BASELINE AND SCOPING STUDIES FOR THE DEVELOPMENT OF INLAND FISHERIES MANAGEMENT PLAN IN SIERRA LEONE: CASE STUDY OF LAKE MABESI AND RIVER MALENI

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ABSTRACT

Inland fisheries in Sierra Leone lacks guiding principles and legislation for sustainable utilisation and management. This was the main motivation to carry out a baseline study among persons involved in fisheries in seven communities where fisheries community management associations (CMAs) exist. This was done in order to obtain information on the inland fisheries resources, local knowledge on fisheries management and perception towards it among locals. The hope is this will influence the design of a sustainable inland fisheries management plan. In this study, 35 experienced fishers answered a questionnaire and five were interviewed from seven fishing communities along Lake Mabesi and the River Maleni. According to fishers, CMAs in the inland fisheries sector have made a success in formulating bylaws, conducting meetings and resolving disputes and conflicts. However, there is an indication of insufficient support from government to effectively implement fisheries policy. There are different perceptions about the main roles of the CMAs, but most mentioned the role they play in reducing the use of illegal fishing gear and conflict management. Findings of indigenous knowledge fishermen were able to identify major breeding grounds and spawning season. It is however evident that the use of small mesh size and fencing during spawning season is on the increase to target brooder entering the flood plains for spawning.

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ABBREVIATIONS

CMAs	Community Management Associations
EEZ	Exclusive Economic Zone
FAO	Food and Agricultural Organization
GEF-AF	Global Environmental Facility Additional Financing
KIIs	Key Informant Interviews
MPAs	Marine Protected Areas
MFMR	Ministry of Fisheries and Marine Resources
MCS	Monitoring Control and Surveillance
NGOs	Non-Governmental Organisations
SSL	Statistic Sierra Leone
TURF	Territorial Use Right Fisheries
WARP-SL	West Africa Regional Fisheries Program -Sierra Leone

1 INTRODUCTION

Sierra Leone is located between latitudes 7° and 10°N, and between longitudes 10° and 13°W on the west coast of Africa. It is bordered with the republic of Guinea on the west, north and northeast and southeast by Liberia. The country has a total area of 71,740 km^2 and a coastline of 560 km (MFMR, 2008). According to Statistics Sierra Leone (SSL, 2005) Sierra Leone has a total population of 7 million. The continental shelf of the coastline is about 100 km wide in the north and tapers to about 13 km in the south towards Liberia. The entire continental shelf area covers about 30,000 km^2. The area of the 200 miles Exclusive Economic Zone (EEZ) is about 161,275 km^2 and most of the fishing activities take place within 17,000 km^2 of the EEZ. Marine fishing grounds of Sierra Leone are classified into inshore and offshore zones. The inshore zone is officially reserved for artisanal fisheries and extends up to 5 nautical miles from the shoreline and beyond this is the (EEZ) which constitutes the industrial fishing zone.

Fisheries resources of Sierra Leone have the potential of contributing immensely to food security, income and employment. Up to 200 species have been discovered, of which about 100 are economically important. Some major important species are Grouper *(Lutjanus*), Crocus (*Pomadasy*), Gwangwa (*Speudotolithus*), Snapper (*Sparids*), Sardinella (*Sardinella madrensis*) and Shrimp, Pink shrimp *(Penaeus notialis*), Rose shrimp (*Parapenaeus longitrosis*) and Tiger Shrimp (*Penaeu kerathuru).* Catch from marine artisanal is based mainly on small pelagic and constitutes 60% of total landings (Jalloh, 2010).

Rent collected from industrial and semi industrial fisheries generates about USD $ 9.6 million in 2017 and USD $ 11.78 million in 2018. It contributes about 10% of GDP and is the major economic activity along the coastline of Sierra Leone (Samba, 2019).

Fishing and fish processing activities provide employment for coastal communities. Roughly 100,000 fishermen are directly engaged in artisanal fishing and an average of 300,000 people work in the fishing industry (Samba, 2019).

Sierra Leone is endowed with large inland water bodies (streams, lakes, rivers and flood plains). In riverine villages, consumption of freshwater fish provides the main source of animal protein since they have limited access to marine fish product markets.

In 2018 the total number of potential landing sites was 154 and the inland fishing communities within these landing sites were around 1000 (MFMR, 2019). This indicates a rapid increase in the number of landing sites, from 54 in 2010 to 154 in 2018. The number of inland fishermen and fishing crafts has also increased as compared to 2010 survey (MFMR, 2019).

Total fish production is not properly recorded in the inland fisheries sector. However, annual catch is estimated at 16,500 tons (FAO, 2008). This type of fishery is for subsistence, using set nets, gill nets, traps, cast nets, fencing, long lines and hook and line. The use of dynamite (explosive) for fishing is also common in remote inland water bodies. Tilapia and catfish are the major fish species harvested in inland water bodies of Sierra Leone. Tilapia is estimated at 60%, and catfish, estimated at 30%, with the remainder including cutlassfish *(Notopterus asp*.), slippery fish (*Clarias spp*.), electric fish and mullet (Kassam, Lakoh & Longely, 2017).

Inland water bodies of Sierra Leone provide various ecosystem functions; they are important for local flood and erosion control, water storage, nutrients retention and stabilisation of the microclimate, as well as for recreation and tourism and provide water for domestic purposes. These environmental factors also contribute to biological diversity, as well as cultural heritage. Aquatic resources are under threat and the ecological capacities is being reduced as a result of increase in illegal fishing activities and other anthropogenic impacts along these rivers (MFMR, 2017).

1.1 Management of inland fisheries resources in Sierra Leone

In Sierra Leone there are eight major rivers (Figure 1) and eleven freshwater lakes. The major river systems are Great Scarcies, Jong River, Little Scarcies, River Rokel, Sewa River, Moa River and Mano River. 16 families of fish comprising approximately 100 species have been discovered in inland water bodies (EPA, 2014).

Figure 1. Map of major rivers in Sierra Leone

In many parts of Sierra Leone, traditional leaders enforce closed fishing areas and close areas for a certain season as well as posing a gear restriction to protect breeding and nursery grounds and common property fishing area of major inland water bodies (MFMR, 2017).

In Gbondapi, the largest inland landing site in Sierra Leone, Nyellomul (fish watchers) are responsible for Monitoring Control and Surveillance (MCS) of fishing activities at community level. All villages along major rivers and lakes have such an authority and his assistant. They

are highly respected, and this is a lifetime job. Fish watchers receive in-kind or monetary payments, given on a voluntary basis by fishermen. Violators are brought to the village chiefs and this normally results in the confiscation of fishing gear and/or imposition of fines (Lohmeyer, 2002).

In Sierra Leone, "fishers" is a collective term that refers to anyone who is involved in fisheries. At the end of every fishing season, fishers pay a minimal monetary payment to fish watchers (community surveillance team) in a form of rental fees. A receipt of payment qualifies an individual to fish again. Prices depend on the size of canoe and type of fishing gear and methods. The total amount of money collected is kept by the youth leader and is used to address emergency issues in the village and chiefdom level (including, for example: fire disaster, sickness, women in labour and assistant teachers that are not on a government payroll). A minimal amount is also given to the chiefs as an appreciation for their support (MFMR, 2017).

A better understanding is needed on the behaviour of fish stock in inland water bodies and the present status of the inland fisheries sector. An assessment of freshwater fish species availability in rivers, streams and lakes undertaken two decades ago needs to be updated with a current inventory of freshwater fish species in Sierra Leone (Kassam, Lakoh & Longely, 2017).

1.2 Introduction of co-management in Sierra Leone

A co-management strategy was developed during the first phase of the West Africa Regional Fisheries Program (WARP- SL) in 2012. Its purpose was to protect and manage specific areas for fisheries and wildlife; breeding and nursery grounds of commercially important fish species, turtle breeding places and migratory bird resting places in partnership with local resource users in the four (4) Marine Protected Areas (MPAs). Indigenous ecological knowledge is applied systems of knowledge based on many years of observations made by local resource users to manage their natural resources (Orrego, 2015). Indigenous knowledge of fishers on spawning, seasoning, and nursery grounds was used to demarcate the MPAs in Sierra Leone. However, inland fisheries water bodies were left out of this process, because they are not adjacent to the MPAs.

It is has been accepted by many nations that governments, with their limited resources cannot manage the fisheries resources very well (Pomeroy & Gareb, 2006). Co-management is a cooperative relationship where by the community of local resource users, government, stakeholders (boat owners, fish processors, traders, boat builders etc.) and Non-Governmental Organisations (NGOs), civil societies, universities and research institutions share the responsibility for management of fisheries resources, as illustrated in Figure 2 (Pomeroy & Gareb, 2006).

