KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI
COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
FACULTY OF RENEWABLE NATURAL RESOURCES
DEPARTMENT OF FISHERIES AND WATERSHED MANAGEMENT

THE CONTRIBUTION OF TONO RESERVOIR FISHERIES TO HOUSEHOLD LIVELIHOODS IN SELECTED COMMUNITIES IN THE KASSENA NANKANA EAST DISTRICT OF THE UPPER EAST REGION OF GHANA

BY

GIFTY ABACHE

June, 2014

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(BSc Applied Biology)
June, 2014

A thesis submitted to the Department of Fisheries and Watershed Management of the College of Agriculture and Natural Resources, in partial fulfilment of the requirements for the degree of Master of Philosophy, in Aquaculture.

DEDICATION

To the Lord Jesus Christ, Son of the living God. Your grace has granted me this award.

ABSTRACT

The contribution of the Tono Reservoir fisheries to socio-economic development of Ghana has over the years been significant. An aspect of this is its contribution to food security for the country and to a large extent provision of livelihoods for communities fringing the reservoir. The ability of the reservoir to offer these benefits has been declining due to a number of factors. This study was conducted, through questionnaire survey in five villages within the Tono Irrigation Project area, in the Kassena Nankana East District, from January to April 2013 to determine the contribution of Tono Reservoir fisheries to household livelihoods in the selected communities. Results indicated that the Tono Reservoir fisheries is a major source of livelihoods for the communities improving food security and currently employing 480 households belonging to the active working age class of 20-50 years. The average per capita income of households of fishermen and fishmongers ranged between GH¢0.90 and GH¢8.60/person/day (equivalent to US$0.45 to US$4.30) with only 30%, considered poor living on less than US$1. There has occurred overfishing in recent years at alarming rates, largely as a result of the following factors: open and unrestricted access to the resource and persistence in climate change, habitat degradation, increased fishing, poor observance of closed fishing seasons and other poor management practices. Lack of effective policy interventions including weak enforcement of laws have also contributed to the current situation. The fishers and fishmongers in the communities, now conscious of the possible collapse of the Tono Reservoirs and hence their livelihoods expressed willingness to cooperate with the local accredited fisheries governance institutions to regulate exploitation of the resource to ensure sustainable production.

DECLARATION

I hereby declare that, I conducted this research work independently towards the award of the M.Phil. Degree (Fisheries and Watershed Management) under the supervision of Mr Godfred Owusu-Boateng, and I take full responsibility for whatever has been reported in this dissertation. I further declare that, to the best of my knowledge, this work has not been accepted for the award of any other university degree nor has any portion of it previously been published by someone else. Related study by others which served as a source of information has been duly acknowledged by reference to the authors.

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Head of Department	Signature	Date

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I drew a lot of inspiration from my dear husband, Charles Bruce Ayuekanbey and precious family. The support of this family was simply overwhelming.

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CHAPTER ONE

1.0. INTRODUCTION

1.1. Background

Fish accounts for 60% of the Ghana's dietary animal protein (GNADP, 2012) and fisheries have contributed 3-5% to the Gross Domestic Product (GDP) since the year 2000. However, the level of national fish production is still far less than the current fish demand. Capture fisheries production in recent years has followed a downward trend, and current annual output is about 420,000 metric tons, which falls short of the national requirement by 460,000 metric tons, equivalent to more than 50% deficit (GNADP, 2012). The situation has compelled the country to spend over US$200 million annually on fish imports to fill in the deficit as much as possible (GNADP, 2012). However, if the current downward trend in capture fishery production is allowed to continue, the socio- economic impact would certainly be disastrous.

