Thesis for the Degree of Master of Fisheries Science

Characterization of Artisanal Fishery for Sustainable Livelihood among the Fishery Actors: in the case of Popoh Beach, Point-Four Fishing Community, New Kru Town in Liberia

by

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(수산업 종사자들 간 지속 가능한 생계를 위한 영세 어업의 특성화: 포포해변, 라이베리아의 새로운 크루 타운 (포인트-네 어업 공동체))

Advisor: Prof. Chul Hyung Park

by

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List of Abbreviations

CIA	Central Intelligence Agency
CCF	Code of Conduct for Responsible Fisheries
CZ	Continental Zone
DUV	Direct Use Value
EEZ	Exclusive Economic Zone
FAP	Fisheries and Aquaculture Policy
FAO	Food and Agriculture Organization
FCWC	Federation of the Central Gulf of West and Central
GRT	Gross Tonnage
GDP	Gross Domestic Product
IUU	Illegal, Unreported and Unregulated
IEZ	Inshore Exclusive Zone
LAFA	Liberia Artisanal Fishermen Association
MCS	Monitoring Control and Surveillance
MSY	Maximum Sustainable Yield
MTU	Mobile Transmitting Unit
NaFAA	National Fisheries and Aquaculture Authority
NM	Nautical Miles
NFDS	NordenFjeldske Development Service
PPP	Purchasing Power Parity
PUFA	Popoh Beach United United Fishermen Association
TURF	Territorial Use Rights for Fishing
TW	Territorial Water

UNCLOS	United Nations Convention of the Law of the Sea
UNMIL	United Nations Mission in Liberia
VMS	Vessel Monitoring System
WARFP	West Africa Regional Fisheries Project

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Abstract

Fishing is a vital social-economic activity for livelihood among the fisheries actors in fishing communities. In recent years, the fisheries actors in the study area have gone through a poverty-stricken situation. The objectives of the study include; scrutinizing the demographic and social-economic characteristics of the fisheries actors and the impacts of fishing among the actors, the economic factors and how it affects the welfare of the fisheries actors, and to identify the management policy and propose recommendations for improvement. To achieve these objectives, random probability sampling technique was used to collect the demographic and social-economic data selecting 110 respondents in the study area. The qualitative information was processed and analyzed in excel using descriptive statistics to quantify the qualitative data. The economic indicators of the fishing activities among the fishers were determined using the

Direct Use Value method to estimate the income and cost of the fishers fishing. The study revealed that the most profitable fish species harvested are *Pseudotolithus Spp*., *Galeoides decadactylus*, *Sardinella Spp.,* and *Cheilopogon melanurus* valued at US$11.43/kg, US$6.29/kg, US$5.58/kg and US$4.58/kg respectively. The less profitable fish species were *Ilisha Africana* and *Chloroscombrus chrysurus* valued at US$ 7.46/kg and US$4.03/kg respectively and were hauled by 25.76% and 12.12% of the fishers. Though *Pseudotolithus* and *Sardinella aurita/maderensis* species are profitable stocks, these species show low in harvest due to the low biomass of the two fish species. The results of the study indicate that there exists a great potential in term of the demographic and social profiles of the fisheries actors support the livelihood activities but there is a serious economic risk in the livelihood activities among the fisheries actors in the fishing community because the fishery is not sustainable. Practical measures are suggested to improve the fisheries activities in the study area such as enhancing the collaborative role of the government, fisheries managers, financial institutions and other stakeholders as well as international partners to improve the livelihood situations.

1 Introduction

Fishing is a vital social-economic activity for livelihood among the fisheries actors in fishing communities. The fishing activities in Liberia are both industrial and artisanal but the focus of this research is the artisanal fishery. The artisanal fishing activities involved the use of inappropriate fishing vessel locally made. The artisanal fishing is both commercial and subsistence, where the owner of the canoe/vessel directly takes part in the daily fishing activities (Government of Liberia, 2010). Vincent et al., 2015 defined artisanal/small-scale fisheries as that which involve traditional fishing for households using a relatively small amount of investment and effort, small fishing boat, with a short trip in fishing time close to the shore and is mostly for home consumption. Globally artisanal fisheries can be productive or unproductive toward the livelihood sustainability of those that are involved in the sector depending on the production and utilization of the fisheries resources. Because of the low level of technology employed in the artisanal fisheries, there are low impacts on the ecosystem. However, over time, the cumulative effects create major impacts on the ecosystem if not managed properly while serving as the genuine source for food security

and livelihood occupation to enhance economic well-being for people globally (Vincent et. al, 2015). With this in mine, Liberia artisanal fishery sectors are of no exception for the anticipation of fishing activities toward the contribution of the food security, social-economic empowerment for those that depend directly or indirectly on the sector for livelihood improvements. Though fishing in Liberia is open access fisheries, the fisheries actors (Fishermen, Processors, traders) in the artisanal fishery have remained poor in recent time while exploiting and marketing fisheries resources. The rising poverty has led to alarming hardship among the fisheries actors and needs investigation in order to understand the diversities of the fishing activities in a particular fishing community to serves as a case study.

In this light, the Popoh Beach, Point Four, New Kru Town Fishing community has been selected to undertake the research study in order to understand the current situations faced by the fisheries actors

1.1 **Problem Statement**

Globally, there exist mismanagement, over-exploitation, and environmental conservation on the fisheries resources as the result of the increasing human capital as pressure and the high cost of fishing. The

need to put a check to find other opportunities for employment show no avail but to consider the fishery sector as last resort for employment at such leads to pressure on the fish stock. This is not the only above mention issues but also encourages the lack of effective conservation and resource management policies in most coastal developing Countries that fascinate the fisheries as the only mean for employment (Sampson Yao Aho, 2013). The situation is of no different from Liberia that is in the artisanal fishery sector there is inadequate management measures, inappropriate fishing canoes/vessel; Low fishing methods; Poor utilization of the fisheries resources; and the Lack of organized market system is even making the problem worth. This has led to the research study in order to investigate the reality of the above mention problems and provide recommendations to address the current problems in the Popoh Beach, Point-Four fish community, New Kru Town in Liberia.

1.2 **Main Objective**

The main objective of the study is to scrutinize the demographic and s ocial-economic characteristics of the fisheries actors and the impact s of fishing among the actors.

1.3 **Specific Objectives:**

- To identify the economic factors and how these factors affect the welfare of the fisheries actors; and

- Identify the management policy and propose recommendations for improvement.

1.4 **Research Background**

1.4.1 ***Geographical Location of Liberia***

The Republic of Liberia is a West African country and is located within the southwestern subdivision of the protuberance of West Africa. The Country lies between the geographical coordinates of 4^0 34' N and 6° 56' N, and 7° 32' W and 9° 26' W (Subah, 2010). The country is bordered by the North Atlantic Ocean to the South, Cote d'Ivoire to the East, Sierra Leone to the West, and Guinea to the North. It has a total area of 111, 370 square kilometers (km^2) of which 96,320 km^2 is land area, while the water area is 15,049 in square kilometers (Glassgow, 2009). There are lagoons, mangrove swamps, and river-deposited sandbars (Subah, 2010). These natural features of the country support the marine environment by bringing in rich nutrient to the coastline and the marine ecosystem.

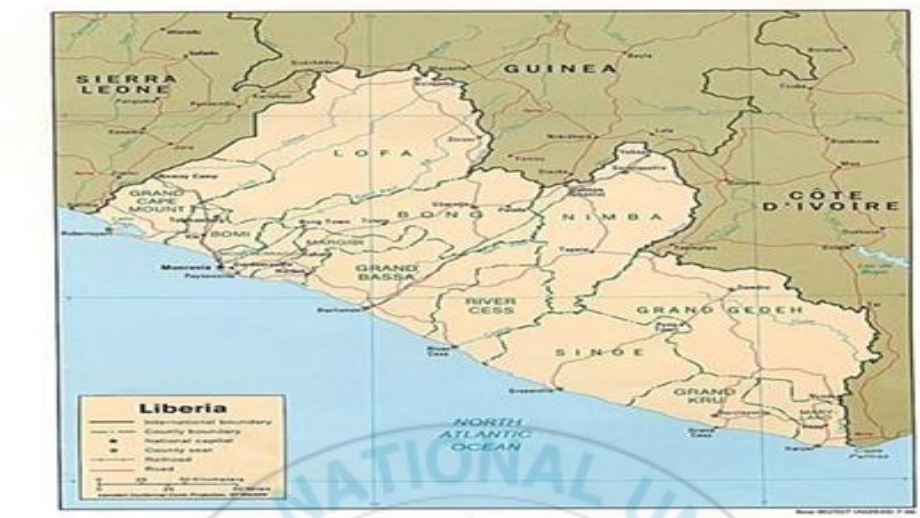

Figure 1: The political map of Liberia showing the Atlantic Ocean, inland water bodies and neighbouring countries. Source: (Subah, 2010).

1.4.2 The Inhabitant, Population, and Climate

The inhabitants of Liberia are the Americo-Liberian, Congo descendants and the natives' groups with respective populations of 2.5%, 2.25% and 95% (Subah, 2010), and (Population Liberia, 2018). The epoch of the Americo-Liberia ended in 1980 with a civil crisis referred to as the popular uprising in the country that led to lose of life and property (John H. T et. al, 1988). Despite the transition in history, the country is the only black African country that was never a colony in terms of the European political ambition and got her independence in 1847 (Belhabib

D et al., 2013). The last census of 2008 indicated the country's population was 3.48 million people with an annual growth and literacy rate at 2.78% and 57.5% respectively (Subah, 2010). However, the current population as of 2018 is 4,869,091 (World Population Liberia, 2018). This is a clear indication of a steady increase in the growth of the population and this would have impacts on food security, livelihood, and social-economic activities in the country in general. With a tropical climate, Liberia has rainy and dry seasons. Rainy season is between April and November with an average temperature of 30^0 C (Welcomme, 1979). The rainfall is heavier in June and July with the arrival of the African monsoon wind in May and a decrease in the month of August. The dry season is from December to February in the north and southern region. On the coastline, the rainfall is high, reaching 3,000mm (118 inches) in a year and is mainly seen in the country capital Monrovia at about 5.1m year-round (Climates to Travel, 2018). This type of climate change, especially in the rainy season, affects the fishing activities in term of production and calamity during fishing as well as the distortion of infrastructure along the coastal area

During this period, the fishers find it very difficult to embark on fishing while the processors and traders are denounced fresh fish for processing

and trading. The processors and traders are left with no option turn cold-storage fish for commercial purpose in order to remain in the business.

*1.4.3 **Economy***

Fisheries contribution to the national economy is through agriculture. Agriculture has taken over the post-conflict period and accounted for 76.9% while the industry service sectors are at 5.4%, and 17.7% of the national GDP. In terms of the working force, agriculture employed 70% of the working force, while the industrial and services sector contributed 8% and 22% (Subah, 2010). The fisheries sector contribution to the national economy was 3.2% toward the national GDP and 12% to agriculture GDP in term of the national economic sustainability (Government of Liberia, 2014).

1.5 **Fisheries Sector**

*1.5.1 **Fisheries Sector Overview***

Liberia has a coastal line of 570 kilometers with an Exclusive Economic Zone (EEZ) of 200NM offshore while the Inshore Exclusive Zone (IEZ)

is six nautical miles from shore support aquatic marine resources exploitation (Government of Liberia, 2014) and

(Sheck, 2014). The continental shelf of the marine fishery has an average width of 34km and fishing grounds that cover an area of 20,000 km^2 up to the 200NM for fishing activities within the EEZ (Drammeh Ousman K.L, 2007).

The fisheries sector involves the marine fisheries, and Aquaculture and Inland subsector fisheries. The Marine fishery sector is subdivided into the industrial and artisanal fisheries sectors (Subah, 2010). The maximum sustainable yield (MSY) of the continental shelf zone in a survey conducted in 2006 shows the biomass of 27,000 and 152,000 tons for the demersal and pelagic species (Subah, 2010). This yield when compared to the overall estimation of 180, 000 Mt/year obtained from Ssentongo in 1988 can be deduced that the biomass of the fish stock can hardly withstand the 180,000 metric tons of the MSY. The gaps in the two estimates indicate some mismatch of close fitting that there is a lack of adequate scientific information on the resources and in data collection. However, as of now, there had been no survey conducted to verify the estimated biomass above mention to the current fisheries biomass of the country fisheries. Figure 2 is the map showing Liberia fishing zones for

both the artisanal and industrial sub-sectors fisheries as well as neighbouring countries maritime zones. The fishing zones are the Inshore Exclusive Zone (IEZ), Continental Zone (CZ), and Territorial Water (TW) and the Exclusive Economic Zone (EEZ) (figure 2).

Figure 2: Map showing a Snapshot Google Earth Maritime Boundaries. Source: (Sheck, 2014).

1.5.2 The Industrial Sector

The industrial sub-sector is composed of commercial fishing vessels that fish in deep-water and target pelagic and demersal fish species. Vessels operating in the fisheries are properties of foreign companies (Sheck, 2014). The catches (shrimp and fish) are frozen on the vessel and landed on shore in order to supply the domestic market. The industrial fishery is

made of two trawl fisheries namely the shrimp and demersal finfish fisheries (Sheck, 2014). Notwithstanding, these fishing vessels under the 2010 fisheries regulation have to collaborate with the management and governance system through Monitoring, Control, and Surveillance (MCS) and has led to increase in the catches of the artisanal fishers (Sheck, 2014). This is a direct result of the implementation of Fisheries regulation of 2010 which mandated fishing vessels to fish off the inshore exclusive zone (IEZ) above the six (6) NM (Government of Liberia, 2014).

*1.5.3 **Marine Artisanal Fisheries***

This sub-sector of the fisheries is made of artisanal, Subsistence and Semi-industrial fisheries. The Subsector is operated along the coastline in nine of the 15 political sub-division of the Country. The nine coastal counties are the Grand Cape Mount, Sinoe, Grand Kru, Rivercess, Margibi, Bomi, Montserrado, Grand Bassa, and Maryland (Government of Liberia, 2014). There are 114 fish landing sites within the nine coastal counties along the coastline of Liberia for artisanal/small-scale fishing activities. The total number of fishing canoes operating in the artisanal fishery sector is about 3,000. The canoes are made of wooden materials

and move by paddlers or sail. Fishing canoes in this sub-sector are of two sizes; one of less than 6(m) in length and a depth of 60cm and operated by one to three crews, the second size is greater than 6 m long and operated by a crew size of three to five men. Fishers use various gear types such as hook and line, set net, ring net, gill net, drift net to target different fish species (Government of Liberia, 2014). The sector is difficult to monitor due to the number of canoes, landing sites and data collection usually understated by inspectors (Glassgow, 2009). However, the bulk of fish supply locally is from the artisanal sector as compared to the industrial sector. Notwithstanding, some of these canoes or vessels conduct fishing above the six Nautical Miles (NM) allocated to the industrial fisheries and can lead to conflict among the two subsectors of the Liberian fisheries. The main actors in the artisanal fishery are the Kru, Fanti from Ghana, Popoh inhabitant from Senegal and Gambia (Subah, 2010). However, as the fisheries develop over time, other tribes have joined the fishery industry for social and economic benefits. The Kru fishermen conduct fishing along the coast using wooden materials and moved by paddlers or sail carrying a maximum of one to three crews for the fishing trip (Subah, 2010). The Kru fishers operate individually and work in a smaller unit and conduct fishing in the day leaving the

shoreline in the morning and then disembark for landing at noon time. The Kru fisher folks are famous for hook and line, drift netting, and set net fishing and live in almost all the fishing communities along the coastal waters of Liberia. The second group of fishers is the Fanti migrants who are efficient than the Kru fishers when compared (Subah, 2010). The fishing canoes size by length is between 12 to 15m and sail by 1 to 40 horse power engine carrying up to 20 crews for a day fishing (Emmannuel, 2012). The third group of fishers is the Popoh people who have introduced the beach seines fishing. The method of fishing takes place near the shoreline and extends in the sea at a distance of 200 to 800 meters. During deployment of the fishing net, they use a crew size of 1 to 2 persons and hauling time require at least up to 20 people (Subah, 2010). The fishers from Senegal and Gambia are the fourth group of fishers. They use much larger fishing canoes with a length of 20 meters. The fishing methods are more efficient than those of the Fanti and Kru Fishermen. Because of the canoe size, these Fishermen are able to conduct long-distance fishing to catch more fish than the others fishers (Subah, 2010).

1.5.4 Classification of the Artisanal canoe per coastal county

Table 1: Number of Canoes Register in the Artisanal Fishery 2010 to 2013

County	No. of canoes registered 2010	No. of new canoes added 2013	No. of damaged canoes in 2013	Current No. of canoes 2013
Grand Cape Mount	279	65	56	288
Bomi county	65	9	31	43
Montserrado	654	65	157	562
Margibi county	116	7	47	76
Grand Bassa	736	32	171	597
Rivercess	302	52	84	270
Sinoe	475	52	140	387
Grand Kru	349	42	101	290
Maryland	300	81	89	292
Total	3276	405	876	2805

Source: (WARF, 2013) Annual summary report Liberia fisheries

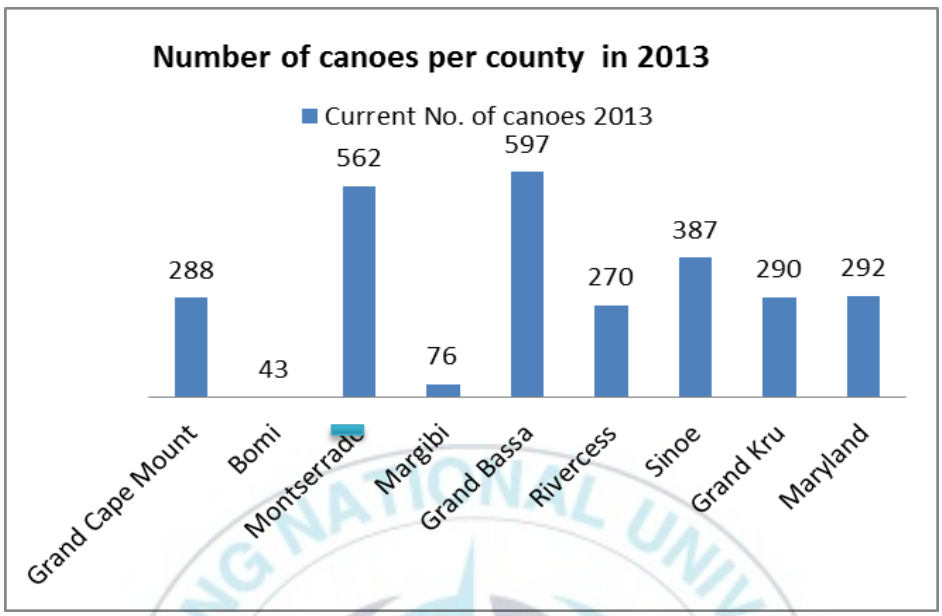

Figure 3: Number of Canoes Registered per County in the Coastal Counties of Liberia. Source: (WARF, 2013) Annual summary report Liberia fisheries table data.

