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Light Fishing Operations in Small-scale Fishing in Ghana –

A case study of the Chorkor and Teshie–Nungua fishing communities in the Greater Accra Region of Ghana

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May God bless us all.

Declaration

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

Gabriel Adjei Agyekum

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

Professor Bjørn Hersoug

Supervisor

Dedication

I dedicate this work to my late dad Mr. Emmanuel Kwame Agyekum and my mother, Mrs. Augustina Abena Nkansah for their love, support, care and encouragement.

Abstract

Coastal fisheries resources play a crucial role in promoting food security and incomes throughout the world. In recent years there has been important concerns all over the world about the overexploitation of wild fish stocks. In many developing coastal countries this overexploitation has been attributed to the increasing demand of fish products and exacerbated by modernization and development of new fishing techniques to increase catch. One of the major problems in the fishing industry is the dwindling levels of fishing output.

Ghana's fishing levels are increasingly becoming unsustainable due to the use of highly destructive fishing equipment like light attraction equipment. Apart from the periodic shortages of pre-mix fuel, light fishing activities is identified by peasant fishers as a major challenge to their livelihood. The use of light fishing method for fishing also has the potential to negatively impact the profitability of poor fishers who are mainly small-scale artisanal fishers. The damaging effect of light fishing operation in the country and the factors affecting the effective enforcement of the ban on such operation leaves us with lots of uncertainties which this research seeks to unravel. To help develop an effective management response to this challenge the study highlights the factors that make artisanal fishermen flout fishing regulations, identify the possible reasons why the prohibition of light fishing is not effectively enforced, and make necessary recommendations on the measures needed to bring the fisheries regulations closer to the realities on the ground. Different data collection strategies were employed in the study and the data was analyzed qualitatively.

It finds that low penalties and poor enforcement for law-breakers are two of the major problems. The study also finds that, the lack of alternative livelihood opportunities for rural fishers contributes greatly to the increasing pressure on coastal fisheries resources which subsequently leads overexploitation. It therefore recommends that, enforcement is tightened, artisanal fishers should be given more education and be involved in the decision making process.

Keywords: Light fishing, poverty, sustainable livelihood, MCS, compliance and legitimacy.

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Acronyms

AMA	Accra Metropolitan Assembly
CBFMC	Community-Based Fisheries Management Committee
CCRF	Code of Conduct for Responsible Fishing
CF	Chief Fisherman
DA	District Assembly
DCE	District Chief Executive
Dof	Department of Fisheries
EEZ	Exclusive Economic Zone
FAD	Fish Aggregation Device
FAO	Food and Agriculture Organization
FC	Fisheries Commission
GDP	Gross Domestic Product
GNCFC	Ghana National Canoe Fishermen's Council
GoG	Government of Ghana
GSS	Ghana Statistical Service
IEZ	Inshore Exclusion Zone
ILO	International Labor Organization
LEKMA	Ledzokuku-Krowor Municipal Assembly
IMF	International Monetary Fund
Km	Kilometer
LI	Legislative Instrument

MCS	Monitoring, Control and Surveillance
MFMD	Marine Fisheries Management Division
MFRD	Marine Fisheries Research Division
MoFA	Ministry of Food and Agriculture
MT	Metric Ton
NGO	Non-Government Organization
PNDC	Provisional National Defense Council
SL	Sustainable Livelihood
SLA	Sustainable Livelihood Approach
UN	United Nations
UNCLOS	United Nation Convention of the Laws of the Sea
UNDP	United Nation Development Program

CHAPTER 1: INTRODUCTION

Background of the study

Light fishing involves the catching of fish that have been aggregated by artificial light through light attraction technique (Bannerman & Quartey, 2004). Commercial light fishing operations began in 2001. Fish species that were mostly caught by the use of light attraction included herring, mackerels and squids. This operation was predominant in Tema, Elmina and Sekondi, all located within the coastal areas of Greater Accra, Central and the Western region of Ghana respectively. The sources of light used for this kind of operation included kerosene lamp, fire torch, gas lit lamp and incandescent lamp supported by generator or battery (Bannerman & Quartey, 2004).

Ghana's fishing industry is estimated to generate around US$ 1 billion in revenue every year thereby contributing to about 4.5% of annual Gross Domestic Product (GDP). The industry supports over 100,000 fishers in the marine sub-sector alone. The aggregate production of fish is estimated to be around 440,000 tons annually and over 2 million people which are a combo of marine sub-sector and artisanal fishers depending on the fisheries sector for their livelihoods. Fish production in the country comes from marine capture fisheries, inland capture fisheries and aquaculture (Tanner *et al*. 2014).

The importance of fish protein in the diet of Ghanaians cannot be underestimated. Fish is consumed on a daily basis by most Ghanaians. It is deemed as the most important source of animal protein. Fish protein is estimated to supply about 60% of animal protein needs of consumers across the length and breadth of the country. Per capita consumption of fish protein is around 23 kg and the total annual requirement of fish is estimated at 880,000 metric tons[1] (mt). The annual production of fish is around 420,000 mt, thereby leaving a deficit of about 460,000 mt (MOFA, 2010).

There are three kinds of fishing fleets in Ghana which are made up the artisanal canoes, semi-industrial boats and the industrial vessels. The small scale artisanal fleet is the biggest among the three. It is made up of in excess of 12,000 wooden dugout canoes and contributes about 60 to 70% of the aggregate annual marine fish output (Tanner *et al*. 2014). Teshie, Jamestown, Chorkor,

[1] 1 Metric tons = 1 tonnes = 1.1023113 tons

Elmina, Weneba, Akplabonya, Adina, Abutiakope and Moree are some of the important landing sites in the country (FAO, 2004). The semi-industrial fleet is the next largest after the artisanal canoes. It has approximately 350 vessels that operate from seven landing sites and the vessels are mainly diesel fueled and wooden plank boats. The industrial vessels are also made up of scale trawlers and tuna boats. The vessels are allowed by legislation to fish beyond the 30 m depth of contour. The vessels are about 80 and operate between the Tema and Takoradi ports (CRC, 2013; Bennett, 2002).

After its introduction into the country under the FAO/UNDP program by the Fisheries Research Unit in 1962, light fishing operations have largely been blamed for the low output of the fishery industry. Light fishing is currently deemed as a harmful method of fishing and it is prohibited in Ghana. The country's fishing regulations do not allow the use of the light attraction equipment to catch fish. Apart from light fishing, the use of dynamite and carbide for fishing is illegal. The Fisheries Act 625, of 2002 and Fisheries Regulation (L.I. 1968) of 2010 are the two main legal frameworks used by the government to regulate the fishery industry. The navy, police and the judiciary are supposed to ensure the enforcement of these laws (Boachie- Yiadom, 2013).

Problem statement

One of the major problems in the fishing industry is the dwindling levels of fishing output. Ghana's fishing levels are increasingly becoming unsustainable due to the use of highly destructive fishing equipment like light attraction equipment. This certainly is a major threat to food security in the country (Akpalu, 2009). The unsustainable levels of fish production are also expected to further increase the fish protein deficit which has become a challenge for the country. Output figures from MOFA shows that total fish production from the marine sub-sector for instance was about 431,405 mt in 2004 but dwindled to about 375, 463 mt in 2007.

The use of light fishing method for fishing also has the potential to negatively impact the profitability of poor fishers who are mainly small-scale artisanal fishers. Apart from the periodic

shortages of pre-mix fuel, light fishing activities is identified by these peasant fishers as a major challenge to their profitability. Fishing with the use of light attraction equipment usually encourage overfishing which leads to the depletion of the fish stocks in the country. The practice is likely to further detain fish off shore. Small-scale artisanal fishers would then have to struggle to make any meaningful catch. The cost of production rises, which means their profitability is impacted.

Regulation 11 (1) of the Legislative Instrument (LI 1968) which was promulgated by Parliament is what has been used to impose a ban on light fishing in the country. According to the fisheries regulation (2010);

(1) "*A person shall not*

a. use light attraction, portable generators, switchboard, 1000 watts bulb and long cable to facilitate light production or any other contrivance for the purpose of fishing,

b. use any other prohibited fishing method which renders fish more easily caught for the purpose of aggregating fishing, or

c. Operate pair trawling.

(2) *A person who contravenes sub-regulation (1) commits an offence and is liable on summary conviction to a fine of four hundred penalty units or to a term of imprisonment of not more than twelve months or to both".*

In spite of the ban, many fishermen still engage in light fishing operation. This practice is mostly common among operators of larger inshore vessels (Bannerman & Quartey, 2004). Government has not been effective in enforcing the laws governing light fishing in the country due to inadequate resources. It is an open secret that the ban of light fishing is violated with impunity by large trawlers. Local fishermen also find it not motivating enough to voluntarily comply (Boachie-Yiadom, 2013).

The damaging effect of light fishing operation in the country and the factors affecting the effective enforcement of the ban on such operation leave us with many uncertainties, which this research seeks to unravel. It is therefore in the light of these that we raise the following research questions:

1. What are the biological, economic and social implications of using light fishing?
2. Why is the prohibition of light fishing not effectively enforced?
3. What can be done in order to bring the fisheries regulations closer to the realities on the ground?

Justification of the study

The use of light attraction equipment for fishing has the potential to deplete the fish stock of the country and further collapse the industry. It has therefore become very imperative for a lot of studies to be conducted in the area of light fishing operations, which is by far one of the major problems facing the fishery industry. The biological, economic and social impact of light fishing and why the ban on light fishing operations cannot be effectively enforced are areas that have not been addressed fully in Ghana. This study however seeks to address these issues in order to bridge a major gap of knowledge as far as light fishing method of fishing is concerned.

The study will provide information for policy makers, fishermen and all other stakeholders in the fishing industry on the way forward to dealing with the problem of light fishing in the study area and the country as a whole. This will help to encourage best practices of fishing, in turn ensure sustainable levels of fish stock, and eventually increase food security in the country. The profitability of farmers would also be impacted positively when the quality of their catch improves.

The study will also provide information for would be researchers who would choose this area and also add onto the body of knowledge that already exist. The study is also to be conducted in partial fulfillment of the researcher's master's degree program in International Fisheries Management. From the foregoing, this study which seeks to assess light fishing operations in the Chorkor and Teshie-Nungua Municipal area, is highly relevant.

Organization of the study

The study is structured into six chapters. It begins with introduction as chapter one. Chapter two will give an in-depth review of the literature that is of importance to this study. It will take a look at global light fisheries; history of light fishing in Ghana, fish and artificial lights; and fishery industry institutions in Ghana. Chapter three will focus on the theoretical framework in which the theories of the tragedy of the commons, and the theories of poverty will be analyzed. A detailed outline of the concept of livelihood as well as monitoring, control and surveillance (MCS) in fisheries management will be discussed. Chapter four will discuss the methodology used in the study; it will touch on a thorough description of the case study areas. The limitations associated with the study will also be mentioned. Chapter five presents the results and discussions of the study whist the sixth chapter deals with conclusions and recommendations by summarizing the findings and policy implications.

CHAPTER 2: LITERATURE REVIEW

This chapter discusses literature that is of relevance to the study. Prior studies in the areas of global light fisheries, fish and artificial light, forms of fish aggregating devices, fishing methods in Ghana, fishery sector in Ghana, and the history of using light as a fishery method in Ghana are reviewed.

Global overview of light fisheries

In the past, kerosene-pressured lamps were used extensively by night fishers in shallow coastal fishing with the aid of hand lines and scoop nets. In Indonesia, fishing with electric lamp, is widely practiced from the coastal fishery to offshore fisheries in combination with seine, lift net and purse seine (Arimoto, 2009). In the new millennium, as pointed out by Arimoto (2009), there are basically two aspects of the development of light fishing technology; how to increase the catch, and at the same time how to conserve the fish resources which is an implementation of sustainable fisheries. According to Amaral & Carr (1980), the use of light attraction techniques to catch fish has been practiced since the 19th century in for instance the United States west coast. They however explained that the first successful technique used torches, small skiffs and purse seines. The industry with time became heavily dependent on lamps, mostly the incandescent type combined with a power assisted brail or purse seine. Artificial lights make it possible to concentrate the fishes (squid) near the surface frequently enough to allow for commercial exploitation. Light fishing activities has also been practiced in Japan, China, New Zealand, Peru, Korea, Thailand, Malaysia, Philippines, Vietnam, France, Norway, Turkey and in Africa. Squids are the fish species that are mostly targeted and this usually goes on all season (ICES, 2012).

Dragesund (1957), mentioned that as far back as 1885 attempts were made in Norway to attract spring herring with the use of submerged electric lamps but the technique didn't yield any positive results and it is only since 1930 that the use of light has been practiced in the commercial fishery using purse and beach seining. The practice was mostly carried out in winter in the herring fishery. The Norwegian purse seiners were well equipped for such fishing with three to six strong searchlights installed on special stands on the wheelhouse and on the stern. Fishers use echo-

sounders and other fish finding equipment to locate and catch hearing although the reaction of the hearing to the light proved erratic and it was difficult to establish a clear behavior pattern.

Light fishing has increasingly developed and widely practiced all over Indonesia. Arimoto (2009), reports that light fishing in Indonesia started from South Sulawesi waters in 1949, using pressure kerosene lamp, which is applied on fixed bagan (box-shaped lift net with fine mesh size of 0.5 cm, operated with lamp for attracting pelagic species). With continuous perfection and improvement in light and lighting technology, light fishing operation became one of the highly effective fishing (Jaya and Arimoto, 2001).

Mills *et al*. (2014) conducted a study on alternatives to fuel-based lighting for night fishing. The authors noted that night fishing using light to attract fish is practiced virtually all around the world in both developing and developed countries. Light fishing is also practiced on both large and small scales. The authors also opined that many of the 12 to 18 million artisanal fishermen in the developing world engage in light fishing with the help of kerosene lanterns. They however observed the use of fuel-based light attraction throughout East Africa, Indonesia, Brazil, Sri Lanka, Nigeria, India, Tanzania and Ghana. They concluded that a significant market potential is available for LED lighting products by night fishermen and therefore justify the marketing investment on the part of lighting manufacturers.

In Lake Victoria (Africa's largest inland fishery) kerosene lanterns are tied to small wooden floats with each float carrying its own light (Mills *et al*. 2014). According to Mills *et al*. (2014), the fishers use rather small boats (4 m long and 1.5 m wide) with floats lined up on the water in 100 m to 200 m intervals, and anchored to the ground using rocks. The fish are attracted to the light source, taken onboard, and the lantern and float are again released onto the water for another cycle of netting. According to the authors the fishers usually stay within sight of land and work between 14 and 21 nights per month for eight to twelve hours each night.

The history of light fishing in Ghana

Fish, like most other living creatures, like to live in preferred environment with desired environmental conditions, therefore the slightest change in these preferred conditions as a result of fishing activities may affect the spawning, feeding, growth and other activities of the fish. Just as fishers will seek conditions to optimize their catch, fish seek areas where there is a high probability of catching their food or prey. Small pelagic fish such as sardines and herring are attracted to light as they follow unknowingly around a light source in schools to feed on zooplankton. Around the world, most night fishers use lights to aggregate small pelagic fish to increase their catch.

