries*, Anthropologist, 12(4): 245-249.

Agbelege, O. O. Raji, A. And Mofio, M. M. (2003). Fishing Gear Survey of Lake Chad. In: Eyo , A. A. and Ajao, E. E. (Eds.). Proceedings of the 16th Annual Conference of the Fisheries Society of Nigeria (FISON). Pp: 87-98.

Agbontale, O. (2009). Motivational factors responsible for women involvement in fish processing and marketing around Lake Kainji, In: O.A. Fagbenro, O.A. Dada and

M.O. Olufayo (Eds.), Proceedings of the 24th Annual Conference of the Fisheries Society of Nigeria (FISON).

Ago, N. D. and Tafida, A.A. (2005) *Marketing of fishing gear materials and fishing gear making in parts of Kainji Lake basin.* In: 19th Annual Conference of the Fisheries Society of Nigeria (FISON), 29 Nov - 03 Dec 2004, Ilorin, Nigeria, pp. 73-78.

Ahmed, Y. B. (2012). Socio-economic Status of the Fishers folk of Yuna Adopted village in Borgu Local Government Area, Niger State. Journal of Fisheries and Aquatic Science. ISSN 1816-4927/ DOI: 10.3923/jfas.

Ajibade, A.C. (1982). The origin of the Older Granites of Nigeria: some evidence from the Zungeru region. Nigerian J. Min. Geol., 19(1), 223–230.

Ambrose, E.E. and Udolisa, R.E.K. and Solarin, B.B. and Lebo, P.E. (2001). Technological status and development prospects of small-scale fishing crafts in Nigerian coastal water. In: 14th Annual Conference of the Fisheries Society of Nigeria (FISON), 19-23 January 1998, Ibadan , Nigeria, pp. 139-144.

Akintunde, E. A. (1976). The biology of Tilapia and Sarotherodon species of Lake Kainji, Nigeria with special reference to *Sarotherodon galilaeus*. M.Sc. Thesis, University of Ife, Ile-Ife, Nigeria. 200 pp.

Araoye, J. O. (2002). Man-made Lakes, Ecological studies and Conservation needs in Nigeria. Biol. Trop., 50: 857-864.

Ayeni, J. S. O. and Mdaihli, M. (1996). Identification of non-fishing income opportunities around Kainji Lake. Nigerian-german Kainji Lake Fisheries Promotion Project Technical Report Series 4. ISSN: 119-1449. 84p.

Balogun, J. K. (2006). Fish distribution in Kainji Lake, Nigeria. Journal of Fish Biology, Volume 29, Isuue 4, pp 489-498. DOI: 10.1111/j.1095-8649.1986.tb04964.x

Bankole, N.O., Sule, O.D., Okwundu, E.C., Umoru, I and Balogun, I. (1994). Preliminary investigation on the frame and catch assessment of Kainji Lake, New Bussa Niger State. *N.I.F.F.R. Annual report.* pp 134 - 147.

Bankole N.O., Raji I.A., Adikwu O.A, Okwundu E.C., (2003). Fishing gear survey of Lake Alau, In: A.A. Eyo and E.A. Ajao (Eds), Proceedings of the 16th Annual Conference of the Fisheries Society of Nigeria (FISON). Maiduguri, 4th-9th November, 2001, pp. 99-103.

Beadle, L. C. (1974). The inland waters of Tropical. London: Longman Group.

Bene, C. and Neiland, A. C. (2003). Contribution of inland fisheries to rural livelihoods in Africa: An overview of Lake Chad basin areas. In: Welcome, R. and Petr, T. (Eds.). Proceedings of the second International Symposium on the Management of Large Rivers for Fisheries Vol. II. FAO Reg. Office for Asia and the pacific , Bangkok. Pp: 1-14.

Birch, M. and Miller, T. (2000). Inviting Intimacy: The Interview as Therapeutic Opportunity. *International Journal of Social Research Methodology* 3: pp189–202.

Bonar, S. A. and Hubert, W. A. (2002). Standard sampling of inland fish: benefits, challenges, and a call for action. Fisheries 27(3):10–16.

Clement, A. R. (2013). Vulnerability of Fisheries Livelihood in the Coastal Area of the Niger Delta Region of Nigeria. World Journal of Fish and Marine Sciences, Vol. 5, NO 2: ISSN 2078- 4589, pp 152- 158.

Davies O.A., Kwen K., (2012). Fish assemblages of selected traditional fishing traps (Malian and Ikara) in the Upper Nun River, Niger Delta, Nigeria, FS J. Res. Basic and App. Sci., 1(2): pp 8- 11.