Figure 3 shows the trend in the number of canoes registered per county in 2013 (table 1). This indicates that two out of the nine coastal counties in the number of canoes registered and is due to the increase in the fishers' population in those counties. In addition, the increased in the number of canoes registered in Montserrado and Grand Bassa counties are due to the productivity of the fishing coastal zones or waters, locations, and the opportunity for livelihood activities coupled with the demand for fish and fish products by the local consumption. Coastal counties having the lower number of canoes registered is due to the low

number of fishers and the population density of the area for the marketing of fish and fisheries products.

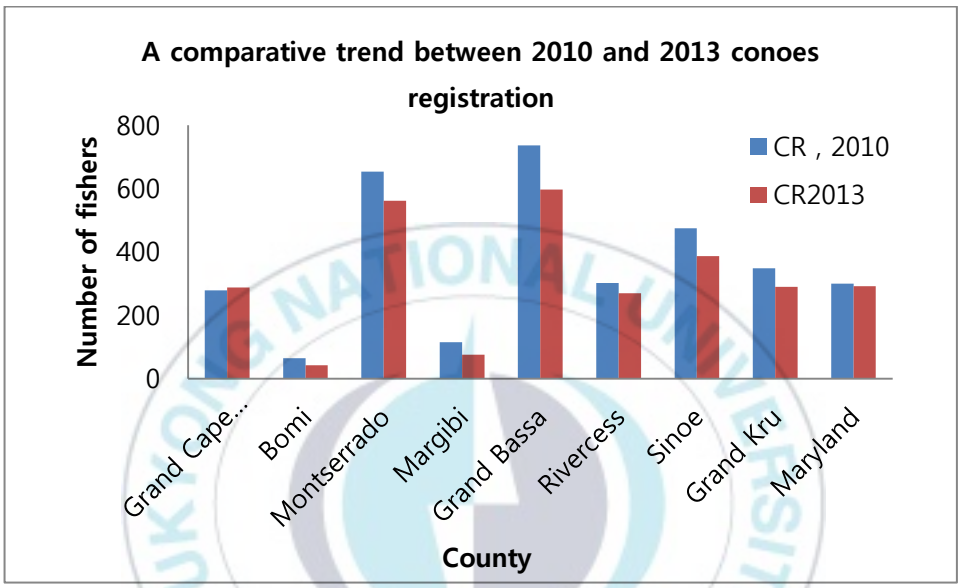

Figure 4: Number of canoes registered in 2010 and 2013 Source: (WARF, 2013) **Annual summary report Liberia fisheries.**

Figure 4 illustrates an increase in fishermen from 2010 to 2013. There were more fishers registered in the fisheries 2010 than 2013 canoes registration. The increase in the registration of canoe in 2010 was due to the high economic constraint and natural fishing conditions such as climate change condition and put the high fishing cost of canoes and gears repair.

Table 2 below provides an annual summary report of Liberia fishing canoe for the year 2010 to 2013 and 2017. The 2017 data is an unpublished of the National Fisheries & Aquaculture Authority (NaFAA) on the number of artisanal fish landing sites and total active canoes (effort).

The most popular fishing settlements are in Montserrado and Grand Bassa Counties. However, Montserrado County shows high in the number of canoe size compare but only seven fish land landing sites to Grand Bassa County which shows the highest in landing sites but the number of canoe size is less than that of Montserrado County. Though there is variation in both the number of landing sites and canoe, the boom in fishing activities fishers in these two Counties are due to the ideal fishing location of the counties and accessibility to fish processors, traders, and consumers.

Table 2: Number of Fish Landing Sites and Canoe (Effort) in the Artisanal Fishery per County

County	Landing Site	Total Canoe 2010	Total Canoe 2013	Total Canoe 2017
Grand Cape Mount	7	279	288	492
Bomi	2	65	43	61
Montserrado	7	654	562	960

Margibi	6	116	76	107
Grand Bassa	22	736	597	787
Rivercess	12	302	270	269
Sinoe	23	475	387	568
Grand Kru	24	349	290	397
Mary Land	9	300	292	318
Total	112	3276	2805	3998

Source: (WARF, 2013) Annual Summary report Liberia Fisheries

1.5.5 Classification of fish resources and vessel types by fishing zones

Figure 5 illustrates the classification of the fisheries resources, fishing zone and vessels types use for the exploitation of the fisheries resources. The zoning of the fisheries sector would best help management to manage conflict zone between the two sub-sectors with respect to fishing space and where the different fish resources can be found. This can enhance management ability to informal well manage the fisheries sustainable to ensure productiveness of the sector fleets and maximized the fisheries resources. The area in (red) on the top of is the deep-sea fisheries while the yellow area is the industrial trawl and artisanal fisheries (figure 5). The resources currently exploitation in the fisheries and is marked in yellow and the red is the future fisheries exploitation as well as the types of species exploited in the IEZ (Subah, 2010).

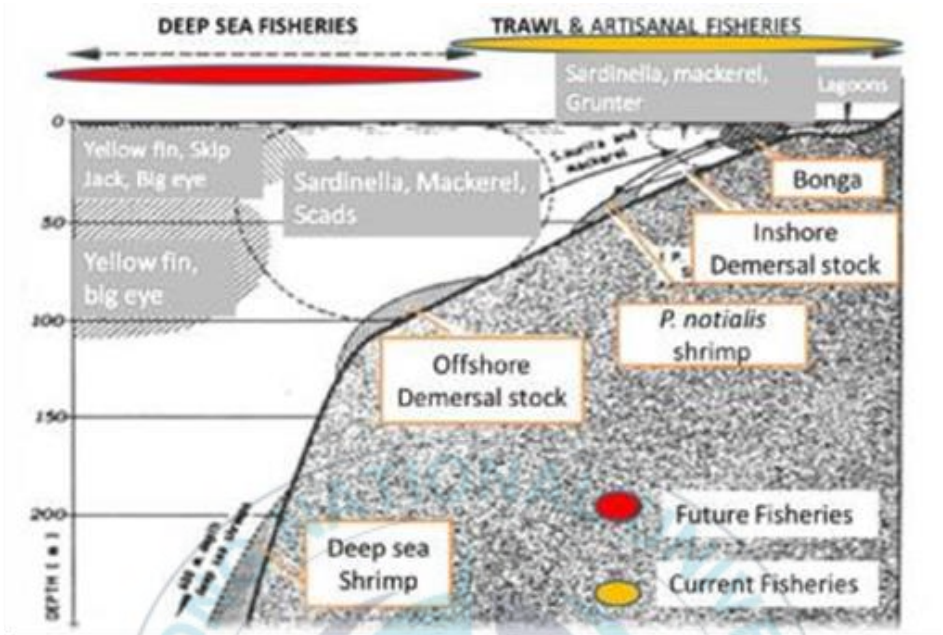

Figure 5: Fishing Locality of Current and Future fisheries on the Shelf of Liberia Source: (Subah, 2010)

1.6 The Fisheries Production

The production of fish and fish products in the Liberian fisheries come from two different sub-sector of the marine fisheries sector. The production of fisheries product in the industrial sub-sector has fluctuated over time from 1997 to 2008 (figure 6). The annual average production trend in catch was between 8,000 and 15, 000 tons. Of the total fish landed of 7,890 tons in 2008, 70% of the catch came from the industrial fishery (Subah, 2010). The biomass estimate of 27,000 in 2006 and 152, 000 tons for both the demersal and pelagic species of the catch cannot

maintain the 1988 biomass estimate of 180,000 Mt (Subah, 2010) cited Ssentongo (1988). The fluctuation in the biomass of the fisheries resources is due to several factors such as the civil war and under or poor reporting of catch data, and the lack of qualified staffs for data collection in these years. However, in (figure 6), greater points in the graph indicate improvement in the political stability of the nation thereby improved catch monitoring by the Bureau of National at the time with the hiring of onboard fisheries observers and the United Nations Mission in Liberia (UNMIL) Arial patrol of the fisheries water (Emmannuel, 2012). Apart from the above mention periods of the fisheries biomass estimate, there had been no other survey conducted to estimate the current fisheries resources of the country.

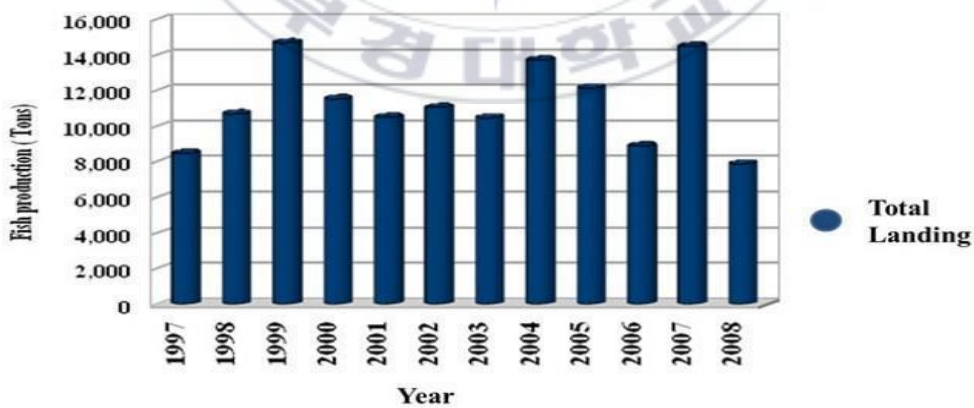

Figure 6: Fish Production Trend 1997 to 2008. Source: (Subah, 2010)

The fish production increases steadily in the catch with high harvest in 1999 and thereafter decreases in the production from 2000 to 2003. However, the catch was moderate in 2004 and then the harvest declined in 2005 and even more in 2006. Notwithstanding, the production sharply increase in 2007 and finally decrease in the catch in 2008. This type of trends in catch implied that the stock productivity was not good and catch not reported due to Illegal, Unreported, and Unregulated (IUU) fishing activities in the fisheries sectors. This means that there was no catch data record as a result of the IUU fishing and the underreporting of the catch data by the staff of the institution.

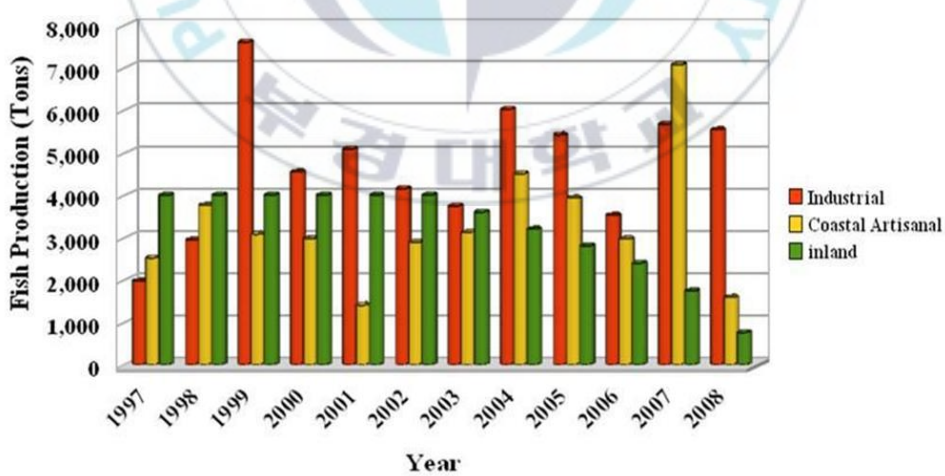

Figure 7: Total Fish Production from 1997 to 2008. Source: (Subah, 2010)

The production of fish is shown between two sub-sector fisheries from the period 1997 to 2008 (figure7). The sub-sectors are the marine industrial and artisanal, and the inland fisheries. The artisanal and inland sub-sector fisheries exceed more than 50% in harvest despite the inland sub-sector indicates a steady fall in the catch landed and reported (figure7) (Subah, 2010). Figure7 shows that there is variation in fisheries catch from 1997 and increase high in 1999 especially in the industrial sub-sector as compare to the other two sub-sectors marine artisanal and inland fisheries. Thereafter, the catch fluctuated up to 2006 and then increase in production in 2007 very high in the artisanal and industrial sub-sector fisheries. In 2008, there was a declined in the catch of the artisanal and inland fisheries but high in the industrial fishery production. However, the decrease in the catch of the artisanal and inland fisheries is due to IUU fishing activities and underreporting of the catch across the sub-sectors fisheries. Moreover, the increase in the industrial catch was the results of the intensification of fishing by the industrial vessels to increase their catch in the fisheries owing to the nation emerge from the civil conflict. However, productivity in the capture fishery has been steadily fluctuating between the artisanal and industrial fisheries with the inland fishery showing very little catch throughout.

1.7 **Fish species in Liberia**

The main fish species in the capture fishery sub-sector are *Sardinella* Spp., *Barracudas*, sharks, *Ilisha Africana, Ethmolosa, Carangidae, Caranx spp., Sciaenidae, Pseudolithus Spp., Polynemidae Spp.,* Spanidae (Dentex angolensis), Balistidae, tuna and tuna-like species and shrimps, crabs and lobsters and made-up 83% and 59% respectively in 2004 and 2005 within the domestic market chain (Glassgow, 2009) and (Subah, 2010).

Table 3: Fish Species and Types of Gears used and Specification of the Gears

Fishing gear	Mesh size (mm)	Gear dimensions (meter) Length	Depth	Target species	Area fishing	Time of fishing
Cast net	25.4-50.8	1-5		Bonga, Mullet, Sardinella, Grunter	Lagoon, and estuaries up to 1 mile from shore	All year round
Drift/floating gillnet	152.4-228.6 & 76.2-101.6	65-70 30-60	2-3 m	Shark, Tuna, rays, (Pseudotolithus senegalensis), Lutjanus goreensis crabs	4 miles & 1-5 mile (s) from shore	All time of the year

Bottom gillnet	76.2-101.6	30-60	2-3	Dentex spp, Threadfins, Pseudotolithus senegalensis)	One fathom from shore	All year round
Purse seine	38.1-44.5	200	20	Sardinellaspp, Flying fish (Cheilopogon melanurus)	Inshore water	Dry season
Beach seine	25.4-50.8	200-800	9-18	Sardinella spp, Pseudotolithus senegalensis, Bonga fish	Inshore	Dry season
Hook & line/hand lines		15-20		Pipe (Sphyraena barracuda), Sparidae	1-3 miles from	All year round
Set net/set hook & line		50-100	100-200	Pipe (Sphyraena barracuda), Sparidae	1-3 miles from shore	All year round

Source: (Subah, 2010)

1.8 **Importance of the Capture Fisheries Sector**

The fisheries sector of Liberia is a significant contribution to the national economy in several ways which include the area of food security, social-economic, employment, cultural, and livelihood sustainability for thousands of people in the urban and rural coastal communities. Employment wise, there are 37,000 fisheries actors within the fisheries sector of which 33,000 are in the artisanal fishery and 4000 in the

industrial sub-sector fishery. The 33,000 employ population in the artisanal sub-sector work in 114 fish landing sites within the nine coastal counties of Liberia. The sector provides employment for approximately 80% of Liberian of which 60% is women participation within the post-harvest sector (Government of Liberia, 2014). The food nutritional in term of the protein intake from fish is 15% and made up 80% of the entire national population in nutritional value (USAID, 2013).

The potential benefit of economic opportunity from the capture fisheries sector in term of the sector contribution is 12% to the agricultural GDP and 3.2% to the national GDP of the national economy (Government of Liberia, 2014). The Revenue generated from the fisheries sector toward the national economy were from USS $ 400,000 in 2001 to 6.0 million mid- 2013 that were accrued from fishing license fees, vessels registration fees, all import and export fish products as well as from fines levied on vessels in violation of the fisheries laws (Government of Liberia, 2014).

1.9 **Capture Fisheries Regulation and Policy for Management**

In Liberia, the Fisheries Regulations and Fisheries Policy are the main national laws relating to fisheries management and governance as the legal framework.

The main objectives of the Fisheries Regulations are to control fishing activities in the following ways:

1. Before fishing activities include doing the following:
    - Must meet authorization requirements and procedures through inspection of all fishing vessels and non-fishing (reefer) vessels for fishing gears and restriction, methods of fishing and others equipment of the fishing vessel to ensure compliance of license.
2. During fishing require implementation of monitoring, Control, and surveillance (MCS):
    - The vessel logbook that involved information on the fisheries activities such as the method of fishing concerning the catch, catch composition, the location of the fishing and gear type

used during fishing and others for due diligent for compliance measures;

- Placement of onboard fisheries Observers for data collection and reporting of the catch and all related fishing activities;
- Mounting of VMS and MTU for monitoring and surveillance of the fishing activities;
- Beach monitoring and surveillance by assigning fisheries inspectors; and
- Conducting Arial and water Patrol for monitoring vessels and related fishing operation.

3. During landing

Assignment of port inspectors for inspecting vessel logbook and verification of the catch data with Fisheries Observer data and related fishing activities with respect to compliance issues.

Output control

This involves compliance to species size and catch limits, By-catch and discard limit as well as the landing of catch at Port, catch documentation check schemes to meet legal fish sizes requirement (Sheck, 2014).

1.10 **Fisheries Policy**

The Liberia Fisheries policy is the main legal framework in the management of the sector and referred to as the Fisheries and Aquaculture Policy (FAP). In the policy, there is Strategy goals of the fisheries sector and seeks to provide supervision toward the consciousness of the fisheries sector vision with respect to management of the sector (Government of Liberia, 2014). Moreover, the policy intentions are to strengthen community stewardship of the fishery resources and to maintain the development of up-and–downstream commercial activities. These include the provision of more food and employment; engage in the right distribution system to enhance economically viable, toward effective and sustainable fisheries. Besides, the policy recognizes poverty alleviation among the poorest fisheries actors population and the issues of climate change resilience on the most vulnerable population. However, the Fisheries Policy was standardized on the National Policy that focused on the Poverty Reduction Strategy with its overall policy and strategic framework couple with the Food and Agriculture Policy and Strategy (FAPS) of the Country for agriculture activities including fisheries.