One of the biggest single innovations in the Ghanaian fishing industry is the use of light in catching fish. Light attraction according to Dinglasan (1972), is the technique of aggregating fish by artificial light; whereas, light fishing is the process of fishing the attracted fish by hooking, gill-netting or by using any other type of gear (cited in Bannerman & Quartey, 2004). The light fishing technique incidentally, was introduced in Ghana under the FAO / UNDP Technical Assistance Program by the fisheries Research Unit, now the Marine Fisheries Research Division (MFRD) of the Directorate of Fisheries in Ghana in 1962 at Teshie (Accra) and Takoradi (Western Region) (Bannerman & Quartey, 2004). The authors mention that these areas have the port facilities for landing of the catch by the larger inshore vessels that carry out the purse seine fishery in Ghana using light attraction. This technology was primarily introduced to increase production and income in the small pelagic fisheries. Initial trials conducted in 1962 were promising, although the cost involved in terms of equipment acquisition in its operation was too expensive for most fishers. In the early 1990s the incentives for light fishing changed when the inshore fleet started adopting the technology, and the canoe fishers followed (Finegold *et al*., 2010). The benefits to the inshore fleet according to the authors were considerable in the sense that light fishing gave them an option to fish throughout the year with an improved catch. Today, the phenomenon is a free-for- all affair for all artisanal and to some extent the semi-industrial vessels. A study conducted by Akonor *et al*., (2013) revealed that fishermen from Cape Coast who use lights in their fishing activities have electric generators together with specifically designed bulbs (about three in number) which have been welded to cone-like metal with electric wires connected to the generator. The authors mentioned that the bulbs are lit up when the generator (mostly placed in small boats called “bar

boat") is sparked and the heavy metal makes the bulbs sink easily in water. This subsequently attracts fishes of all kinds and the fishers then pull the bulbs gradually one after another whiles getting set or casting their nets right after the last bulb is pulled out of the sea to catch as many fishes attracted by the light. The purse seine gear is used by most fishers in the light fishing operation in Ghana. They generally have a small size generator to power the incandescent lamp together with minimally mechanized fish finder equipment (a two-way radio for communication) and a diesel driven winch drum to facilitate the search and hauling of the catch (Bannerman & Quartey, 2004).

The incidence of the use of light attraction for catching fish began seriously in the year 2001. During the late 1990s however, landings of the small pelagic dropped from about 210,000 tons in 1995 to about 164,000 tons in 1999 due to unfavorable climatic conditions. The drop in catch volume was also attributed to the overexploitation of the fishery resource. As a result of the fluctuating catches coupled with the high cost of fishing inputs and fuel, most fishermen had low profitability. The fishermen however, decided to use illegal and unorthodox methods of fishing which included the use of light attraction for fishing. Herring, mackerel and squid were the species caught by the use of light fishing methods. This method also became very predominant in Greater Accra (Tema), Central (Elmina) and Western (Sekondi) regions of Ghana. These areas are the major coastal municipalities in Ghana. Fish were attracted and aggregated with light source from a kerosene lamp, a fire torch, a gas lit lamp or an incandescent lamp supported by a generator or battery (Bannerman & Quartey, 2004).

Between 1999 and 2000, mean catches of small pelagic by the inshore fleet hovered around 4500 tons. Between 2001 and 2003, when the intensity of light fishing was massive, mean catches hovered around 7000 tons. The increased catches could be attributed to the intense use of light attraction in fishing, which invariably could have some adverse effect in the short to medium term. The inshore operators were largely blamed by some canoe operators for the use of this method of fishing. The lights kept the fish trapped further offshore from the area of operation of the canoes for the operators to make any meaningful catch. The use of light attraction in fishing during the period has been variable. Catch rates were comparatively low in the earlier stages and became

more favorable in the later stages. Sometimes there are also small sizes of fish during a particular month that light fishing is carried out. Light fishing may however, not be so effective during the minor upwelling period from January to February (Bannerman & Quartey, 2004).

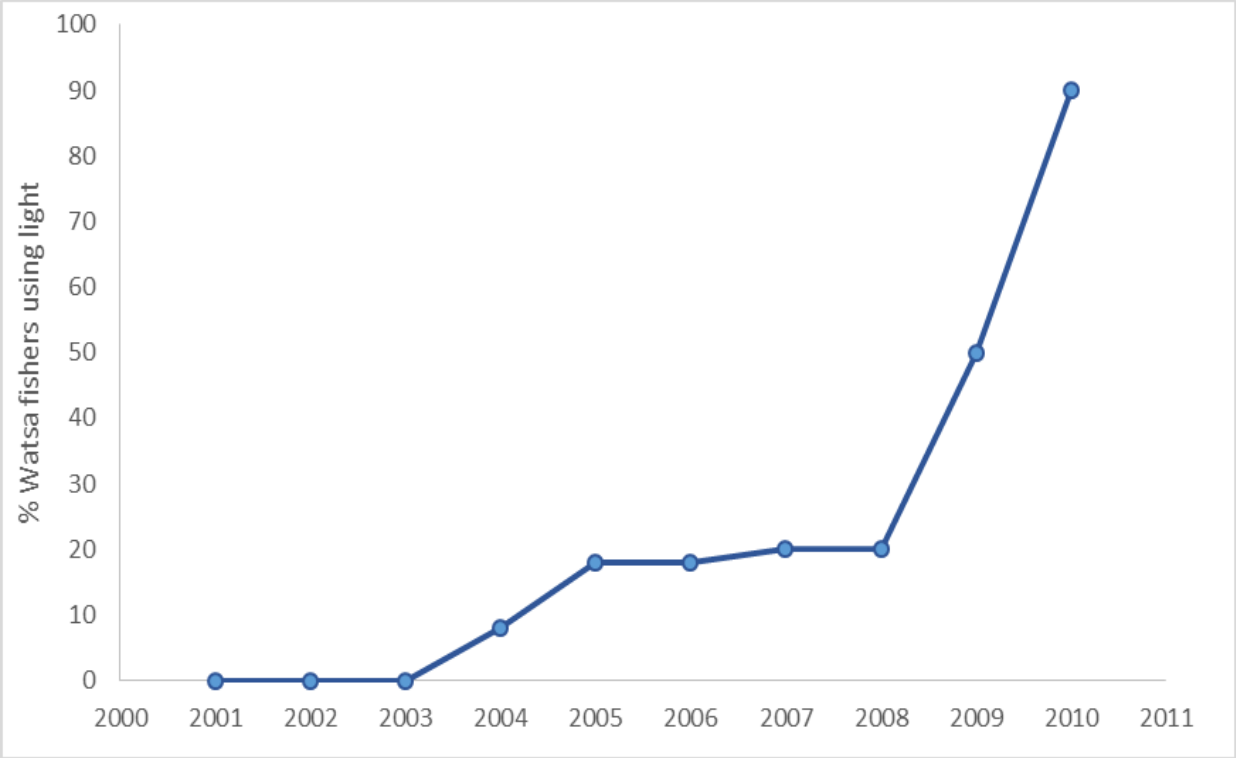

Figure 2.1: Percentage of interviewed Watsa fishers in the Western region engaging in light fishing over the past 10 years. Time of uptake varied considerably between landing areas.

Source: Finegold *et al*., (2010).

Fish and artificial light

Hua & Xing (2013) carried out a study on LED fishing light in China. The authors opined that the use of light is a common way to trap fish in fishery industry. Artificial light can be used to induce the fishes to form a massive shoal using the artificial light source at night taking advantage of the fish's photo taxis. They indicate in their study that most sources of artificial light could be harmful to human health as well as young and juvenile fish whose visual system are yet to fully develop. The results of their study however, show that LED is more suitable to be used as source of artificial light. They conclude that LED semiconductor lighting is an important way of energy saving and environmental protection.

Marchesan *et al*. (2005) conducted a study on behavioral effects of artificial light on fish species of commercial interest such as the European seabass (*Dicentrarchus labrax)*. They carried out two sets of experiments in laboratory conditions. In the first set of experiments, they increased and decreased light intensity within several ranges. In the second set of experiments, they shifted light color from the shorter to the longer wavelengths of the visual spectrum or back using six different color filters. All the experimental fish were acquired either from the Aquarium or from fishermen operating from Italy. Their results showed that at all illumination levels, fish showed a higher aggregation with increasing light intensity. During both experiments, fish showed a tendency to move far away from the artificial light source especially when the illumination was lower. The effects of artificial light on fish behavior however differ between species.

Anongponyoskun *et al*. (2011) compared the effect of different light spectra in fishing lamps in Thailand. The authors opined that the use of artificial light is one of the most advanced and successful methods to control the behavior of fish and squid for capture purposes. Fishermen in the study area believed in the use of a higher lamp power which was able to attract fish from a wider radius and increased the fishing area. The effectiveness of aggregating fish by light attraction depended on the power and the color of the lamp, the weather, the temperature and the abundance of fish. The underwater pattern of light intensity of light fishing differs according to the fishing

time, season and ground. They concluded that the use of metal halide[2] and incandescent lamps to attract fish utilizes only less than 1% of whole radiant energy and most of the input energy is converted into heat. Only the 500-600 nm spectrum range could be radiated into deeper waters.

Cornelisen (2011) in his study on the assessment of environmental effect of submerged artificial lighting opined that artificial lighting directly affects the physical characteristics of the water column. It has the potential to affect a number of biological processes of fish. Artificial lighting inhibits the rate of maturation of salmon. The author argues that the physical effects of the lights need to be described first before the environmental effects of artificial lighting on the marine environment can be assessed. He concludes that the effects of submerged artificial lighting on the surrounding marine environment are likely to be highly localized and small in scale. This is in terms of the physical effects on the underwater light environment and subsequent biological and ecological effects. However, he recommends that efforts should be made to ensure that only the amount of lighting required for beneficial outcomes is used.

Becker *et al*. (2013) looked at the potential effects of artificial light associated with anthropogenic infrastructure on fishes in South Africa. The authors opine that there is not much understanding on the effects of artificial light on coastal aquatic ecosystems and that many predatory fish rely on visual cues to locate and capture prey. The results of their study indicated that large predatory fish increased in abundance when floodlight was turned on a pontoon structure. Only certain size classes of fish were attracted towards the light. Increased lighting conditions around the man-made structure optimized the feeding conditions and attracted these fish. The authors, however, recommend that artificial lighting should be reduced around coastal infrastructures. The use of red lights should be encouraged because they have limited penetration through water.

An International Council for the Exploration of the Sea (ICES) 2012 report opines that in the presence of artificial light, pelagic fish usually school and move towards the light source. The

[2] It is a type of high-intensity discharge (HID) gas discharge lamp that produces light.
Source: https://en.wikipedia.org/wiki/Metal-halide_lamp (28/04/2016)

applications of light in purse-seines and lift nets are widely practiced in commercial fisheries. In recent time fire and gas lamps have been replaced by incandescent lamps as the source of artificial light. The report also argues that there is a need to understand the structure and function of the fish eye and the natural underwater light environment in other for one to fully understand the process by which artificial light can be used to attract fish.

Light fishing and the associated impacts on the fish stocks

Akpalu (2009) conducted a study on illegal fishing in Ghana. In his study he noted that fishermen use illegal light attraction equipment to improve their catches in the Ghanaian waters. This has the potential to negatively affect the sustainability of fishing in the country. The practice of light fishing has led to over-harvesting of the nation's inshore wild fish stocks. Fish of all kinds are attracted towards the artificial light so that they can be easily harvested. The author concludes that the overexploitation of the wild fish stocks has the potential to collapse it and reduce future levels of fishing.

Sudirman & Nessa (1992) in their study on the impact of light fishing on sustainable fisheries noted that light fishing has spread all over Indonesia. This technique overexploits the fish stock to the extent that even juvenile fish are caught. The authors first of all identified the kind of light fishing operated in the study area. This was followed by both field and laboratory researches to understand the capture process and the size composition. They, however, concluded that purse seine using light and lift net is very destructive and has negative impact on sustainable fisheries. This was because higher number of immature fish species like Indian mackerel and Russel scad were caught as well as use of high energy consumption for fish lamps. They recommended the use of environmentally friendly technology of lift net and better management of the fishing units.

Fishing methods for commercial purposes

Galbraith and Rice (2004) discussed thoroughly most fishing methods for commercially important species. The methods include trawling, seine-netting, purse-seining, potting and creeling, scallop dredging, long lines, set-nets and bag-nets and stake-nets. According to the authors, trawling is the operation of towing a net to catch fish. The fundamental requirements for operating the trawl-net are enough power to tow the net. Trawls can be towed over the seabed or at a depth in mid-water. This is done with respect to the species sought. Forms of trawling include bottom trawling, shooting and hauling otter trawl gear, twin rig trawling, demersal pair trawling, beam trawling, shellfish trawling, pelagic pair trawling and pelagic single boat trawling.

Galbraith and Rice (2004) also described the seine-netting method of fishing as a modern form of demersal seining or bottom fishing, usually with rope warps and wing trawls. This method is believed to have been first used by a Danish fisherman called Jens Laursen Vaever in 1848. The ropes and net are positioned from an anchored marker buoy by the fishing vessel which is also stationary by the anchor. Pair seining and Scottish seining are variations of the method. Pair seining basically involves a second vessel picking up the marker buoy and both vessels towing the gear like a demersal pair trawl before hauling. Pair seining has the ability to improve catch tremendously when fish concentrations are small and widely dispersed. The method increases the area of seabed swept by the fishing gear.

The authors opined that purse seiners are able to capture large aggregations of pelagic fish that shoal in mid-water or close to the surface. This is done by surrounding the concentrated fish with a deep curtain of netting which is supported at the surface by floats. Large purse seine is usually about 1 km long and 200 m deep. This method tries to prevent bottom contact as the small mesh nylon netting is easily damaged. Potting and creeling method of fishing employs creels and pots as small traps baited with fresh or salted fish to catch crabs, lobsters and nephrops. The traps are set down on the seabed to catch fish either separately or in groups with the use of strings. Scallop dredging is the use of dredges where each dredge consists of a ruggedly constructed triangular steel frame and tooth bearing bar. A mat of linked steel rings is secured behind this structure. The entire assembly is towed onto only one wire warp and bigger vessels usually tow two bars.

Bank of Ghana (BoG) (2008), identified a number of methods employed by fishers in Ghana. It however classified the methods according to artisanal, semi-industrial and industrial system of fisheries. Artisanal fisheries use basic fishing methods, like the use of canoes usually powered with outboard motors. This can be found in almost all 300 landing sites in 200 fishing villages along the coastline of the country. It employs a lot of fishing gears, which include purse seines, beach seines, drift gill nets and surface set nets. Semi-industrial fisheries also use locally built wooden vessels measuring about 9-12 meters in length and fitted with 30-90hp diesel engines. Fishers use this fishing method during the upwelling seasons. They use purse seines mostly in the inshore waters between 30-50m depth, where it is possible to compete with the canoe fleet. Industrial fisheries also employ vessels made up of 30-200 hp diesel engines and large steel-hulled built vessels. Operators use either purse seine or pole and line with live bait to catch fish.

Overview of the Ghanaian fishery sector

Kwadjosse (2009) in her study on the impacts on the conservation and management of fisheries resources of developing coastal states of Ghana indicated that Ghana's coastline measures about 538 km long. This is made up of long stretches of sandy beach, interspersed with rocky shores, estuaries and lagoons which forms the breeding grounds of many marine fishes. The country's fishing is largely supported by the oceanography of the western Gulf of Guinea. The major upwelling occurs from July to September, while the minor occurs from December to March. This upwelling is what supports the entire fishing industry of the country. However, the industry began as an artisanal fishery for subsistence purposes which employed very simple methods in rivers, lakes, marine waters and other water bodies. The commercial fishery began in the late 1900s when the demand for fish increased.