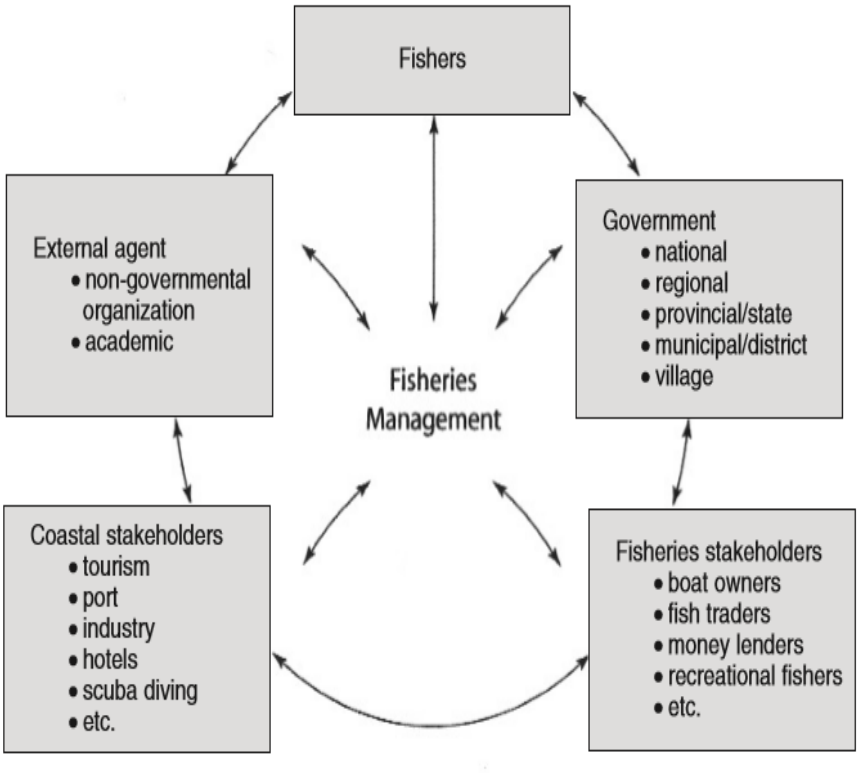

Figure 2. Fisheries Co-management (Pomeroy & Gareb, 2006)

The inland water bodies are regulated by traditional bylaws which do not address management issues relating to fishing gear restrictions, access rights, sanitary control at the landing sites, anthropogenic impact on aquatic habitat and destructive fishing methods.

In 2017, the Ministry of Fisheries Marine Resources in partnership with the Global Environmental Facility Additional Financing (GEF-AF) project supported the formation of six (6) Co-Management Associations (CMAs) along two major inland water bodies. These are Lake Mabesi and River Maleni in Pujehun District, Southern Sierra Leone. The purpose was to create awareness and encourage the adoption of best practices and policies. This was done through the formulation of community bylaws by local resource users to establish an effective management system, for rational exploitation and conservation of inland fisheries resources. However, Co-Management approach is implemented only along these two inland water bodies (Lake Mabesi and River Maleni) using community fisheries bylaws by local resource users.

1.3 CMA structure

CMAs are made up of a cluster of villages. Membership is comprised of fishermen, fishmongers, fish processors, boat owners, boat builders, traders and traditional leaders. The associations consist of elected executive members who are responsible for the day-to-day running of the association and serve as the communication pathway between government, NGOs, civil societies and local resource users to promote an effective and efficient communication system for sustainable fisheries management. There are three committees (Figure 3) within each CMA responsible for monitoring control and surveillance, fish quality management and beach management.

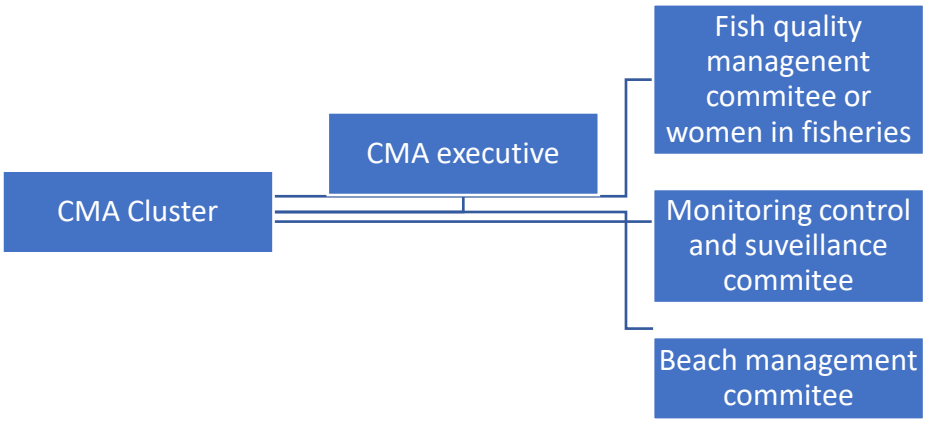

Figure 3. Structural Organization of CMAs

1.4 Rationale

In Sierra Leone, effective and efficient management of inland fisheries resources has not existed in the past. The use of destructive fishing gear, such as fences and gill nets with small mesh sizes, is of great concern for the sustainability of the inland fisheries resource (Kassam, Lakoh& Longely, 2017). Fishing activities in the floodplains may also have negative impact on the breeding and nursery grounds. Ineffective enforcement of fishing gear regulation and protection of breeding and nursery grounds has led to an increase in illegal fishing activities (Kassam, Lakoh & Longely, 2017).

1.5 Research objective

Since the subsector lacks guiding principles and legislation for sustainable utilisation and management, there is a risk of fishing pressure on inland water bodies when the nearby Marine Protected Areas (MPAs) graduate to Territorial Use Right Fisheries (TURF), if the inland water bodies remain unrestricted. This project will undertake a detailed baseline assessment for the development of inland fisheries management plan to enhance the adoption of sustainable best practices for rational utilisation and management of the inland fisheries resources of Sierra Leone.

1.1.1 Specific objectives

- Assess the role of CMAs in implementing fisheries policy
- Examine the type of fishing gears and method of fishing by season inland water bodies
- Capture indigenous ecological knowledge on inland fisheries
- Assess the role of women in inland fishing activities

2 LITERATURE REVIEW

1.6 Management status of inland fisheries

The inland fisheries sector is extremely diverse and highly dynamic. It includes commercial, subsistence and recreational fisheries, each with a different economic and social dimension (Surronen & Bartley, 2014).

Globally, inland fisheries provide an estimated 60 million full and part-time jobs in fishing and fishing related activities like processing. More than half of these jobs are carried out by women (Fish Site, 2010). Division of labour in the subsector is highly gendered, men are mainly involved in fishing and women mostly undertake preharvest and postharvest operations (Funge-Smith, 2018). In many cases women are not involved in the decision-making process whether in management or in fisheries co-operatives and union (Biswas, 2017).

Exploitation of natural resources from inland water bodies is common in many rural communities of the world. Local resources users do not only harvest fish, but also other freshwater resources like molluscs, crustaceans, amphibians, reptiles, insects and aquatic plant. Aquatic resources provide major contribution to the sustainability of most remote rural communities in the world. In most cases these communities are not assessable to alternative livelihood activities (FAO, 2006).

Human activities can have devastating impacts on the aquatic food web (Ngor, MacCann, & Grenouillet, 2018). Inland fisheries strive for aquatic resources with agriculture and hydroelectric power plants that are mostly given priority for development and the rapid growth in human population have posed high pressure on inland fisheries resources. Loss of breeding and nursery grounds is a major problem for many species, especially those with strict ecological demand. In most cases there are no centralised landing sites or dedicated markets where accurate data can be obtained, and large portion of the catch is for household consumption. Catch composition and types of fishing gear have great differences in different seasons, these make data collection difficult and expensive. There are great knowledge gaps in fish stocks harvested, total landings and numbers of fishers and fisheries related jobs (Surronen & Barttely, 2014).

The notion of acquiring quality assurance in the inland fisheries subsector is a challenge, because the sector is described as small scale, traditional, including many household-based activities (Funge-Smith, 2018). These households are mostly poor, inaccessible to other employment opportunities and carried out their operations in remote rural communities (Funge-Smith, 2018). Inland fisheries operations lack guiding policy and legislation and are mainly regarded as self-employed. People involved in fishing and other fishing related activities are mostly not aware of their rights to quality assurance or focus mainly on their sustenance instead of ensuring quality operations. Since the sector lacks standard operating procedures or guiding policy and regulation there is a risk of health hazards that are harmful to both children and adults (Funge-Smith, 2018).

Fish harvests from the world's rivers, streams, floodplains, wetlands, lakes, canals, reservoirs and even rice fields have not been managed properly for decades (Nichols, 2019). Accurate data is needed to determine the impact of inland fishing activities and to rate the strength of existing fisheries policy, and the importance of inland fisheries to food security and national revenue (Welcome, 2011). This emphasises the need for a sustainable management of inland fisheries resources (Taglor, Youn, & Lunch, 2014).

Fish stock enhancement and restocking have been identified as sustainable inland fisheries management tools used by many developing countries. Restocking can be described as a means of recovering fish stock whose population has declined due to anthropogenic impact on aquatic ecosystem (Kartamihardja, 2015).

Anthropogenic impacts like, flooding, pollution, erosion and siltation may have a devastating effect on fish reproductive migration in inland water bodies, as the migratory routes are either blocked or contracted that make fish vulnerable to catch. Restoration of degraded fish habitat is another tool use for management of inland fisheries. This involves clearing of fish migratory routes in other to ease movement of fish to nursery and breeding grounds (Mamun, 2007).

1.7 Indigenous knowledge and its use in management of inland water bodies

Fishermen have vast experience and clear perception of the aquatic environment, including knowledge about fish species and their changes over time (Aswani & Halmilton, 2004). Many developing countries have limited resources and inadequate human capacity to carry out fisheries research. Most of their research focuses only on important commercial species. Biological models have also become more advanced and complicated for policy makers in most developing countries to put them to use. There is a need to incorporate indigenous ecological knowledge, since it is a cost-effective way to manage fisheries resources (Welcome, 2011).