Dalzell P. (1996). Catch rates, selectivity and yields of reef fishing. In: N.V.C. Polunin & C.M. Roberts (eds) Reef Fisheries. London: Chapman & Hall, pp 161–192.

Dickson-Swift, V. James, E, Kippen, S. and Liamputtong, P. (2006). Blurring Boundaries in Qualitative Health Research on Sensitive Topics', *Qualitative Health Research* 16: pp 853– 71.

du Feu, T. A. and Kasali, A. (1996). Fishing gear survey, Kainji Lake, Nigeria. Tech. Rep. Ser.

du Feu, T. A. (2003). Tropical Reservoir Fisheries; Lake Kainji, Nigeria - a case study. Ph.D. Thesis. University of Hull. pp334.

du Feu, T. A. and Abiodun, J. A. (1998). Predictions of fish yields and the status of the Kainji Lake fishery, KLFPP *Technical Report Series No. 17.* ISBN 978-037-015-3. pp56.

du Feu, T. A. Abayomi, O. S. Seisay, M. D. B. (1997). Fishing Gear Survey, Kainji Lake, Northern Nigeria, 1996. Nigeria German Kainji Lake Promotion Technical Report No. pp 6-20.

Dunn, L. (1991). Research Alert! Qualitative Research May be Hazardous to Your Health! *Qualitative Health Research* 1: 388 92.

Ekpo, I. E. and Essien-Ibok, M. A. (2013). Development, Prospects and Challenges of Artisanal Fisheries in Akwa Ibom State, Nigeria. International Journal of Environmental Science, Management and Engineeering Research Vol.2 (3), pp. 69-86.

Ellingson, L.L. (1998). Then You Know How I Feel: Empathy, Identification and Reflexivity in Fieldwork. *Qualitative Inquiry* 461(1): pp 492–532.

El-Zarka, E.L. (1973). Kainji Lake Nigeria. In: *Man-made Lakes. Their problems and Environmental Effects.* (Eds. W.C. Ackerman, G.F. White and E.B. Worthington). Geophysical Monographs Ser. 17: pp 197-219.

Emmanuel, B.E. (2009). The artisanal fishing gears, crafts technology and their efficiency in Lekki lagoon, Nigeria. Ph.D. Thesis. University of Lagos. Pp 256.

Emmanuel, B. E. (2010). Fishing crafts characteristics and preservation techniques in Lekki lagoon, Nigeria. Journal of American Science; 6 (1): pp 105-110.

Eyo, J. E. and Akpati, C. I. (1995). Fishing gears and Methods. Pages 143 – 159. In: Ezenwaji, H.M.G., Inyang, N.M. and Orji, E. C. (Eds.). Proceedings of the UNDP-Sponsored Training Workshop on Artisanal Fisheries Development. Held at University of Nigeria.

FDF (2007). *Fishery Statistics of Nigeria*. Federal Department of Fisheries Publication. Abuja, FCT, Nigeria. 11-24pp.

Fife-Schaw, C. (2001). *Questionnaire design.* In Breakwell, G.M., Hammond, S. and Fife-Schaw, C. (Eds.), pp 158-174.

Fisheries Statistical Bulletin, Kainji Lake, Northern Nigeria. (1997). Nigerian-German (GTZ) Kainji Lake Fisheries Promotion Project. Technical Report Series 9. ISSSN 1119-1449. ISBN 978-037-088-0.

Fontana, A. Frey, J. (2005). The interview: from neutral stance to political involvement. In: Denzin N, Lincoln Y, Eds. The Sage Handbook of Qualitative Research. 3rd edn. Thousand Oaks, California: pp 695–727.

Food and Agricultural Organization, (1995). Current status of the fisheries and fish stocks of four largest African reservoirs: Kainji, Kariba, Nasser/Nubia, and Volta. CIFA Technical Paper, NO. 30. FAO. Rome, pp 134.

Food and Agricultural Organization, (1999). Guidelines for the routine Collection of Capture Fishery Data. Prepared at the FAO/DANIDA expert consultation Bangkok, Thailand. Access on 03-06-2014. http://www.fao.org/docrep/003/x2465e/x2465e00.htm

Food and Agricultural Organization. (1985) Practical guidelines for statistical monitoring of fisheries in manpower limited situations. FAO Fisheries Technical Paper 257 FIRM/FIDI/T257. ISBN 92-5-5102256-9. pp 78.