There are several hundreds of reservoirs in Ghana majority of which are located in the northern sector. Apparently, reservoir fisheries in Northern Ghana are important sources of fish protein and livelihoods to the people. Currently, the Ghanaian fisheries sector generally provides direct and indirect livelihoods for an estimated 10% of the population (GNADP, 2012). In general, comprehensive assessment of the contribution of reservoir fisheries in Ghana to household livelihoods is lacking. The major problem is the general lack of reliable information on many of the different types of fisheries, and this tends to impede the structures and processes of governance of the resource. In other cases, the fisheries resource base is threatened by environmental degradation, loss of spawning and nursery habitats and overexploitation (Sarch and Allison, 2000). A great number of the people engaged in the fishing industry earn incomes that increase their access to food and other necessities of life.

In the event of crop failure or declining crop yields due to unfavourable climatic conditions, which is common in the country, especially in the northern savannah ecological zone, fish landings from inland fisheries become an important source of food supplement. Taking cognizance of this fact, the concerns of successive governments, civil society organizations and individuals have been directed towards proper governance and preservation of the inland fisheries (Adua, 2000).

In the Upper East Region, for example, the Irrigation Company of Upper Region (ICOUR) was set up by government since 1985 to manage the Tono and Vea Irrigation schemes located near Navrongo and Bolga respectively to ensure enhanced agricultural production and fisheries (ICOUR, 1995). The impact was positive for some time as fish from capture fisheries in the Region was in abundance and cheap, but the situation is not the same today: fish has become scarce, expensive and smaller in sizes.

The concern about overfishing is not limited to the Ghanaian capture fisheries alone, but it is world-wide. In fact, many of the fresh and coastal water habitats that support and sustain viable fisheries are gradually and extensively being degraded and polluted (Dugan, 2003). Reducing fishing capacity is generally agreed to be the way forward to minimize overfishing, yet it is proving difficult, if not impossible, to achieve because of the underlying socio-economic implications (Bavinck *et al*., 2005). There is also a serious lack of knowledge about of how the fish value chain functions (Bavinck *et al*., 2005). Furthermore, it is common knowledge that fishers are notorious for finding ways around measures to regulate fishing for sustainable production, and poverty is generally believed to be the main reason why fishers overfish and destroy the fisheries resource base (Bavinck *et al*., 2005). A reduction of poverty among fishers should therefore relieve pressure on the fisheries resource base to ensure

sustainable exploitation. Therefore knowledge of the factors that contribute to fishers' poverty is essential to address the problem of overfishing.

Ecosystem considerations are paramount to fisheries resource exploitation and biodiversity preservation but are complex to handle (Brown, 2003). For example, extraction levels risking local species extinctions may be permitted within the context of a broader social benefit (Brown, 2003). Thus**,** natural resource management is essential for both biodiversity conservation and socio-economic development. A balance between the two is needed to sustain the resource, and in the present study it would be interesting to know whether overfishing and habitat destruction have, in any way, affected the Tono reservoir fisheries and the fish biodiversity.

One promising way to improve food security and reduce poverty in tropical developing countries with persistent harsh climatic conditions is to increase water availability via the development of irrigation schemes. Irrigation water is primarily harnessed for dry season agriculture. The reservoirs and canals created have the potential to support fish production through capture fisheries and aquaculture development to augment food security, alleviate poverty and diversify livelihoods. The current capture fisheries crisis anywhere on the globe is related to too many boats and too few fish, among other factors, and it is a great challenge to policy-makers, researchers and resource users, including fishers and fishmongers (Bavinck *et al*., 2005).

Co-governance is probably the most effective recently pursued approach in fisheries governance and management. It assumes that no one actor is in control or has all the answers, Often, however, the state exercises major responsibilities in the harvest sector through controlling or enabling fishing activities, but at the end of the fish chain, market institutions govern how fish and fish products find their ways from the natural ecosystems to the

consumer, while civil society acts as the guardian of the natural ecosystems through efforts to minimize environmental impact of fishery activities (Bavinck *et al*., 2005). Some of the common ways fisheries managers employ governance are gear control, licensing and quota systems (Bavinck *et al*., 2005).