In order to enhance an effective and efficient management and conservation of aquatic resources, a full knowledge on fish migratory patterns, fish habitat formation and fish species, seasoning, breeding and nursery grounds of fish are essential (Johannes, Freeman, & Hamilton, 2000). The inclusion of indigenous ecological knowledge will assist fisheries scientists and policy makers to have a wealth of experience on the ecological formation of inland water bodies and fisheries resources and help involve local resources users in the decision-making process. Experience of fishers can be considered as an important instrument for policy makers, trying to enhance rational utilisation and management system (Mamun, 2007).

Indigenous knowledge of fishing gear and methods is also important for research and rational exploitation and management of fisheries resources (Raju, Sekhara, & Rao, 2016). Fishers' knowledge in planning fisheries management regime will help achieve an effective co-management approach, because the perception and belief of local resource users could be used as foundation for a consensus fisheries administration and will provide base line information for future management decisions (Espinoza-Tenorio, Wolff, & Espejel, 2013).

Fisheries management regime that does not incorporate in-depth knowledge of ecological dynamics may not be successful and will lead to conflict among local resource users (Mamun, 2007).

2.1.1 Inland fisheries value chain

Inland fisheries production in Sierra Leone is presently low and mostly for subsistence. Women are responsible for net mending and sales, especially when the catch is abundant (Kassam, Lakoh & Longely, 2017). Catch from inland fisheries is traded fresh, although in some parts of the country small quantity is smoked. Smoked inland fish has a higher market price than marine fish as most consumers consider it more tasty than marine fish. Women in inland fishing communities generally trade the inland fish products. It is normally carried on head and transported by foot or motorbike (Kassam, Lakoh, & Longely, 2017).

Gbondapi, Pujehun district, has the largest inland fish market. This market that takes place on every Tuesday and Wednesday, traders (fish mammies) travel from different parts of the country to buy both fresh and smoked fish. Fresh fish is packed in ice boxes and smoked fish packed in baskets and transported by vehicles or trucks to the different fish markets in the country. Since the landing site lacks cool rooms and proper storage facilities for fresh and

smoked fish product, fishermen sometimes sell their catch at low cost to prevent spoilage. (MFMR, 2017).

3 RESEARCH DESIGN AND METHODOLOGY

In this study, information was collected in two ways. Firstly, by gathering detailed information by going over relevant published and unpublished literature from journal articles, reports and government documents and secondly, by data collection in the study area with a survey and interviews.

1.8 Sampling strategy

Questionnaires and semi-structured key informant interviews (KIIs) were used as survey instruments for this study. The questionnaires were administered to individual fishers, master fishermen, fish processors and harbour masters, to capture their various opinions on the study topic. KIIs were limited to traditional leaders to get an in-depth knowledge of the study objectives, and to verify and complement the information obtained from the questionnaire. These instruments were used because they were easy to administer and manage, produced large amount of data in the shortest time, and this method of data collection brought together the respondent and interviewer, and produced a positive feedback for omission that might occur during interviews.

1.9 Study area

The survey focused on Lake Mabesi and River Maleni, Pujehun District, since these areas have the largest inland landing site in Sierra Leone (Gbondapi) and have benefited a lot from project activities through capacity building. Three communities were selected along Lake Mabesi and four communities along river Maleni (Figure 4 below). They are the largest fishing communities along the lake. Fishing and fishing related activities are main source of income; followed by farming and vegetable garden (mostly practiced by women). These are riverine communities, only accessible by boats. People in these communities dwell in mud houses mostly covered with thatch roof. Social services like secondary schools, health care, shops etc. are not available. People come to Gbondapi, the biggest village in the study area to access these services.

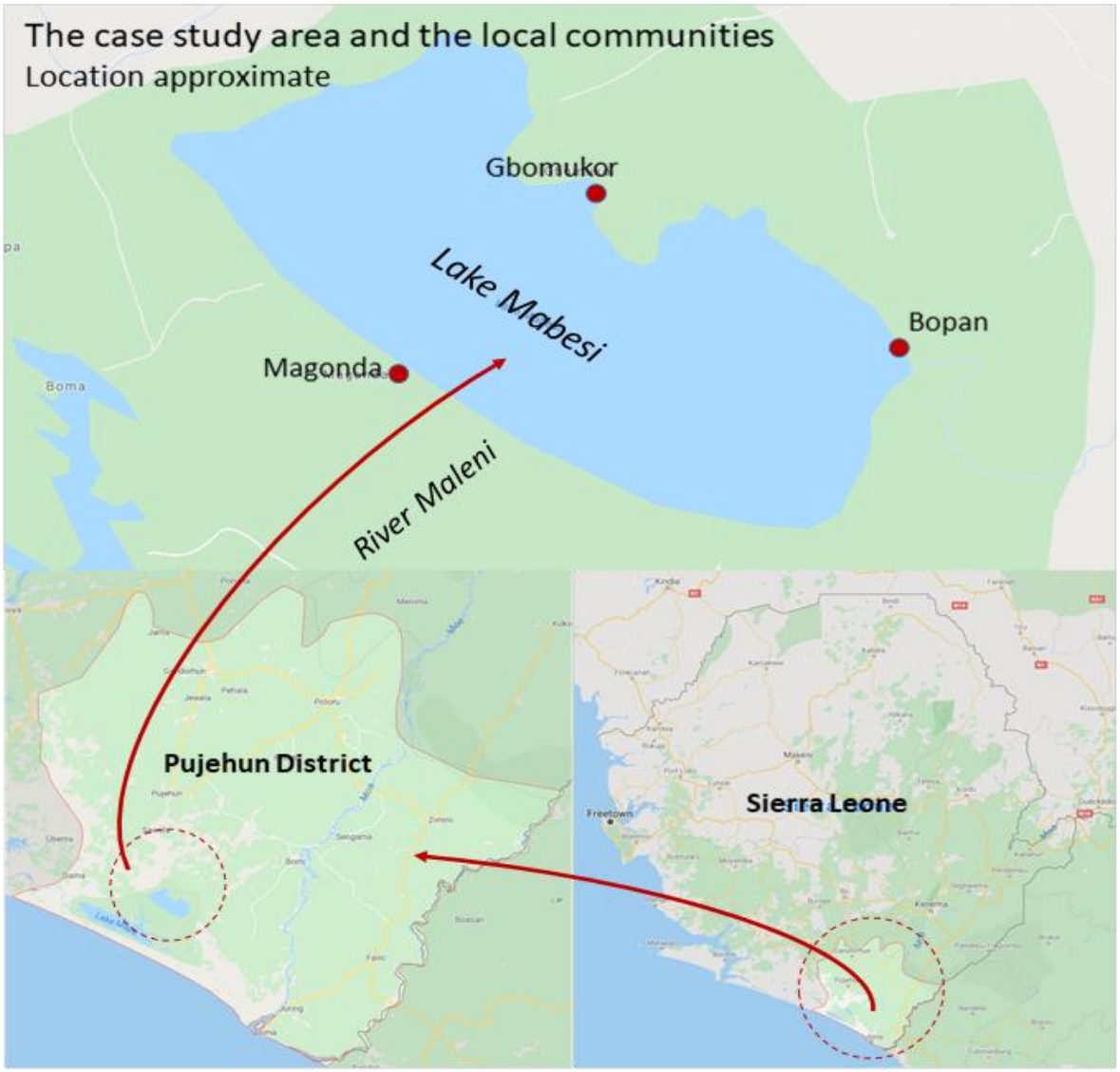

Figure 4. Map of study area (Source: Google maps)

1.10 Sample size and sampling procedure

Questionnaires were prepared using the Survey monkey programme and were administered to 35 individual fishermen, master fishermen, fish processors and harbour masters. Random and non-random sampling techniques were used. Random sampling was used to choose respondents for questionnaires and non-random sampling was used for selecting five stakeholder representatives to target those who have vast knowledge on the study topic. KIIs comprised of a Chief, CMAs Chairman, a fish processor and experienced fishermen from the study communities. Four communities along River Maleni and three communities along Lake Mabesi were selected for the survey. Table 1 shows the distribution of respondents by occupation and data collection methods.

Table 1. Distribution of sample respondents by tools

Questionnaire Respondent occupation	Number	Key informant Respondent occupation	Number
Individual fishermen	20	Chief	1
Master fishermen	5	CMA chairmen	1
Harbour master	5	Experienced fishermen	2
Fish Processor	5	Fish processor	1
Total	35		5

1.11 Data processing and analysis

Answered questionnaires were recorded into Survey Monkey and that software used to produce descriptive statistics in the form of tables and graphs which provide a basis for interpretation of the findings. For the KIIs, which were recorded, a content analysis method was employed to this analyse this qualitative information by themes. Content analysis suits qualitative data which can consist of direct quotations from respondents about their experiences, opinions, feelings and knowledge.

4 FINDINGS

1.12 Demographic characteristics of respondents

The sample of respondents by gender was given due consideration in the study because division of labour in the inland fisheries sector in Sierra Leone is highly gendered and women were actively involved in the formation process of CMAs. 75% of the respondents were male and 26% were female as seen in Figure 6 below.