Food and Agricultural Organization, (1995). Review of the state of World fishery resources: inland capture fisheries. FAO Fisheries Circular No. 885. FAO, Rome. pp 63.

Food and Agricultural Organization, (1991). FAO year book fisheries statistic catches and landing 1989, fisheries series 36 and FAO Statistic series 68. Rome, FAO.

Food and Agricultural Organization, (2002). Sample-based Fishery Surveys. FAO Fishery Technical Paper. No. 425. ISBN 92-5-104699-9. pp 144.

Gale, J. (1992). When Research Interviews are more Therapeutic than Therapy Interviews. *The Qualitative Report* 1, URL (consulted 21 November 2004): http://www.nova.edu/ssss/QR/QR1-4/gale.html.

Gell F.R. & Whittington M.W. (2002) Diversity of fishes in seagrass beds in the Quirimba Archipelago, northern Mozambique. Journal of Marine and Freshwater Research 53, pp 115– 121.

Gilbert, G. P. (2008). Ancient Egyptian Sea Power and the Origin of Maritime Forces. Foundation of International Thinking on Sea Power. No. 1, pp 1-179.

Ibrahim, B. U. Auta, J. Balogun, J. K. (2009). A survey of the Artisanal Fisheries of Kontagora Reservoir, Niger State, Nigeria. Bayero Journal of Pure and Applied Sciences, Vol.2, NO: 1: pp 47-51.

Imevbore, A.M.A (1970). Some preliminary observations on the sex-ratios and fecundity of the fish in the River Niger. *In: Kainji Lake Studies, Vol.1, Ecology*. S.A. Visser ed. Puublished by NISSER, Ibadan: pp 87-103.

Ipinjolu, J.K. Agbelege, O.O and Hassan, W.A. (2005). Exploratory Survey of Malian and Ndurutu Traps in River Rima, North Western Nigeria. In: Araoye, P.A. (Ed.), Proceedings of the 19th Annual Conference of the Fisheries Society of Nigeria (FISON), pp 341-348.

Ita E.O., (1978). Analysis of Fish distribution in Kainji Lake. Hydrobiologia Journal, Volume 58, issue 3, pp 233.244. DOI 10.1007/BF02346958.

Ita, E. O. (1982). Biological Indices of overfishing in Kaiinji Lake and the management Proposal for the Lake fishery. Kainji Lake Research Institute. *Technical Report Series No 8*. Pp 31.

Ita, E.O., (1993). Inland Fisheries Resources of Nigeria. FAO, CIFA Occasional Paper No. 20, Rome, Italy. FAO. pp 120.

Jamu, D.M. and A.O. Ayinla, 2003. Potential for the Development of Agriculture in Africa. NAGA, 26(3): pp 9-13.

Kingdom, T. Alfred-Ockiya, J.F. and Adeyemo, A.O. (2008). Women's Involvement in Fisheries in the lower Taylor Creek Area, Bayelsa State. Journal of Agricultural Res. And Policies. Vol. 3 (3): pp 34-38.

Kingdom, T. and Kwen, K. (2009). Survey of Fishing Gear and Methods in the Lower Taylor Creek Area, bayelsa State, Nigeria. In: World Journal of Fish and marine Sciences 1 (4): pp 313-319.

Lawson, O.E. and Olaitan, O.M. (2010). Fish Diversity in Three Tributaries of River Ore, South West Nigeria. World Journal of Fish and Marine Science 2 (6): pp 524-531.

Lepš, J. and Šmilauer, P. (1999) Multivariate analysis of ecological data. *Faculty Biological Sciences, University of South Bohemia, Eské Budejovice,*

Liamputtong, P. and Ezzy, D. (2005) *Qualitative Research Methods*. South Melbourne: Oxford University Press.

Marie-Therese Sarch, (1996). Fishing and Farming at Lake Chad: overcapitalization, opportunities and Fisheries management. Journal of Environmental management, Volume 48, issue 4. DOI: 10.1006/jema.1996.0080. pp 305-320.

Mc Curry, P. (1976) The Geology of the Precambrian to Lower Palaeozoic rocks of Northern Nigeria-a review in: C.A. Kogbe (Editor), Geology of Nigeria. Elizebethan Publ., Lagos. pp 15–39.

Meye, J. A. and Ikomi, R. B. (2008). A study on fish fauna of Urie creek at Igbide, Niger Delta. The Zoologist. 6: 69-80.