1.11 **Governance System**

Government is the decision maker and approval of law and policy. In Liberia, the preparation of the fisheries regulation and policy are based on a Top-up to the down management system. Government is the key decision maker and policy formulator for the governance of the fisheries sector. To this note, the president is the one responsible for the general oversight in term of the laws and policy approval (Government of Liberia, 2014). The NaFAA is the main regulatory arm of the fisheries sector in term of the management and governance system.

*1.11.1 **County Level***

At the Country level, management of the fisheries sector begins with the county administration and operates through the NaFAA. The management regime type is the top to bottom approach and its offer little consideration in term of the participation and accepting the opinion of the state stakeholders inputs in planning, monitoring, and enforcement as it relates to the fisheries management. However, the collaboration with the County Agricultural Coordinating Committee chair under the control of the County Agricultural Officer embraces the fisheries actor and stakeholders participation in the fisheries management within the

different fishing communities at the County level (Government of Liberia, 2014).

1.11.2 Monitoring, Control, and Surveillance (MCS) in the fisheries sector

Actually, the used of MCS in the protection of the natural resources and ecosystem as a new management strategy for ensuring the effectiveness and successes in fisheries management is very important. Since, the fisheries management objectives are to maximize the social, economic, and employment benefits, a successful MCS system in a fisheries management regime can reduced significantly the threat of Illegal, Unreported, and Unregulated (IUU) fishing activities in any fisheries sectors. With the implementation of MCS in Liberia fisheries from 2010, IUU fisheries activities in the sector have reduced considerably in Liberia. The successes in the Liberian fisheries management as it relates to MCS implementation in the fisheries sector were achieved through progressive monitoring and compliance regarding information sharing at local (communities involvement in MCS), national (MCS Coordinating Committee), regional and international level in a cost-effective and practical way has reduced IUU (Government of Liberia, 2014).

In Liberia, all fishing vessels are to mount VMS and MTU as electronic monitoring devices to enhance surveillance before, during and after fishing for MCS tracking activities (Government of Liberia, 2014). Monitoring, Control, and Surveillance in Liberia has focused on achieving acquiescence with the fisheries rules and has been successful in the reduction of IUU activities that had continuously affected the fisheries before 2011 for sustainability (Sheck, 2014). The implementation of MCS has led to the growth of the sector thereby increasing revenue for the sector toward the national economy, and fish caught in the artisanal fishery activities to boom the local market supply of fish for livelihood sustainability.

*1.11.3 **Community and Stakeholder participation in the fisheries management***

Under this strategy government has a top to down central management approach and has led to open access to artisanal fishers causing uncontrolled effort putting fish stock arise at such, the government has put into place a participatory management method such as the Co-Management initiative. That is the involvement of community and stakeholder structure in the fisheries management regime for allocation

of fishing rights and adaptive participatory monitoring and enforcement in the fisheries sector. The Co-management arrangement has led to the formulation of a TURF in Robertsport, Grand Cape-mount County. This type of management strategy allows the fishers and the community dwellers that they are part of the management system as result they can be very active in their participation toward the sustainability of the resources (Government of Liberia, 2014).

2 Methodology

2.1 Description of the study area

The artisanal sector is divided into three regions namely region one, two, and three for proper monitoring. The selected fishing community of Popoh Beach, Point-Four in the Borough of New Kru Town for conducting the research is found in region one and is a coastal urban area. The study area lies along the coastline on the north end of the Bushrod Island of Monrovia, Montserrado County in Liberia. According to the (WorldWide Index, 2018), geographically the Borough of New Kru

Town lies on the coordinates at Latitude 6^0 22' 00" and Longitude -10^0 47' 00". The ideal location of the fishing community has definitely encouraged many fishers and coastal dwellers to settle in the area for livelihood activities. The fishing settlement is an important fishing area because the area is easily accessible by the public for the purchase of the landed catch of fresh fish for daily consumption and processing. Because of the proximity of the area to the Atlantic Ocean couple with the cluster population size there exist intensive fishing activities. The fishing community is next in population size to that of the most populated fishing community of West Point among the entire fishing areas in Montserrado County. The selection of the study site for the research was based on the population density and ethnicity, the intensity of the fishing activities, the inhabitants (family), and the ideal location of the fishing community as well as the interaction between others dwellers and the fisheries actors for mutual benefit for livelihood.

However, the fishing community is historically known as the first fishing area where the beach seine method of fishing was introduced and practiced by the Popoh people (Subah, 2010). The beach seine method of fishing is one of the fishing methods for catching fish and operates

within the 3NM. Currently, the fisheries authority in Liberia has banned the beach seine method of fishing due to its destructive way of catching spawned fish species, juvenile, and their eggs that settle along the coastline of Liberia. To this note, Popo Beach fishing community portrays a perfect site for conducting the research study. The map below displays the study area of the fishing community in the Borough of New Kru Town, Monrovia Suburb in Liberia (figure 8).

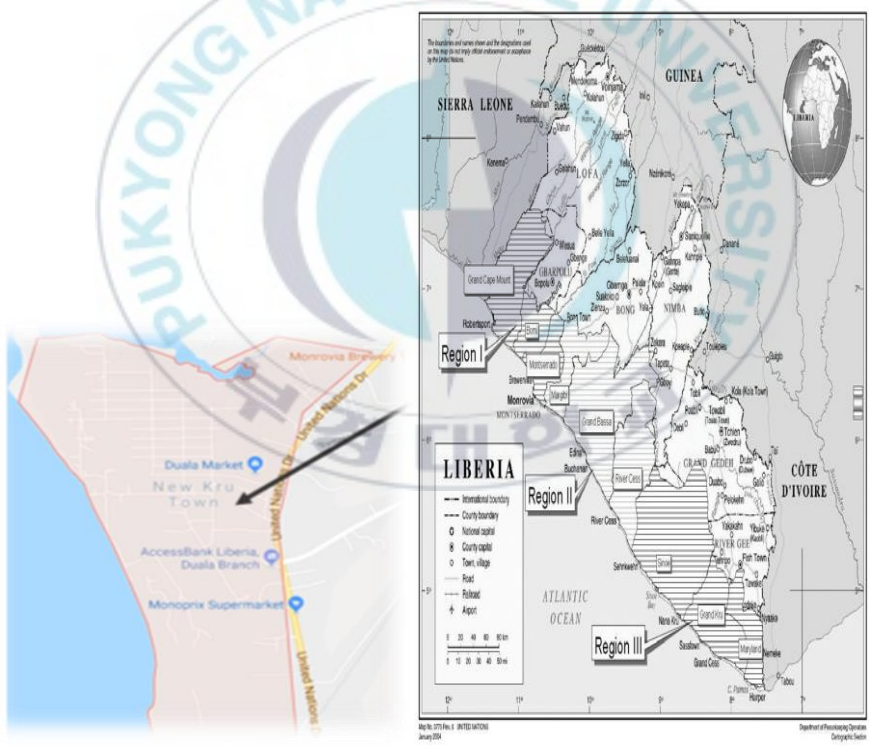

Figure 8: Map showing the Fishing Community in the Borough of New Kru Town Monrovia, Liberia. Source: Coastal Region of Liberia (FAO, 2009)

2.2 **Data collection**

The method employed to collect the demographic and social-economic data involve qualitative method using random probability sampling technique with a purposive approach based on a voluntary response rather than self-selected volunteers in order to get a representative sample for the analysis. This approach is to reduce significantly the biases in term of the estimation of the different parameters considered in the research survey. The selection of the technique is due to the suitability of the method for the resolution within my research area for analysis. According to (Halcomb E, 2016), qualitative research methodology can include grounded theory, phenomenology, storytelling, naturalistic inquiry, and ethnography but the most common of these types of qualitative research method used are the structured interviews, focus group discussion, and observations approach. This research work applied the voluntary response interview by reaching out to the respondents through questionnaire and focus group discussion methods to collect the demographic and social-economic data. This was to obtain evidence on the demography and social-economic characteristics of the fisheries actors. The characteristics include the gender, age, marital status, family size, educational level, fishing experience, and affiliation

and societal norms as well as the economic performance among the fisheries actors in the study area. The economic performance indicators include fishing inputs such as the fishing gear (net and canoe) and fish production as the output of the fishing asset.

The questionnaire prepared was in three sections namely a) the profile of the fisheries actors, b) the fishers, and c) the processors and traders activities within the fishing community. The survey questionnaire targeted 110 fisheries actors as the sample size of the population for the analysis. The questionnaire was prepared and sent to the fisheries authority in Liberia for the collection of the demographic and social-economic data in the study area. To get the target sample, the fisheries actors were selected from the different fish landing sites and at near sea traditional fish processing facilities in the community.

During the data collection, field staffs were taken from the National Fisheries and Aquaculture Authority (NaFAA) which includes a male and female participation in the data collection. The survey conductors follow the instruction of the questionnaire by approaching the fisheries actors randomly for the interview. The Fisheries actors were the respondents and interviewed on the beach at the time of landing their catch, at home after fishing, when not fishing, and those involved in the

fish processing. However, the focus group discussion was carried out to ensure that the questionnaire used for the data collection suit the objectives of the research. The data collection for the demographic and social-economic analysis lasted for a period of one month from March to June 2018. A total sample size of 110 fisheries actors was interviewed out of the fishing population of 450 for the demographic and social-economic performance of the fishing activities in the fishing community.

The strategy for the data collection (sample selection and field design) involves reaching out to the fisheries actors in the community to obtain responses. To this ends, respondents at the fishing community fish landing site show collaboration with the field staffs especially the fishers who landed their catches and those that were at home mending their fishing nets or doing something else. Non-cooperation was from the fish processors and traders who have to turn to their fish processing activities giving not much attention for the interview.

Though there was great progress made in administering the interview, there were some constraints as it relates to implementing the interview due to some respondents being tired with the interview conducted since

there was no indication of some form of material or financial benefit at the end of the data collection. The Success of the data collection was mainly due to the fishers' chief and community Stakeholders intervention as well as the collaboration from the fisheries authority. In addition to the above mention constraint, there was also fear among the fisheries actors about providing personal information such as their profile and business operation as it relates to tax payment and others. Therefore, if the fisheries actor is not prepared to respond to the interview, other fisheries actor targeted to obtain the sample size of 110.

The demographic and social-economic data collected on the status of the fisheries actors' structures involve (gender, age, marital status, family/household size, level of education, years of fishing experience, type of fishing organization) were collected to determine their involvement in the fisheries activities including the methods of fishing, gears type used, cost and income per fishers.

2.3 **Species and gear identification.**

The fishers in the fishing community provided the local names of the fish species at the time of the data collection. The local names of the fish species were then compared to match with the scientific name from the

fish identification pocket guide produced by the Food and Agriculture Organization (FAO). The FAO fish species identification pocket guide fish finder used referred to as “Important coastal fishery species of Liberia” (FAO, 2013). The identification of the gear types used was acquired from the fishers and match with the specification of the gear used by the artisanal fishers (table 6) (Subah, 2010).

2.4 **Data analysis**

The data collected was processed and analyzed in excel using descriptive statistics to quantify the qualitative information. Quantifying the data collected from the field concord with the various responses in order to understand the conditions unfolding among the fisheries actors and the fishing activities. The research considers a number of others factors especially on the issues of climate change effect on the fisheries actors’ and behavior of the actors in the fisheries as it relates to (harvest and post-harvest, marketing, and others). The Measurement of fishing effort is relevant to determine the amount of catch to help fisheries managers to know whether a fish stock is overfished. Upendo M. H., 2012, has revealed that fisheries census on the total number of fishers fishing or the sum of the fishers used as a proxy of the fishing effort to determine

the fishing power. In the artisanal fisheries, nominal fishing effort describes the resources shared to fishing in term of time such as (the number of days or the hour fished, number of vessel days or Labor (number of person-hours or number of crew)) (McCluskey & Lewison, 2008). In this research, the number of fishers sample is used as proxy of the fishing effort in order to determine the quantity of fish caught and landed by species type.

*2.4.1 **The Analysis of the demography profile of the fisheries actors***

The qualitative data was processed and analyzed in excel using descriptive statistics to quantify the demographic profile and the social-economic performance of the fisheries actors in the study area. The characteristics of the fisheries actors were based on the classification of the fisheries actors' on the different fishing activities undertaken within the fishing community to ensure food security and livelihood.

*2.4.2 **The Analysis of the Economic Assessment of the Fisheries Actors***

The profitability of the fishers was determined using the Direct Used Value (DUV) method. The method was to analyze the value-added from

the income and cost of fishing among the fisher hauling the fish species in the fishing community. The income and cost of fishing depended on the cost of the fishing gear used, canoe, and fish species caught, as well as the market price that the fishers are willing to sell at the time of the data collection period. The calculation of the total operational cost per fishing trip was from the cost of the gear (nets, canoe, and the local sail materials) as well as the food purchase for the day fish. In term of the gear type, the cost on the gear was from the usage of the gear base on the hiring of the labor for the time the gear was used, gear depreciation, and the cost of food and others items used. All prices of items used to determine the economic assessment of the fishers investment were by taking the average on the indicators such as the cost of fishing (gears, hiring, and food) and selling price of fish in local currency and then converted to the prevailing rate of the United State dollars (US $). The weight of fish converted from a local unit of measurements such as a bucket of fish, a pack of fish, and a tube of fish to Kilograms (kg) for calculation. However, the price of fish estimated was based on the prevailing market forces of demand and supply of the fish landed by fishers taking into consideration the local price determination method (Example: Fish size, species, and quality). The difficulty in price

determination is due to the lack of the use of scale for measurement to determine the price of fish in the artisanal fishery.

Mention above, the economic assessment to determine the values of the different fish species caught using different fishing gears in the artisanal fishery were from applying the Direct Use Value (DUV) method. The method in equation form stated as Equation 1 below:

$$\mathrm{DUV} = \sum_{i=0}^{n} (Pi * Qi - Ci)$$

Where: DUV= Direct Use Value; P_i = price; Q_i = Quantity of fish landed; C_i = Cost of fishing; i, refers to the item under description (in this case, fish species); n = the total number of fishers taking part in the fishing activities.

The t-test for testing the significance of the correlation coefficient between the value-added from income and cost of fishing was from Equation 2 below (Doulglas A.L et al., 2012)

$$t^* = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

The critical t value obtain came from the student's t distribution table which illustrates the confidence or significance level and degree of freedom. Where: t* is the t-test to compute the t_{value} and calculated using

Equation 2. Small r is equal to the correlation coefficient and is calculated from the sample of the population in the study area, n is equal to the number of pair of data used to do the correlation test and r^2 is the coefficient of determination that is the percentage of the response variable variation that is explained by the independent variables in the linear model.

3 FINDINGS

3.1 Characterization of the local fisheries actors

The analysis of the demographic profile of the fisheries actors in the study area is shown in a tabular form to display the demographic indicators (sex, age, marital status, household size, education, and year of fishing). The result in (table4) shows that fishing is the main source of livelihood activities in the local artisanal fishery. The labor force is highly dominated by male employment in the sector as fishers and fish traders than their female counterpart. Though the analysis shows that there is more male than female participation, the female demonstrates major roles in the artisanal fisheries activities.

Table 4: Demographic Profile of the Fisheries Actors

Parameter/Indicator	Range	(%) Percentage of the Fisheries Actors in the Study Area
Fisheries actor Age in year	<=25 26-30 31-35 36-40 41-45 46-50	7.27 % 21.82% 17.27% 30.91% 16.36% 6.36%
Sex **Male** **Female**	66 44	60% 40%
Marital Status	Number of families	Percentage
Single **Marital** **Widowed**	37 68 5	33.64% 61.82% 4.55%
House Hold and Average family size	Extended family	100 % Extended family size with an average family size of 5.83
Fishers years of Experience	Range 5-9 10-14 15-19 20-24	Percentage 28.79% 46.97% 18.18% 6.06%
		Average year of fishing experience 11.80
Educational Status	**number of household**	**Percentage**
No Education **Elementary** **Junior High** **High School**	29 16 31 34	26% 15% 28% 31%
Participation by fisheries actors Fishermen Processors Traders	 66 18 26	 60% 16% 24%
The participation of fisheries actors in the fishing Organization.	Yes : 67 persons No: 43 persons	61% 39%

Of the ages of the sample size of 110 fisheries actors' interview, the survey result shows that 60% are male and 40% female in the fishing population (table 4). This implied that there is more male involved in the fisheries activities than their female counterpart with an average of age 35 and 36 for male and female respectively. Despite, the ascendancy by male participants, the female play so many important roles in the fishing activities as such their involvement cannot be underestimated. This is shown especially in the post-harvest and the marketing sectors of fisheries products. Besides, they take full social responsibilities in the area such as the cultural norm, marital and parental roles with respect to the family social life in the local fisheries community. More to that, female population in the fishing community not only focus on the above mention social-cultural things but demonstrate an intermediary role in the fish trade and can be the owner of the fishing business too.