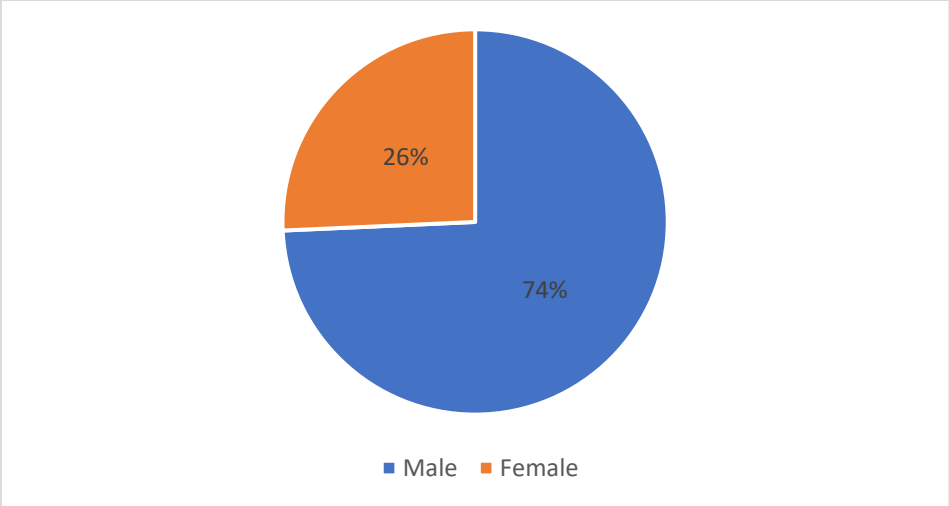

Figure 5. Gender of respondents

Fishers were asked about the number of years they have been involved in fishing, since indigenous knowledge of experienced fishers is very important for the development of smarter fisheries policies and regulations. This helped to get an in-depth knowledge about the study topic because more experienced fishers were involved as seen in Figure 7 below. The average number of years in fishing was just under 19 years. The shortest experience was 3 years (for 3 respondents) and the longest experience was 48 years.

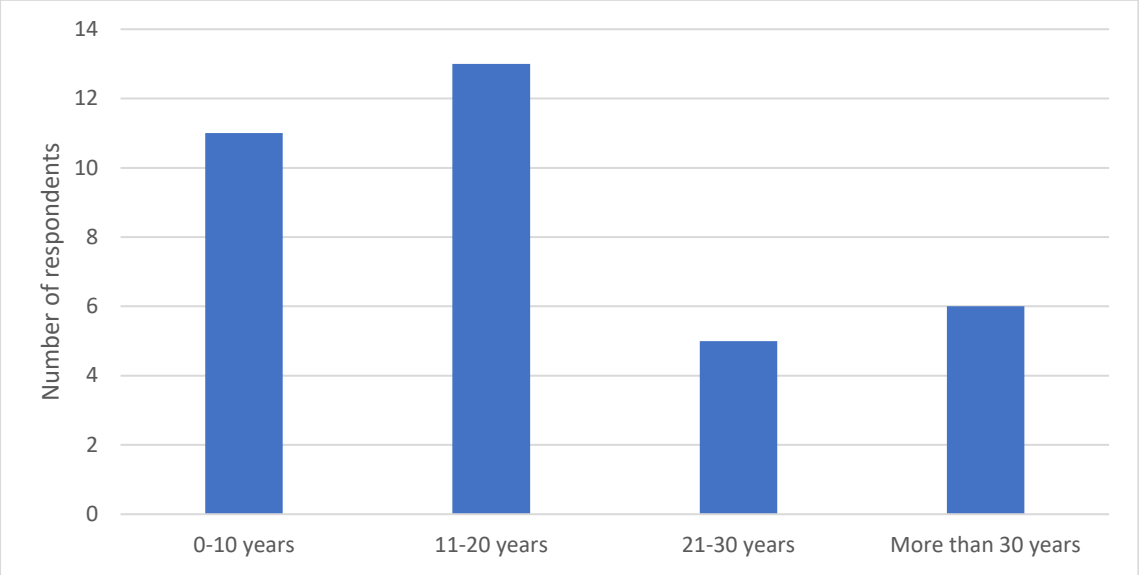

Figure 6. Respondents years in fishing

Education level was considered in the study because it is a significant parameter for assessing socioeconomic and political development in any community. This is indirectly a measure of literacy and in Sierra Leone, the literacy rate is measured by the ability to read and write English language for those without post primary school education. Respondents were asked about their educational level and majority (40%) reported that they have Islamic education which indicates that the study area is Muslim dominated, 34% have primary school education, 20% no schooling and 6% have high school education as indicated in Figure 8 below. Islamic education in Sierra Leone is acquired from teaching people the Holy Quran at home or in Islamic schools (madrasat). It is a means of preparing future religious leaders for the Muslim religion.

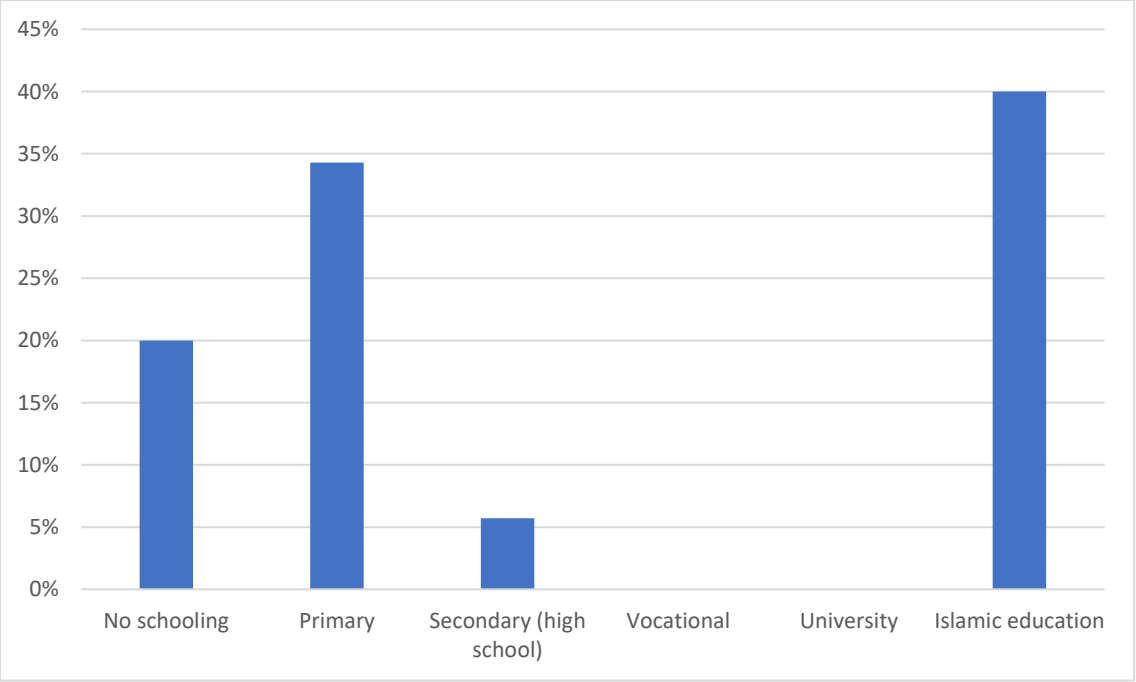

Figure 7. Level of education by respondents

1.13 Sources of income

Knowledge on household income of fishers is very important in planning a sustainable fisheries management regime for small scale fisheries and a good measure to determining the level of dependency on fisheries resources for economic reasons. Fishers were asked about the main source of their household income and 86% indicated fisheries related activities for their subsistence and 15% farming as demonstrated in Table 2. Responses from KIIs also indicated that fishing is the main source of income. However, responses from KIIs revealed that crop failure and limited alternative livelihood activities have led to increase in the number of fishermen.

Table 2. Sources of income

Number of respondents	Main household income	%
30	Fishing related activities	86
5	Farming	14

1.14 CMAs effort in fisheries management

With the co-management strategy, CMAs are expected to have mechanism in place to enhance rational utilisation and sustainable management of inland fisheries resources for future generations. Views of fishers were collected to obtain information on whether they believe CMAs have met their objectives or not. 91% acknowledged that CMAs have bylaws that regulate fisheries resources. Controlling of illegal fishing gears and methods, conflict management and savings scheme are main reasons why fishers think CMAs formulated bylaws as described in Figure 9 below. This is also in line with responses from key informants, who revealed that CMAs have made some progress in formulating bylaws, reduce the use of illegal fishing gear and methods, especially the use of monofilament nets and explosives. However, responses from key informants also indicate that CMAs have developed an informal savings schemes (osusu) in their respective communities, since they do not get support from the central government or NGOs. Every member contributes an equivalent of $2 per month. The total amount collected is then used to provide loans to members of the association only, mostly women, at 10% interest rate. Because of this, most female members considered CMAs as being informal savings scheme. Beside their effort, fishers reported that CMAs lack logistics support (speed boat and motorbike) to carry out their operations, limited knowledge on flood plain management, inadequate capacity to enforce measures and lack support from government and other stakeholders.