Moses, B.S., (1992). *Introduction to Tropical Fisheries*. Second Edition. Ibadan. University Press. Pp 133.

Moses, B. S. Udoidiong, O. M. and Okon, A. O. l. (2002). A statistical survey of the artisanal fisheries of south-eastern Nigeria and the influence of hydro-climatic factors on catch and resource productivity. *Fisheries Research* 57: pp 267-78.

Mshelia, M. B. and Okaeme, A. N. and Dantoro, N.O. Abiodun, J. A. Olowosegun, O. M. Yemi, I. Y. (2005). *Responsible fisheries enhancing poverty alleviation of fishing communities of Lake Kainji.* In: 19th Annual Conference of the Fisheries Society of Nigeria (FISON), 29 Nov - 03 Dec 2004, Ilorin, Nigeria. pp 597-604.

Mustapha M. K. (2013). Potential Impacts of Climate Change on Artisanal Fisheries of Nigeria. J Earth Sci Climate Change 4: 130. doi:10.4172/2157-7617.1000130.

National institute for freshwater fisheries Research (NIFFR), 2002. National surveys of fishing gears and crafts on Nigerian inland water bodies. NIFFR occasional paper No.4.ix, pp 4. ISSN 0794-2451, ISBN 978-177-051-1.

Neiland, A.E., Béné, C., Jolley, T., Ladua, B.M.B., Ovie, S., Sule, O., Baba, M., Belal, E., Tiotsop, F., Mindjimb, K., Dara, L., Zakara, A., and Quensiere, J. (2002). The Lake Chad Basin Fisheries: A strategic analysis of key policy issues affecting aquatic resource management, stakeholder livelihoods and economic development. In Neiland, A.E. and Béné, C. (eds) Sustainable Development of African continental Fisheries: A regional study of policy- formation mechanisms in the Lake Chad Basin. Final Report. Commission INCO Project No. ERBICI18CT980331.

Neiland, A. E. Jaffry, S. Ladu, B. M. B. Sarch, M. T. Madakan, S. P. (2000). Inland Fisheries of North East Nigeria including the Upper River Benue, Lake Chad and the Nguru-gashua Wetlands. I. Characterization and analysis of planning suppositions. DOI: 10.1016/S0165- 7836(00)00180-6. pp 229-243.

Nuhu, M.B. and I. Yaro, (2005). Selection of efficient hanging ratios of gill net on fish catch in Lake Kainji, as a means of alleviating poverty among artisanal fishermen in Nigeria. *In: P.A. Araoye (Ed). Proceedings of the 19 Annual Conference of the Fisheries Society of Nigeria (FISON).* pp 64-72.

Nworgu B. G. (2006). Educational research: Basic Issues and Methodology. Wisdom Publishers Ltd. Ibadan, pp 1-5.

Omorinkoba W.S., Ogunfowora O.O., Ago N.D.and Mshelia M.B. (2011). Artisanal fisheries activities in Lake Kainji. *In:* Forty years on Lake Kainji Fisheries Research (Eds: A. Raij, A. N. Okaeme and M. O. Ibeun.). pp 43 – 53.

Orensanz, J. M. Parma, A. M. Jerez, G. Barahona, N. Montecinos, M. Elias, I (2005). What are the key Elements for the Sustainability of "S-Fisheries"? Bulletin of Marine Science, Vol. 76, NO. 2. pp527-556.

Oyakhilomen, O. and Zibah, R. G. (2013). Fishery Production and Economic Growth in Nigeria: Pathway for Sustainable Economic Development. Journal of Sustainable Development in Africa, Vol.15, NO. 2, ISSN: 1520-5509. pp 11.

Ovie, S.I., Raji, A. (2006b). Fisheries Co – Management in Nigeria: An Analysis of the underling Policy Process. Food Security and Poverty Alleviation through Improved Valuation and Governance of River Fisheries in Africa Project: Report No. 3 December 2006. pp31.

Obot, E. A. (1989). The macrophytic flora of the draw-down area of Lake Kainji, Nigeria. African Journal of Ecology 27: pp173-177.

Olaoye, O. J. Odebiye, O. C. Omoyinmi, G. A. K. Akintayo, I. O. Udolisa, REK, Ezeri, G.N.O. Hundeyin-Agoro, O.C. (2011). The socio-economic analysis of small scale fish farmers in Lagos State fish farm estate, Ikorodu, Nigeria, In: R.M. Koko and A.M. Orire

(Eds), Proceedings of the 26th Annual Conference of the Fisheries Society of Nigeria (FISON). 28th November-2nd December, Minna, Niger State, Nigeria. Pp 214-222.