Food safety is an important component of food security. However, in the fisheries and aquaculture enterprises, food safety is a big risk because fish is an extremely perishable commodity (Bavinck *et al*., 2005; Clucas, 1981). Effective post-harvest handling and treatment techniques should improve the quality and safety of fish and hence profitability of the fisheries and aquaculture enterprises.

Poverty is problem that has retarded the development of many global communities particularly those in the developing countries. In sub-Saharan region currently, 49% of the people live on less than US$1.00 a day, which is the global poverty line (World Bank, 2004). In Ghana rural poverty and food insecurity are fundamental challenges battling socio-economic development effort. It is generally known that poverty and food insecurity levels are highest in the northern part. Poverty may be the result of a variety of factors including, frequent conflicts, food shortages and famine, diseases, persistent environmental degradation and slow growth of economic development (Dugan, 2003) which are characteristics of the northern Ghana. In the Upper East Region, for example, nine out of every ten rural people are considered poor (NDPC, 2005). This situation is worrisome and calls for immediate attention.

1.2. Problem statement and justification

Generally, accurate and up-to-date information for socio-economic assessment of the global fisheries situation is lacking, and where they even exist they often reflect poor planning: for food security, enhancement of livelihoods and poverty reduction (Kacynski and Looney,

2000). The situation, which is not different in Ghana, certainly makes fisheries governance very difficult (Bavinck *et al*., 2005). One category of aquatic systems used extensively as important system for fisheries in the bid to go round the problem is the reservoir. There exist several hundreds of reservoirs in Ghana majority of which are located in the northern sector of the country, where they serve as important sources of fish protein and livelihoods to the people.

Collection and proper analysis of reliable data is crucial for the assessment and categorization of reservoir fisheries or specific fish stocks into one of the three internationally recognized fisheries/fish stocks categories i. e. lightly fished, moderately fished or over-fished is a prerequisite for effective management of the resource (Gulland, 1978). In the context of the Tono Reservoir, which is extensively relied on by the fringing communities not much has been done. The situation militates against comprehensive assessment of the contribution of the fisheries of the Tono Reservoir to food security for the country and to a large extent enhancement of livelihoods for reservoir communities.

This research, which is of regional and local relevance, will generate an up-to-date information on the extent to which the fisheries of the Tono Reservoir contributes to socio-economic advancement of the country through provision of livelihoods in the Kassena Nankana East District of the Upper East Region of Ghana.

1.3. Aim and Objectives

1.3.1. Aim

The aim of this study was to determine the extent to which the Tono Reservoir fisheries form part of livelihood structures of communities in the Kassena Nankana East District of the Upper East Region of Ghana.

1.3.2. Objectives

The objectives of the study were:

i. to assess the current status of the fisheries resource and its contribution to livelihoods, food security, employment and income at the household level in the Kassena Nankana East District.

ii. to analyze the causes of vulnerability to poverty and identify human activities and factors that are vulnerable to the fisheries resource base.

iii. to identify the institutional structures and processes involved in determining accessibility and governance of the fisheries resource.

CHAPTER TWO

2.0. LITERATURE REVIEW

Below is a survey of some of the current relevant literature on inland fisheries resources and the roles fisheries livelihoods play, particularly as a source of food security, employment and income to alleviate poverty, as well as issues of gender, environment, governance and fishing practices that influence sustainable extraction by fishers. This survey is by no means exhaustive, considering the enormity of the available literature on this subject.

2.1. Inland Fishery

Inland fishery may be defined in one of three ways:

- the exploitation of living aquatic resources as a common or open access property (FAO, 2000):
- fishing in natural or artificial ecosystems, including rivers, lakes, reservoirs, gravel pits, and other manmade standing water bodies to benefit from the fish and other aquatic organisms in them (Arlinghaus *et al*., 2002) and
- capture of wild freshwater fish stocks, including migratory species that move between freshwater and the oceans (Allan *et al*., 2005).

Essentially, inland fishery involves commercial fish capture, sport or recreational fishing, subsistence fishing, aquaculture, and allied services such as gear manufacture, water rights ownership, ecotourism, fish processing, transport and marketing (Arlinghaus *et al*., 2002).