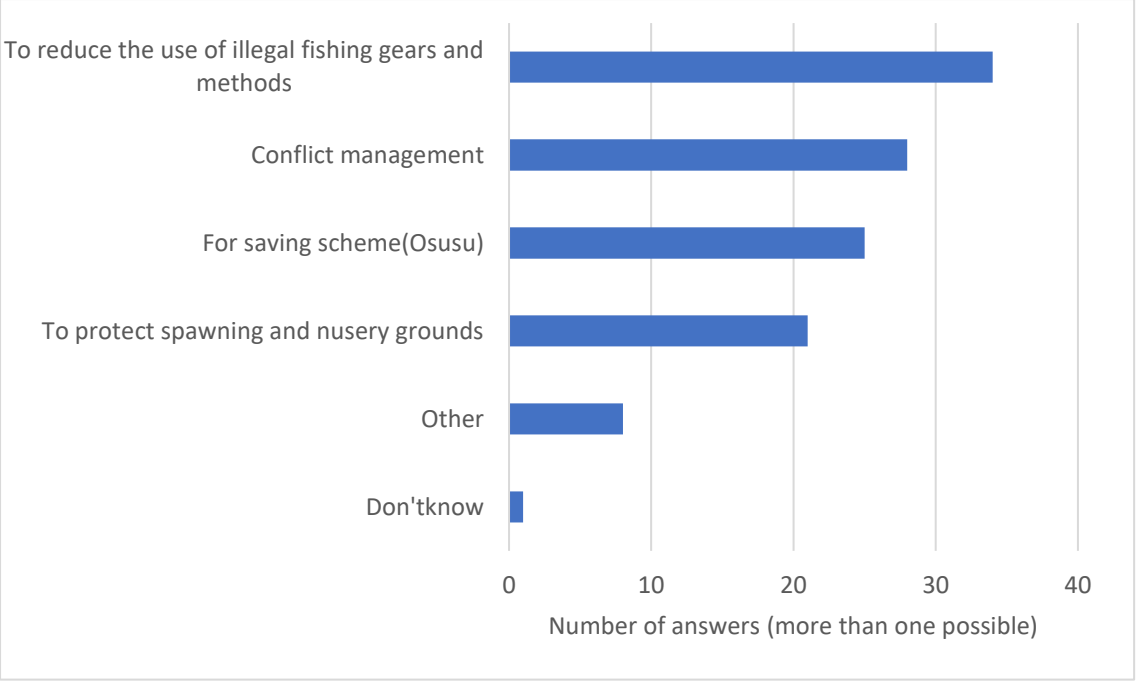

Figure 8. Fishers' perception on why CMAs formulated bylaws

1.15 Assessment of CMAs operations

Fishers were asked to asses the performance of CMAs in undertaking a number of operations. 97% of respondents indicated that CMAs were effective in formulating bylaws, 74% in resolving conflict and 77% in conducting meetings. However, CMAs ratings are very low in confiscation of illegal gear/fishing method, data collection and keeping inventory (Figure 10 below). Key informants also indicated that CMAs have only been effective in formulating bylaws, conflict resolution and conducting meetings, since they lack support from the government and other stakeholders. CMAs are more effective in conducting meetings because of the activities of their informal saving scheme (osusu).

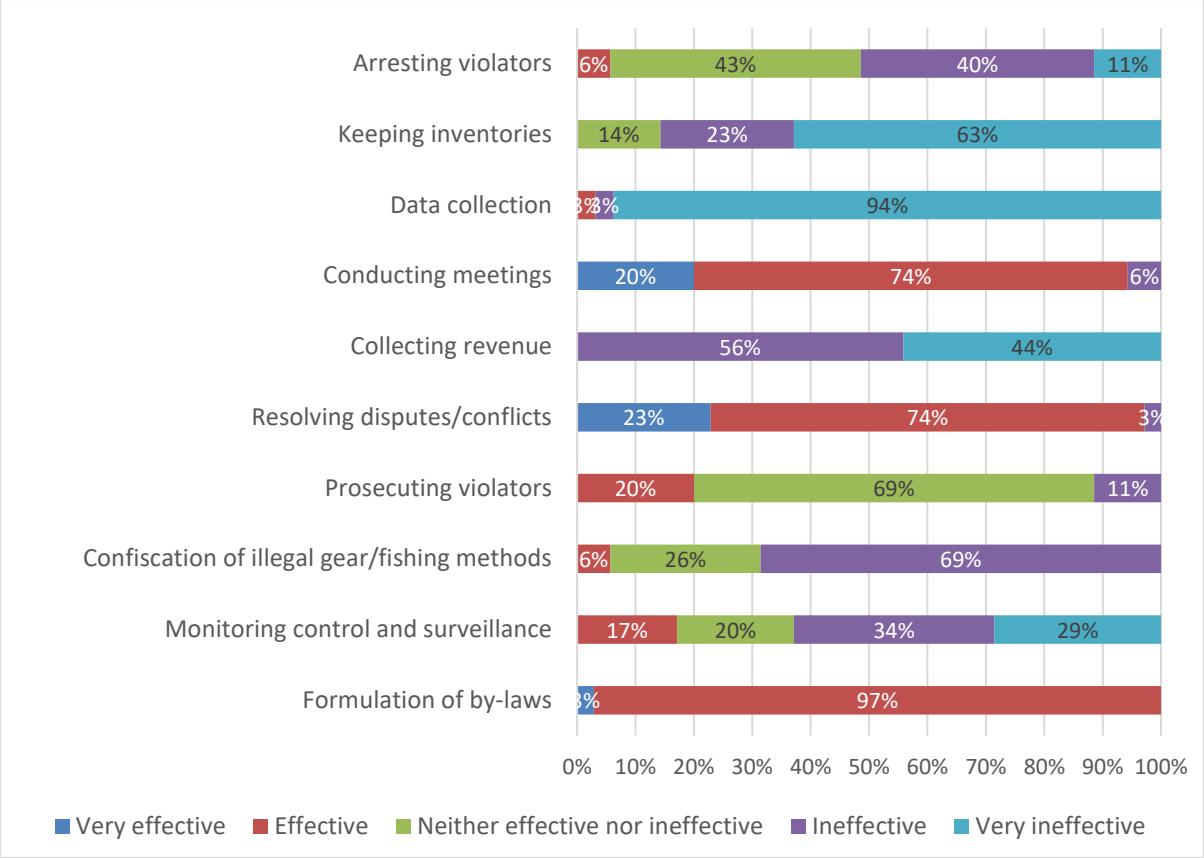

Figure 9. Perception of CMA Performance

1.16 Views of fishers on improving CMAs performance

Fishers suggested that performance of CMAs may be improved by provision of credit facilities, legal fishing gear at cost recovery price, awareness raising among fishers and CMAs executives and cooperation with government and other stakeholders as detailed in (Table 3).

Table 3. Suggestion of fishers on improving CMAs operations

Measures	%
Provision of credit facilities (micro finance) to CMAs	55
Cooperation with government and other stakeholders	10
Identification cards for CMAs executive	2
Speed boat for community fisheries surveillance	5
Increase awareness raising to CMAs executive and fishers	10
Provision of legal fishing gear at cost recovery price	18
Total	100

1.17 Indigenous knowledge on fish migration

Indigenous knowledge of fishers is utilised in the management of small-scale coastal fisheries of Sierra Leone. Fishers' knowledge was used to identify high impact and vulnerable areas and demarcate major spawning areas for the establishment of MPAs. It is therefore important to incorporate indigenous knowledge in designing inland fisheries management plan. Respondents' views were gathered on in which season fish migrate for spawning in inland water bodies and 75% of fishers revealed that fish undertake spawning migration in the early raining season when the water level starts rising (May-June) and 23% reported it is in May-July as described in Figure 11. Respondents in KIIs were also able to identify two migration

periods: May-June when the rain starts mixing the water, according to them most fish are full of eggs during this period and October-December when the water level is rapidly falling, the recruit population migrates to the lake. It was reported by fishers that some species of fish (brooders) leave the juvenile in the nursery grounds, while others move together with them. However, they were unable to identify the species

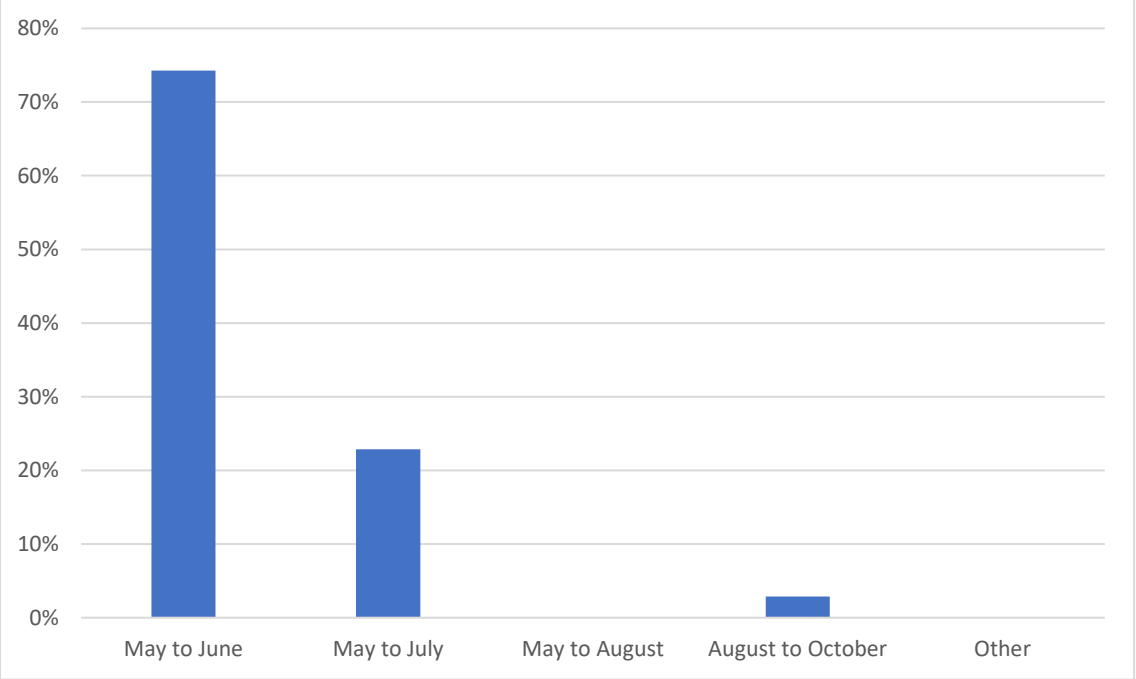

Figure 10. Months when fish migrate for spawning

4.1.1 Fishers indigenous knowledge on fish species that undertake spawning migration in inland water bodies

Fishers were asked to name fish species that migrate for spawning. Majority reported that all inland fish species undertake spawning migration (Figure 12). However, respondents from the KIIs added that majority of fish in inland water bodies migrate for spawning, but tilapia and catfish are the most dominated species on nursery grounds. KIIs also revealed that all fish in inland water bodies migrate at the same time to the nursery grounds, but only fish of the same species deposit their eggs at the same location.