Omojowo, F. S. Olowosegun, T. Omojowo, T. M. (2010). Fish Consumption pattern in Kainji Lake Areas. Marsland press: World Rural Observations; 2(1): pp 75 – 79.

Opdenakker, R. (2006). Advantages and Disadvantages of Four Interview Techniques in Qualitative Research [44 paragraphs]. Forum Qualitative Sozialforschung /Forum: Qualitative Social Research, 7(4), Art. 11, http://nbn-resolving.de/ urn: nbn: de: 0114-fqs0604118.

Portt, C.B., G.A. Coker, D.L. Ming, and R.G. Randall. 2006. A review of fish sampling methods commonly used in Canadian freshwater habitats. Can. Tech. Rep. Fish. Aquat. Sci. pp 2604.

Raji, A. Okaeme, A.N. Bello S.D. Gulma, M.M. Mshelia, M.B. and Yemi, I.Y. (2008). Argungu Fishes and Festival, Kwbbi state, Nigeria. Rem Thomas press, Ilorin, Nigeria. Pp 16-51.

Richard, L. B. Attahiru, M. S. Innocent, Y. Y. Simon, N. and Rafiu, A. (2010). Indigenous Fish Identification Methods in Lake Kainji and Jebba, Nigeria. Report and opinion, Vol. 2. No. pp 6. 7. http://www.sciencepub.net/report

Seisay, M. D. B. (1998). The cast net fishery, Kainji Lake, Nigeria, 1970-1997. Nigerian-German (GTZ) Kainji Lake fisheries promotion project Technical Report Series 12. ISSN: 1119- 1449: pp 28p

Scott A. Bonar & Wayne A. Hubert (2002) Standard Sampling of Inland Fish: Benefits, Challenges, and a Call for Action, Fisheries, 27:3, 10-16, http://dx.doi.org/10.1577/1548-8446 (2002)027<0010: SSOIF>2.0.CO;2

Smith, Ian R., 1979. 'A Research Framework for Fisheries Development'. ICLARM Studies and Reviews 2. Manila: International Center for Living Aquatic Resources Management (ICLARM).

Solarin, B. B. (1998). The hydrobiology, fishes and fisheries of the Lagos lagoon, Nigeria. Ph.D. Thesis. University of Lagos. pp235.

Stambaugh, K. (2010). To Vee or Not to Vee…. A designer's perspective. www.cmdboats.com/pdfs/vee_E-book.pdf. Accessed on 7th July, 2014. pp 1-5

Tafida, A. A. Adebayo, A. A. Galtima, M. Raji, A. Jimme, M. John, C. T. (2011). Livelihood Strategies and Rural Income: The case of Fishing Communities in Kainji Lake Basin Nigeria. Agricultural Journal 6 (5): pp 259 – 263.

Tagago, T. A. Ahmed, Y. B. (2011). Fishing gear survey of Tatabu floodplain, In: R.J. Koko and A.M. Orire (Eds), Proceedings of the 26th Annual Conference of the Fisheries Society of Nigeria (FISON). 28th November-2nd December, Minna, Niger State, Nigeria. pp 109-116.

Ter Braak, C. J. F. and Šmilauer, P. (2002) *CANOCO reference manual and CanoDraw for windows user's guide: Software for canonical community ordination* (4.5th ed.) Wageningen, Biometris, Wageningen University and Research Centre.

Thorpe, A., Reids C., van Anrooy R. and C. Brugere (2004): African Poverty Reduction Strategy Programmes and the Fisheries Sector: Current Situation and Opportunities. African Development Bank Project funded by FAO Sustainable Fisheries Livelihood Programmed.

Tsadu, S.M., Ojutiku, R.O and Anyawale, A.V. (2006). A survey of fungal contamination of some fish species from Tagwai Daru, Minna, Niger State, Nigeria. Jour. Of Tropical Biosciences. 6: pp 1-5.

Tuegels, G.G. and Powell, J.R., (1993). Freshwater biodiversity a preliminary global assessment: Important areas for freshwater biodiversity in Niger basin Area. In WCMC Biodiversity series no.8. http://www.unep-wcmc.org/information _services/publications/freshwater/4.htm.

Udolisa REK., Solarin B.B., Lebo P., Ambrose E.E., (1994). A catalogue of small scale fishing gear in Nigeria. RAFR Publication RAFR/041/F1/94/02. pp 142.