Kwadjosse (2009) again mentioned that the fishery sector is made up of the marine and inland components. The marine is made up sea and lagoons whiles inland comprises of lakes, rivers and reservoirs. The marine fishery is a combo of the small-scale subsector and the industrial subsector. It is exploited by a small-scale fleet of about 11, 213 dugout canoes with majority of them being motorized. The industrial subsector exploits an inshore fleet of about 230 locally manufactured

wooden vessels. The total capture of fish hovers around 325,000 tons annually. Small pelagic and tuna stocks are exploited in the sector. Both the marine fishery and the inland fishery contain a robust value added sector in terms of fish. There are a number of fish processors, wholesalers and retailers along the value chain. There are also cannery companies that absorb most of the fish supply and process them.

According to a FASDP document published in 2011 on the fisheries and aquaculture sector development plan, Ghana's total domestic production which includes aquaculture, hovers around 440,000 tons per annum and fish production is valued in excess of US$1 billion in annual income. The sector also accounts for about 4.5% of Gross Domestic Product (GDP) but the cost of producing fish in the country is on the high side. The expenditure on fisheries management in the country is less than 2% of average expenditure in OECD countries. However, there are about 2.2 million people engaged economically in the fisheries sector for their livelihoods. This includes about 135,000 fishers in the marine sector of which about 92% fish on an artisanal basis (Kassam, 2014). A characteristic of the sector is its low profitability from investment aimed at improving the quality and value of the catch. Fish produced domestically was estimated at 444,000 tons in for instance 2008 and made up of 291000 tons from marine capture, 150000 tons from inland capture and 3000 tons from aquaculture production. The consumption of fish around that time hovered around 540000 tons which left a deficit in domestic production of about 190,000 tons. The deficit in domestic production was dealt with through imports which were estimated at 213000 tons in the previous year. However, overall fish production in the country increased by 10% between 2009 and 2012, from approximately 415,000 tons in 2009 to over 455,000 tons in 2012 (Kassam, 2014)

Fisheries policy and the legal framework

The country's fishery industry is regulated by two main legal frameworks, the Fisheries Act 625, of 2002 and the Fisheries Regulations (L.I 1968) of 2010. The Fisheries Act 625, of 2002 is made up of six main parts. They are: the Fisheries Commission, Administration, Fisheries Development Fund, Fisheries Management and Development, Jurisdiction and Evidence, Miscellaneous provisions. The Act however provides for the regulation and management of the fisheries sector. It also provides for the development of the industry and to ensure the sustainable exploitation of the fishery resources and other matters related to the industry.

The Fisheries Act establishes a Fisheries Commission made up of a chairperson and other members who are appointed by the president in consultation with the Council of State. Under this Act, the Fisheries Commission is responsible for regulating and overseeing the utilization of the fishery resources and to co-ordinate the policies in relation to them. It also has the responsibility to ensure the monitoring, control and surveillance of the fishery waters. The Commission is also charged with standardization of fish quality, weight and the basis for fish pricing. This is to be done in consultation with any other agency with a responsibility for ensuring fish quality standards. The minister in charge of fishery has ministerial responsibility for the Commission.

With respect to fishing activities in the country, the Act stipulates that the commission is given the authority to declare closed seasons, including their duration, for fishing in particular regions of the coastal waters. When an international body of which Ghana is a member declares a closed season, it will be binding for the country. It is an offence for a person to fish during a closed season. The Act also states that the Fisheries Minister is responsible for prescribing the types and sizes of gear or devices that may be used for fishing. This includes prohibited nets and the relevant fishing activities.

The Fisheries Regulations (L.I 1968) of 2010 are a set of regulations for the fishery industry made on the 16th of June, 2010. The regulations are made for fishery plans and fishing vessels; fishing equipment; fishing licenses; compliance measures; monitoring mechanisms, aquaculture and miscellaneous matters. According to the regulations, the prohibited fishing methods include use of bamboo for the purpose of aggregating fish, use of explosives, obnoxious chemicals and other

prohibited fishing methods, pair-trawling and the use of light fishing. Light fishing here is described as using any fishing method that aggregate fish by light attraction. These include the use of portable generator, switchboard, bulbs beyond 500 watts or bulbs whose cumulative light intensity attracts fish and long cable to enhance light production or any other contrivance for the purpose of fish aggregation by light.

The regulations also provide for the application for renewal of fishing licenses. Prospective applicants are mandated to submit the application by means of an approved form and also pay a prescribed fee as determined by the Fisheries commission. Applicants must submit their total catch and species in the previous year and annual total exports if any. They must also submit the amount of foreign exchange earned and evidence of its repatriation among others. Canoe operators must also apply for licenses from the Commission. According to the regulations it is an offence to engage in transshipment of fish. One cannot transship fish from a Ghanaian fishing vessel to a foreign fishing that is not licensed under the Act and vice-versa. It is also an offence for a person to transfer fish from one canoe to another canoe, except in areas where there are no safe landing sites and with the permission of the owners.

Fishing industry institutions

Kukwaw (2013) in his study on fishing in the Volta lake of Ghana discussed the key institutions as far as the fishery sector is concerned. According to the author, the sector involves a number of governmental and non-governmental institutions which operate at both local and national levels. The Ministry of Water Resource is the lead government agency that is responsible for formulation and coordination of fishery sector policies and programs relevant to water resources which is an important resource for fishing in the country. The Ministry is mandated to coordinate and supervise public and private agencies in dam operation. As far as the fishery sector is concerned, the Ministry performs its responsibility in consultation with the Fisheries Commission established under the Fisheries Act, 2002. However, for the Fisheries Commission, its exclusive mandate is to ensure efficient and sustainable exploitation of all fisheries resources.

Kukwaw (2013) also discussed the role of Volta River Authority as far as the fishery sector is concerned. The authority now has an additional mandate apart from generating and supplying electricity, to develop the Volta Lake for fishing and its transportation. Fish catch from the lake is mobilized from the various landing sites and communities along the shores of the land. Other fishery institutions include the Ministry of Fisheries and Aquaculture and Ministry of Food and Agriculture responsible for formulating policies and programs for the fishing sector. The rest includes Ministry of Employment and Labor Relations and Community-based Fisheries Management Committees.

Under the general guidance and direction of the Minister of Fisheries and the Fisheries Commission, the Directorate of Fisheries is mandated to formulate and implement policies. The Directorate of Fisheries (DoF) is headed by a Director who is responsible for the management and control of the fishing industry. The mission of the Fisheries Directorate is to promote sustainable exploitation and responsible utilization of fishery resources of Ghana through, research, sound management practices and appropriate technological development for both culture and capture fisheries, effective extension services and provision of other assistance to fishermen, fish processors and traders for improved income and fish food security (DoF, 2004). The directorate basically has five operational divisions. They consist of; Marine Fisheries Management Division (MFMD), Inland Fisheries Management (and Aquaculture) Division (IFMD), Marine Fisheries Research Division (MFRD), the Finance and Administration Division (F&AD), and a Monitoring Control and Surveillance Division (MCSD) (DoF, 2004).

The administrative hierarchy of the fisheries sector is portrayed in Figure 2 below.

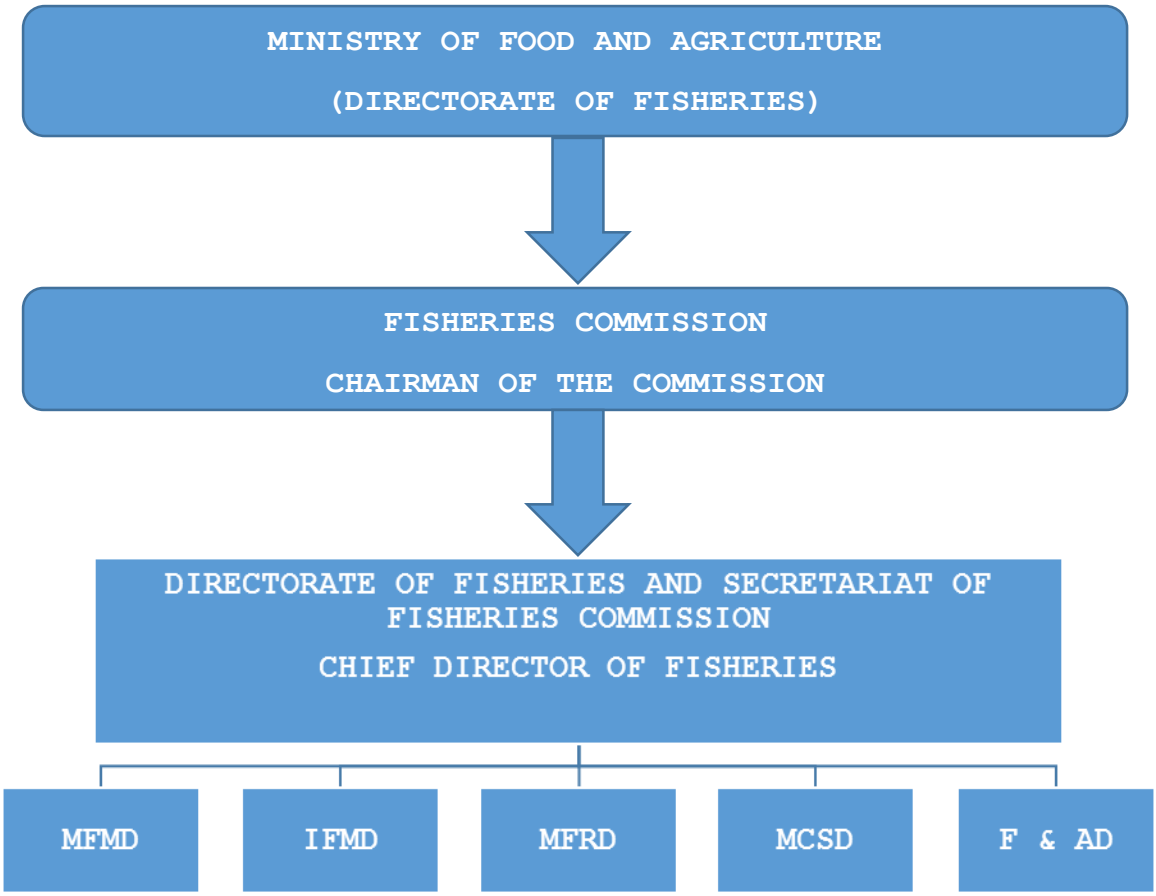

Figure 2.2: Organizational chart for fisheries administration in Ghana at the national level. Source: Yamoah (2012).

The Fisheries Commission (FC) provides information and recommendation to the Minister in all matters pertaining to the fishing industry. The current Fisheries Law (Act 625 of 2002) is the main regulatory instrument for the management and effective utilization of the fisheries resources of Ghana.

Small-scale fishing as a source of livelihood for fishing communities

Gordon and Pulis (2010) conducted a study on the livelihood diversification and fishing communities in Western region of Ghana. The authors opined that fish capture, processing, marketing and associated services constitute a significant source of livelihood in the coastal areas along lakes and rivers. Their study suggested that one fishing job created seven additional livelihoods. Each of these incomes will help to support an extended family.

Aheto *et al*. (2011) conducted a study on the economic value assessment of small-scale fisheries in Elmina of Ghana. The study assessed the net economic benefit that accrued to respondents whose livelihood depended on fishing. Fishers place higher value on quality of fish and cost of their fishing gear rather than demand and supply. Their profitability is mostly dependent on this. Therefore, the most dominant fish species caught by the majority of fishermen was the *Sardinella aurita*. Also the higher the capital outlay of fishers, the higher their returns and vice versa which was attributed to the method of fishing. Fishers mostly employed purse seining because that was able to target shoal of fish occurring in large quantities. The authors concluded that urgent management of specific fish stocks is needed in order to improve the livelihood of fishers. Serious effort is also needed to improve value addition through processing of the least valuable fish species. This will increase the profitability of the fishermen who supply them.

Asiedu and Nunoo (2013) also conducted a study on the alternative livelihoods for fishers in Ghana. The authors argue that fishery resources in Ghana are under pressure as a result of the preponderance of demand for fishery products, poverty and lack of alternative livelihood options which is common among fishing communities. Consequently, there is a need to look at alternative livelihoods in small-scale fisheries in order to ease the pressure on fishery resources and ensure sustainable exploitation of the available fish stocks. The study revealed that the majority of the fishers interviewed were ready to diversify their sources of livelihoods. They were willing to do other jobs apart from fishing. However, there were some few fishers who would not want to consider additional sources of livelihood apart from fishing. They did not want to take on other

jobs. A significant proportion of fishers (about 50%) did not have the requisite skills to work outside fishing and agriculture related areas.

CHAPTER 3: CONCEPTUAL AND THEORETICAL FRAMEWORK

This chapter discusses the conceptual and theoretical framework that underpins the study. Monitoring, control, surveillance and enforcement in fisheries management, compliance and legitimacy in fisheries management, theory of the tragedy of the commons, the concept of poverty and the livelihood approach to fisheries management are discussed thoroughly.

Monitoring, control, surveillance and enforcement in fisheries management

Today**,** most fishermen operate in an environment partly controlled by the authorities even though their field of operation is often isolated from an effective enforcement system. Decreasing stocks and overfishing is a huge concern in modern fisheries. Nearly 20 years after the United Nations Law of the Sea Conference (LOS) laid the foundation for a more responsible management of fisheries resources in 1975, by extending the jurisdiction of coastal state to 200 nautical miles, most developing countries were not able to reap the full benefits of the EEZs (Hersoug & Paulsen, 1996). One of the main reasons according to the authors is the lack of effective management measures; formal jurisdiction did not necessarily imply real control. Sutinen *et al*., (1988) mentioned that, the lack of adequate enforcement may be the most serious weakness in the management and conservation of fisheries resources in South-East Asia, Latin America and other areas. The authors opined that the problem has been recognized for some time, possibly because no management problem is greater for fisheries authorities and fishermen than that of enforcement. Fishers (this includes countries with a rather sophisticated fisheries management systems) are easily and frequently tempted to violate regulations designed, as they often see it, specifically to limit their effectiveness (FAO, 2002). The emerging picture is the task of ensuring compliance with fisheries regulations and laws in modern fisheries management. This is usually indicated in the generic term monitoring, control and surveillance (MCS) one of interlinked fishery management system that create room for feedback and checks to the management strategy.

MCS according to Doulman (1992), is exercised by countries in their territorial seas and adjacent exclusive economic or fishing zones primarily to: a) enforce sovereignty over fisheries resources under their national jurisdictions and b) to ensure that information necessary for the development

of fisheries management programs is gathered and that such programs are implemented and observed.

A more precise meaning of the three components of MCS has been defined by the FAO (2002) as:

a) "*Monitoring* - the continuous requirement for the measurement of fishing effort characteristics and resource yields;

b) *Control* - the regulatory conditions under which the exploitation of the resource may be conducted; and

c) *Surveillance* - the degree and types of observations required to maintain compliance with the regulatory controls imposed on fishing activities".