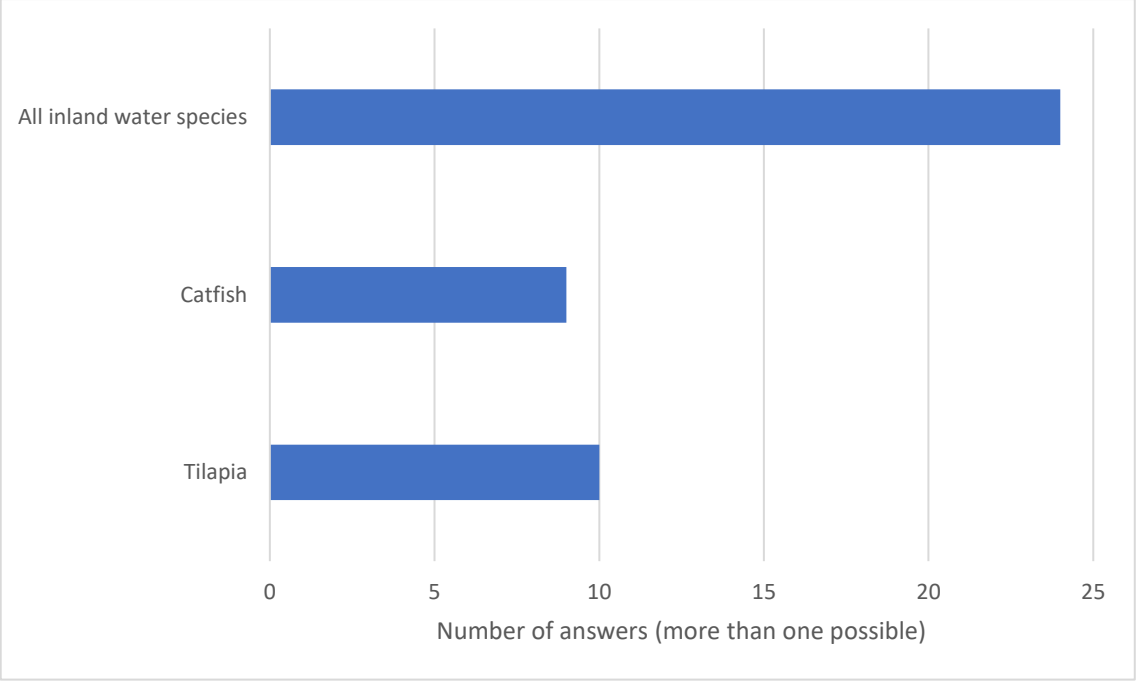

Figure 11. Fish species that migrate for spawning

4.1.2 Indigenous knowledge of fishers on major spawning grounds

Indigenous knowledge on spawning and nursery grounds is very important for the development of fisheries management plans to protect or properly manage major breeding and nursery grounds. Respondents were asked to demarcate major spawning areas (Table 4) along lake Mabesi and river Maleni. 42% revealed that fish spawn on the flood plains, 29% in grass and forest along the two inland water bodies and 29% in a densely wooded flat island, found in northern part of lake Mabesi. This is also in line with responses from key informants and further revealed that in the rainy season, the island in the northern part of Lake Mabesi is submerged completely and attracts fish by providing food, shelter and spawning environment. Arrival of fish for spawning, is indicated by high turbidity of the water as a result of nest construction activities.

Table 4. Spawning areas

Number of respondents	Name of spawning areas	%
15	Flood plains	42
10	Grass and forest along inland water bodies	29
10	Wooded flat island in northern part of lake Mabesi	29

4.1.3 Fishers indigenous knowledge on changes in fish migratory pattern

Fishers were asked if they experienced changes in the migratory route of fish in the past five years and 80% agreed that there are changes in the migratory patterns. A majority also reported that flooding and increase in agricultural activities around breeding and nursery grounds have led to changes in the migratory route of fish as detailed in Figure 13. According to responses from key informants, agricultural activities near and around inland water bodies have limited movement of many fish species to their spawning habitat and as well reduced forest cover along inland water bodies where some fish species take dry season refuges.

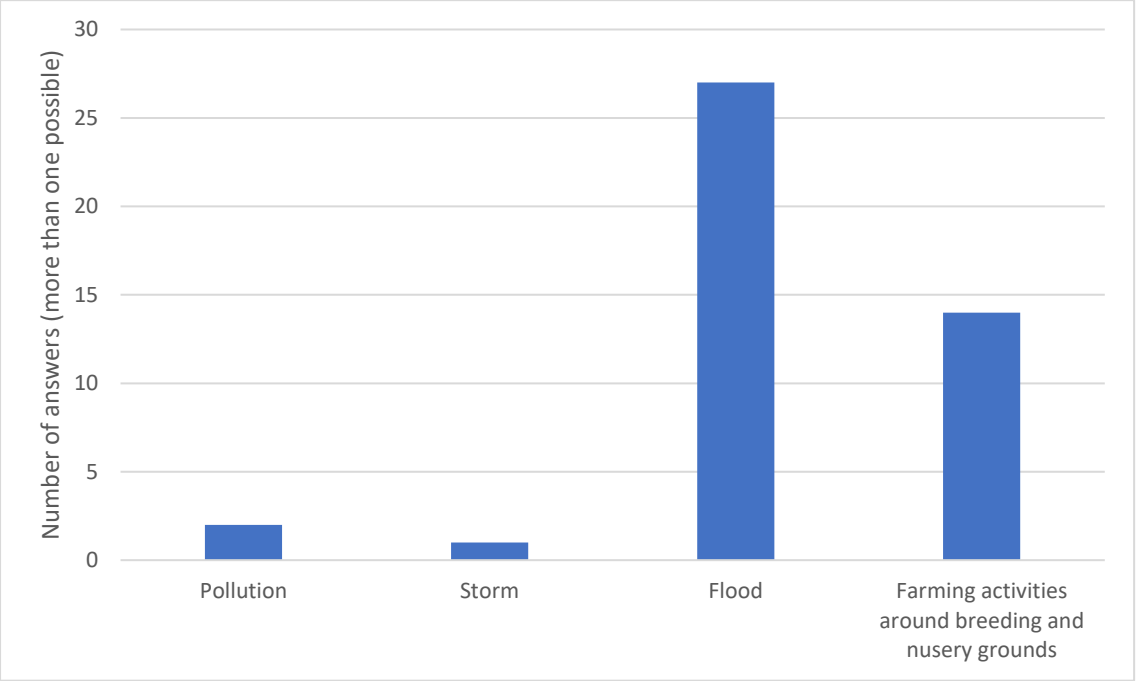

Figure 12. Cause of changes in fish migration patterns

1.18 Fishing gear and methods used in the rainy season

Key informants reported that fencing and gill nets with small mesh sizes are used in the early rainy season (May-June) to catch fish (brooders) entering the floodplains for spawning. Catfish is the most targeted species during this period. Hook and line, set net, gill net, trap and fencing are major fishing gear and method use during rainy season as described in Figure 14. Cast net and scoop net are mostly used in shallow water bodies in the dry season.