Valdez-Pizzini, M. Acosta, A. Griffith, D.C. and Ruiz-peres, M. (1992). Assessment of the socio- economic impact of the fishery management options upon gill nets and trammel nets fishermen in Puerto Rico: An interdisciplinary approach (Anthropology and

Fisheries biology) for the evaluation of management alternatives. Final report NOAA/NMFS, pp 96.

Van den Brink, P. J. Van den Brink, N. W. And Ter Braak, C. JF. (2003). Multivariate Analysis of Ecotoxicological Data using ordinatio: Demonstrations of utility on the basis of various examples. Astralasian Journal of Ecotoxicology, Vol. 9. pp 141-156.

Welcome, R. L. (1985). River fisheries. FAO Fisheries Technology Paper No.262. FAO, Rome, pp330.

Williams, S. (2007). Gender and Youth perspective in effective fisheries extension method. Proceedings of the National Stakeholders workshop on Inland Capture Fisheries Development in Nigeria. Pp 12.

World Bank (1996): Nigeria: Poverty in the Midst of Plenty: The Challenge of Growth with Inclusion. A World Bank Poverty Assessment Report, Population and Human Resources Division, West African Department, African Region, World Bank.

Yisa, Z. Apeloko, F. and Kasali, A. (1994).Fishing gear survey of Kainji Lake, Nigeria, West Africa. NGKLFPP Tech. rep. Ser. pp 7.

APPENDICES

1. Copy of the interview schedule used to interview fishers in Kainji lake lower basin, Nigeria

Section A: Socio-demographic characteristics of respondents

Gender: Male ( ) Female ( )

Age: …….

Marital status: Single ( ) Married ( ) Widow ( ) others (specify): …….

Number of household: …….

Are any of them involved in fishing activities? Yes ( ) No ( )

If yes, what role do they play? ……

Education level: No education ( ) First School Leaving Certificate ( ) Quranic education ( ) Trade test ( ) Senior School Certificate ( ) Tertiary education ( )

Name of fishing village/Landing site: ……

Fisher's status: Full time ( ) Part time ( )

If part time, specify other occupation: …….

Cooperative society: Member ( ) Non member ( )

Fishing experience: 1-5 ( ) 6-10 ( ) 11-15 ( ) 15 and above ( )

Ethnic group: ……

Nationality: Nigerian ( ) Non Nigerian ( )

State of origin: …….

Local Government Area: ……

Section B: Fishing craft specification

Do you have any fishing craft? Yes ( ) No ( )

If yes, which type? Planked canoe ( ) Dug-out canoe ( ) Half dug-out canoe ( ) steel boat ( ) Fiber-glass boat ( ) others (specify): …….

Do you use an outboard engine or paddle? Outboard engine ( ) Paddle ( )

If outboard engine, what is the capacity (horse power)? ……

Why do you prefer the above type? ……

How much does it (craft) cost? …….

Do you know Price range of different craft? Yes ( ) No ( )

If yes, what is the price range? ……

How long have you be using your craft? …….

How many craft(s) do you have? ……..

What is the length overall (LOA) of fishing craft(s)? …….

What is the shape of the craft(s)? Flat bottom ( ) V- bottom ( ) others (specify): ……

Why did you choose to have the type of craft(s)? ……

Source of fishing craft: Self fabricated ( ) Borrowed/rent ( ) Govt. donation ( ) Cooperative society ( ) NGO ( ) others (specify): …….

Why do you source from the above? .....

Section C: Fishing gear specification

What are fishing gear(s) used? i. ii. iii. iv. v. vi. vii. viii

Number of fishing gear owned by the fisher: ……..

Source of fishing gear: Self fabricated ( ) Borrowed/rent ( ) Family donation ( ) Govt. donation ( ) Cooperative society ( ) NGO ( ) Others …...

How long have you been using your gear? …….

Do you know the cost range of fishing gears Yes ( ) No ( )

If yes, what are the cost range of different gear? ……

Gear type and targeted species

Gear type	Fish species
i. …	…
ii. …	…
iii. …	…
iv. …	…

What species of fish are usually caught? .....

Which kind of Species do you catch most? ……..

What species do you prefer to catch? ……..

What factors determine the use of your fishing gear?

i. Season ( ) ii. Fish to be caught ( ) iii. Cost of fishing craft and gear ( )
iv. Safety at operation ( ) v. Efficiency ( ) vi. Freshness of catch ( )
vii. Live catch ( ) viii. Area to be fished ( ) ix. Others: ……..