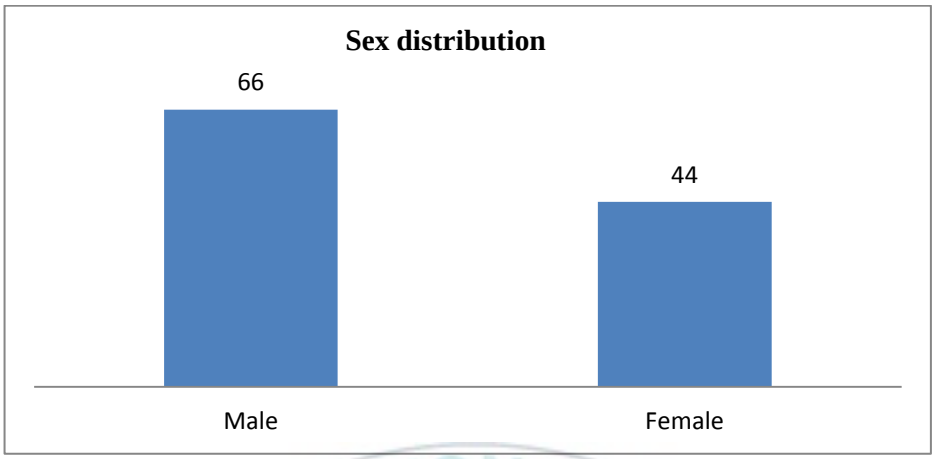

Figure 9: Sex Distribution among the Fisheries Actor

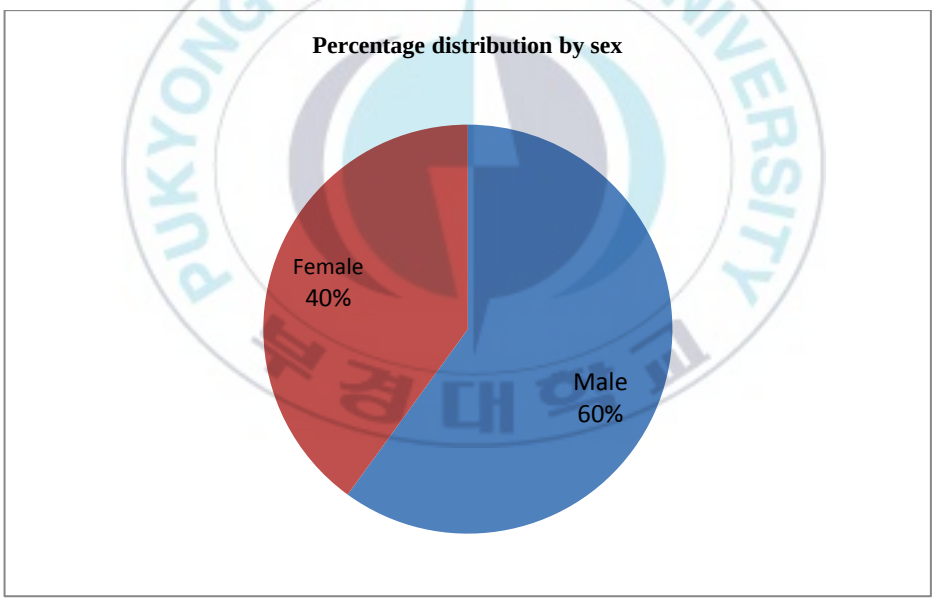

Figure 10: Percentage Distribution of Fisheries Actors by Sex

Out of the 110 fisheries actors interview from the total fishing population of 450 (fishers, fishmongers or processors, and the trader),

the active fishing ages are in the range of 36-40 years and represents 30.91% of all the fisheries actors.

Figure 11 shows the age distribution among the fisheries actors with the main or active fishing age range of people involves in the fishing activities in the interval of 36-40 years.

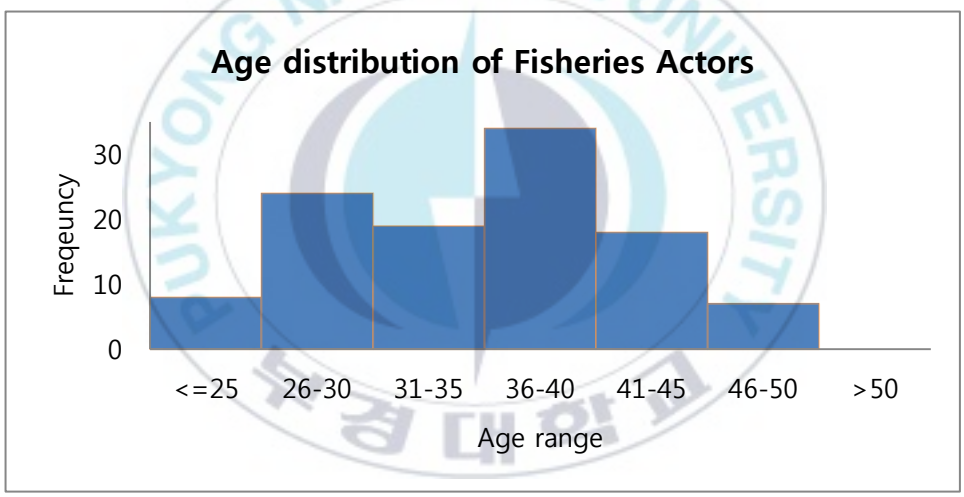

Figure 11: Age Distribution of the Fisheries Actors

The above trend in the ages of the fisheries actors shows that there is active labor force employed in the artisanal fishery. This is to ensure that there exist opportunities for the enhancement of livelihood activities to generate employment and income toward sustainable fishing. Besides,

the above active labor force portrays a mature or late youthful population participation in the fishing activities. The anticipation of this type of labor in the local fisheries when well organize can ensure productive fishing capacity.

Additionally, most of the fishers have spent 10-14 years (figure 12) of fishing and represent 46.97% (table4) of the different age range among the fishers.

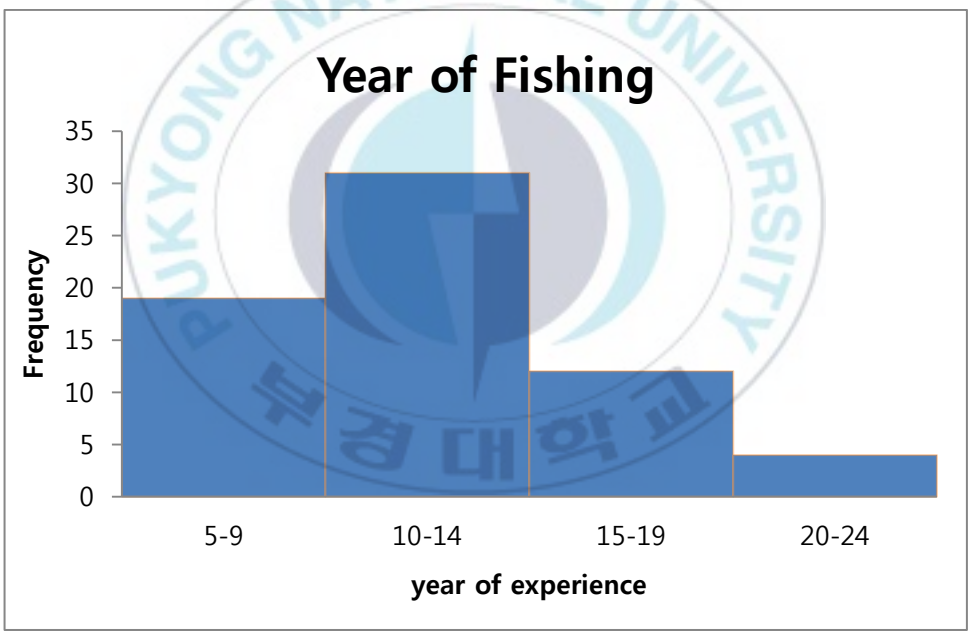

Figure 12: Fishing Experience of the Fishers

However, on average the fishers have experienced 11.80 years of fishing within the fishing community (table 4). Moreover, most of the fishers are

full-time employees in the fisheries. The livelihood of the fishers directly depends on fishing while others are involved with the post-harvest and marketing sectors.

The marital status among the fisheries actors is very important to exhibit a high level of sensitivity and responsibility among the fisheries actors. The interview conducted on the sample size of 110 fisheries actors; the result indicated that 68 of the respondents are married and represent 61.80% of the marital status among the fisheries actors. The single and widowed made up 37 and 5 representing 33.64% and 4.55% respectively (figure 13).

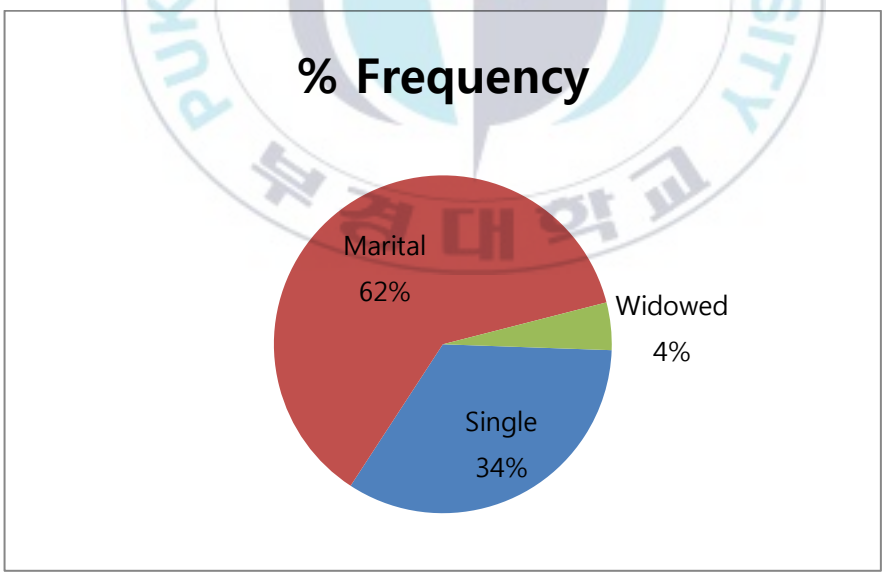

Figure 13: Marital Status among the Fisheries Actors

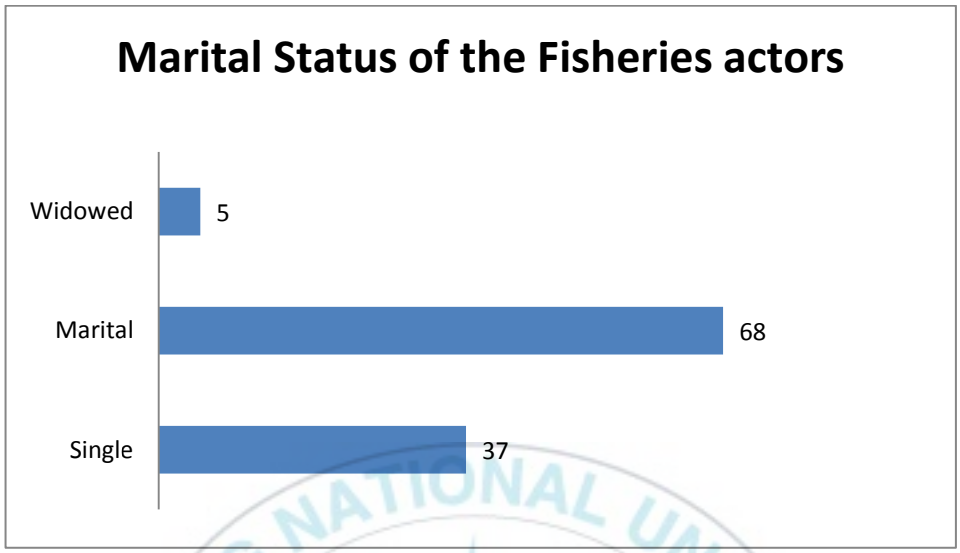

Figure 14: Marital Status of the Fisheries Actors by Frequency

Figure 14 shows the difference in the marital status among the fisheries actors in the fishing community. This brings about dependencies problems toward the livelihood and social-economics ambition among the fisheries actors and leads to the fishers to put fishing pressure on the fishery resources thereby resulting in overfishing of the fish stock.

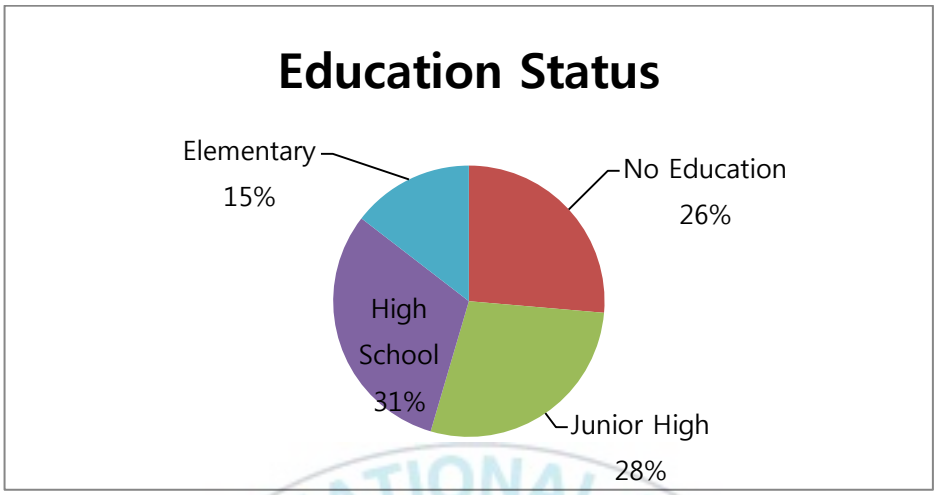

Figure 15: Educational level among the Fisheries Actors in the Fishing Community

The educational status among the fisheries actors in the fishing community is very important for the sustainability of fisheries resources. Moreover, the growth of any society depends on the human resource capacity of the people being educated. Though in most artisanal fisheries there exists a lack of educational status among the fisheries actors. This brings about fisheries collaboration among resource users and the government to be very difficult for management purpose. This is quite different among the fisheries actors in the study area. The result from the analysis indicates that the fisheries actors in the fishing community have some formal level of education though not at a high level. In view of the above, (figure 15) show that 31% of fisheries actors acquired high

school or secondary education (grade 10-12) out of the total sample size of 110 fisheries actors' population interview which represents the bulk of the fisheries actors education. The next level of education is the elementary (primary to grade 6) and junior secondary level (grade 7 to 9) representing 28% and 15% respectively. Though the local fisheries actors show interest in education, there is a good amount of the actors' interview that is illiterate and represents 26% of the fisheries actors. Contrary to the notion about the artisanal fishing community in Liberia, that nearly all of the rural and coastal fishing communities lack or have a low level of education, the fishing community of Popoh Beach Point Four showed the different in the educational level. There is a high level of educational attainment (74%) as compare to the illiterate fisheries actors (26%) in the study area. This is an added advantage to the fisheries actors' knowledge to easily comprehend and implement the fisheries management policy. This is achievable if the fisheries actors are part of the decision-making processes with the national government for sustainable management of the resources to improve their social-economic welfare.

Figure 16 and 17, shows the classification of the fisheries actors by percent distribution in the different fisheries activities within the fishing

community. The fishers are 66 and represent 60% of the total fisheries actors in occupation while the processors and traders account for 18 and 26 representing 16% and 24% of the fisheries activities.

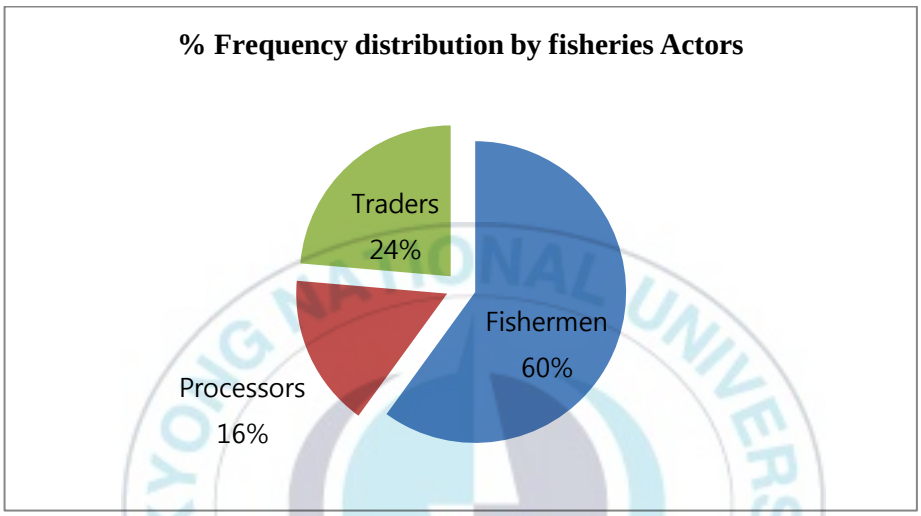

Figure 16: Percent Distribution of the Fisheries Actors by Occupation

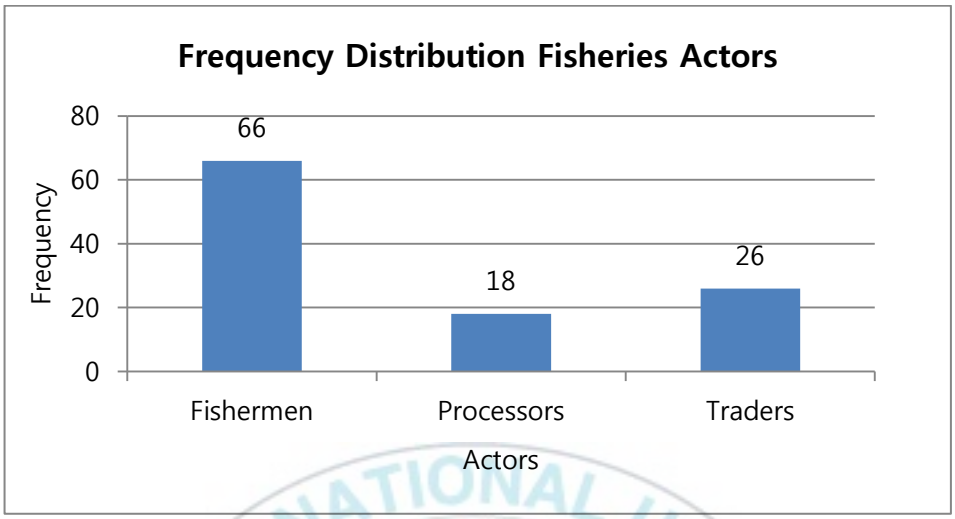

Figure 17: Frequency of the Fisheries Actors by Occupation

There are two fishing organizations in the local fishing community of Popoh Beach namely Popoh Beach United Fisherman Association (PUFA) and the Liberia Artisanal Fisherman Association (LAFA). The social and cultural affiliation as mentioned in (table 4) provide an important implication in term of the traditional fishing norms and governance system regarding the behavior of fishing practices by the fishers in the local fishing community. This aspect helps the fishers to conduct themselves well with morals in the fisheries to ensure the long-term collaboration and tie in the community especially among the fisheries actors and the local stakeholders. Not only that this lead to fishing community customary traditional norms that result to local

fisheries to develop laws or rules to sustain stability toward avoiding conflict among the fishers on the use of fishing space, restricted access area, and the social and cultural governance. For example, issues of violating the fishing holidays, fighting at sea, stealing of catch, and the refusal of payment of due and fined toward the empowerment of the fishing organization. The fishing norms or rules are followed to the letter with regard to before, during and after fishing at all time of the fishing year for the proper management system at the community level. Figure 18 and 19 display the social affiliation of the fisheries actors. Socially, the respondents' information indicates a very good entry for policy formulation. The different responses by the fisheries actors as "Yes or No" status of being part of a fishing organization shows that 67 of the fisheries actors agree that they are part of a fishing organization and account for 61% and those that said No to be part of any fisheries organization are 43 and represent 39% of the fisheries actors in the sample of the population.