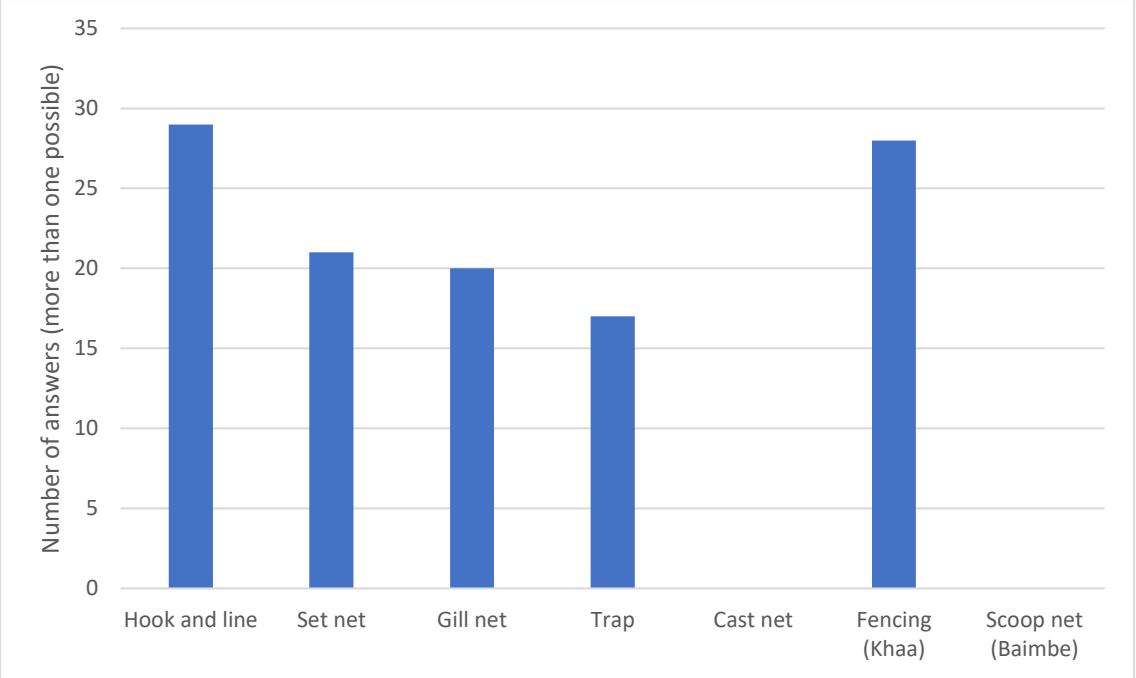

Figure 13. Types of fishing gear and methods used in rainy season

4.1.4 Fishing gear and methods used in the dry season

According to key informants, groups of fishers including both men and women clear or smash grass along rivers using scoop net to catch fish that shelter in grass for dry season refuges. A majority of respondents also stated that hook and line, set net, gill net, cast net, scoop net and cutting or clearing of grass along rivers (destroying fish habitat) are the major fishing gear and methods (Figure 15 below) used during dry season.

Fishers revealed, that Kru canoe and standard 2-3 are types of boat commonly used in inland water bodies.

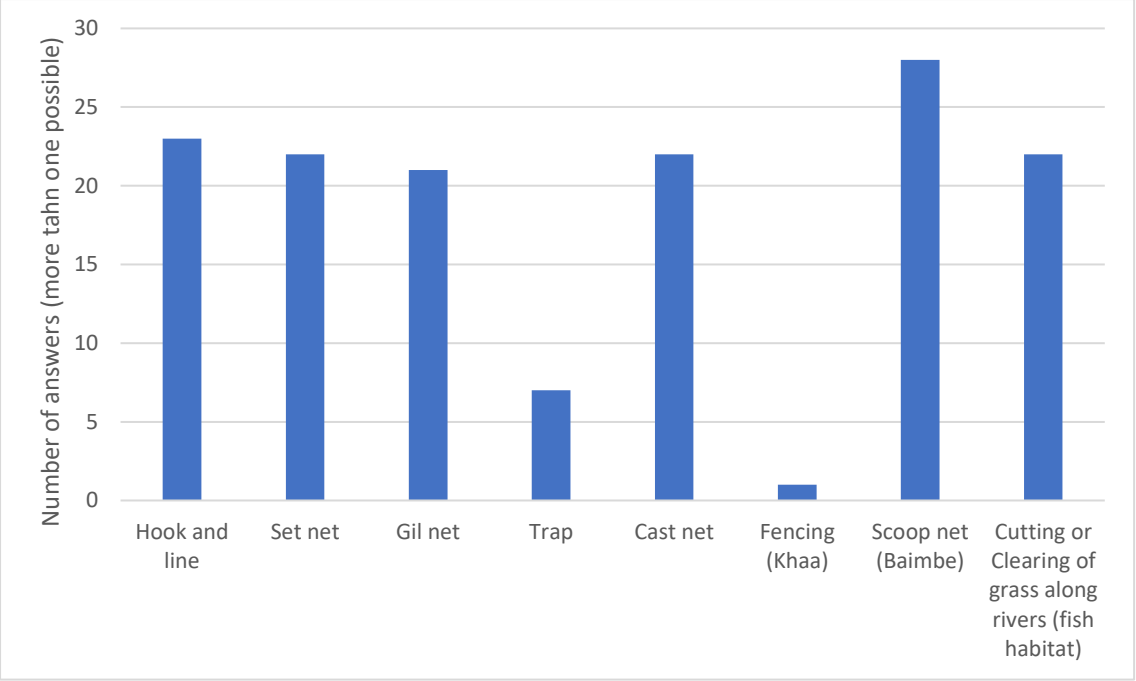

Figure 14. Types of fishing gear and methods used in rainy season

1.19 Role of women in inland fisheries

Respondents were asked if women are involved in formulation of community bylaws, 97% stated that women are involved in decision-making process of inland fisheries resources and only 3% reported that women are not involved, because they are shy of taking responsibility outside of the home. 51% of respondents also revealed that women serve as chairperson (women's leader) in CMAs executive, 43% as a treasurer and 6% as a secretary (Table 5). Respondents further disclosed that women are more reliable in handling money than men by taking on the duty of being treasurers. 80% of respondent also agreed that women are involved in formulating fisheries bylaw.

Table 5. Women's representation in CMAs

Number of respondents	Executive positions	%
2	Secretary	6
15	Treasurer	43
18	Chairlady (women's leader)	51

4.1.5 Alternative of source of income for women besides fishing

Respondents were asked to name alternative source of income for women. 46% stated that women do petty trading, 40% mentioned vegetable garden and 14% farming (Table 6) as an alternative source of income to help their husband

Table 6. Alternative source of income for women

Number of respondents	Alternative source of income	%
16	Petty trading	46
14	Vegetable garden	40
5	Farming	14

5 DISCUSSION

A base line study for development of a management plan for a natural resource involves collection of in-depth information about the resources. It gives a detailed description on what local resource users know about resources they exploit, traditional management system in place and the level of their dependency on the resources for economic reasons (FAO, 2013).

Lack of guiding policy for enforcement of fishing gear regulation and protection of breeding and nursery grounds has led to an increase in the use of destructive fishing practices (Kassam, Lakoh & Longely, 2017). The continued ineffective management system of inland fisheries resources provided the ground for formation of fisheries community management associations (CMAs) with the thought that inclusion of local resources users in management of inland fisheries resources will enhance effective and efficient management system in place. CMA formation is in consultation with traditional leaders (Paramount chief, section chief and town chief), district council, police, civil society and fishers. CMAs are mandated to formulate and enforce fisheries bylaws, raise awareness to fishermen of sustainable fishing practices, provide training to members in fish handling, processing and preservative techniques, manage conflicts among fishers, and maintain hygiene at landing sites. The bylaws contains: mesh size restrictions, close seasons and close area restrictions, monitoring of hygiene at landing sites, bans on the use of dynamite, monofilament and explosives for the purpose of fishing, restrictions on school-going children at landing sites during school hours, bans on destroying fish habitat and conflict resolution. Bylaws are formulated by CMA executives in collaboration with traditional leaders. The formulation process is supervised by a Fisheries Officer and endorsed by traditional leaders, district council chairperson, CMA chairman, CMA sectary, master fisherman and harbour master. CMAs have also introduced an informal savings scheme (osusu), since they do not have government support for alternative livelihood projects to reduce fishing pressure and effort on the inland fisheries resources.

The study focused on six CMAs. These six were selected because they have endorsed their bylaws and are the largest fishing communities. The study collected socioeconomic information of fishers, information on CMAs performance in implementing fisheries policy, obtained an indigenous knowledge on inland fisheries resources, information on types of fishing gear and methods used in both rainy and dry season and information on the role of women in inland fisheries management.

Findings on literacy level shows that 40% of the respondents have Islamic education and 34% have attained primary education. Islamic education is these communities is a free system of education acquired at home, as most people cannot afford to support their kids to go to formal schools. On knowledge of household income, due to crop failure and limited alternative livelihood activities, majority (86%) of fishers indicated fishing related activities for their subsistence. This is similar to findings by (Luomba, 2013).

Based on CMAs effort in inland fisheries management, it is evident that they have formulated bylaws that regulate fisheries resources and according to fishers' perceptions, CMAs have achieved some impact in regulating fisheries such as, controlling the use of illegal gear and methods (especially monofilament and explosives) and conflict management. The findings support Luomba (2013) that local resource users have achieved some impact in implementing fisheries policy. However, introduction of informal savings scheme by CMAs has impacted the life of most female members through petty trading.

Inability of the CMAs to limit illegal fishing gear/methods, collect data, arrest violators, conduct monitoring control and surveillance and keep inventory is because they lack support for both logistics and capacity building programs to undertake such activities. Insufficient support from government to CMAs in the inland fisheries sector has limited the associations to effectively conserve and manage inland fisheries resources for future generations. These shortcomings can be attributed to the fact that central government concentrate more on management of marine fisheries.