It should be noted that a technical definition alone as described above will not be enough to assist a fishery manager to understand fully the core objective and role MCS play within fishery management taking into account the options available and management costs to achieve these objective. An excellent management measure or plan on paper may turn out to be impossible or extremely costly to be put into practice. Hersoug and Paulsen (1996) in their study use the term MCS meaning "all the different control activities undertaken in order to check that management goals are implemented and observed". According to the authors MCS activities should always be an integral part of fisheries management and should include control both at sea and inshore, by vessels, planes and land based inspectors as well as document control of vessels, processors and exporters. In addition, MCS may include control of gear, and the control and collection of data by the fishermen themselves. The objective of MCS is clear: to contribute towards good fishery management through ensuring that appropriate controls (input, output and technical controls) are set, monitored and adhered to. Input, output and technical controls here refer to regulatory instruments in fishery management in pursuit of certain objectives through direct or indirect control of fishing effort. They include: a) *limited entry licensing* b) *gear and vessel restrictions* c) *area closures, time closures, and area zoning* d) *global non-allocated catch quotas (TAC)* e) *allocated catch quotas* f) *Taxes/fees on catch* g) *selectivity of gear/mesh sizes.*

At this point, a brief observation of the Norwegian MCS-System would be worthwhile. It is often used as a model in discussing issues related to the establishment of new MCS-systems. The system is generally regarded as one with the most comprehensive and efficient in the world, even though one may admit a 100% effective control is impossible. There are still some considerable loopholes taking into account the increasing level of fishing taking place outside the EEZ. The Directorate of Fisheries is by law requested to handle MCS-activities. According to Hersoug and Paulsen (1996), the Directorate runs four different types of control operations which basically comprise of operations performed by the Coast Guard (the most important with specific service set up with fisheries inspectors on board on vessels manned by the Navy), a separate surveillance unit, control of technical regulation measures and the quota control inside the territorial waters. The Norwegian regulation system is established over a long period of time, because of a much diversified fishery, with a large number of fishing vessels, fishing for different species with different gear all along a coast of more than 2,500 km, and 300 harbors.

Furthermore, the country has more than 50 years of formalized cooperative experience of the fishing sector and the government where the fishermen and their organizations are consulted before major regulatory measures are put into practice (Hersoug & Paulsen, 1996). Norway is considered politically and economically stable which puts the country in a better position to afford a high level of MCS activities. This includes support for the operation of nearly 3000 inspections each year performed by the Coast Guard, aircrafts and inspecting vessels for surveillance. The same cannot be said about Mozambique, a country with rather very little resources that has struggled with establishing an effective MCS-system. Namibia has demonstrated success in the establishment of a new effective MCS-System set up nearly from scratch. The case of Namibia is special in the sense that Namibia lacks the traditional artisanal fishing, has a favorable economic situation, combined with developmental aid from several donor countries including Norway. In addition, Namibia has very small domestic fishing fleets, and the fishing industry contributes an appreciable amount of income to the economy of the state. In either case the quality of the MCS-system depends on the type of fisheries (few or many boats), the amount of resources employed (e.g. number of inspectors, few or several patrol boats etc.) and the natural conditions such as the number of harbors.

Fisheries management in Ghana and the Enforcement Unit

Fisheries administration in Ghana seem to indicate an emphasis on control and enforcement of the fisheries laws, rather than on implementation strategies, and fisheries plans and policies. The Marine Research Unit is often mandated to monitor fishery proceedings both at sea and on land and are expected to advice the ministry on policies based on their findings. An important provision of the Ghanaian Fisheries Act 2002, is the establishment of Fisheries Monitoring, Control, Surveillance and Enforcement Unit hereafter referred to as the Enforcement Unit.

According to the Act the Enforcement Unit will be responsible for:

> "*Monitoring, control and surveillance of all fishing operations within the fishery waters by whatever appropriate means, including the management and running of a satellite base station for using satellite communications for data transmission relating to the activities of foreign fishing vessels licensed to operate within the EEZ and the enforcement of the Act, Regulations made under the Act and any other enactment relating to the regulation of fishing activities."*

Here the Minister shall in consultation with the Minister for Defense, appoint the head of the Enforcement Unit. Additionally, the Minister may, appoint any public officer as an authorized officer for the purposes of the Act. The person is mandated to exercise all powers and functions provided by or under the Act. These personnel will assist the Enforcement Unit to carry out its duties. They basically comprise of persons from the Ghana Navy, air crews and personnel of the Airforce deployed for fishery duties, officers of the Water Research Institute and the Secretariat of the Fisheries Commission. An authorized officer as established by the act shall have the same power of arrest as a police officer. They may stop, board, remain on board and search any vessel in the Ghanaian EEZ and beyond the limits of the EEZ as well as search any vessel registered in Ghana found outside the fishery waters when the need arises. Further, the Act empowers an authorized officer to require to be produced and examined and take copies of any license, logbook, record or other documents required under the Act or concerning the operation of the vessel, vehicle or aircraft. Officers of the Enforcement Unit are given full insurance protection for the duration of

their sea duties, in addition with indemnity from prosecution for acts done in good faith in the performance of their functions as sets out by the Act. The Act further establishes duties of authorized officers towards masters and crew of vessels as well as the compliance of masters and crew with respect to directives of authorized officers. Penalties for contraventions of these rules are stated clearly under the act. The Act requests that, all seized vessels should be taken to the nearest or most convenient port. Here masters of vessels are responsible for the safety of the seized vessel, the port charges, every person on board the vessel, which includes the crew and any authorized officer involved until the vessel arrives at the designated port. Issues related to detention, sale, release and forfeiture of property where offences are committed are defined clearly under the Act, which makes provisions for cases such as the court's power of forfeiture, application of bond, disposal of forfeited goods and liability for loss, damage or deterioration of items in custody.

MCS operations were first directed exclusively at industrial fishing vessels, primarily to keep them out of the inshore zone where trawling and other industrial fishing is prohibited (FAO, 2002). In recent years, the artisanal fisheries have been included since they are increasingly flouting the regulations. In Ghana, artisanal fishers are involved in MSC activities even though it is not officially recognized by law. Lack of formal management systems and institutions does not necessarily mean lack of management. A case study conducted by FAO (2002) in Mumford (Central region) revealed that artisanal fishers assists the local fisheries administration in collecting catch data at landing sites for monitoring purposes. They act as informants, lend their boats to authorities for surveillance operations within coastal areas, help control mesh size of nets and report illegal activities.

What can the fishery manager do? A more courteous approach is to balance the enforcement and compliance aspects of the MCS system. This, according to the FAO (2002) will encourage an environment where maximum compliance from fishers occurs and to use enforcement where voluntary compliance is not successful or requires support.

Compliance and legitimacy in fisheries management

The concept of compliance

Everyone breaks the law sometimes, others break it quite often. This is in spite of increased MCS and enforcement activities have drawn the attention to increased punishment and penalties by policy makers. Legal rules and regulations must affect the actions of those toward whom the laws were made for, in order to be authoritative. A judge's ruling as Tyler (1990) puts it, means little if the parties to the dispute feel they can ignore it. Similarly, Tyler (1990) contends that passing a law prohibiting some behavior is not useful if it does not affect how often the behavior occurs. Meanwhile the term compliance in my context can be defined as the act of obeying an order, a law, rule or request**.** In the fisheries management literature compliance is often understood and pictured from an economic perspective since fishers are assumed to act as rational agents. This perspective of compliance is most often regarded as an instrumental approach in the sociology literature. Fishers are perceived as utility maximizing individuals, who in every situation will compare the costs (social and economic) to the expected gain of non-compliance behavior (Nielsen, 2003). According to Nielsen (2003), the potential economic gain of noncompliance is compared to the risks of being detected (effectiveness of the enforcement) and the amount to be paid in penalties if detected. Sutinen *et al.* (1990) in their study explain that the high incidence of non-compliance behavior in the ground fish fishery on the US East coasts can partly be attributed to the relatively low economic sanctions in contrast with the large economic gain accrued from illegal fishing. According to the authors this provides evidence that instrumental incentives are essential factors to understand fishers' compliance behavior.

The normative approach deals with social relations and normative values of fishers'. The social relations can go either way and create incentives or disincentives for compliance behavior. Norms are seen as social pressure and are often defined as the typical actions; attitudes, standards and expectations among fishers which is influenced by the behavior and attitude of peers (Nielsen 2003). This includes moral values which are established through interaction with other individuals in the group together with one's own values based on personal reflections. They most often create both positive and negative sanctions. Nielsen (2003) points to the fact that fishers' personal moral and perception of what is right and wrong as well as personal experiences with enforcement

authorities and the Court will have a large consequence on fishers' attitude towards compliance and noncompliance.

Control and legitimacy

The lack of compliance in many fisheries has drawn the attention to the importance of legitimacy of fisheries management. This is in spite of increased enforcement and MCS activities. Often times the tendency among social anthropologists has been to see fishers as predominantly law-abiding whiles most fisheries managers or authorities have tended to regard all fishermen as potential violators. Hoel *et al.* (1991), pointed out that "regulation is about the articulation and aggregation of conflicting interests and demands, and the exercise of "cruel choices"'. Legitimacy introduces the political aspect of the regulation process. People will obey the law if the law enforcement authorities and the law itself are seen as legitimate. Generally, the way one has been treated (fair or not) and experience with the authorities is an essential factor which can undermine or enhance legitimacy. Jentoft (1989) pointed out four factors in this respect, where the hypothesis is, that ''the more directly involved the fishermen are in installing and enforcing the regulation, the more the regulation will be accepted as legitimate''. This includes: (a) content of the regulations; (b) distributional effects; (c) making of the regulations and (d) implementation of the regulations.

More so, Tyler (1990) argues that personally recognized obligation to comply with regulations is the single most important element with regards to legitimacy and compliance, whereas support to the involved institutions happens to be less important. The current legitimacy crisis in fisheries management must also be explained by the mismatch between what users regard as reasonable and imperative within the local context in which they operate, and what governments see as rational and efficient from a global point of view (Jentoft, 2000). Hersoug and Paulsen (1996) used the term legitimacy to describe the acceptance and compliance on behalf of the fishermen or the whole fishing industry. They contend that all types of fisheries regulations have to be based on a minimum legitimacy so as to reduce the cost of control and enforcement and ensure that rules and regulations are considered just in fair among participants.

At this point it will be prudent to highlight on the two dimensions of legitimacy "content legitimacy" and "procedural legitimacy" as Jentoft (1993) puts it. The former deals basically with what the regulations entail and the later describe the process and parties involved in formulating the regulations. These two dimensions can be combined as shown in figure 1.

		Content legitimacy	
		HIGH	**LOW**
Procedure	**HIGH**	1	2
Legitimacy	**LOW**	3	4

Figure 3.1: Types of legitimacy.
Source: Jentoft (1993: 110).

Square 1 represents a simple scenario where the fishermen are expected to abide by the regulations, while square 2 presents an interesting case where the fishermen may be dissatisfied with the final decision (rules or regulations), even though they accept the procedure that has been followed. Here, fishermen are involved in the decision-making process but ignored in the final outcome and there is still a good chance of the fishermen obeying the regulations. The same applies to the case of square 3, although this situation is less likely to occur, possibly because fishermen are totally ignored in the decision-making process. Square 4 represents a situation where one would expect fishermen to act dishonestly and seek possible alternatives that will suit their interest. Frustrated and disappointed fishers' may show their discontent by disobeying the regulations like deliberately using illegal gear or exceeding their catch quota. Thus Jentoft (1993) concludes that:

a) Fishermen must be involved, in order for a regulatory system to be effective,
b) A management system will never be better than is permitted by the fishermen.

However, the question of efficiency and involvement is difficult to put into effect. Involving too many fishermen in decision-making can be equally bad as too little. The optimal mix of involvement as pointed out by Hersoug and Paulsen (1996) depends both on the type of fishing and the general political conditions of the state in question. In addition, the quality of the regulatory system as mentioned by the authors will also depend on the types of fisheries (few or many boats), amount of resources employed in the MCS-system (e.g. few or several patrol boats, inspectors etc.) and the natural conditions such as harbors.

Theory of the tragedy of the commons

The Tragedy of the Commons (Hardin, 1968) which has been cited many times, helped in several studies on cooperation in the face of collective action problems. These kinds of problems are imperative for resource managers and also of some theoretical interest in the area of fishery (Diekert, 2012). Population invariably grows and in a finite world this means the per capita share of the world's goods must steadily decrease while a fair defense in finite world can be put forward for the view that the world is infinite. However, a finite world can only support a finite population which means that population growth must eventually equal zero.

The tragedy of the commons also resonates with the conundrum of pollution and overexploitation of fishery resources including water bodies. Fishing with banned substance or chemicals, radioactive and release of heat waste into water bodies through light fishing is distracting and unpleasant. The estimations of utility or satisfaction are much the same as before. The rational person is able to observe that his share of the cost of the wastes he discharges into the commons is lower than the cost of purifying his wastes before releasing them into the commons. Everyone is therefore locked into what Hardin (1968) calls "fouling our own nest", when we behave as independent, rational and free-enter-prisers. As a food basket, the tragedy of the commons is reversed by private property. Since the air and especially the sea cannot readily be fenced, it is important that the tragedy of the commons be prevented by different means. This could be done through legislation or taxing devices that make it easy for fishers to engage in illegal fishing.

Hardin (1968) argued that it will be farfetched to think that we can control the breeding of mankind in the long run by means of an appeal to conscience. With reference to Charles Galton Darwin, the

people vary and when they are confronted with appeals to limit births, some will respond to the plea more than others. Parents with more children will produce a larger fraction of the next generation than those who have a more susceptible consciences and the difference will be accentuated, generation by generation. The long-term disadvantage of an appeal to conscience must be able to condemn it but there is also a short-term disadvantage. Conjuring up a conscience in someone is tempting to anyone who wants to extend their control beyond the legally accepted limits. People in high level leadership usually succumb to this kind of temptation. Chief fishers or very experienced fishers for example can brainwash young and inexperienced fishers to behave in a particular manner.

The idea of a relative punishment scheme to enforce cooperation of the fishery laws and regulations could be to merge it with a more realistic modeling of climate change situation through the use of a game theory. Most of the problems in the fishing industry could be solved if both the natural and social aspects of the respective problem are appreciated and well understood. Sustainable development and in fact exploitation of natural resources could be achieved through a change of human relationships with the environment (Diekert, 2012).

It has been mentioned by Bebbington (1999) that, access is, perhaps, the most critical resource if people are to build sustainable and poverty alleviating rural livelihoods. Therefore, in order for an effective management of small scale fisheries to reduce the problems associated with open access, there is the need to examine the concept of poverty in order to understand the links between rural poverty and resource sustainability.

The concept of poverty

According to Gordon (2006), poverty has become a universal concept but its definition is mostly contested. The concept has different meaning depending on the subject area under discussion. In spite of the no-clear- cut definition for the term “poverty”; there are clearly relative definitions of poverty. All the definitions refer to poverty not as some ‘absolute basket of goods’ but in terms of the minimum acceptable standard of living which is applicable to a particular country and within a person’s own society. There is a universal agreement that poverty can be defined as having inadequate command of resources over a period of time. The concept of poverty has over the years

evolved from a simple statistical or economic indicators based on nutritional inputs, income and consumption for a given household which was commonly used in the 1960s to the development of the basic needs concept which was promoted by the International Labor Organization (ILO) in the 1970s (Agbenya, 2009). The 1980s set the tone for a more robust approach in redefining the concept of poverty which took on a multidimensional and complex perspective (FAO, 2006). The diagram below illustrates the evolution of the concept of poverty with its multi dimensionality of indicators showing the shift from simplified statistical/economic to more recent attempts which try to embrace the multi-dimensional aspects of poverty.