Section D: Fish catch

How many hour do you spend on water?

Daily …… weekly …… Seasonally ……..

How deep is the ground you fish? ……

How do you share your catch per trip (%)?

Boat owner ……. Fish seller (Monger) …….

Wife/family …… Other ……..

How do you sell your fish?

Cooperative…….. Fish seller ……

Yourself …….. Other ……..

Type of fish	Quantity of fish (kg/day)	Price/kg (₦)
i. …	…	…
ii. …	…	…
iii. …	…	…
iv. …	…	…
v. …	…	…

Section E: Challenges facing the fishers in the study area

What are the challenges you can identify by using your gear and craft?

Challenges	Frequency	%	Rank
High cost of fishing materials	……	…	…….
Stealing of craft or gear or catches	……	…	……..
Fish spoilage	……	…..	……..
Poor durability of fishing materials	……	…..	…….
Inadequate of fishing materials	……	…..	…….
Gear inefficiency	……	…..	…….
Inability to repair craft and gear	……	…..	……..
Problem of water plant	……	…..	……
Lack of access to credit facilities	……	…..	…….
Tearing of nets by engine boats	……	……	……
Others	…….	……	…….

Fisheries Management Practices

Do you know any fisheries law? Yes ( ) No ( )

If yes, what are the law? Local ( ) National ( )

Local: ……

National: …….

Do all fishers in this area know these law? Yes ( ) No ( )

In your view, what can be done to protect the fishery in relation to gear and craft used? ……

……

2. Table of species caught with their corresponding gears

S/NO	Common Name	Family	Scientific Name	Code	GN	CN	H&L	TR	BS	SN	LN
1	African pike	Hepsetidae	*Hepsetu odoe* (Bloch, 1794)	Heod	0	0	1	1	0	0	0
2	African carp	Cyprinidae	*Labeo senegalensis* (Valenciennes, 1842)	Lase	7	5	0	2	0	1	0
3	African catfish	Clariidae	*Clarias gariepinus* (Burchell, 1822)	Clga	8	4	13	2	1	1	0
4	Butterfly fish	Schibeidae	*Schilbe mystus* (Linnaeus, 1758)	Schi	1	0	0	0	0	0	0
5	Catfish	Bagridae	*Auchenoglanis occidentalis* (Valenciennes, 1840)	Auoc	1	0	0	1	1	0	0
6	Catfish	Bagridae	*Clarotes laticeps* (Ruppell, 1829)	Clla	2	0	4	0	0	0	0
7	Catfish	Clariidae	*Heterobranchus bidorsalis* (Geoffroy saint-Hilaire, 1809)	Hebi	4	0	6	0	0	0	0
8	Catfish	Mochokidae	*Synodontis membranaceus* (Linnaeus, 1758)	Sysp	35	6	2	1	1	5	0
9	Clupeid	Clupeidae	*Pelonula afzeliusi* (Boulenger, 1916)	Peaf	1	0	0	0	0	0	1
10	Electric Fish	Malapteruridae	*Malapterurus electricus* (gamelin, 1789)	Mael	3	0	3	0	0	3	0
11	Globe fish	Tetraodontiformes	*Tetraodon lineatus* (Linnaeus, 1758)	Teli	1	0	1	0	0	1	0
12	Grass	Distichodontidae	*Distichodus*	Diro	7	2	0	0	0	2	0

	eater		*rostratus* (muller&Troschel 1844)								
13	Moon fish	Citharinidae	*Citharinus citharus* (geoffroy St. Hilaire, 1808-1809)	Cici	36	21	2	4	0	4	0
14	Nile perch	Centropomidae	*Lates niloticus* (Linnaeus, 1758)	Lani	23	6	17	0	0	4	0
15	Osteoglossid	Osteoglossidae	*Heterotis niloticus* (cuvier, 1829)	Heni	11	4	0	1	1	1	0
16	Ray-finned fish	Mormyridae	*Marcusenius senegalensis* (Pellegrin, 1922)	Mase	6	5	0	0	0	1	0
17	Silver catfish	Bagridae	*Bagrus bayad* (Forsskål, 1775)	Baba	11	3	12	0	1	0	0
18	Silver catfish	Bagridae	*Chrysichthytes auratus* (Geoffroy St. Hilaire, 1808-1809)	Chau	3	0	0	2	1	0	0
19	Silver catfish	Characidae	*Alestes baromoze* (Joannis, 1835)	Alba	13	4	1	1	1	1	0
20	Snakehead	Channidae	*Chana obscura* (Teugels & Daget, 1984)	Chob	2	1	2	0	0	0	0
21	Tilapia	Cichlidae	*Tilapia species* (Gervais, 1848)	Tisp	31	23	3	6	1	5	0
22	Tiger fish	Characidae	*Hydrocynus forskalii* (Cuvier,1819)	Hyfo	11	2	1	2	1	0	0
23	True big scale tetra	Characidae	*Alestes macrolepiditus* (Valenciennes, 1850)	Alma	2	0	0	0	0	0	0
24	Trunkfish	Gymnarchidae	*Gymnarchus niloticus* (Cuvier, 1829)	Gyni	4	0	1	0	1	0	0
25	Trunkfish	Mormyridae	*Gnathonemus*	Gns	1	0	0	0	0	0	0