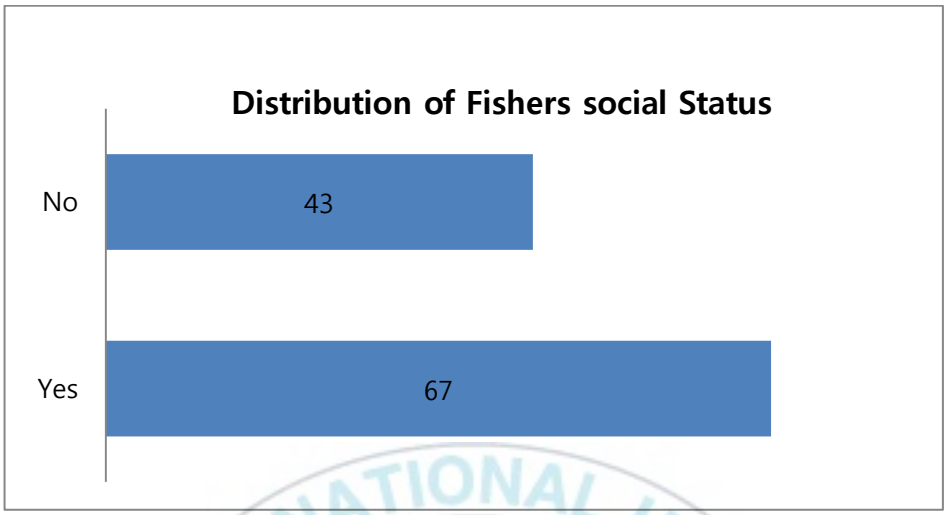

Figure 18: Distribution by Social Status

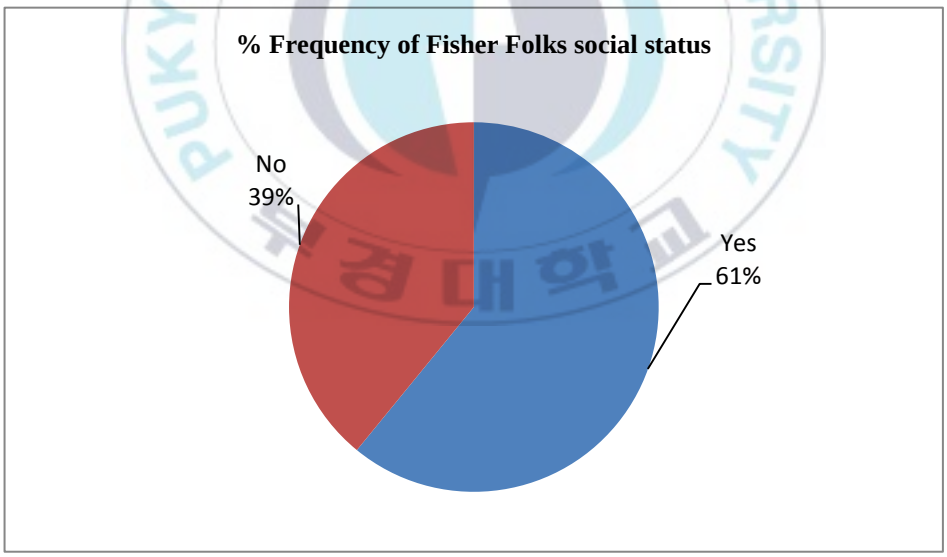

Figure 19: Percentage of the Social Status in the fisheries Community

3.2 **Economic assessment of the fisheries Actors by fish hauled**

Table 5: Classification of the Fish by species and Number of Fishers Hauling the Fish by Species

Scientific name of Species	Number of fishers	Percentage of fishers	Quantity of catch	Percentage of catch
Ilisha africana	17	25.76%	1971	22.81%
Sardinella aurita/maderensis	7	10.61%	1097	12.70%
Pseudotolithus senegalensis	9	13.64%	1080	12.50%
Chloroscombrus chrysurus	8	12.12%	1071	12.40%
Galeoides decadactylus	6	9.09%	800	9.26%
Cheilopogon melanurus	6	9.09%	737	8.53%
Trichiurus lepturus	4	6.06%	644	7.45%
Scomberomorus spp.	4	6.06%	635	7.35%
Sphyraena barracuda/afra	3	4.55%	320	3.70%
Istiophorus albicans	1	1.52%	160	1.85%
Lutjanus goreensis	1	1.52%	125	1.45%
	66	100.00%	8640	100.00%

To calculate the quantity of fish caught and landed and the number of fishers taking part in the fishery, the number of the fisher is used as a substituted or proxy for the fishing effort.

The analysis in (table 5) shows that *llisha africana* was the highest in the catch at 22.81% and caught by 17 fishers representing 25.76%. However, the mean problem of the fish species was the low market price of the fish. The next higher fish species caught are *Sardinella aurita/maderensis,*

Pseudotolithus Spp., and *Chloroscombrus chrysurus* respectively as 12.70%, 12.50%, and 12.40%. *Galeoides decadatctylus, Cheilopogon melanurus, Trichiurus lepturus, Scomberomorus,* and *Sphyraena barracuda/afa* species were the moderate catch. However, *Istiophorus albicans,* and *Lutjanus goreenis* show the lowest in the catch and haul by two individual fishers. Notwithstanding, when comparing the total number of fishermen catching a specific type of fish in the fisheries and the quantity of fish brought at the different community fish landing sites, the result shows that *llisha Africana* was the highest in the total catch. However, this fish species is among the low-value fish species in Liberia and was not the targeted stock but dominated the catch due to the increased in the quantity supply and low market price at the time of the data collection period. The price could even further reduce as long as fishers keep harvesting this type of fish species. The fish species *Sardinella aurita/maderensis, Pseudotolithus, Galeoides decadatctylus,* and *Cheilopogon melanurus* in the catch are among the country valuable fish products. Notwithstanding, the two fish species (*Sardinella* and *Pseudotolitus SS)* are already overfished because they are the most widely caught species in the fishing community. Moreover, the two species are caught by all the fishers in the artisanal fisheries sector both

in the rural and coastal fishing settlement in Liberia and are due to the preference and profit nature of these species.

Figure 20 describes the analysis in (table 5) as it relates to the number of fishers and the quantity of fish landed. The figure clearly showed that *Ilisha Africana* was high in the catch and account for 1971kg. The number of fishers' landing this quantity of catch was 17 while *Istiophorus albicans* and *Lutjanus goreenis* were the least in the catch respectively at 160kg and 125kg and landed by different individuals. The next higher fish species harvested was *Sardinella* at 1097kg and caught by seven fishers. Though nine fishers hauled *pseudotolithus* species, the harvest was a little over that of the fish species *Sardinella* when compare *pseudotolithus Spp* shows the highest in value added from the total sum of the unit income.

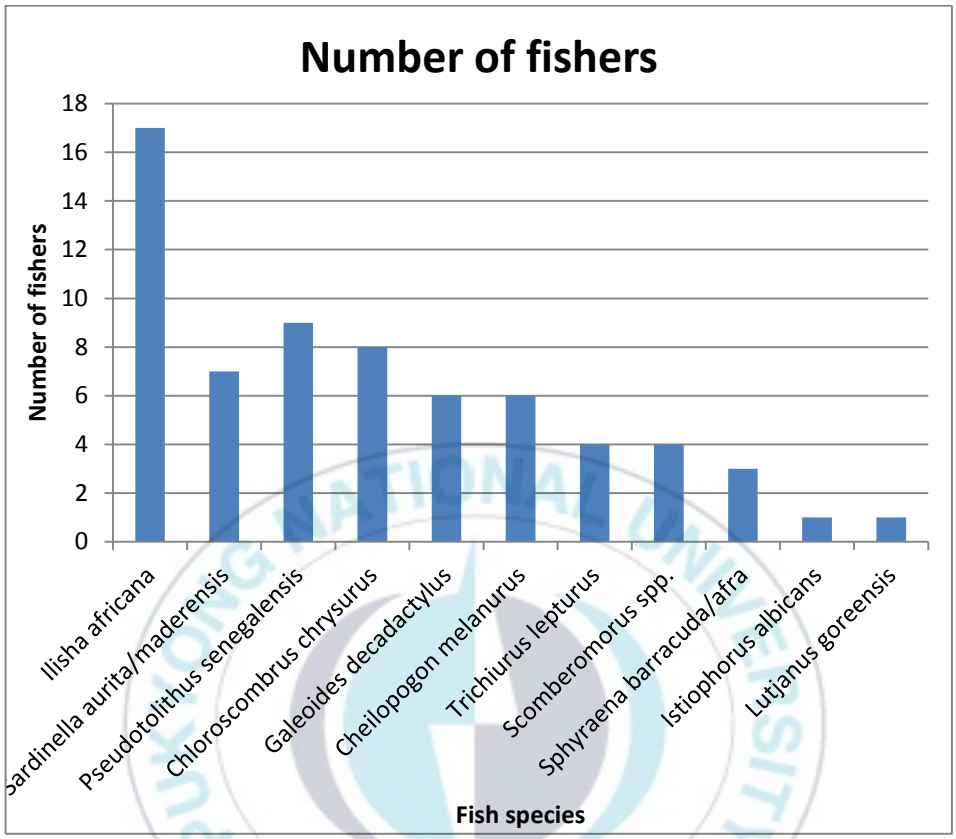

Figure 20: Number of Fishers and Fish Species Hauled during Fishing

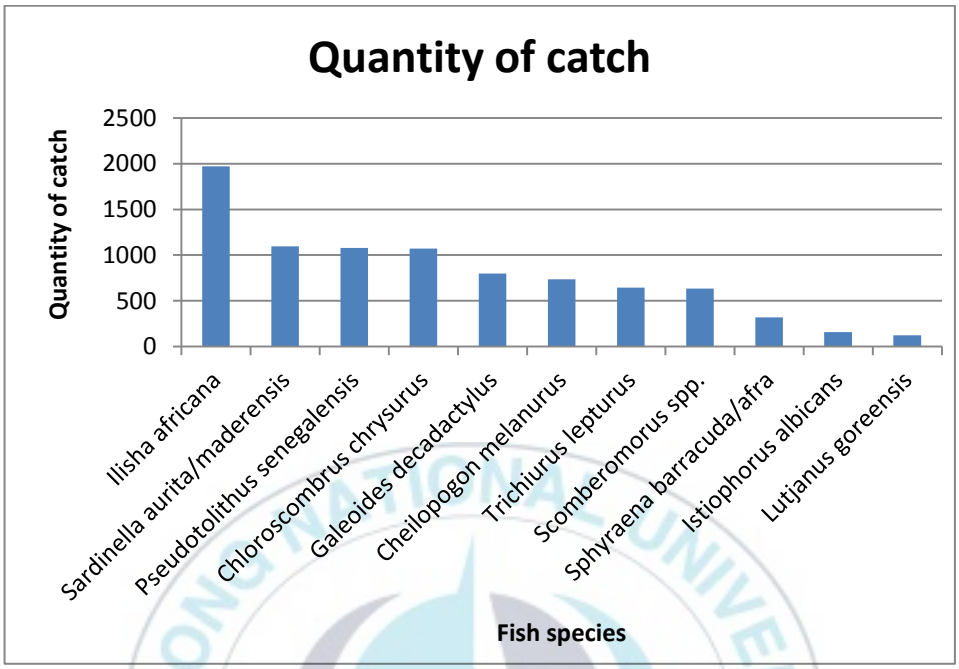

Figure 21: Quantity of Fish Catch and Type of Species

3.2.1 The survey of fishers and gear type used in the fishing community

The participation of the fishers is vital in the fishery activities in the local fishing community. The survey shows that the fishers' involvement in the fishing activities can affect the flow of supply of the fish product for the public consumption for both the local community market and elsewhere in the country.

Table 6: Number of Fishers and Gear type used and Gear type used during Fishing

Gear	Number of fisherman	Percentage
Drift net	42	64%
Set net	15	23%
Hook and line	9	14

The number of fishers and type of gear use are analyzed in (table 6) and (figure 22). The result indicates that drift net was the most widely employed gear (nets) used by the fishers in the local fishery and account for 64% of the fishers. In Liberia, most of the fishers prefer this type of gear in that the gear target the fish species demanded by local consumers in the country. The fish species target mostly includes *Sardinella, Chloroscombrus chrysurus, Cheilopogon melanurus, Ilisha Africana and* others. The next gear type used was the set net and utilized by 23% of the fishers while hook and line gear was utilized by 14% of the fisher and is the least gear type used in fish capture. Usually, the catch of the gear type hook and line is small and Fisher often gets high profit due to

the gear selectivity to ensure the right fish sizes are caught and are of a quality which leads to high market demand and price.

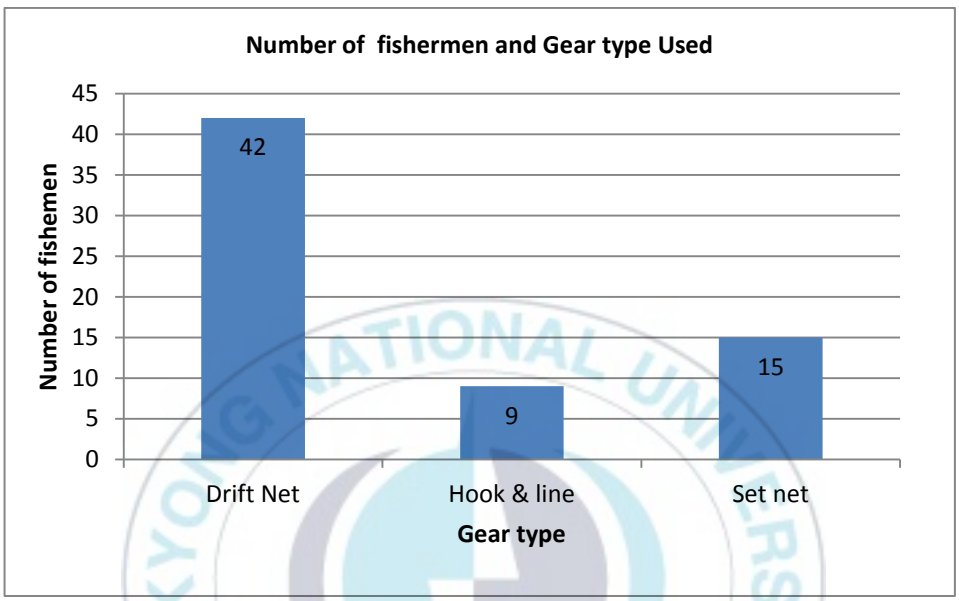

Figure 22: Number of Fishers per the Gear Type Used for Fish Capture

*3.2.2 **Economic assessment of the fisheries Actors***

Table 10 display the fishers' income, cost of fishing, and the value-added of the fish species caught and landed. The estimated total value-added in the unit income per fisher was obtained by using the direct use value method to calculate the fisher income and cost of fishing operation in the US ($) and quantity in kilogram (kg) for all the landed catch.

Table 7: Analysis of the Fishers Income, Cost, and Value-Added from Fish Capture

Scientific name of Species	Income of fishing (US$/kg)	Cost of fishing trip (US$/kg)	Product (fish) Value-added (US$/kg)
Pseudotolithus senegalensis	14.89	3.46	11.43
Ilisha africana	10.86	3.40	7.46
Galeoides decadactylus	8.27	1.98	6.29
Cheilopogon melanurus	7.28	1.70	5.58
Sardinella aurita/maderensis	5.96	1.38	4.58
Sphyraena barracuda/afra	5.62	1.13	4.49
Chloroscombrus chrysurus	5.74	1.71	4.03
Scomberomorus spp.	3.31	0.97	2.34
Lutjanus goreensis	2.65	0.49	2.16
Istiophorus albicans	2.21	0.47	1.74
Trichiurus lepturus	2.21	0.67	1.53

The fishing cost for the fishers in the local fishing community in term of the economic worth of the 11 fish species harvested does not only depend on the market forces of demand and supply of fish caught and landed by fishers. Others influential factor such as the fish processors and traders' play vital roles in the marketing process. Fish processors and traders contribute by enhancing the fish trade to meet the local consumers demand relating to post-harvest issues that have to do with the fish quality. This includes the consumers' taste of fresh smoke fish

product being supply on the local market. The analysis indicates that *Pseudotolithus* species, *Galeoides decadactylus*, and *Cheilopogon melanurus* are the most valuable fish in the catch. The total value-added in unit income of each of the fish species are at US$11.43/kg, US$6.29/kg, and US$5.58/kg correspondingly in term of the high quality and nutritional value. Even though *Ilisha africana* is high in the catch as well and value-added was US$7.46/kg, the species is not a target for the fishers. The increase in the catch valued of *Ilisha africana* are mainly due to the high biomass, the number of fisher landing the catch, the low market price and high demand for the fish species because the fish price is affordable by the local consumer. Moreover, this fish species in Liberia is among the low-value fish species with respect to the consumers' preference when compared to other fish species for consumption. Notwithstanding, the increase in the catch of *Ilisha africana* is a disincentive to the fishers in the local fisheries in that it reduces the income and increase the fishing cost. Not only that the fish species reduce the fishers' income but also require a lot of energy since the fishers are using traditional methods and equipment for fishing. In the (table 7), the fish species *Sardinella aurita/maderensis*, *Chloroscombrus chrysurus*, and *Sphyraena barracuda/afra* are in

moderate catch range and prized at US$4.58/kg, US$4.49/kg, and US$4.03/kg while *Scomberomorus spp, Lutjanus goreensis, Istiophorus albican,* and *Trichiuris lepturus* are the least in the catch quantity and value-added.