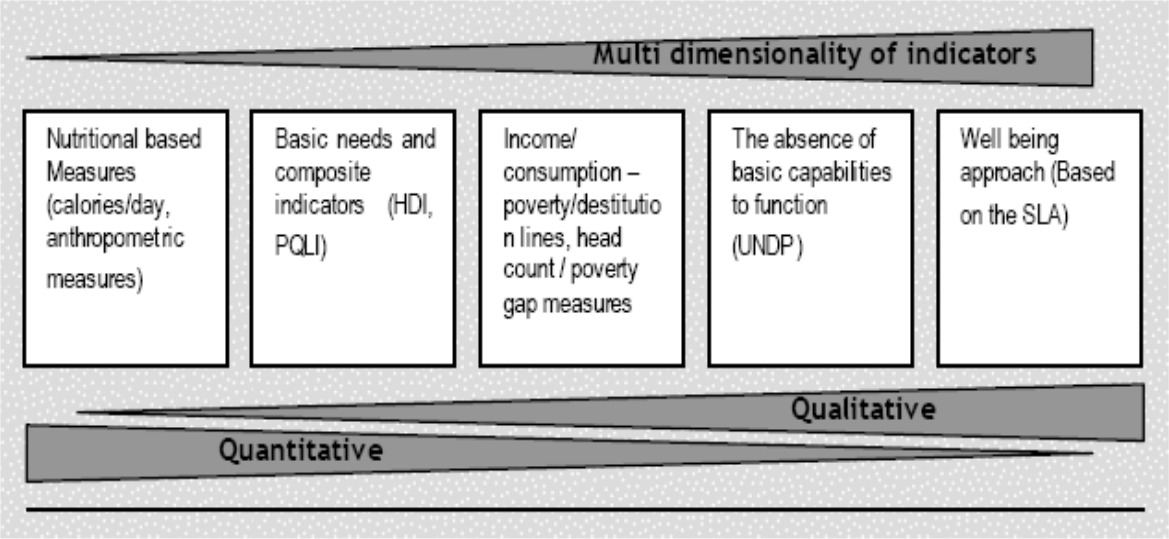

Figure 3.2: Different indicators of poverty showing their evolution to embrace a more holistic understanding of poverty.

Source: FAO (2002).

Bebbington (1999), argued that the concept of poverty has wide implications, which must be addressed in order to understand the links between rural poverty and livelihood sustainability. Broader definitions of poverty have been used, for example:

"Poverty: a human condition characterized by the sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of

living and other civil, cultural, economic, political and social rights" (UN Committee on Social, Economic, and Cultural Rights, 2001).

According to Naryan et al. (2000), five key elements contribute to the concept of poverty with regards to the poor. These are:

- Poverty is multidimensional and complex.
- It is a lack of the assets needed for well-being.
- It includes psychological aspects (feeling of powerlessness, humiliation and insecurity).
- It is an absence of basic infrastructure.
- It focuses on assets and vulnerability to risk, not income.

The World Bank (2000) defined poverty as a pronounced deprivation of well-being where well-being is measured by an individual's possession of income, nutrition, health, education, housing, assets, certain rights in society as freedom of speech and lack of opportunities, powerlessness and vulnerability. Likewise, poverty is not necessarily related to money, a person may be poor according to income poverty indicators, but be better off in terms analyzed outside the cash economy. Poverty has been analyzed using both quantitative and qualitative indicators. Béné *et al.* (2004), categorized poverty into two broad headings: the Monetary Poverty Profile and the Human Poverty Profile.

Monetary poverty profile / Quantitative indicators

The monetary poverty profile, seeks to measure poverty based on certain defined minimum welfare functions that are necessary for an individual to meet the poverty line (Adjasi et al. 2007). The poverty line can be defined either as biological, needs based or normative (Béné et al. 2004). Biological needs include expenses incurred in obtaining the daily calories necessary for the survival of individual, whereas, needs based involves expenses needed to satisfy other basic necessities in life like housing, clothing, health, apart from food, and normative deals with selecting a certain amount of daily expenses such as the daily threshold of $1 and $2. Here individuals with mean per capita income below the established poverty line are regarded as the

poor or needy in society. Other monetary poverty indicators include, the incidence of poverty, the severity of poverty, the extent of poverty, the capacity to overcome poverty and the vulnerability to poverty (Béné et al. 2004).

Human poverty profile / Qualitative indicators

The human poverty profile as proposed by the UNDP (1997) describes poverty as the absence or lack of basic capabilities to function such as access to proper health care (life expectancy rate, infant mortality rate), education (the ability to read and write), living conditions (access to potable water, access to good roads and access to other basic infrastructures) (Agbenya, 2009). It incorporates the concept of vulnerability and dwells mainly on social and physical indicators rather than monetary indicators.

Meanwhile, vulnerability as pointed out by the FAO (2002) is a separate issue to poverty and it is linked to the asset-base of the household or individual. It refers to defenselessness, powerlessness, insecurity and exposure to risk, shocks and stresses. That is, situations that are outside peoples' control. They are usually seen as negative but can also provide positive opportunities. This component includes comprehensively three main external factors (shocks, trends, seasonality) that may affect the livelihood assets of a fisher. Shocks may include storms and events that destroy shore facilities such as fishing boats, nets, fuel-price hikes, market price fluctuation of fishing products and currency devaluations that affect the costs of fishing inputs (Allison and Beniot 2006). For instance, the death of a relative is obviously considered as a shock. Trends has to do with events beyond the control of the fishers household which might include decrease in catches, increased restrictions imposed by authorities, and trend in migration of fishers (Atta Mills, 2004). Seasonality refers to seasonal changes within the fishing seasons such as temporal closures and closed seasons.

Many of the factors embedded in vulnerability are mentioned in the definitions of poverty. "The poor are those who experience vulnerability, social marginalization, exclusion from a sustainable livelihood, and have self-perceptions of poverty as well as income poverty." (Beck and Nesmith 2001). If poverty reduction is the priority of governments and aid agencies, then decreasing the vulnerability of people to fall into poverty must be one important element of this task (FAO 2002).

It is therefore appropriate to assist the vulnerable in the society rather than the poorest, if one wants to reach the largest number of people.

To sum up, the concept of poverty has gone through a lot of redefining and currently it embraces both the monetary indicators and the human poverty indicators giving it a multifaceted and complex approach (Agbenya 2009). More so, how one defines poverty, affects what should be measured, and how, as well as the ability to identify poverty reduction measures (FAO, 2002). New approaches are needed to cope with more sophisticated understanding, in step to narrow the gap between previous professional definitions and local perceptions (FAO, 2002). Understanding the relationship between poverty and fisheries will be worthwhile.

Poverty in small-scale fisheries

The relationship between poverty and fisheries is complex but mostly reduced to a level that does not allow for the development of an appropriate response. This relationship can even be presented in both competing and contradictory arguments. The ways in which people's livelihoods depend on fisheries is influenced by or influences poverty differs greatly. Degradation of fisheries resources will result in disproportionate impacts on poorer people. Since the relationship between poverty and fishing cannot be a simple correlation between poverty and dependence on fishing. It is imperative to use a more rigorous analysis which will account for both the diversity of fish-dependent livelihoods and the complex nature of the causes of poverty. Poverty must be combined with other concepts like vulnerability and marginalization. This will enhance the thorough discussions of the issues. Vulnerability looks at the various risks associated with fishing. Marginalization is also an aspect of poverty that is peculiar to fishing communities (Béné and Friend, 2011).

The causes of poverty in small-scale fishing communities are not only related to low catch but other socio-institutional constraints. Although the overexploitation of fishery resources may be a major cause of poverty in fishing communities, extreme poverty can also be seen in very remote fishing areas where fishers catch and trade adequate volumes of fish but lack access to health and other public services. It is important to state that the nature of poverty in fishing communities is

not necessarily specific to the fishing communities. It rather mirrors a broader issue of rural poverty and the general lack of economic, political and institutional development that affects rural areas within which fishing communities usually live. For many households that engage economically in fishing activities in developing countries, fishing does not generate high profitability. It rather helps them sustain their livelihoods and prevent them from sinking deeper into deprivation (Béné, 2006).

According to Asiedu *et al*. (2013), in most Sub-Saharan African countries, there is a widely held view that fishing is exclusively for the poor and therefore little potential for development. Income and consumption of respondents can be used as indicators of poverty or wellbeing of fishers. There is however, an urgent need to find solutions to all the causes of poverty. This could be done by providing credits, fishing inputs and market, among others for fishers in the fishing communities. Poverty and low profitability among fishers could be reduced through diverse and complementary actions.

The change in perspectives on both poverty and extreme poverty in fishing communities is partly due to recent research. Urban coastal fishing communities are usually affected by the proximity of basic services, reliable markets and alternative employment opportunities. They are also affected by price hikes and pressures from the tourist industry that is increasing land prices along the coast. Rural coastal fishing communities have on the other hand benefited from the improved road network that has resulted in a newly surfaced and speed controlled road running almost the entire length of the coast. This improves their accessibility to services and markets. The nature of poverty in inland fisheries is basically the same as what prevails on the coast. Small-scale fishers face similar constraints and difficulties regardless of the water body they fish in. For marine fishery in particular, two peculiar issues help to explain the existence and perpetuation of poverty on the coast. They are the distribution of wealth in the fishing community and the nature of the pelagic stocks usually targeted by marine fishers. Fishing communities may cope with poverty by migrating to the cities or use salt and brackish water lagoons for fishing during the lean period (Bennett, 2002).

The sustainable livelihood approach, which is vital in recent development, seeks for a greater involvement of all stakeholders with specific sets of guiding principles and an analytical framework for fisheries management (Neiland & Be´ne´, 2004). These set of operational principles

aim at reducing vulnerability and poverty in communities engaged in small-scale fishing, their assets and access to fishing grounds, fish processing and trading (Stirrat, 2004). The main idea is to empower rural fishers to improve their livelihoods through the application of sustainable livelihood approaches.

Sustainable livelihood approach to fisheries management

The importance of sustaining small-scale fisheries has in recent times become very palpable with fisheries management. More and more of people within fishing communities make a living from the fisheries value chain which includes the actual fish capture, processing and distribution. However, the scaling up of both industrial and artisanal fishing has become worrying for many countries. The overexploitation of the fishery resources is affecting the livelihoods of fisher folks. The Sustainable Livelihood Approach (SLA) has increasingly become useful in development thinking as a way of conceptualizing the economic activities of poor people and very helpful in bringing fuller understanding of fisher folk's adaptive strategies into the policy arena of small-scale fisheries management in low-income countries. (Michelle and Ruth 2002; Allison, 2003).

The approach is increasingly adopted by NGOs and development agencies to achieve better understanding of natural resource management systems since it has a chief point of departure to avoid undue preoccupation with a particular component of individual or family livelihood strategies to the neglect of other components that make their own demands on the resources available to households involved in natural resource-based activities (Ellis, 1998; Bebbington, 1999). The SLA seeks to identify what people have as a fundamental percept than what they do not have and to strengthen people's own inventive solutions, rather than substitute for, block or undermine them by seeking to improve rural development policy and practice through seasonal and cyclical complexity of livelihood strategies (Moser, 1998; Allison, 2003).

In all, the framework helps in making livelihoods as a whole to cope with adverse trends or sudden shocks by removing access constraints to assets and activities that complement existing patterns (Allison, 2003).

According to Allison (2003) there is no prescribed principles of the SLA, but the core principles underlying the SL can be summarized as:

a) Making links between local issues and wider concerns such as the national policy and economic or social change.
b) Putting people's social and economic activities at the center of the analysis (rather than, for example, just their 'fishing effort').
c) Taking a wide view of sustainability through four key main dimensions – economic, institutional, social and environmental.
d) Being responsive and participatory in addressing management priorities i.e. working in partnership with fishers and other stakeholders both in the public and private sectors to promote dynamic, adaptive approach to management.
e) Taking a view of the options for management and development intervention that transcends traditional sectoral boundaries such as fisheries.

The core principles, concepts and method of the SL framework centers the link between individual or household assets and the mediating process that govern access to assets and alternative activities. This is applied to understanding the role fisheries play in the rural economy of developing countries (Allison and Ellis, 2001).

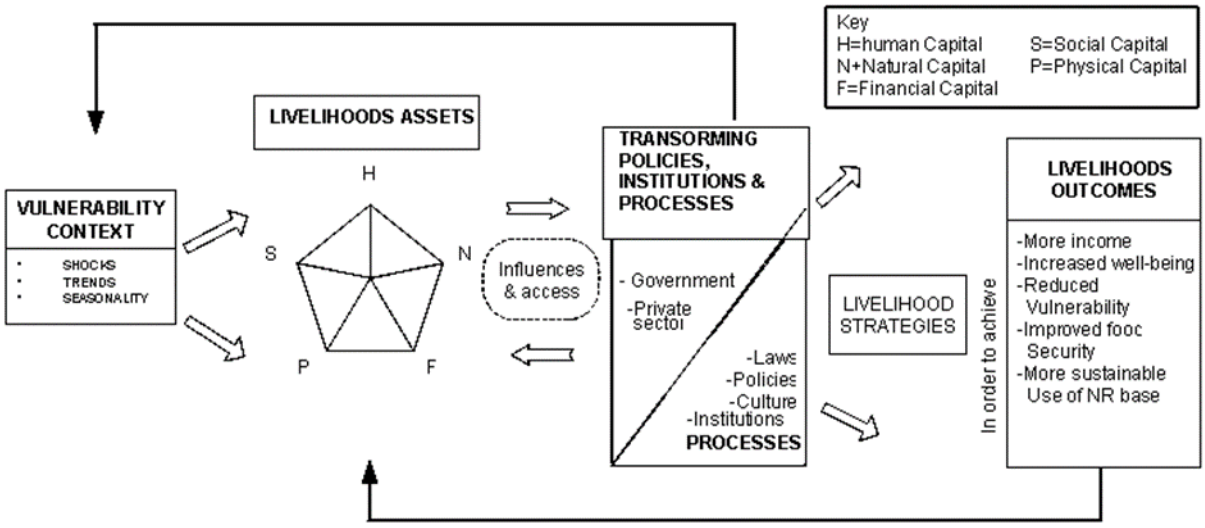

Figure 3.3: Sustainable Livelihoods framework

Source: Allison (2003).

From the SL framework, livelihoods are built on a platform which comprises of assets that an individual or households can draw on (Allison, 2003). These assets (Asset Pentagon) which forms the starting point of the framework are the capital assets (divided into 5 categories) owned, controlled, claimed, or through other means accessed by a household. The assets comprise of physical capital (at household level-boats, house, cars, buildings, at community level- access to roads etc.), natural capital (fish species, water, tree, area of seabed etc.), financial capital (money, loan access, savings, credit), human capital (skills, labour, education, health), and social capital (network and associations) (Allison, 2003).

The sustainability of livelihoods (assets or activities) are associated with or threatened by risk factors i.e. external shocks, trends and seasonality of activities which is referred to as the Vulnerability Context**.** Access to the use of the assets are regulated by structures both formal and informal (policies and institutions) which is summarized in the framework as Transforming Policies, Institutions and Processes. Livelihood Strategies are developed by people based on their response to available assets and within the constraints provided by the institutional environment. Efforts by people should improve the standard of living whiles maintaining natural resource base (e.g. fish stock) and reducing risks (vulnerability). This is referred to as the Livelihood Outcomes.