			species (Gunther, 1862)	p							
26	Trunkfish	Mormyridae	*Mormyrus rume* (valenciennes, 1847)	Mor u	4	2	0	0	1	0	0

Appendix 3: Pictures showing some fishing gear types, craft with making of gill net and craft.

Plate 5: Hook and line (*Kujiya*);

Plate 6: Trap (*Gura*)

Plate 7: Lift net (*Atala*);

Plate 8: Gill net (*Taro*)

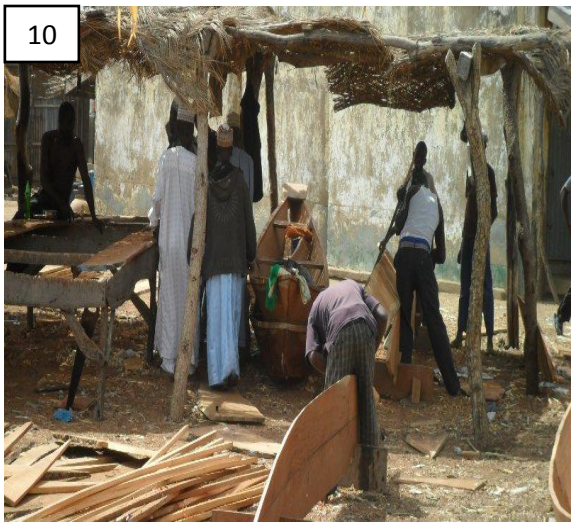
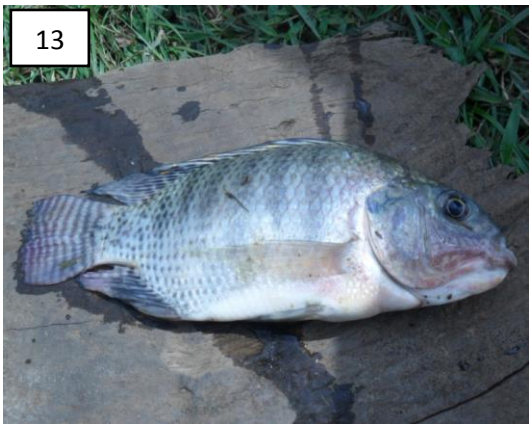


Plate 9: Gill net weaving using multifilament; **Plate 10: Planked canoe maker**

Plate 11: Planked Craft with outboard engine; **Plate 12: Planked Craft with Paddle**

4: Pictures of Consistent, Abundance, prefer fish together with how they package fish



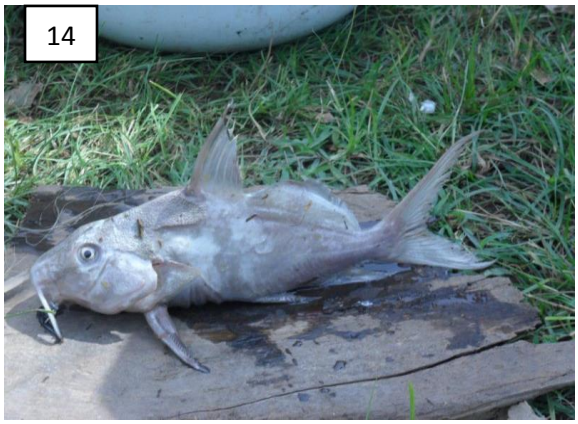


Plate 13: ***Oreochromis niloticus*** **(Local name - Gardagaza)**

Plate 14: ***Synodontis membranacea*** **(Local name – Kurungu)**

Plate 15: ***Lates niloticus*** **(Local name - Giwan ruwa)**

Plate 16: Packaged fish