3.2.3 ***Relationship between the Cost and Income (Value-added) of fishers***

Table 8 displayed the relationship between the total unit cost and Value-added from income (US$/kg) per fish species harvested. In the (table 8), the correlation coefficient of 0.9421 indicates that there is a direct relationship between the total unit cost of fishing and value-added and the relationship is positive. The implication is that the fishers' income and cost of fishing are increasing and is due to the high market demand and price for some of the fish species both locally and internationally thereby resulting into increase in the cost of fishing. Therefore, fishers target the high-value fish species because of the high market demand and price. This implied that the higher the income of fishing the high-value fish species, the higher the cost of fishing on the harvest and is shown in (table 8). For instance, the species *Pseudotolithus* is among the most valuable fish species caught and is the highest in the catch. The fish

species was 12.50% of the fishers total landed catch and the total unit income in value-added was US$11.43/kg. Although there is increased in the income of the fishers targeting the high-value fish species, such as *Pseudotolithus and Sardinella aurita/maderensis Spp* there is pressured on the fish stock due to overfishing.

Table8: Analysis of the Correlation Coefficient between the Fishers Income and Cost

Scientific name of species	Cost (US$/kg)	Value-added (US$)/kg	Correlation Coefficient
Pseudotolithus senegalensis	3.46	11.43	
Ilisha africana	3.40	7.46	
Galeoides decadactylus	1.98	6.29	
Cheilopogon melanurus	1.70	5.58	
Sardinella aurita/maderensis	1.38	4.58	0.9421
Sphyraena barracuda/afra	1.13	4.49	
Chloroscombrus chrysurus	1.71	4.03	
Scomberomorus spp.	0.97	2.34	
Lutjanus goreensis	0.49	2.16	
Istiophorus albicans?	0.47	1.74	
Trichiurus lepturus	0.67	1.53	

The correlation coefficient of the fishers income and cost relationship of the total fish species harvested is 0.9421 and shows a strong positive relationship. However, the t value of 8.4303 obtained for the correlation coefficient is from the relationship between the income and cost of fishing for all the fish species haul and the t critical at 5 percent and 9

degrees of freedom is 2.262. To this note, the study result shows that the observed positive correlation between the total value-added from the income and total cost of fishing operation relative to the total fish species caught was statistically significant. This is because the t value obtained is greater than the t critical value of 5 percent confidence interval.

Table 9: The Relationship between Cost and Income per Fish Species Hauled

Relationship between Cost and Income per Fish Species Hauled						
Fish species	Correlation Coefficient of cost/income analysis	T obtained	P value	T critical	Degree of Freedom	confidence interval
Pseudotolithus Spp.	0.7838	3.339	0.0000004	2.365	7	
Galeoides decadactylus	0.8191	2.856	0.00085	2.776	4	
Cheilopogon melanurus	0.8046	3.053	0.00013	2.776	4	
Sardinella aurita/maderensis	0.76	2.615	0.0022	2.571	5	5%
Sphyraena barracuda/afra	0.9983	17.3	0.006	12.706	1	
Chloroscombrus chrysurus	-0.9504	7.482	0.000038	2.447	6	
Ilisha africana	-0.722	4.042	0.00000027	2.131	15	
Scomberomorus spp.	0.9618	4.967	0.0012	4.4303	2	
Trichiurus lepturus	0.9712	5.774	0.00017	4.303	2	

Table 9 shows the cost and income correlations of fishers. There exist positive correlations between the total cost of fishing and income for

individual fishers. There is positive correlation in seven fish species out of 11 of the sampled species in the study area. These species include *Pseudotolithus Spp., Galeoides decadactylus, Cheilopogon melanurus,* S*ardinia aurita/maderensis,* S*phyraena barracuda/afra, Scomberomorus* spp, and T*richiuris lepturus*. The incentive is consumers' willingness to pay for more for the landed fish species, although the price is high. However, there is also dissimilarity in the correlation of the income of fishers and the cost fishing. This is observed in two sample fish species namely *Ilisha africana and* C*hloroscombrus chrysurus* at -0.7220 and -0.9504 respectively. This suggests that the income of the individual fishers' decreases while the cost of fishing increases. The decrease in the fishers' income is due to the low price of the fish species and the increase in the quantity supply at the market because of high harvest. The increase in the harvest is attributed to the higher biomass of the two fish species. Moreover, the intensification in the catch of low-value fish species will furthermore decrease the fishers' income even more if harvest is increased. The high values obtained in the quantity for the two fish species are from the cumulative catch of the individuals' fisher landing the fish (table 9). The high quantity is because of high biomass

and the increase in the quantity demanded by the consumers since the market price of the fish species is affordable.

*3.2.4 **Identification of issues of livelihood situation***

Table 10: Expenditure of the Fishers

Expenditure of fishers		
Fishers Expenditure	Freq	Percentage
FISHING materials, Feeding & school fees	33	50%
Fishing materials, Feeding, Medical & school fees	9	14%
Rent, Fishing materials, Feeding & school fees	24	36%

Characteristically, the table10 shows that the fishers' priority for expenditure in the fisheries toward fishing materials, feeding & school fees and account for 50%. Those fishers that do not have their own shelter and have to pay rent, fishing material, feeding and school fees is 24%. The fishers that making expenditure on medical cares, fishing materials, feeding and school fees account for 14% on income spending and is the least expenditure category among the fishers.

3.2.5 ***Livelihood problems encountered by fishers during fishing and impacts***

Figure 23 displays the problems encountered by the fishers during fishing in order to enhance their livelihood. In the pie chart, the survey analysis indicates that bulk of the fishers in the local fishing venture are affected by bad weather and result to different situations that would lead to the fisher losing properties such as (damage to canoe, loss of nets and gears, or loss of catch). The result points out that loss of nets and damage to canoe are the major problem faced by the fishers when fishing and represent 44% of the respondents. The loss of catch and nets account for the 23% of the fishing problems encounter by the fishers during the fishing time and is not common among the fishers.

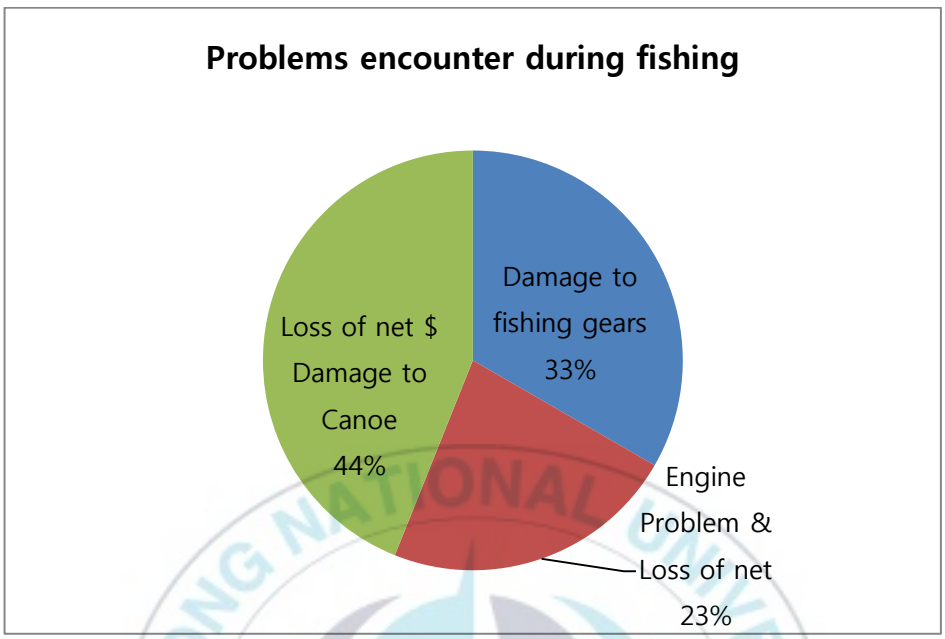

Figure 23: Distribution of problems encountered during fishing.

Moreover, the result of the study also reveals that all the fishers have had some declined in their catches. This is due to the availability of the fish for harvest, bad weather condition, the seasonality of fishing, holding time and others. Additionally, no fishers in the fisheries carry ice on board in order to preserve the catch during the fishing time. This is a poor fishing practice and can contribute to the poor quality of the fish products harvested. If the holding time of the catch on board during fishing is long can affect the fish quality and lead to post-harvest losses

thereby reducing the fishers' income. This frequent practice in the fishing community has the tendency to affect the fishers' livelihood.

Figure24 shows how desperate the fishing community has been endangered by the sea encroachment on the fishing community. The sea encroachment leads to undermining of the land area and is one of the major problems facing the fishing community. The causes of the situation are due to sea level rise, sea erosion, and flooding. The situation destroyed home and properties of the fisheries actors such as fishing equipment, processing facilities, and the marketplace. Not only the destruction of homes and properties but lead to the displacement of the community dwellers.

Figure 24: The Effect of Climate Change on Infrastructure in the Fishing Community

Figure 25: Effects of Climate Change on the Infrastructure in the Fishing Community

The pictorials view of the livelihood activities of the fishing community (figure 26). The fish landing site when fishing weather is favorable. During bad weather, the landing site becomes so dangerous and indicates that the fishers and their inhabitants, and properties (canoes and homes) are affected. The canoes are ever washed away by the sea erosion and destroy seriously.

Figure 26: Pictorial view of the main Fish Landing Site

Figure 27: Fish Processors and Traders awaiting the Fishers arrival from Fishing

The pictorial view of the fish processors and traders awaits the fis hers' arrival with the catch. If the waiting time is long, there can be some serious problems both to the fisherand the processors. Mo reover, the fish products bought by the fish processor immediately start to spoil as the holding time increase and affect the overall q uality of the fish product for marking as appetizing fish.

Figure 28: The Landing Site and Bad Weather

Figure 28; display the fish landing under bad weather and the negative effect on the fishing community. Fishers are in desperate need of better infrastructure such as jetty for landing their catch. This can only be possible if the fishers and government can work to seek environmental impact solution that would lead to the long-term protection of the coastal fishing community.

Figure 29: Net Mending by Fisher for the next Fishing Trip

Figure 29 shows the pictorial view of the fisher seen mending his drift net for the next fishing trip. This gear type is the most common fishing gear used in the fishing community. The drift fishing net is set with a number of floaters. The opening and closing point during fishing can trap the fish so long the fish enter the gear the fish cannot lead the net.

Figure 30: Coastal Defense Project

Figure 30 shows the improvement in the fishing community as a result of the benefit received from the coastal defense project initiated by the current Government of Liberia. The project is to rescues the entire fishing community and the Borough of New Kru Town. Most especially, the project would protect the only high school in the fishing community in the Borough of New Kru Town.

*3.2.6 **Analysis of the Livelihood Activities of Fish Processors and Traders***

Figure 31 categorized the livelihood activities in the fishing community by the percentage based on the different fisheries activities undertaking.

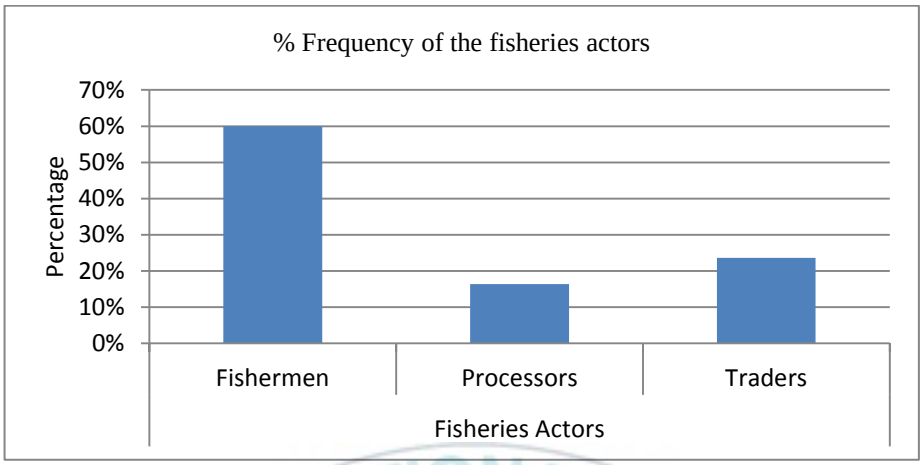

Figure 31: Distribution of the Fisheries Actors

The fish processors and traders livelihood activities in the artisanal fisheries depend on their competences, the resources, and the enabling environment to sustain their mean of existing. The survey in term of occupation, the fisheries actors are classified as fishers, processors, and traders. The fishers represent 60% while the processors and traders are 16% and 24% of the entire sample of the population in the study area. The 16% represents the woman participation as the processors in the fishing community. The fish traders comprise of both the women and men. The sixty percent are men and represents the fishers only in the total sample of the population. Though the women representation is less than the male counterpart in gender balance when compared nevertheless, the women played major roles in the livelihood sustainability. The major

roles played are as processors involve add-value through processing, trader, pre-finance the fishing activities, generate income, and can be a boat or canoe owner. The research result is of no different from other comparable studies that the marginalization of women is real and is in term of the gender balance and equity in the fisheries livelihood activities. The marginalization includes but not limited to the inadequate access to the social-economic, cultural, and political participation in the decision-making process of the management of the fisheries resources, profitable venture in the marketing of the fisheries products due to the livelihood challenges. The challenges include housekeeping, reproductive role, and childcare.

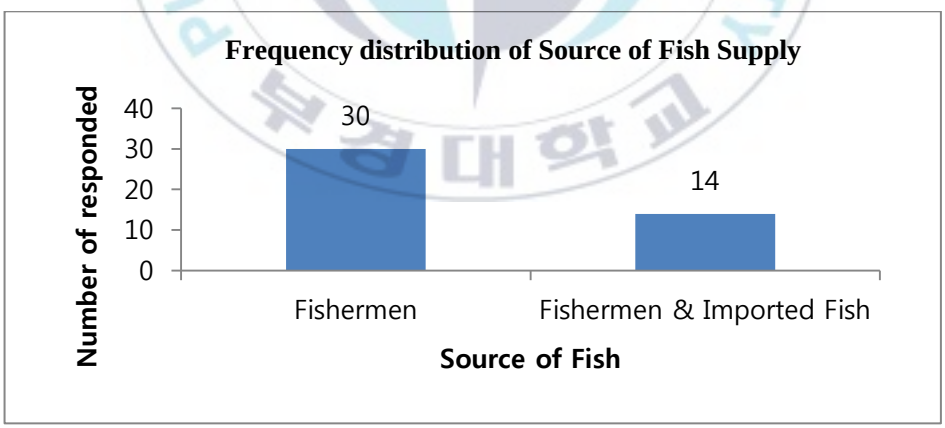

Figure 32: Sources of Fish Product for Marketing

Figure 32 and 33 shows the sources of fish product and reveals that 30 of the fish processors get their fish products from the fishermen and

represent 68%. This implied that the bulk of the fish products for smoking are from the fresh fish harvested by the fishermen and give the desired quality for good taste.

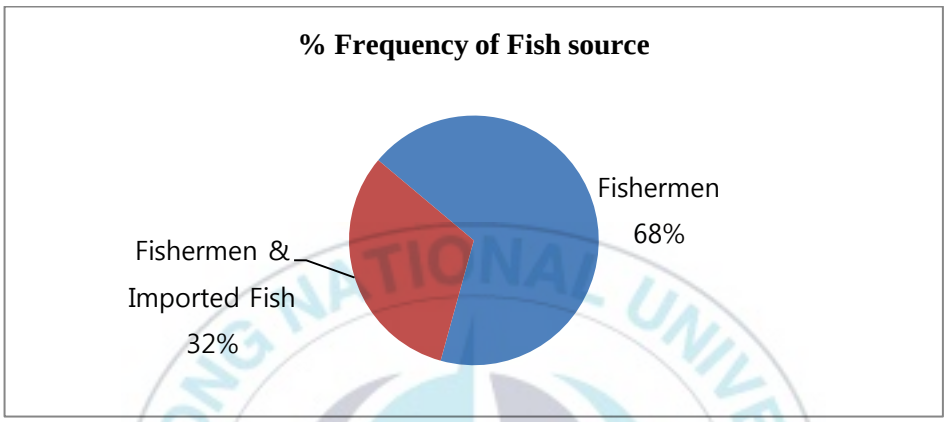

Figure 33: Percentage of Fish Source by the Processors and Traders

Moreover, during the good fishing seasoning, the fish processors and traders get fish from the fishers and during the lean season, the fish processors obtained fish from the fish importer. The fish importers and fishermen together represent 32% in fish supply. The fish processor and traders experience this during the poor fishing period due to bad weather as a result of climate change.