Therefore, the SL framework points to several ways to support livelihoods by reducing vulnerability, creating enabling policies or institutions with existing asset base or livelihood strategies (Allison, 2003).

The vulnerability context

Vulnerability context, refers to situations that are outside the control of a household usually comprises of trends and shocks (Allison, 2003). Shocks may include storms and events that destroy shore facilities, cost of in fishing inputs, and death of a relative (Allison, 2003). Trends has to do with events beyond the control of fishers e.g. the increasing price of fuel, decreasing catch rates, increased restrictions imposed by authorities, and trend in migration of fishers (Atta Mills, 2004) as well as a change in the fishing seasons such as closed seasons or seasonal closure.

Understanding of the vulnerability context (how people succeed or fail) in sustaining of livelihoods helps in the formulation of policies and interventions to assist in existing coping and adaptive strategies (Allison, 2003).

Transforming policies, institutions and processes (structures)

Structures affect how people use their assets to improve their livelihoods. Access to both assets and activities is either enabled or hindered by structures (policies, institutions, processes) which includes social, institutional and organizational relations (Allison, 2003). This may occur at different levels i.e. global, national, community and household i.e. through formal or informal institutions e.g. a fisher may only be possible to access fishing if he has a license or he is a member of a local fishing community. The license forms part of a formal institution enshrined in national (or bye-laws) whiles being part of a local group forms the informal institution regulating access to the fishing groups (ibid).

Access regimes and how they work (or not) are the heart of fisheries management since policies, institutions and organizations can help by supporting the design of appropriate regime and providing an enabling environment by ensuring that any fisheries management intervention gives full consideration to the range of resources available (Allison, 2003).

Livelihood strategies

Livelihood strategies as to do with the individual's available and implemented options for pursuing livelihood goals. The greater the diversity of livelihood strategies adopted, the higher the household's resilience to the shocks, trends, and seasonality conditions within the vulnerability context, hence the more sustainable the livelihoods of the people (Allison and Beniot, 2006). Some of the strategies adopted by fishers especially among Ghanaian small-scale fishers are mobility and migration. This is seen as a livelihood diversification strategy especially during lean seasons of fishing.

Livelihood outcomes

The final component of the framework is the outcomes of livelihood strategies thus referring to the outputs of livelihood strategies. Achievements may include higher income, high capital assets, greater well-being (e.g. self-esteem, physical security, and political empowerment), reduced vulnerability, greater food security, and/or improved environmental sustainability. (DFID, 1999). A sustainable livelihood is one that is able to maintain or improve the standard of living of people, reduce their vulnerability to external shocks and trends and ensuring their activities are compatible with maintaining natural resource base e.g. fish stocks. (Allison and Beniot, 2006). Therefore, a sustainable livelihood is likely to build people's capital assets, maintain natural capital and maintain social capital (Allison, 2003).

To ensure a sustainable livelihood, all the components of the framework must be efficient.

CHAPTER 4: METHODOLOGY

This chapter basically focuses on the approach employed for the study. The chapter gives a vivid description of the study area, sampling methods, data collection methods, data analysis and the limitations of the study.

Description of the study areas

The geographical area of study is the Chorkor and Teshie-Nungua area in the Greater Accra region of Ghana. Chorkor and Teshie-Nungua are well organized communities according to certain structures. The local fishers, chiefs, chief fishermen, representatives of the traditional council, assemblymen, and fish mongers play active roles in the fishery. A lot of governing takes place at the local level through the local government which are linked to traditional government. These two fishing communities are long established centers of artisanal fisheries dating back to the 18th century (AMA, 2010). Fishing is the main occupation in both communities and often regarded as the currency too. The men usually engage directly in fishing (weave the nets, build the boats, and sail all night to catch and land the fish), whereas the women are mostly involved in all forms of fish processing (drying, smoking, salting and marketing). The whole process is very fascinating and the people are more relaxed in their activities. Child slavery is not a prevalent problem in these two communities as it is in the Volta Lake region of Ghana (Agbenya, 2009). However, most children often assist in retrieving the nights catch before they go to school. The two fishing communities were selected because they have been directly affected by issues regarding the use of light fishing technology.

Chorkor is a fishing community and part of the Accra Metropolitan Assembly in the Greater Accra Region of Ghana. It is a densely populated area and Ga-Dangme is the largest ethnic group in the area. A major source of employment for the people of Chorkor is fishing along the coast of Accra. The Accra metropolitan assembly has an estimated land area of 173 km^2. It shares boundary with the Gulf of Guinea, to the south, which stretches from Gbegbeyese to La. To the east, the assembly shares boundary with the Ledzokuku-Krowor Assembly. The Ga East and Ga West are on the Northern and Western frontiers respectively (AMA, 2015).

Nungua is also located in the Ledzokuku-Krowor Municipal Assembly (LEKMA) and it is the capital of the assembly. LEKMA is a relatively new district that was inaugurated on 29th February, 2008 under the Legislative Instrument (LI 1865) and through a merger of Teshie and Nungua sub-metros. It shares boundaries with La Dade-Kotopon Municipal and Tema Metropolitan to the west and east respectively. It has a population of 227,932 according to the 2010 population and housing census. About 121 canoes which operated within LEKMA were registered in 2014 to help the assembly to have a database of the fishing industry. It is imperative in initiating more effective solutions to constraints confronting fishers in the area (Ghana Districts, 2014).

Figure 4.1: Map showing the position of the study areas.

Source: Sobang (2014).

Sampling methods

Two main types of sampling are invariably employed in research. These are the probability sampling and non-probability sampling. Probability sampling is where every respondent in the sampling frame has an equal chance of being selected to be part of the sample. Non-probability sampling does not give equal chance to every respondent to be selected to be part of the sample. Probability sampling is chosen mostly because it assures us that the sample is representative and that errors for the sampling can also be estimated. The types of probability sampling include random sampling with and without replacement, stratified sampling, cluster sampling, systematic sampling, among others. For sampling with replacement, a certain element is selected after measuring the variables needed in a certain study. This technique is also referred to as simple random sampling. If the element cannot be selected again after being chosen once, the sample obtained is through sampling without replacement. For stratified sampling, a conscious effort is made to make all groups or strata to be represented in the sample. In cluster sampling, the population is divided into groups which should be as represented as possible for the population. The sample must represent the heterogeneity of the population and should also be homogeneous among them. Systematic sampling is however akin to random sampling if the elements are randomly numbered (Barreiro and Albandoz, 2001).

Non-probability sampling methods also include convenience, purposive, snowball and quota sampling. Convenience sampling is where respondents or participants are selected because they are readily available and agree to participate in a study. It can also be called accidental sampling. In purposive sampling, the participants are selected based on the researchers own knowledge of the population, its elements and also based on the research aims. This type of sampling is very appropriate for pilot studies. Snowball sampling is where previously identified respondents are relied upon to identify others who may have similar characteristics as the respondents already identified. This method can be used where the population that we are interested in cannot be identified other than by someone who knows that a particular person has the necessary experience to be included in the sample. Quota sampling is an appropriate method to employ to non-randomly selected groups based on age, gender, ethnicity and other socioeconomic characteristics. The population being studied is divided into subgroups (Latham, 2007).

However, for this study, the purposive sampling technique was used to select the communities (Chorkor and Teshie-Nungua). The local council and the assembly members were first used to gain access to the communities. After gaining access to each community, the respondents were also contacted by using the snow-balling method, yielding a sample size of 40. The respondents included fishers and key stakeholders in the fishing industry. The stakeholders included Chiefs, Chief fishermen, Non-Governmental Organization (NGOs) and Assembly members.

Respondents

The target population for this study were inhabitants of Chorkor and Teshie-Nungua who are fisher people. They include the chiefs, chief fishermen, boat owners, net owners, fishmongers, 'fish mammies', migrant fishermen, assemblymen, NGOs, and the Directorate of fisheries.

Table 4.1: Showing the number of respondents interviewed in the two fishing communities.

Respondents	Number
Traditional chiefs	2
Chief fishermen	2
Assemblymen	2
Boat owners/ net owners	10
Directorate of fisheries	1
Fishermen	18
Fish Mongers/ 'fish mummies'	5
Total	40

Source: Author's own construction

Data collection methods

Chaleunvong (2009) identifies the various data collection methods as using available information; observing; interviewing; administering written questionnaires and focus group discussions. Observation involves the systematic selection, watching and recording of behavior and characteristics of phenomena or living beings. Interview involves the use of written questionnaire to collect data from respondents. The written questionnaires can be administered by sending them by mail with clear instructions on how to answer the questions. Written questionnaires can also be administered by hand-delivering them to respondents and collecting them later. The respondents can also be gathered in one place at one time to fill out the questionnaires. In focus group discussion, a group of 8-12 informants meet to openly or freely discuss a particular subject with the guidance of a facilitator. The study relied on both primary and secondary data. Primary data was obtained through field work using qualitative interviews, focus group discussion and participant observation. Secondary source of information included reports, publications, fishing records, and online sources.

Photo 4.1: Interviewing a chief fisher at Chorkor.

Source: Fieldwork (July, 2015).

Data analysis

The data collected will be analyzed qualitatively to give a better understanding of light fishing in the study area. The analyzed data will also bring to the fore most of the effort made by government and other stakeholders to bring the problem of light fishing under control. The data of the research will first be managed by doing data coding. A critical observation and cross-checking of the data will also be done to identify themes, patterns and topics. The patterns and topics identified will then form the major findings for further discussion. Unfortunately, not much quantitative data was available on most of the issues related to light fishing. This could have enhanced the knowledge on how the various institutions are faring in abating this illegality by comparing the quantitative data over a period of time.

Limitations and ethical consideration of the study

Consent was sought from the respondents before conducting interviews in the various communities. Some limitations however became associated with the study and it is worth noting. The study is based on only two fishing communities in the Greater Accra region of Ghana. Financial constraints made it impossible to explore all the three active fishing regions in Ghana, especially Central (Cape Coast) and the Western region (Takoradi) which have a high incident of light fishing activities. Hence, generalizations were focused on just small percentage of the population of both fishing villages. The method of sampling was however not robust enough to make a more effective and general conclusion of what pertains to the fishing communities in Ghana. The study may be limited due to time constraints and adequate quantitative data. It was difficult to do a more detailed study within such limited time frame (2 months). In spite of these limitations the quality of this study was not affected.

CHAPTER FIVE: RESEARCH FINDINGS AND DISCUSSION

Having discussed the methodology used in collecting the data for the study and the theories underpinning this research in the previous two chapters, the subsequent two chapters of the thesis presents the research findings and interpretations from my fieldwork in Chorkor and Teshie-Nungua fishing communities. As mentioned earlier, data was collected from traditional chiefs, chief fishermen, local fishermen, boat and net owners, assemblymen and some fish mongers**.** Interpretations of data and results were analyzed, based on the responses from these participants.

Overview of research findings and interpretations

The Government's decision to abolish the use of light aggregating equipment in the Ghanaian fishery has divided opinion. This development has to some extent divided the leadership front (chiefs, chief fishermen) of fishermen in the country. Whilst some fishermen are kicking against the law, describing it as harsh and poor enough to ruin their business, others in the same community believe the new law prohibiting the use of light aggregating equipment is good and satisfactory. During the interviews with the respondents, there were conflicting views and stories with regards to the use of light aggregating equipment to attract fish and the associated biological, social and economic impact on the society and the fish stocks. The Ministry of Fisheries/Fisheries Directorate eschew this practice as well as some Non-Governmental Organizations (NGOs) and other fishermen. According to the Fisheries Commission of Ghana, light fishing is practised in all coastal communities across the country including Chorkor and Teshie-Nungua fishing community. I noticed that although this fishing method is prohibited in the country, and strongly backed by the chiefs, chief fishermen and the assemblymen in the Chorkor and Teshie-Nungua traditional areas, some fishermen still use this method to attract fish. The majority of the fishermen believe any attempt to ban light fishing is likely to be resisted since it will throw them out of business. The practice has become part of their ordinary business and according to some skippers, it is now a free-for–all affair. Fishermen in these two communities also travel as far as Cape Coast (Central region) and Takoradi (Western region) to practice this fishing method.

Not surprisingly it was evident that fishermen who think that other skippers are breaking the law are more likely to practice the act themselves. Another interesting development was the fact that fishermen who do violate the law also feel that they are less likely to be arrested than those who do not engage in such practice. More so, the perceived probability of being fined if arrested is much higher for non-violators than violators of the regulation. Also data gathered from my findings show that those fishermen who support the abolishment of light fishing method probably do not have access to light fishing equipment and bigger vessels to fish deeper in the sea, hence there is a problem of distribution with regards to the use of light. Some Chief fishermen were of the opinion that the practice is mainly carried out by the young fishermen who are not so skilled in the industry and yet call themselves fishermen.

To sum up, fishing with light aggregating equipment is prohibited in Ghana but still persist. This is due to several causes but the most important is that the regulations are not enforced. The MSC-system in Ghana is weak, partly because the cost of logistics and personnel required to undertake surveillance activities is too expensive for the government. The government relies on foreign aid to help carry out some of its operations. To add to this, the country has a large coastal area and even efforts by some local communities to act as watch dogs have not been successful. There is also an issue of different jurisdictions: one official and one traditional, where light fishing is accepted by some communities in Ghana and backed by the traditional chiefs. Other communities like the Chorkor and Teshie-Nungua traditional areas do not accept light fishing, although one will admit some fishermen in these two communities still use this fishing method. The big question, however, is; if the chiefs/headmen do not accept light fishing, why are they not doing anything to enforce the prohibition? Fishermen migrate to other fishing communities along the coast to practice this method. This together with other key concepts such as legitimacy (extent to which fishermen are involved in decision making) and respect for rule of law are questions to be addressed. Jentoft (1989) pointed out in this respect that, ‘‘the more directly involved the fishermen are in installing and enforcing the regulation, the more the regulation will be accepted as legitimate’’

Last but not the least, light fishing is a case of conflicting technologies, and hence a case of different class interests. Light fishing changes the distribution of the total catch, in favor of the

industrial fishers as most artisanal fishers claim. Some artisanal fishers cannot afford the generators, premix - fuel and high wattage bulbs used for light fishing. This makes it difficult for most of these fishers to make ends meet since there is no alternative livelihood source of income. They go for fishing and return with empty nets, a situation they have to deal with even during the peak fishing seasons.

The history of light fishing in Ghana

According to Mr. Mr. Nemorius N. Peng-Yir, a director of the Ghana Fisheries Commission, light fishing was practiced elsewhere (although he couldn't state the exact place) before being introduced into the Ghanaian fishing sector. It was done on experimental basis in the Teshie-Nungua District (Greater Accra) and Takoradi (Western region) by the then Minister, Honourable Gladys Asthma. The results turned out to be very destructive and had to be abolished. The director contended that the result of fishing with light aggregating equipment was efficient but not productive in the sense that it destroys the juvenile and spawning biomass. He therefore asserted that light fishing should be banned in a multispecies fisheries system in Ghana. According to him, the practice was never legalized at all. Some people saw it and advocated for it. The innovation of light fishing has allowed fishers to fish all year round.

Photo 5.1: Light aggregation fishing.