Co-management and the use of fishers' indigenous knowledge in management of small scale fisheries have been given better results than the top-down or centralised management system (Bagossi, 2008). Indigenous knowledge of fishers can provide policy planners with baseline information in a relatively quick and cheap way (Valbo-Jorgesen, 2008). Finding of fishers' indigenous knowledge on spawning migration indicates that fish in inland water bodies undertake spawning migration in the early rainy season (May-June/July). This is similar with the findings of (Valbo-Jorgesen, 2008) that fish migrate for spawning from May-July in inland water bodies and most fish are full with eggs during this time. Finding on fish species that migrate for spawning also indicates that majority of fish species in inland water bodies undertake spawning migration, but tilapia and catfish are the most dominant species on spawning grounds. On the knowledge of major spawning grounds, it is evident that fish spawn on the flood plains, grass and forest along inland water bodies and in wooded flat island in northern part of Lake Mabesi. This finding supports Lohmeyer (2002) that fish migrate to the three densely wooded flat islands in northern part of Lake Mabesi to spawn, in the early rainy season. This area is identified by respondents as tilapia hot spot area. However, anthropogenic impacts like flooding and agricultural activities around breeding and nursery grounds has impacted movement of most fish species to spawning habitats and as well reduced forest cover for dry season refuges and (Valbo-Jorgesen, 2008) confirmed that inland fish species are extremely vulnerable to environmental impact.

Findings on types of fishing gear and methods used in the rainy season show that most fishermen use gill nets with small mesh size and fencing to catch fish (brooders) entering the flood plain for spawning in the early rainy season. This corresponds with findings of Kassam, Lakoh & Longely (2017) that fishing gear and methods used on flood plain in the rainy season may have negative impact on breeding population. It is also evident that, most fishers, including both men and women join to clear or smash grass along rivers (destroying fish habitat) using scoop net to catch fish that shelter in grass for dry season refuges.

On the role of women in inland fisheries management it is evident that women participate in the decision-making process. This is in line with findings of Westlund & Zelasney (2019) that women have played a key role in management of small scale fisheries in supporting government initiated projects but contradicts findings that women are not involved in decision making process weather in management or fisheries co-operatives and union (Biswas, 2017). It is however, confirmed that majority of the women do petty trading and vegetable garden as an alternative livelihood source.

6 CONCLUSION

Based on the perception of fishers it is evident that CMAs have formulated bylaws for sustainable management of inland fisheries resources and fishers have also acknowledged the

significance of the bylaws in enhancing rational utilisation and management. However, most of these measures have not been addressed well, due to lack of support from government and other stakeholders. It is recommended that CMAs in the inland fisheries sector need to be provided with logistic support and capacity building programs to effectively implement the bylaws and as well extend formation of CMAs in other inland fishing communities in the country. Further research is also required to obtain more indigenous knowledge on inland fisheries resources and undertake a holistic inventory of fish species in inland water bodies of sierra Leone.

However, the major management deficiency identified in the study should be addressed in designing the inland fisheries management plan, with special preference to flood plain management, close season and closed area restriction.

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ANNEX 1: STRUCTURED QUESTIONNAIRE

STRUCTURED QUESTIONNAIRE

Introduction
This research is undertaken by Mr. Mohamed Kemokai as a part of his study at the United Nations Fisheries Training Programme. The researcher is undertaking a baseline and scoping studies for the development of inland fisheries management plan in Sierra Leone. The case study area is lake Mabesi and river Mallen in Pujehun District, southern Sierra Leone. The answers of the questionnaire will be treated with confidentiality and not analysed or reported against any individual. Your participation is very important in order to get valuable data for this research, which may contribute as a basis for policy making in Sierra Leone's inland fisheries.

Name of Village _____ Date_____

SOCIO ECONOMIC DATA
1. Age of respondent_____
2. Respondent's gender
(1) Male
(2) Female
3. Marital status (1) Single (2) Married (3) Divorce/separated (4) Widowed/er

4. What is your main role in fishing (2) Fisher man (3) Fish monger (4) Fish Processor Other_____
5.What is your level of education (1) No schooling (2) Primary (3) Secondary (4) Tertiary (5) University (6) Other specify_____
6. How long have you been involved in fishery_____
7. What is your main household income (1) Farming (2) Fishing related activities (3) Other_____
SUSTAINABLE INLAND FISHERIES MANAGEMENT
8. Do Community Management Association (CMA's) have by-laws ?1 (Yes) 2 (No)
9. Why has CMA's developed by-laws?
(1) To reduce the use of illegal fishing gears and methods (2) To protect spawning and nursery grounds (3) Conflict management (4) For saving scheme (Osusu) (4) Other_____
10. How do you estimate performance of CMA's in the following activities?
(1) Very effective (2) Effective (3) Neither effective nor ineffective (4) Ineffective 5 Very ineffective

(1) Formulation of by-laws
(2) Monitoring control and surveillance of fishing ground
(3) Confiscation of illegal gear/ fishing methods

4 Prosecuting violators
5 Arresting validators
(6) Resolving disputes/ conflicts
(7) Collecting revenue
(8) Conducting meeting
(9) Data collection
(10) Keeping inventories

11. What the major constraint for CMA's in enforcing fisheries management measures? (1) limited knowledge on fisheries issues (2) Inadequate capacity to enforce measures (3) Corruption (4) unavailable support from other stakeholders/government (5) Other, please specify_____

12. Is the CMA's an effective management system for inland waterbodies? (1) Yes (2) No. In your own perspective how can the CMA's operation be improved? _____
_____
_____

INDIGENOUS ECOLOGICAL KOWLEDGE ON INLAND FISHERIES

Traditional ecological knowledge of fishers on seasoning, spawning and nursery grounds will help to demarcate breeding and nursery grounds, this will be use as base line information for the development of inland fisheries management plan to enhance rational utilisation and management of inland fisheries resources

14.When do fish spawn? (1) May to June (2) May to August (3) August to October 5 Other……...
15. When do fish migrate to the spawning habitat?
(1) May (2) June (3July (4) Other

16. What species of fish migrate for spawning? 1Tilapia 2 Catfish 3Other
17. Where do fish migrate for spawning? (1) In the floodplain (2) Other ---------
18.Which month do the brooders leave the nursery grounds?
19. When do the recruit population move away from the nursery grounds?
20. Do you experience changes in the migration route of fish during spawning in the past five years? (1) Yes (2) No
21. If yes, what could be the changes? (1) Pollution (2) Storm (3) Flood (4) Farming activities at breeding and nursery grounds

TYPE OF FISHING GEAR AND METHODS OF FISHING IN INLAND WATER BODIES BY SEASON

22.What are the type of fishing gear and methods you use for fishing in the rainy season
(1) Hook and line (2) Set net (3) Gill net (4) Trap (5) Cast net (6) Fencing (7) Scoop net (biambe) (8) Other…..
23.What are the type of fishing gears and methods you use for fishing in the in the dry season?
1)Hook and line (2) Set net (3) Gill net (4) Trap (5) Cast net (6) Fencing (7) Scoop net (biambe) (8) Cutting or clearing of grass along rivers (fish habitat) (9) Other
24.Indicate the type of boat you use for fishing? (1) Kru canoe (2) Standard 2-3 (3) Standard 3-5

ROLE OF WOMEN IN INLAND FISHERIES

25. Are women involved in the formulation of community fisheries by-laws in your community? (1) Yes (2) No 3 Not sure
Do women have executive positions in the Community Management Associations? (I) Chairman (2) Sectary (3) Treasure (3) Other---
26Are women entitle to own fishing gear and boat in your community? (1) Yes (2) No
27. If no, why are they not?
28.What is the alternative source of income for women besides fishing? 1Petty trading 2 Vegetable garden 3 Other…...

28. What are the activities do women undertake inland fishing?
(1) Join the husband to fish (2)Fish alone in the nearby habitat in the dry season (3)Take care of the children and cook for the husband or crew (4) Support the husband in net mending (5) Post-harvest activities (smoking, drying and marketing)

THANK YOU VERY MUCH

ANNEX II: KEY IMFORMANT INTERVIEW

Introduction
This research is undertaken by Mr. Mohamed Kemokai as a part of his study at the United Nations Fisheries Training Programme. The researcher is undertaking a baseline and scoping studies for the development of inland fisheries management plan in Sierra Leone. The case study area is lake Mabesi and river Mallen in Pujehun District, southern Sierra Leone. Your participation is very important in order to get valuable data for this research, which may contribute as a basis for policy making in Sierra Leone's inland fisheries.

Name of interviewee……. Date…… Occupation----------

Community---------- Gender----------

1.How long have you been staying in this village……

2.What is your main source of income……

3.What activities has the CMA's initiated to manage inland fisheries resources along river (Select more than one) Mallen and lake Mabesi?

(1) Formulated by-laws
(2) Conduct patrols
(3) Confiscate illegal fishing gear
(4) Create awareness to fishermen
Other (specify)
……..

4.What are the achievements of the CMA's since it was formed? (Select more than one)

(1) Reduced illegal fishing gears and methods
(2) Managed conflict among fishermen
(3) Established savings scheme
(4) Improved hygienic status of landing sites
Other (specify)
……
……
……

5.How can the activities of CMA's be improved?
……
……

6.When do fish spawn?
……

7. When do fish migrate to the spawning habitat?
……

8. What species of fish migrate for spawning?
……
…….

9. Where do fish migrate for spawning?
……
……
10.Which month do the brooders leave the nursery grounds?
……
11. When do the juvenile fish (young fish) return to the lake or move away from the nursery grounds?
……
……
12. Do you experience a change or changes in the migration route of fish during spawning in the past 5 years?

13.If yes, please identify the cause or causes of the change in detail
……
……

THANK YOU VERY MUCH