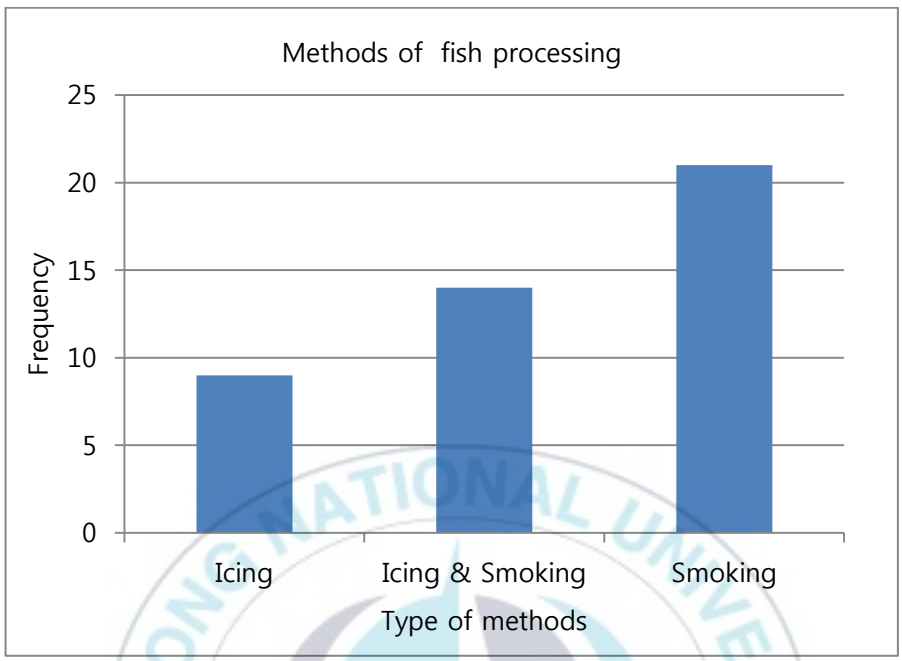

Figure 34: Preservation Methods in the Fishing Community

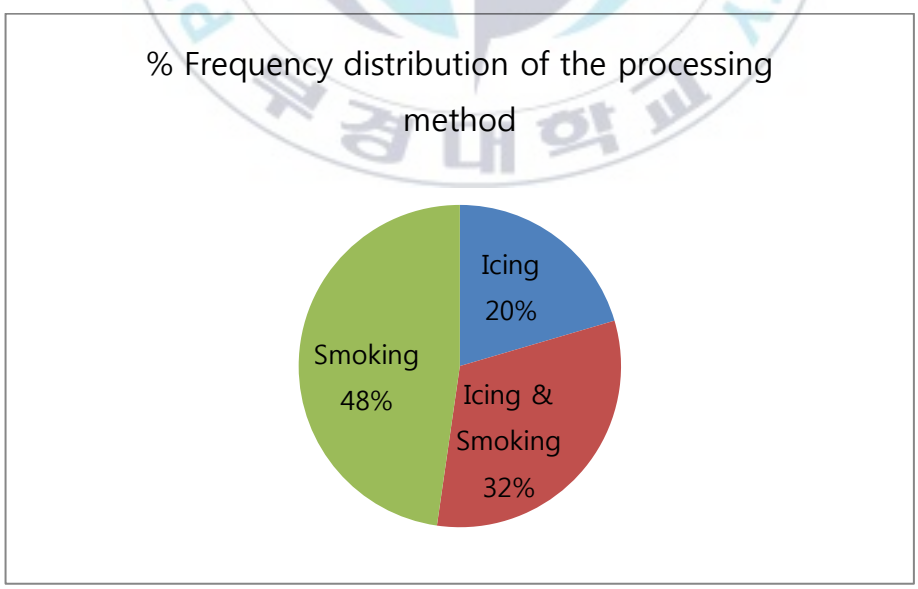

Figure 35: Percent Distribution of the Type of Methods

The analysis in (figure 35) indicates that the most popular method of fish preservation in the artisanal fishing community is smoking and account for 48%. The next method is by both icing and smoking and represents 32% while the least used method is icing representing 20%. The used of icing as a preservation method is the least due to the high cost of the ice and transportation, the poor quality of the water used for producing the ice, availabilities of ice and the high price of the cooling boxes for preservation. The fish smoking method of preservation is highly preferred by the processors due to the low cost of the processing materials used, profitability when value-added to the fish products, the fish quality, as well as the keeping time of the fish product after smoking for marketing. Moreover, most of the fish processors preferred smoking method due to the lack of fish freezing equipment and storage facility especially when there are unsold fish products. Over the long period, this method has been in existence and known to the fish processors as the best preservation method in the fishing community. The smoking method is traditional and involves the use of the old drum as the key equipment for fish processing.

The percent frequency of the fish processors and the type of fish traded.

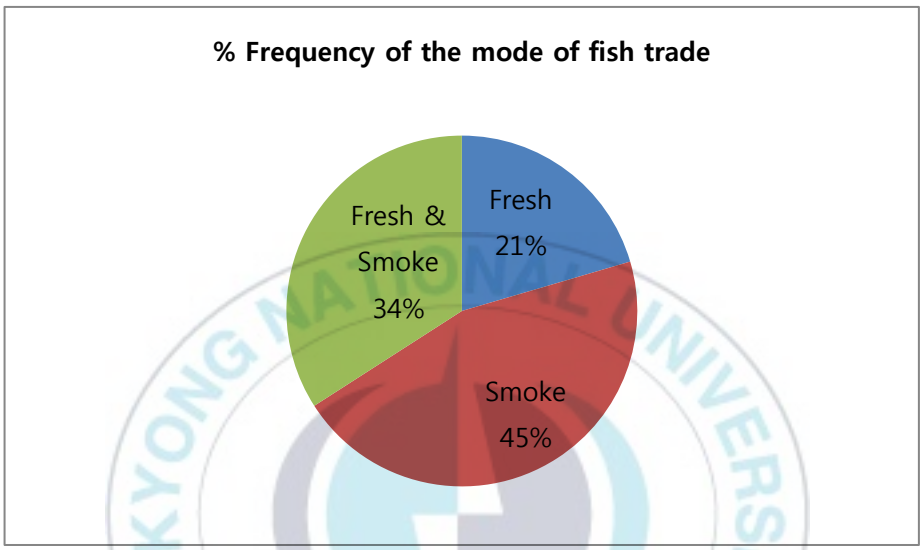

Figure 36: Mode of Fish Traded

Smoke fish is the most preferred fish type traded accounting for 45% and followed by fresh and smoked fish comprising 34% while selling fresh is the least mode in fish trade in the study area and account for 21% in trade.

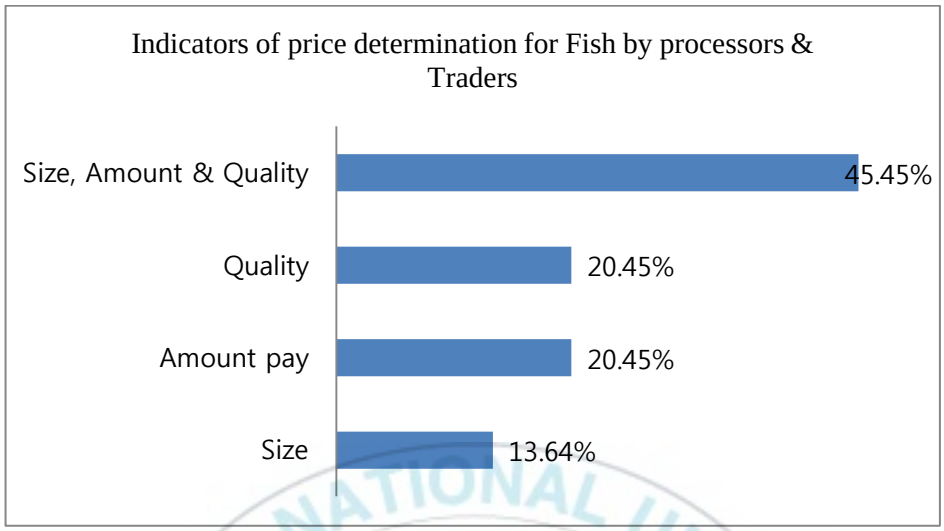

Figure 37: How the Processors and Traders Determine the Price of Fish

Most of the fish processors and traders agreed that the price of their fish products is determined by the size, amount pay and quality of the fish. This represents 45.45% of the respondents and is indeed a good judgment to ensure good marketing practice.

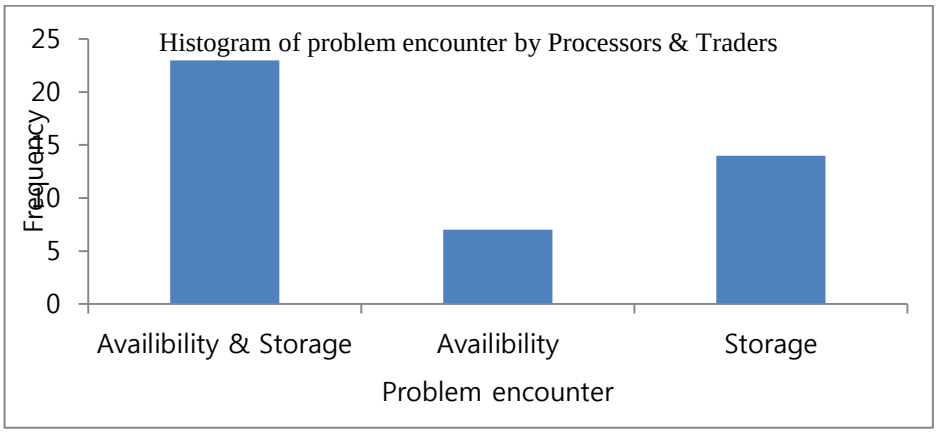

Figure 38: Problems Experience among the Fish Processors and Traders

Figure 38 displays the problems experience among the fish processors and traders. The fish processors and traders have held some form of a decline in fish supply as a result of the availability, storage, and in both of the problem among the local fish processors and traders. The major problem experienced by the processor and traders is the availability and storage and represents 52% among in the post-harvest sector.

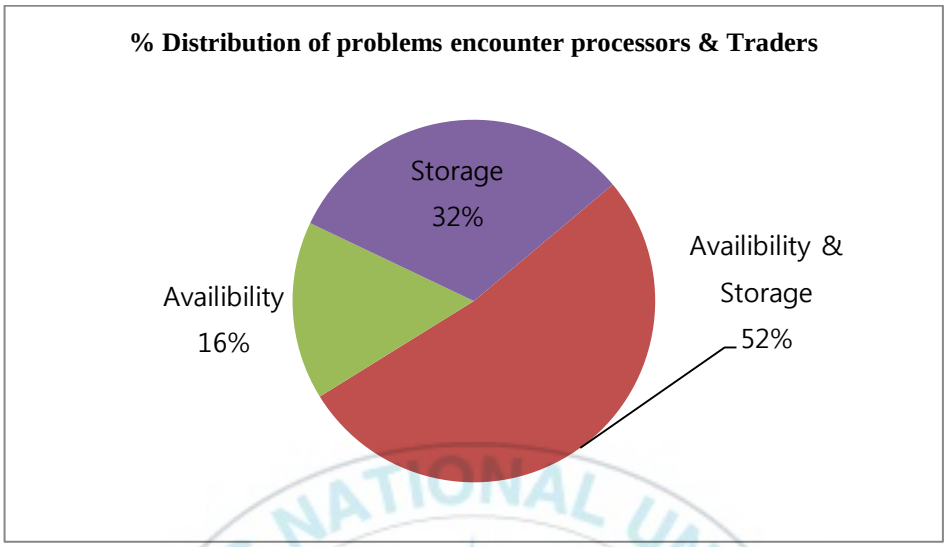

Figure 39: Percentage of the Problems Experience by Fish Process and Traders

This suggests that the fish supply to the processors and traders depend on the fishers abilities to catch more fish. There limited supply of fish by the due to the use of low fishing technology in the artisanal fisheries. During bad weather, the fishers are unable to conduct fishing activities because of the inappropriate fishing equipment used for catching fish. Besides, the processors and traders find it difficult to preserve the surplus during good fishing season and result into a wastage in the utilization of the fisheries products. This is because the coastal communities lack cold-storage facilities and is a common characteristic in most of the fishing communities along the coast of Liberia.

The main medium of transporting fish products to the point of destination is by the commercial car. Of the 44 fish processors and traders, 63.64 % agree to the use of a commercial car to convey their products to the marketplaces. 36.36% of the fish processors and traders walk to the marketplace to transact the fish products.

Fresh Fish Market at the Landing Site in the Fishing Community

Figure 40 shows the fish processors and traders awaiting the fishers to land their catches. Some of the traders buy the fresh fish and sell the fish to consumers that come at the landing site to buy freshly harvested fish for their daily used.

Figure 40: Fresh Fish Market at the Landing
Fish Processing Facility in the part of the fishing community

Figure 41: Processing Facility with Smoke Fish

Figure 41 displays a good quality fish being processed by the fish mongers but the processing equipment is traditional and remote in nature. This can leads to health problem as a result of the low quality of the equipment used for processing the fish product. Figure 42 illustrates the poor sanitary nature of the environment and processing materials used by the processors. Though the fish product shows the desire color and quality there is a serious sanitary implication about the fish quality. There is poor health hazard of the fish processors due amount of heat and smoke intake by the fish processors. This is a long-term health effect on the processors as they inhale the smoke.

Figure 42: Processing Facility with Smoke Fish

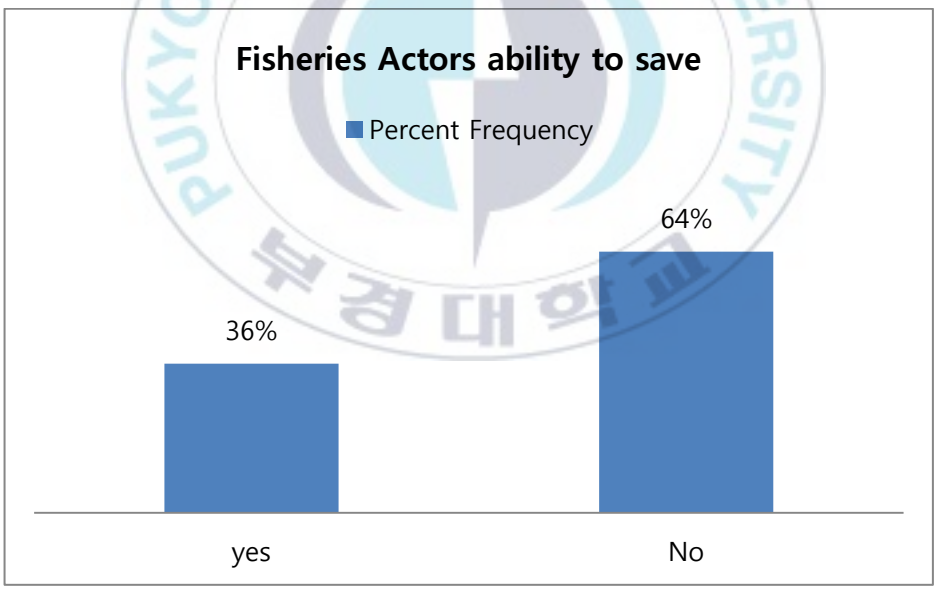

Figure 43: The Saving Nature of the fisheries Actors

Figure 42 shows that 64% of the fisheries actors admitted that they cannot afford to save from their income generated while 36% of them agree to save a portion of their income. This is not a sustainable fishery to ensure livelihood activities.

3.2.7 ***Livelihood problems face by the fisheries actors***

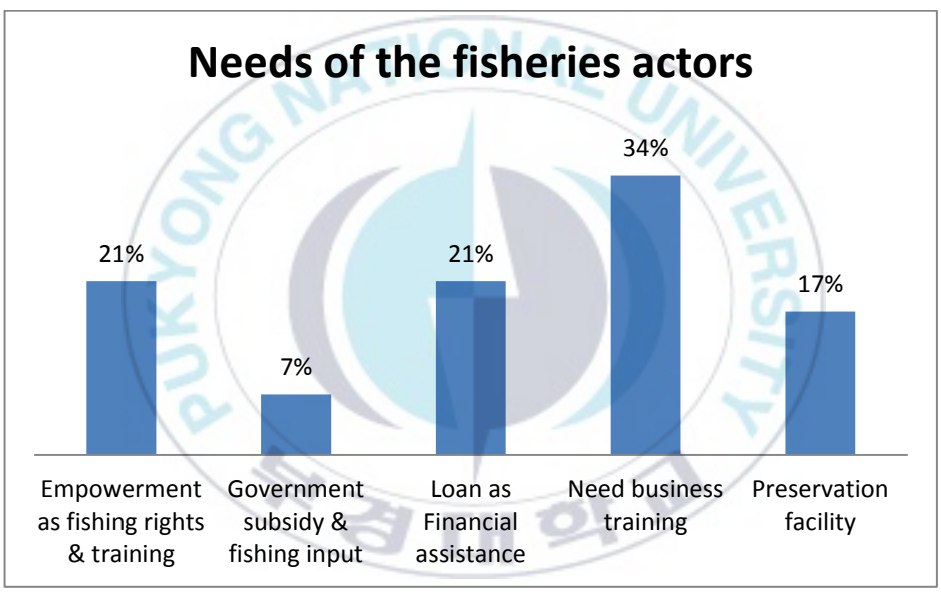

Figure 44: Need of the fisheries actors

The analysis in figure 44 shows the different type of constraint faced by the fisheries actors. The main constraint facing the fisheries actors is the need business training and represents 34%; follow by loan as financial assistance and account for 21%; next is empowerment as fishing rights

and training and accounting for 21% of the total fisheries actors sample in the study area. The least of the problem experienced in the fishing community among the fisheries actors is the government subsidy and fishing input accounting for 7%. These constraints bring about economic pressure for sustainable livelihood activities.

4 Discussion

The analyses conform to the objectives of the study. There are three main objectives of the study. The first objective of the study is to scrutinize the demographic and social-economic characteristics of the fisheries actors and the impacts the of fishing among the actors in the artisanal fisheries community of Popoh Beach, Point 4, New Kru Town in Liberia. The result of the study indicated that fishing is the main livelihood activity of the community dwellers based on the demographic indicators (sex, age, marital status, household size, education, year of fishing, and social affiliation) among the fisheries actors. The demographic components include the fishers, fish processors, and traders in the study area. The demographic profiles showed that 60% of the fisheries actors interviewed are male and the female participants are 40%.

The active fishing age range was between 36-40 years and made up 30.91% of all ages in the sample size of 110 fisheries actors interviewed in the study area. The female participants of 40% are actively involved in the post-harvest sector taking up various responsibilities in the fishery as compared to their male co-worker. The responsibility roles played by the women include fish processing, trader, pre-financing the fishing venture, generating income, boat or canoe owner as well as the housekeeper, reproductive role, and childcare. The fishers in the fishing community have a maximum of 10-14 years of fishing experience and account for 46.97% of the fisheries actors. This leads to fishers providing excellent information relating to the fishing history to support productive labor force and aid fisheries managers to make beneficial management decision about the fishery to be sustainable. The social and cultural responsibility reveals that the marital status of the household is high among the fisheries actors and represents 68.82% with an average depended or family size of 5.83. This type of natural phenomena in the characteristics of the fisheries actors' as having an extended family type is prevalent among the actors and have the tendency of putting a direct economic effect on the fish stock. However, the pre-judgment that most artisanal fisheries actors lack education is contrary in this fishing

community in that 74% of those undertaking fisheries activities have some formal educational status. Although, the previous study have shown that there had been weak human capital in all the nine coastal counties including the study area (Moustapha Kebe el al, 2009). The research study has shown that there is great potential among the fisheries actor in-term of the human capital. The human capital examines in the sample of the population with respect to the demographic classification showed that there is high perspective in education and highly productive labor force among the fisheries actors in the fishing community. Though the fishers are using low fishing technologies and methods as well as the fish processing methods being traditional and lack modern technologies to enhance the reduction of high post-harvest losses experience in the fishing community are disadvantages to sustainable livelihood activities.