Source: Yamoah (2012).

When asked why the experiment turned out to be destructive, the director said it catches all kinds of fish, including big and small fish, young and the spawning biomass. According to him taking the young ones will destroy the stock of the fish. The spawning biomass cannot produce their offspring or lay the eggs and therefore after some few years the fish in the ocean will be destroyed. Light fishing aggregates both the mature and young fish which in turn renders fish more easily to be caught. There is more pressure on the fish stock.

When asked if the light fishing method is productive, he said,

> "*What do you mean by productive? '' I do not know the figures'' '' I won't know the figures. If you are talking about quantity of fish it will definitely catch huge amount of fish but you can't call it productive when you are destroying the juvenile fishes in the ocean considering the fact that the Ghanaian fisheries is a multi-fisheries system*". (Interview with a director of the Ghana Fisheries Commission).

The various stakeholders (chiefs, chief fishermen, NGOs, assemblymen) shared a similar perspective although some chief fishermen believe the practice was introduced by the Japanese and Italians who were fishing in Ghanaian waters many years ago. Local stories have it that light fishing method was introduced in the country by the Korean and Chinese semi-industrial fishing vessels.

According to Nii Odai, a chief fisherman in Chorkor, light fishing started in the 1960s. The Chorkor community does not encourage light fishing. It is practiced from Axim to Kasoa Nyanyano. Although government has passed a law to prohibit light fishing, it is still being practiced in the central region (Fante) and Takoradi (western region), and from Tema to Sogakope. Again Nii Odai in sharing his views about the evolution and impact of light fishing had this to say,

> "*It was started by commercial vessels or big trawlers. It is a cheat to those in the Greater Accra region partly because the fish migrates from the central region to Accra and they are seriously seeking for ways to stop this practice. In an effort to fight against light fishing*

in 2010, the Chorkor community went on a demonstration to protest against this illegal fishing method only to be punished by the government (with guns and tear gas at the Castle)". (Chief fisherman from Chorkor).

A representative from the Ghana National Canoes Fishermen Council (GNCFC) of the James Town traditional area was also interviewed. According to Nii Kai-Okaishie, light fishing started in the Central region. Fishermen in the central region of Ghana are best known to invent new fishing methods. Light attracts all kinds of fish including the juvenile fish and the adult. The local fishers found the practice very profitable and effective and adopted the light fishing technique. They use a small boat called U-boat with generators and bulbs. The bulbs are lowered down into the sea. This attracts all kinds of fish before the bulb is removed slowly not to distort the movement of the fishes around the boat and also prevent the boat from capsizing because the fishes around can be very huge in number. Again, he mentioned that all kinds of fish like light, especially in the night just like how light attracts swamp of termites at night after a heavy rain. Day light however is not able to attract fish. As to who he introduced the method, he had this to say,

"*Personally I think light fishing was initiated by the Japanese and the Italians. I don't think the government introduced it. The issue is, in the past lights were used in fishing at night but these lights were just small bulbs and fire woods, they were not so powerful (advance) and produced no heat as compared to the high wattage of bulbs we have today. It was just an arms-length torch light*". (Interview with a representative from GNCFC).

Biological implications of light fishing

According to the chief fishermen interviewed in Chorkor, light fishing does not affect the biomass of the fish. Decrease in stock size of fish can be attributed to increasing population size of the community and the country as a whole. Thus, there is too much pressure on the fish stock due to inadequate income generating activities in the community. Further, global warming and general economic hardship is also a reason for the decrease in stock. Some fishermen believe the state of the fish stock is not encouraging. The fishermen in the area are able to gauge or estimate the stock level by normal sea observation. They claim that the 'fishy stench' from water is an indication of abundant fish stock in a particular fishing area. The stock level has become an important concern due to the overexploitation of the fishing resource. Some fish mongers and assemblymen were quick to attest to this claim. The director of the Fisheries Commission was also of the opinion that stocks have indeed declined in recent years. He mentioned that there is a need for a research based stock assessment to ascertain the true state of the fishing stock. This was what he actually said,

> "*The stocks have declined; we have not done any stock assessment for so many years now. All we know is that the stocks are declining from empirical information but we have no scientific data to back it. We have been fighting for research vessels for so many years. The government does not have the money (third world countries don't have the strong financial backing to carry out such analysis). The accepted period for stock assessment should be at least 5 years. I can tell you for a fact that for the last 10 to 20 years now there has not been any stock assessment in this country. We will need assistance from abroad. We had a project to acquire research vessels but we were not able to reach an agreement with our partners to acquire one because of our bureaucratic system coupled with politics"*. (Director of the Fisheries Commission).

The GNCFC opined that, light fishing has destroyed the fishing stocks. Although fishes do have their peak seasons coupled with seasonal migration, the use of this method has reduced the stock. The violators use this method as far as 30 nautical miles. They practiced this and realized their catches were reduced and they had to move closer to 20, 10, 8 and 5 nautical miles, very close to

the shore. This is a problem for those fishers who don't use this kind of method to fish. They are not able to get the fish. So many canoes in each household have contributed to the rapid decline in stock size (increase in population size and urbanization). Previously there were very few canoes in each house but it is different these days. According to the head of the GNCFC it is difficult to assess the stock of the fish, something which has not been done for years. You can't measure the size or quantity of fish in the sea because the fish migrates from one place to another. For instance, the stock of hearing migrates from Morocco through to West Africa all the way to Angola. This is influenced by the water temperature. Currently, (June- July) the waters in Morocco are very hot so all the hearing migrates here. The scent of the sea is an indication that there are lots of fishes in the sea mostly at certain distance. Before, old fisher folks could sense and spot huge scoops of fish at very long distances.

Economic implications of light fishing

The economic implication of light fishing is quite significant. Fishermen are more likely to receive low prices for their fish supply due to the quality of fish. According to the NGOs, light fishing affects the fish in the system. Fishermen end up bringing dead fish instead of live ones (probably as a result of previous activities by others' leftovers). Filth (human waste) that is dumped into the sea has become a major challenge in the fishing communities. The NGOs claim there has been instances where fishermen have gone fishing and their nets have captured only human waste. However, a Chief fisherman from Chorkor traditional area pointed out that, the quality of fish could be same as fish caught without the use of light aggregating equipment if handled properly but the fish mongers sometimes complain of low shelf lives of the fish caught by means of light fishing. The fish mongers lamented that,

> "*They invest so much in the business only for fishermen to bring in dead and decayed fish which had been trapped in the sea for days. Sometimes they have to reduce the prices of fish to recover some of the cost of operation*". (Interview with fish mongers).

The director of the Fisheries Commission was of the opinion that the quality of fish could be affected due to the fact that high wattage of light bulbs heats up the water and this could destroy the flesh of the fish. They use several bulbs with very high wattage to trap the fishes in the sea for hours. He contends that the practice cooks the fish in the sea before they are brought out. The fish mongers complain a lot about this practice too. The heat kills the fish and they smell sometimes. With regards to the differences in fish caught with light fishing method and that of the 'normal' fishing technique, he mentioned that, there is so much difference in quality of fish caught using light fishing. Light destroys the eyes of some fish, for example the "kankama" (*Sardinella auritus*). This reduces the market value of the fish.

Social implications of light fishing

Light fishing can cause significant social effects. According to a chief fisherman in Teshie-Nungua, the practice has indeed affected people in the community. He was quoted as saying;

> "*The light people are disturbing us. We don't get more fish anymore even at peak times like this month (June –August). When the fish is coming from far, they put light on it and catch all of them. We buy fuel and generators at high prices but we don't get any fish. We can't buy the big trawlers not even to access loans or credit even through the associations. The problem is when they give us loans we can't pay them back*". (Chief fisherman in Teshie-Nungua).

Some fishermen also attributed the phenomenon to the influx of Chinese activities and vessels in the fishing industry and other sectors of the country. The 'Chinese people' as one fisherman puts it, claim they also pay tax to the government therefore they are free to fish in the Ghanaian waters. This development has made it difficult for some artisanal fishers to make ends meet because they cannot afford the expensive generators and bulbs needed to compete with these 'Chinese people'. They say it is difficult for them to cater for the education and health needs of their children and families.

Also according to the head of GNCFC, fishermen who use this method can get over 200 crates of fish and make more profit. That is the huge difference between the violator and non- violators. They have the means (heavy vessels and equipment). Some also don't get any profit in it at all (thus a problem of distribution). He is also quoted as saying;

> "*If this practice is not stopped we will all soon go hungry because those fishermen who operate the trawlers own other businesses (have other livelihood alternatives) aside the huge amount of money they recoup from light fishing'. Let me tell you, an ordinary fisherman doesn't earn so much today. Gone are the days when we had other livelihood alternatives such as farming in the 'Korle Lagoon" in Accra, but what do we see today? All these resources have been used for settlement and construction*". (Interview with Nii Kai-Okaishie).

Monitoring, control and surveillance (MCS) of light fishing activities

According to the respondents, the Fisheries Enforcement Unit (FEU) under the MCS does the enforcement of light fishing laws. Culprits of light fishing sometimes have their equipment seized. The enforcement unit claimed that the number of generators seized from culprits were enormous and they were packed in their warehouse in Tema. Some of the fishermen still practise light fishing and advocate for the use of light fishing equipment. Those who have not been arrested still practise light fishing. Once a fisherman throws light and get fish, he will continue. Chorkor is between Fante and Tema, so obviously they do it. The practice is carried out all over the country. The stretch of the sea lies between Fante and Tema and Chorkor happens to lie between the two. The people in Chorkor mix with the others there and do it. Fishermen always point accusing fingers at others. When these law breakers are trapped, they move to other areas and it is difficult for the law enforcers to track them every day.

According to the head of the traditional council there is no standard MCS in the Teshie-Nungua fishing community. All MCS activities are done by the local people (the Traditional chiefs, fishermen, chief fishermen, fishmongers). He also said although recently the government came up

that all the landing beaches have to create a watch dog which should comprise of fishermen, chief fishermen, fish mongers and the police, the proposal was never implemented.

> "*Light fishing is not allowed here but our people have adopted it and practiced it elsewhere. The government enforces the laws. The thing is there is a lot of money in this business of light fishing*". (Interview with the head of the traditional council from the Teshie-Nungua fishing community).

Why the prohibition of light fishing is not effectively enforced

It is difficult to fathom why destructive, non- sustainable, and illegal fishing practices have plagued artisanal fishing. Some have attributed the problem to the system of ownership, and the type of control pertaining in the Ghanaian fisheries. Ghana's marine resources according to Ostrom (2000), are an open access resources which means that it does not have ownership or control. Although all natural resources are vested in the state by law. Marine resources are therefore state property. As such, the state must have the prerogative to enforce the rules of access and sustainability (Heltberg, 2001). Law enforcers have found it very difficult to effectively enforce the law on light fishing. The laws are communicated to the fishers through local assembly meetings, there they receive copies of the rules. Government uses force to help stop them by arresting them, seizing generators which are quite expensive (about 1000 GHS). Government force them to stop light fishing, but they still practice it. Those arrested using light to fish have never been jailed according to Nii Odai Lai, a chief fisherman at Chorkor. Moreover, they make more money (about 20,000 GHS) from light fishing so they are able to replace the seized generators and maneuver their way through. The prohibition of light fishing is not effectively enforced because some chief fishermen say "no" to light fishing and yet, practice "yes". Indeed, in many cases, they preach a double message in the fishing communities which undermine the legal interest for others to follow.

Another important factor, according to the respondents, is the influence of top government officials in the fishing industry. Most government officials as some of the key informants put it, have their own interest in the fishing sector. According to them these officials can afford the expensive light

fishing equipment and it is difficult to prosecute such officials. They stressed that the top government officials own big trawlers and have joint cooperation with the industrial vessels. MSC activities are done by the local people. Currently there are no government interventions regarding the use of light in fishing. The respondents believe government's commitment towards enforcing light fishing laws is too low and inefficient.

Reasons why artisanal fishers break the rules and regulation

There are several factors that are attributed to the reason why fishermen are tempted to break the rules. Research findings shown that artisanal fishers normally will decide whether to obey the rule and regulations set by authorities. Four key factors according to responses from research participants are listed below;

a. The risk of punishment and the severity of the expected penalty.
b. The gain and benefit ratio that may result from carrying out illegal activity.
c. Social influence; fisher's peers and the society exert some influence in the industry. Age influence greatly how skippers violates decision. Younger fishers were more likely to break rules in the community.
d. Moral obligation; the role of religious norms in the society is very striking. Generally, every fisher in Ghana believes the seas is controlled by a god irrespective of their faith. Most of the skippers will comply with regulations they consider to be fair and necessary.

Bringing the fishery regulations closer to the realities on the ground

Chorkor and Teshie-Nungua fishing villages over the years have had different concerns regarding the effective management of fisheries resources. Among the major factors gathered from respondents was that, fishing regulations such as the control of input and output regulation were practically nonexistence in both villages. The chief fisherman of Teshie-Nungua in his response to the main regulatory activities at the landing site, lamented that the situation looked very miserable. According to him they are often reminded on regulations outlined in the Fisheries Act at the national level yet they hardly enforce them at the local level. The assemblyman of the Chorkor traditional area was quick to attest to this claim. He was however emphatic that,

regulations such as the type of gear, and fishing method have several advantages in protecting juvenile stocks.

While the Community-Based Fisheries Management Committees (CBFMCs) did not pose much of a challenge to traditional authorities, they were seen as a threat to their resources base. However, it was obvious that their contribution and political influence gave legitimacy to CBFMC decisions where they did participate in co-management. In James Town for example, the chief fisherman through CBFMCs has been successful to impose a ban on the use of explosives and poisons as well as ban light aggregating equipment in fishing. Usually decisions makers at the community level involving the CBFMC is headed by the chief fisherman and council of elders with representatives from the various landing sites. Management objectives and decisions are made through organized CBFMC forums. The content of such decisions determines the success or failures within the fishery as outlined in the theoretical chapter. One will admit that, both the content and decision making process have a direct bearing on each other. For any fisheries management system (particularly at the village level) to be seen as legitimate and sustainable, careful consideration must be given to the role and extent of participation of traditional authorities.

Respondents such as the chiefs, chief fishermen, and assemblymen were of the opinion that all stakeholders must come on board for it to be possible to effectively enforce the fishery regulations. According to them government must make more effort to prosecute the offenders of light fishing laws. The director of Fisheries Enforcement Unit in trying to explain his commitment towards the enforcement of the law recited the existing regulation with regards to prohibited fishing method in Ghana. He was quoted as saying;

"*A person shall not*

d. use light attraction, portable generators, switchboard, 1000 watts bulb and long cable to facilitate light production or any other contrivance for the purpose of fishing,

e. use any other prohibited fishing method which renders fish more easily caught for the purpose of aggregating fishing, or

f. Operate pair trawling".

He contends that "a person who contravenes these regulation commits an offence and is liable on summary conviction to a fine of 400 penalty units or to a term of imprisonment of not more than twelve months or to both". The director was however emphatic that the practice can never be allowed in the country. He also mentioned that discipline is needed in our part of the world in other to completely abate this practice. He had this to say;

> "*As for light fishing I don't think we can ever allow them. I mean the results were clear, very destructive. We are in a multispecies system and the idea is to make fish sustainable and available all year round. It's a matter of discipline especially in this part of the world*". (Director of the Fisheries Enforcement Unit).