The second objective of the research is to identify the economic factors and how these factors affect the welfare of the fisheries actors. This has to do with each fisher's production, the fish processor and traders as it relates to post-harvest issues (preservation and processing) and the marketing of the fish produced. The study result reveals that there exist variations in the fish production by each individual fisher to the fish species haul. In the analysis (table5), the number of fishers was used as a

proxy of the fishing effort to determine the quantity of fish caught and supply to the market. The fish species *llisha africana* was the highest in the catch at 22.81% and hauled by 25.76% of the total fishers (table5). The value-added for this species was US$ 7.46/kg (table7). The high percentages of 22.81% and 25.76% were obtained by the number of fishers and the amount of fish caught. The next fish species in high quantity was *Sardinella aurita/maderensis* at 12.70% of the total haul with 10.61% of the fisher's (table5). The next higher catch in production was the fish species *Pseudotolithus* with 12.50% of the total catch and hauled by 13.64% of the fishers (table5). The value-added for *Pseudotolithus* Species was US$ 11.43/kg (table7) and is the highest in the value-added among the total fish harvested in the study area.

Although the number of fishers hauling *Pseudotolithus* was higher than that of *Sardinella aurita/maderensis species,* the catch percentage for the fish species *Sardinella aurita/maderensis* was almost the same as *Pseudotolithus species.* Lastly, next the fish species is *Chloroscombrus chrysurus* and represent 12.40% of the total catch with 12.12% of the fishers hauling the fish (Table 5). Notwithstanding, there were five fish species in the result that show moderate in catch and number of fisher comparing to the two fish species which were the least in harvest and

caught by two individual fishers (table 5). The five moderate fish species are *Galeoides decadactylus, Cheilogon melanurus, Trichiurus lepturus, Scomberomorus,* and *Sphyraena barracuda/afra* while the two least fish species are Istiophorus albicans and Latjanus goreensis.

The correlation between the value-added and cost of fishing was obtained using the regression analysis. The result shows the correlation coefficient of 0.9421 indicates that there exists a strong positive correlation between the value-added and cost of fishing (table8). The test for the significance of the correlation coefficient observed was 8.4303 and implied that there exists statistical significance because the observed t value of 8.4303 was greater than the t critical value of 2.262 at 5% and 9 degrees of freedom.

To understand fully what was unfolding in the fisheries, the correlation between the total sum of the value-added from the income of each individual fisher and the cost of fishing per the fish species haul was investigated (table9). The result shows positive correlations between the total value-added and cost of fishing for seven fish species harvested. The fish species include *Pseudotolithus Spp., Galeoides decadactylus, Cheilopogon melanurus,* S*ardinia aurita/maderensis,* S*phyraena barracuda/afra, Scomberomorus* spp, and T*richiuris lepturus* (table 9).

The relationship implied that the high the income gained from the price of the fish, the higher the cost of fishing. The good side is that the consumers are in readiness to pay more for the fish due to nutritional value of these fish species.

However, there was variation in two fish species that show a negative correlation in the income and cost of fishers. The two fish species are *lisha africana and* C*hloroscombrus chrysurus* (table 9). This indicates that the income of the individual fishers decreases as the cost for fishing the two species increases. The increase in the harvest is a result of the higher biomass of the two fish species. The economic implication is that the low price of these fish species cannot offset the cost of fishing and would even further decrease if the fishers continue the harvest of the fish species. The species are incentives for the consumers because of the low price which is affordable for the consumers to buy and is a disincentive to the fishers harvesting the species in the fisheries in that the fishers can offset their cost of fishing neither can they get profit in the fishing business.

Though seven fish species show the positive correlation coefficient in the value-added from the income and cost of fishing for nine fish species instigated, the species *Pseudotolithus* and S*ardinia aurita/maderensis* in

the Liberian fisheries have shown overfishing in their biomass. This is a direct result in the low harvest of the species *Pseudotolithus* and S*ardinia aurita/maderensis* in the artisanal fishing community (table 5). The species S*ardinia maderensis* is at its exploitation rate at the maximum sustainable yield (MSY) and experiencing overfishing before the full growth in the Liberia fisheries (Wehye AS, et al, 2017). Furthermore, his research on the fish population status of commercially important fish species in Liberia, the species *Pseudotolithus senegalensis* and *typus* are overexploited at the MSY level. He mentions that the increase in exports to the Asian market is due to the doubling in prices of these two important fish species. Similarly, it is reported that *Pseudotolithus Spp, and Sardinella maderensis and aurita* are overexploited in Liberia (MRAG, 2010).

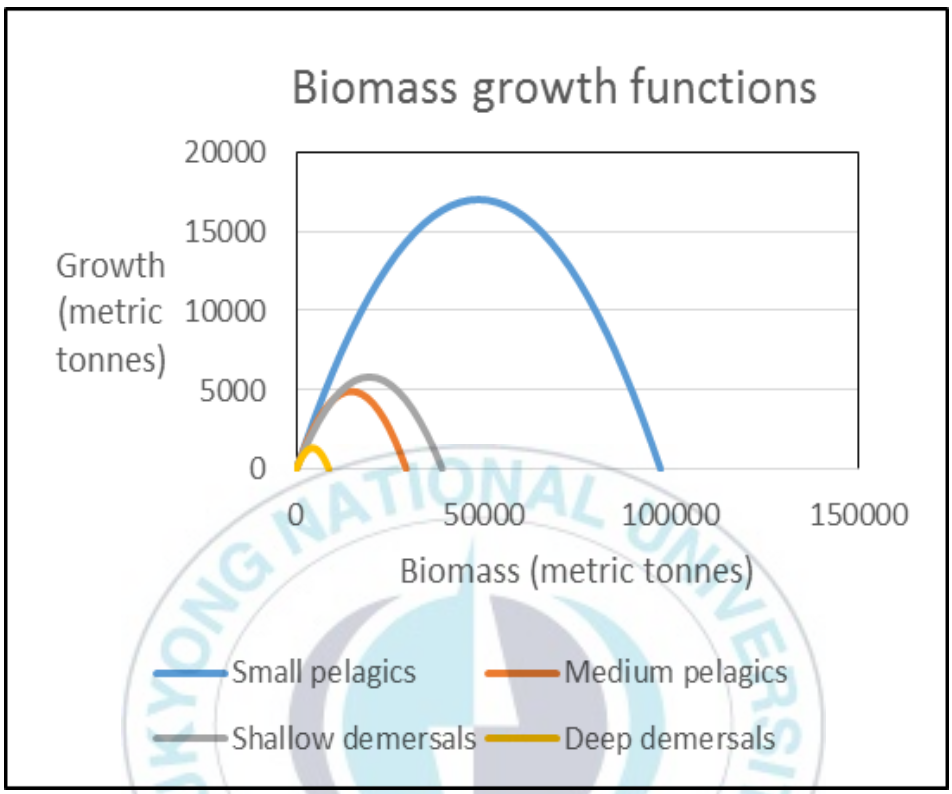

Figure 45: Fish Biomass of different fish stock. Source: MRAG and NAFAA Unpublished Data 2014

Figure 45 shows the biomass of the different fish stock harvested by the artisanal fishers. The graph indicates that the biomass of the small pelagic fish is high and need to be fished sustainably in the Liberian fisheries. The small pelagic fish stock includes the two fish species *lisha africana and* C*hloroscombrus chrysurus* discuss in the study area. The biomass of the medium pelagic fish stock show small biomass size and this is an indication that the fish stock is overfished this includes species

Sardinella maderensis and aurita (figure 45). Likewise, the small biomass size of the shallow demersal show an overfished fish stock and the species *Pseudotolithus* is inclusive. These situations are also shown in (figure 46) which displays the harvest function of the different stock biomass. The shallow demersal species show high harvest by the Kru canoe/vessel and less harvest in the biomass of the small pelagic stock (figure 46).

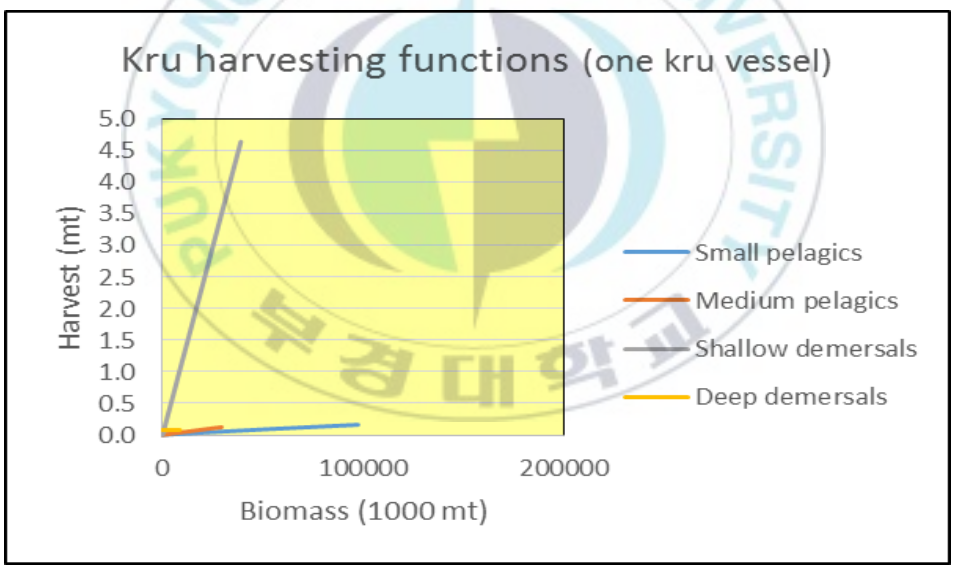

Figure 46: Kru Harvest Function (one kru vessel). Source: MRAG and NaFAA Unpublished Data

The fact that most research studies on the above fish species have shown overexploitation, some measures to reduce overfishing considerably is

important. Not only reducing overfishing in the harvest of high-value fish stock, but measures to promote the harvesting of the low-value fish species is also important through export strategies. This will lead to an increase in the income of the fishers harvesting the low-valued fishes sustainably to reduction fishing pressure on the high-value fish stock. Therefore, management measures are needed to improve the livelihood situations in all the fishing communities including the research area in Liberia.

In view of the ongoing situations in this fishing community, the profitability of the fishing activities with respect to fishers' cost and income, require the sustainable production of the fisheries resources. This is because some important fish stocks mentioned above have decreased in catch while others stocks have shown an increase in catch but low in income because the species are low-value fish. In so doing, any management measures taken must involve the collaboration between the fisheries authority and community stakeholders' in an effort to administer sustainable management regimes.

The technical measures are achievable in a number of ways but not limited to the below:

- Effort control to reduce overfishing of the high-value stock; this is where the fisheries management should control fishing effort in the fishery of the high-value fish stock and promote fishing of the higher biomass fish stock sustainably. This way the fishers would have the choice to increase the catch of low-value fish if there are economic incentives that will lead to an increase in the income of the fishers and ensure the food security needs.

- Modification of the gear type used in fish capture that has to do with the mesh size control.

- Rebuild those fish stocks that are overexploited and maintain the stocks at the Maximum Sustainable Yield (MSY) and harvest at the Maximum Economic Yield level in the fisheries (MEY) since the fisheries sector in Liberia aim is to increase fish production sustainably in the artisanal fishery toward the local fishers livelihoods activities.

The graphs below show how fish stock rebuilding path works (figure 47).

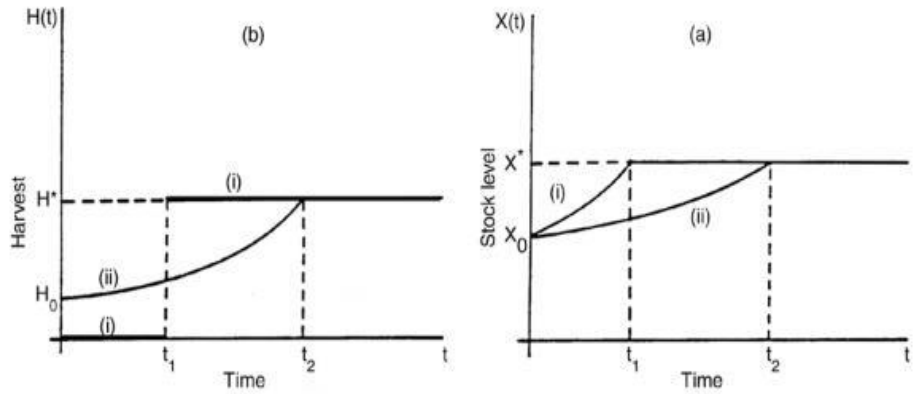

Figure 47: Rebuilding an overfished stock Source: (Ola Flaaten, 2016).

Figure 46 shows how the fish stock rebuilding path works. There are two options for rebuilding the fish stock when the stock is overfished. The first option mark at t_1 in (figure 47) shows no fishing adjustment path but to close the fisheries completely (on the left) for the stock to rebuild on the right speedily up to X* and then harvest is allowed at the optimal stock level H*. The first option implied that fishers' are going to be out of the fishing business and would impose severe social-economic stress on the fishers and community dwellers while rebuilding the fish stocks. Therefore, the second option is preferable for the fisheries in that, the option embraces the adjustment path for slower recovery but allow some fishing while the stock is rebuilding from H_o until the optimal level of

H* is reached and then harvest is allowed in the fisheries. This suggests that with small harvest the fishers receive higher price and recovered their cost of fishing with some profit incentives from the sale of high-valued fish species.

Notwithstanding, in order to increase the fishers income toward the production of the low-valued fish species, fisheries managers need to embrace the best management practice. This is where the fisheries authority should work closely in collaboration with the stakeholders and fishers to ensure export strategies for trade in low-value fish species. The above management measures if initiated can positively enhance the fisheries sector. The measures would improve the fishers' long-term fish production and generate more income for the fishers in the fishing community.

The third objective of the research is to make recommendations on policy issues to help fisheries managers and stakeholders to improve the livelihood of the fisheries actors in the coastal fishing community for growth in sustainable fishing activities. This portion of the work is being discussed in the conclusion and recommendations of the study paper.

5 Conclusions and Recommendations

To conclude, the artisanal fishery of the coastal fishing community of Popoh Beach Point 4, New Kru Town embraces exceptional perspective among the fisheries actors in term of the livelihood resources. Besides, the research indicated that fishing is important and is the mean livelihood source for the community dwellers. Though there are potential in both human and natural capital, the fishery is not sustainable because of poor management (top to bottom approach system) in the utilization of the fisheries resources and poor economic performance. These difficulties have hindered the full realization to grasp the long-term sustainability of the fisheries in the study area. Therefore, the national government, international partners, stakeholders, and the fisheries actors need collaboration to considerably improve the livelihood situations.

Moreover, to overwhelm the current situations encounter in the urban fishing community, the subsequent recommendations are propounded.

1. Subsidy the fishery through micro-financial loan will reasonable interest;

2. Institutional and capacity building (maintain fishing community in the decision-making process, infrastructural development, and small business management);
3. Apply market-based policy or mechanisms with policy objectives that will lead to maximizing the fishery economic value to the users and the society toward efficiency, marketability, and profitability of the fish resources;
4. Institute regulatory and legal measures for a healthy stock by way of Community-based Fisheries Co-Management; and
5. Improve the fish value chain for the long-term utilization of the fisheries resources.

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Appendix

Demographic Profile

1. Sex Male ☐ Female ☐

2. Age group 15-20 ☐ 21-25 ☐ 26-30 ☐

   31-55 ☐ 36+ ☐

3. Nationality_____ Marital status yes ( ) No. ( )

   Single ( ) Widowed ( )

4. Type of Work: Fisherman ☐ Fish processors ☐ Trader ☐

   other_____

5. Educational Level? _____ & Employment full time ( )

   Part time ( )

6. Number of household/family size_____

Part II. Fisheries section

7. Are you a member of any fishing organization? Yes ( ) No ( )

8. If Yes which organization_____

9. How many fishermen on this landing site? Provided only by Fishermen chief/ leadership (Total) _____

10. Year of fishing experience_____

11. How many landing/fishing trips do you make a day?

    _____

12. How many hours do you spend on the sea before landing?

    _____

13. Which type of method do you used to catch fish? Gill Netting ( ),

    Hook & line ( ),

    Set net ( ), Ring net ( ), Beach seine ( ), Draft net ( )

14. What is the total cost of your fishing equipment (boat, paddle, net, and other)_____

15. Total cost of fishing per day or month_____

16. Income per fishing trip_____ Monthly is the average income_____

17. What are the major spending areas of your income trade?

_____

,_____, _____,

18. What are the problems you encounter as a fisherman? List them:

_____

_____

19. Have you realized any decline in the catch? Yes_____

No_____

20. If yes, reasons? Underline : cost of fishing material, availability fish, price of fish storage facility,

21. What quantity do you typically catch on an average basis?

Species	Quantity Kg

22. Catch per day/trip measure in (bag, bucket, bundle) _____

23. Do you carry ice on board during fishing? Yes ( ) No ( )

24. Do you save any money from the fishing?

25. What is your average Selling price or how much do you sell the fish per Kilogram, beg, or tub

In USD: 5 to 8 ( ) 9 to 12 ( ) 13 to 16 ( ) 17 to 20 21 to 25 ( ) other ( )

Fish Processors &Traders (used the same form but write their name on the top of the first sheet with the basic information that requires.) and just continue from here for fish processors & traders

26. How much do you pay for the fishes of the above species for fish processor & traders? Small size ---------- Medium size ---------- Large size----------

27. How do you buy the fish by bag ☐ bucket ☐ bundle ☐ Pack ☐

28. Main species: 1_____, 2_____, 3_____

    Source (s) of fish? (Please tip) Fishermen_____ or Imported fish_____

29. Do you sell fresh ( ) if no then tip process ( ) then check by which one or more than one of the below: smoking, ( ) dry ( ) or Fermented ( )

30. Method of processing fish? ----------

31. What is the average price do you sell your fish (piece, bundle, tube, bag, and bucket)? If fresh_____, smoke_____ or Fermented _____

32. How do you determine the price fish? By the size ( ) Amount pay ( ), Quality ( ) Species

( ), Cost ( ) Number of buyer ( ) please underline one or more if possible

33. Have you noticed any decline in the supply of fishes of the above species?

    Yes ☐ No ☐

34. If yes, reason ----------

35. What do you do with the remaining? Icing ( ), smoking ( ), Drying ( )

36. Where do you sell the fish _____

37. How do you judge the quality of the fish you buy? Gill ( ) , eye ( )
    Smell ( ) Touch ( ) Taste ( )
38. How do you transport your fish to market place_____
39. Have you ever had any training for your business? Yes ( ) No ( )
40. Have you felt or experience any impact of climate change
41. If yes what training _____
42. Do you have any recommendation that I can make from your end in writing my thesis? For both fishermen and processors