The NGOs in the fishing communities must also play their role effectively. They need to educate fishermen more on the need to disengage in light fishing activities. The main NGO in Chorkor fishing community is the Disciple Aid Foundation which was founded in 2001 by the 70 Disciple church. The NGO collaborates with other international agencies such as SOS international to support the fishing communities. Financial support is obtained from the United Nations Development Program (UNDP). Actually Disciple Aid Foundation interacts with the various stakeholders through organized meeting every three months but they do not have direct contact the government officials. It is therefore imperative that they collaborate with government to explain the fishing regulations to the fishermen, who are mostly uneducated and can barely read and write.

The role of government and other stakeholders in enforcing light fishing laws

It is imperative that government provides the infrastructure and needed resources to enhance MCS activities. There should be enough law enforcers on the ground and they must be provided with the needed resources and logistics to make their work effective. More commitment must be shown by government in prosecuting offenders of light fishing laws. The traditional council can also support the monitoring and control activities relating to fishing in the communities. The chief fishermen are very instrumental in creating awareness and promoting compliance in the Chorkor and Teshie-Nungua fishing communities. Fishermen normally would want to listen to the traditional council because of its influence in the community. When violators of the law are caught, the council normally steps in to resolve the case. It is important that the council hands over violators to the police for them to face the full rigour of the law. The NGOs also complement the effort of government by helping with the education of fishermen on the light fishing laws. Some of the fishers said government through the Fisheries Commission and some extension officers do visit them sometimes to train and educate them. They are taught about different methods to preserve fish caught directly from the sea as well as the consequences of destructive fishing and illegal fishing methods.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

This final chapter provides the conclusions of the findings of the study. The chapter ends with the policy recommendations drawn from the study.

The history of light fishing in Ghana

Light fishing is not exclusive to only Ghana. It was practised elsewhere before being introduced into the country on a trial basis but could not be legalized because of it turned out to be very destructive. Aggregating fish with light attraction equipment proved very efficient but unproductive since it destroys the fish stocks. It is mostly practised from Fante and Takoradi, and from Tema to Sogakope. In 2010 fishers from Chorkor in the Greater Accra region staged a demonstration for the abolishment of the practice. Some local fishers in Central region for instance practise light fishing because they have found it to be profitable. Small boats called U-boat with generators and bulbs are mostly used for light fishing by these fishers.

Biological, economic and social implications of light fishing

The biological implications of light fishing are mixed. Some of the respondents hold the view that a decrease in stock of fish cannot necessarily be attributed to light fishing but rather increasing population size, global warming, and unpredictable fishing season, among others. The rest of the respondents believe light fishing has some negative implications biologically. Light fishing is the main reason for the destruction of the fishing stocks in the country because of the frequent harvesting of juvenile fish. The practice undermines conservation practices and causes overexploitation of the fishery resource. The economic implication of light fishing is quite serious. Fishermen could end up bringing dead and low quality fish. The fish, if handled properly, could maintain its quality but might have low shelf live due to light fishing. High wattage of light bulbs heats up the water and damages the flesh of the fish and sometimes kills them before they are even brought to shore. This reduces the market value of the catch. Socially the effect of light fishing is quite significant. Fishermen who cannot afford light fishing equipment such as generators and bulbs are thrown out of business. They don’t get more fish as they used to, and most often return

home with empty nets, a situation they consider as a major threat to their livelihoods, considering the fact that they have no other income generating activity. These fishers therefore struggle to provide for their families and contribute towards their children's education.

MCS activities and law enforcement in the fishery sector

Responses gathered from interviewing fishers reveal that government have not dealt effectively with illegal fishing practices in the country. This is due to lack of resources, personnel, and logistics on the part of the law enforcers. Monitoring, control and surveillance activities are carried out by the Fisheries Enforcement Unit (FEU). It is enlightening to say that some fishermen still engage in light fishing, but those caught are usually punished through the seizure of their equipment. In most cases, offenders of light fishing laws move to other areas when trapped. This makes it quite difficult for law enforcers to be able to track them down all the time. There has been an attempt by the Fishery Commission to have all canoes registered and embossed with special numbers for easy identification and tracking. Unfortunately, the whole idea was politicized and it proved to be difficult to implement. Another factor why it didn't materialize was the issue of "open access" coupled with the huge number of canoes and artisanal fishers. Common property means resources that are owned by a community and hence the rules of access to the said resources are defined by the community that owns the resources (Heltberg, 2001). MCS activities are mostly done by the local people themselves, even though the government claims it is making an effort to ensure an effective MCS.

It has been quite challenging for the effective enforcement of the light fishing laws because of low compliance. In most cases the law enforcers would have to arrest offenders and seize their equipment. However, these offenders make more money from the practice and so are able to quickly replace the seized equipment. The influence of top government officials in the fishery sector is also a major constraint as far as effective law enforcement is concerned. Local stories have it that some of these officials own big trawlers and have close working relationship with industrial vessels owners. They collude to break the laws with impunity because of their status. Akonor *et al*., (2013), in their interaction with rural fishers in the Central region of Ghana pointed out that the laws are not strictly enforced. One of their respondents had this to say;

"*Politicians will not allow the laws to work. When you arrest people doing illegal fishing the politicians will come and defend or make political gains out of it… you just look at the premix... full of politics. There is this notion among the fishers that our party is in power so we can do anything"* (Akonor *et al*., 2013).

Bringing the fishery regulations closer to the realities on the ground and enforcement of the fishery regulations

Compliance with fisheries regulation will be low when the accrued benefits from illegal activities are high, the probability of detection proves to be a lower deterrent than increasing fines, punishment are non-deterrent and the regulations are not perceived to be right in the eyes of the local fishers. Skippers who would normally want to conform to the regulation will regard it as foolish to comply with when it is rather a free-for-all affair. It is incumbent on government to make more effort in prosecuting offenders of the fishery laws. NGOs in the fishing areas must complement government effort by educating fishermen on the fishery regulations and the need to disengage in the illegal practice. Even though the NGOs interact with various stakeholders through meetings, they hardly have contact with government officials. Law enforcers of the fishery law must be provided with requisite resources so they can be effective in their work. This will help the FC in its commitment to enforce fishing regulations and operational ethical standards as set by the Ministry of Fisheries through active participation of local actors in the management process. Jentoft (2000) argued that, participation by the communities could only possible, if they share common 'management' interests and identify themselves with each other. Thus, an active participation of the local fishermen in the management of their own resources needs to be promoted.

The realities on the ground

The Fisheries Commission should empower other community-based institutions such as the CBFMOs to manage their own assets. Addressing the acute poverty in these communities, and providing education and alternative livelihood sources of income could help reduce the violation rate. The livelihood approach is used in different ways. It forms the basis for recent policy-relevant

empirical research that seeks to identify how people's pursuit of improved livelihoods is helped or hindered by change in policies such as decentralization (Ellis and Freeman, 2004). Thus, livelihood studies have indicated that maintaining a diverse portfolio of activities in addition to fishing is important to small-scale fishers since fishing is a high risk occupation prone to seasonal and cyclical fluctuations in stock size and location which are highly unpredictable (Allison, 2003). Further, livelihoods analysis has shed light on the status of small-scale fishing in Africa and other continents such as Asia and Latin America by helping policy makers to see small-scale fisher folk's, not as poor, marginal, backward and problematic but rather important contributors to rural economy and potential focal points for market development. (Allison, 2003). While vulnerability and poverty in fishing communities are sometimes thought of as end results of policy failures, marginalization is conceived as resulting from negative social and power relations with others; the marginalized in the society are those excluded from social, economic, and political opportunities enjoyed by other citizens. Decreasing rural fisher's vulnerability and marginalization are important ways of reducing poverty among fishing-dependent communities without putting extra pressure on over-exploited fishery resources. The emerging picture is that poverty in artisanal fisheries, in terms of income and types of assets, has sometimes been overstated, while key concepts such as vulnerability and marginalization has been under-emphasized.

POLICY RECOMMENDATIONS

From my discussions with the participants the most persistent illegal activity currently in the Ghanaian fishing industry is light fishing which has virtually become associated with artisanal fishing. It is one of the reasons behind the country's over-fishing crisis and any attempts to completely eradicate it might not come cheaply.

Recommendations

a) The Fisheries Commission (FC) must ensure effective implementation of the Fisheries Act, (Act 625) 2002.
b) Stock assessment is needed to be carried out urgently to aid the Fishery Commission in determining the actual biomass of the fish stock as well as the biological effect of light fishing.
c) Government and other stakeholders must support the Fisheries Enforcement Unit with logistics to be able to carry out effective monitoring, control, surveillance and enforcement of the fishery regulations.
d) Offenders of the fishery laws must be dealt with by law enforcers without fear or favour. This will ensure compliance in fishing communities.
e) The FC which has the mandate to regulate and manage the fishery resources should collaborate with traditional chiefs, chief fishermen, District Assemblies (DAs), fishermen and other stakeholders to enact by-laws at the community level. This will require active participation of fishermen in the decision making process. The Community Based Fishing Management Committees (CBFMC) requires immediate reinvigoration.
f) Rural fishermen must be given more education by the government through the FC on the importance of fishery regulation as well as the consequences of unsustainable practices.
g) Addressing the acute poverty in these communities and providing alternative livelihood sources of income could help reduce the violation rate.
h) The FC must ensure that fisheries development projects address small-scale fishers poverty, vulnerability and social marginalization. The government through the FC should

identify vulnerable groups within the fishery. These may include the disabled, women, the elderly, youth, and those affected by diseases and illness.

i) Conservation-based NGOs such as Wetlands International can incorporate social inclusion and vulnerability reduction in their integrated conservation and development projects.

j) Traditional institutions should help instil discipline and promote cultural norms and values in fishery communities. This will help ensure a more sustainable fishing practices. For instance, traditional authorities could reinitiate the fishing holiday and ban.

Recommendations for future studies

Looking at the issue of light fishing, more scientific research is necessary to unearth the biological impacts of this fishing method. A longer-term study should look at the direct implications of the effects of artificial light on marine resources and ecosystem services. It is very important to increase the number of respondents and include more fishing communities in order to generalize my findings. Future studies should examine the possibility of using both quantitative and qualitative research methods.

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APPENDIX

LIGHT FISHING OPERATIONS IN SMALL SCALE FISHING IN GHANA: THE CASE OF CHORKOR AND TESHIE –NUNGUA DISTRICT/MUNICIPAL IN THE GRAETER ACCRA REGION OF GHANA.

JUNE 2015

INTERVIEW QUESTONS

Interview guide for boat owners, net owners, and some selected fishermen

1. What is your name?
2. How old are you?
3. Which region do you come from, your ethnicity, your clan?
4. Are you married with kids? If yes, how many wives, how many children, how old are they, where do they live?
5. Do your children go to school? Do they fish with you? Are they going to inherit your business some day?
6. Who are your household members and what are the income generating activities in the household?
7. Do you combine fishing with other occupation?
8. What is your educational background?
9. How much do you earn from fishing monthly?
10. How long ago have you been fishing?
11. Have you been a small scale fisher all your life?
12. Why did you become a fisherman? Were you recruited through your family? How did you learn how to fish?
13. Are you an owner of a boat/net or a crew?
14. How many boats/nets do you have, are they active currently, how many outboard motors? Is it joint owned?
15. Do you (and your crew) collaborate with others when you fish? In what way?

16. Are you a migrant or permanently settled in this community?
17. What are your main fishing method? Main reasons for this fishing method?
18. What are your targeted species? Reasons for your choice of the mentioned species?
19. In your opinion what is light fishing?
20. Have you ever use this fishing technique? If yes, why did you use this fishing method?
21. Do you still practice this fishing method? Yes, or no, if no why did you stop using light to aggregate fish?
22. Are there any restrictions on the number of nets, gear, how much you can fish, number of boats, time of fishing, specific landing sites, etc. in this community?
23. Will you adopt this fishing method if you have the means (available technology, equipment and vessel)
24. Do you think the traditional chiefs in this community promote the interest of this fishing community? If yes, why are they not doing anything to enforce the prohibition?
25. How are government policies communicated to you?
26. Do traditional chiefs and chief fishermen accept light fishing in this community?
27. What forms of institutions and cooperatives exist in this community?
28. Do you belong to any of the above mentioned cooperation or organization? If yes, how does it affect your livelihood and business?
29. In your opinion what role can the government and other NGOs play to enforce the prohibition of light fishing?

Interview guide for chief fisherman, traditional chief of Chorkor/ Teshie-Nungua community and the Fishery Directorate

1. In your opinion, what is light fishing? Can you give a brief history about this fishing method?
2. When was this activity introduced in this part of the fishing community?
3. Why was it introduced?
4. In your opinion do you think the introduction of light fishing increased production and income in the small scale fisheries? If yes, why do you think it was ban or prohibited?
5. Do some fishermen still encourage light fishing in this community? If yes or no, explain

6. According to the fisheries directorate, light fishing was supposed to be abolished in 2010, why do you think this law was promulgated?

Why is the prohibition of light fishing not effectively enforced?

1. What laws are made to prohibit light fishing?
2. Who are included and excluded in the process of making these laws? You have to explain
3. What kind of decision –making process is there? You have to explain.
4. How are these laws enforced?
30. Do traditional chiefs and chief fishermen accept light fishing in this community? If no, why are they not doing anything to enforce the prohibition?
5. Are there sanctions for fishermen who engage in light fishing?
6. In your opinion, do you think the fishermen in this community obey rules and regulations?
7. How often do you encounter cases of light fishing?
8. Are such cases often reported to the appropriate authority?

What can be done in order to bring the fisheries regulations closer to the realities on the ground? (Either change the present regulations or enforce them).

1. Do fishermen ahead to fishing regulations in this community? if yes or no, why
2. Are there any government interventions or regulations regarding the use of light fishing?
3. Are there any MCS activities in this fishing community?
4. Do you think the fisheries commission should intensify its MCS activities around the coast?
5. Are fishermen often involved or consulted in making decisions regarding fishing regulations?
6. In your opinion, what do you think can be done to ensure that decisions on fishing regulation are made with the consent of fishermen?
7. How are government policies regarding fishery regulations communicated to you?
8. What role can the government and other NGOs play to help crack down illegal fishing methods?
9. Do you think the present fishing regulations regarding the use of light in fishing are accepted by the fishermen in this community? If no, why?

10. What do you think are the future challenges of using light as a fishery method?

Interview guide for boat owners, fishermen, 'Fish mummies', Chief fishermen and Directorate of fisheries

1. What are the implications of using light as a fishery method in terms of;

a. Biology – Do you think light fishing method has any impact on the fish stock? You have to explain. What is the state of the stock of fish currently in this community? How do you access the stock level of fish in this community (where do you get knowledge about the stock situation? Do you think the stock level is a cause of concern for light fishing?
b. Economy – Does the quality of fish harvested by the use of light fishing technique differs from that of normal harvesting method? If yes does it affect the market value and consumer preferences? You have to explain. How do you examine or compare the difference in quality of fish caught using light to aggregate fish and the normal fishing method?
c. Social – In what ways do think using light as a fishery method has affected your livelihood? You have to explain.

2. Will you encourage light fishing if you are given equal opportunity with the semi-industrial and industrial fishers in terms of fishing gear used?

3. Do you have options to acquire motorized fishing gears to fish offshore? Yes, or no, if yes will this option influence your decision to adopt light fishing method?