2.2. Sources of inland fishery

2.2.1. Rivers

Rivers are open, linear water systems with numerous small headwater streams that depend mainly on external nutrient inputs, and the food webs are based on organic matter that is

progressively degraded by activity of invertebrates and micro-organisms along the course of the channel (Vannote *et al*., 1980). River fishery is significantly influenced by deforestation and agricultural activity in the vicinity of the river, and nutrient deposition on the flood plain (Junk *et al*., 1989). Floodplains are of particular importance to the breeding, feeding and growth of many species of fish and catches from any particular system are closely correlated to the degree to which the floodplains were flooded in preceding seasons (Junk *et al*., 1989).

2.2.2. Lakes and reservoirs

Lakes and reservoirs are closed systems consisting of a defined body of water and are classified according to their nutrient richness into oligotrophic, eutrophic and mesotrophic waters which are respectively low, high and medium in nutrients and productivity (Wetzel, 1983).

2.2.3. Wetlands

Wetlands are extensive shallow swampy areas often associated with river or lake systems such as riparian flood lands, including rice fields colonized by fish during the wet season which support fisheries production (Khoa *et al*., 2005).

2.2.4. Aquaculture ponds

The contribution of freshwater aquaculture in ponds and other production water systems is now the major contributor to inland fisheries production, having overtaken inland capture fisheries since 1986 (FAO 2004).

2.3. The concept of sustainable livelihoods

A livelihood comprises the capabilities, assets (including both material and social resources) and activities needed for a means of living (Ashley and Carney, 1999). A livelihood is

sustainable when it can cope with and recover from stresses and shocks, without undermining the natural resource base (Mearns and Dulamdary, 2000). A sustainable livelihoods framework organizes the factors that constrain or enhance livelihood opportunities, and shows how they relate to each other in poverty analysis (Ashley and Carney, 1999). Institutional arrangements play a critical role in sustainable livelihoods, since they determine the access of individuals and households to key resources, and they range from customary and local rule systems to formal laws and administrative procedures (Mearns and Dulamdary, 2000). An example of a livelihood framework that has had widespread application in recent times in the analysis of poverty was generated by DFID (1999) (Figure 2.1).

The framework does the following:

i. It provides a check on important issues and sketches out the way these link to each other.

ii. It draws attention to core influence and processes

iii. It emphasizes the multiple interactions between the various factors which affect livelihoods.

The DFID's (1999) framework, describes five basic capital assets upon which livelihoods are usually built, namely, financial, physical, human, social and natural assets.

2.3.1. Financial capital

Financial capital assets denote the financial resources that people use to achieve their livelihood objectives. There are two main sources of financial capital, namely, available stocks and regular inflows of money (e.g. remittances from family members and friends).

2.3.2. Physical capital

Physical capital assets comprise the basic infrastructure and producer goods needed to support livelihoods. Examples of infrastructure are affordable transport, adequate water

supply and sanitation, affordable energy, and access to communication.

2.3.3. Human capital

The human capital assets represent the skills, knowledge, labour and good health that together enable people to pursue and achieve different livelihood objectives.

2.3.4. Social capital

Social capital assets are the social resources upon which people draw in pursuit of their livelihood objectives. They are developed through networks and connections, membership of formalized groups and relationships of trust.

2.3.5. Natural capital

Natural capital assets are the natural resource stocks from which resources flow and services useful for livelihoods are derived. A natural resource is very important to those who derive all or part of their livelihoods from the resource-based activities such as fishing, farming, gathering and mineral extraction (DFID, 1999).

The framework suggests that people are vulnerable to shocks, trends and seasonality in pursuit of their choice of livelihood options, and the people adopt various strategies to respond to them. Thus in fisheries, benefits are obtained through the production of fish and its distribution across the various social sectors, e.g. between producers and consumers, and between the wealth classes poor (Briones *et al*., 2004b).

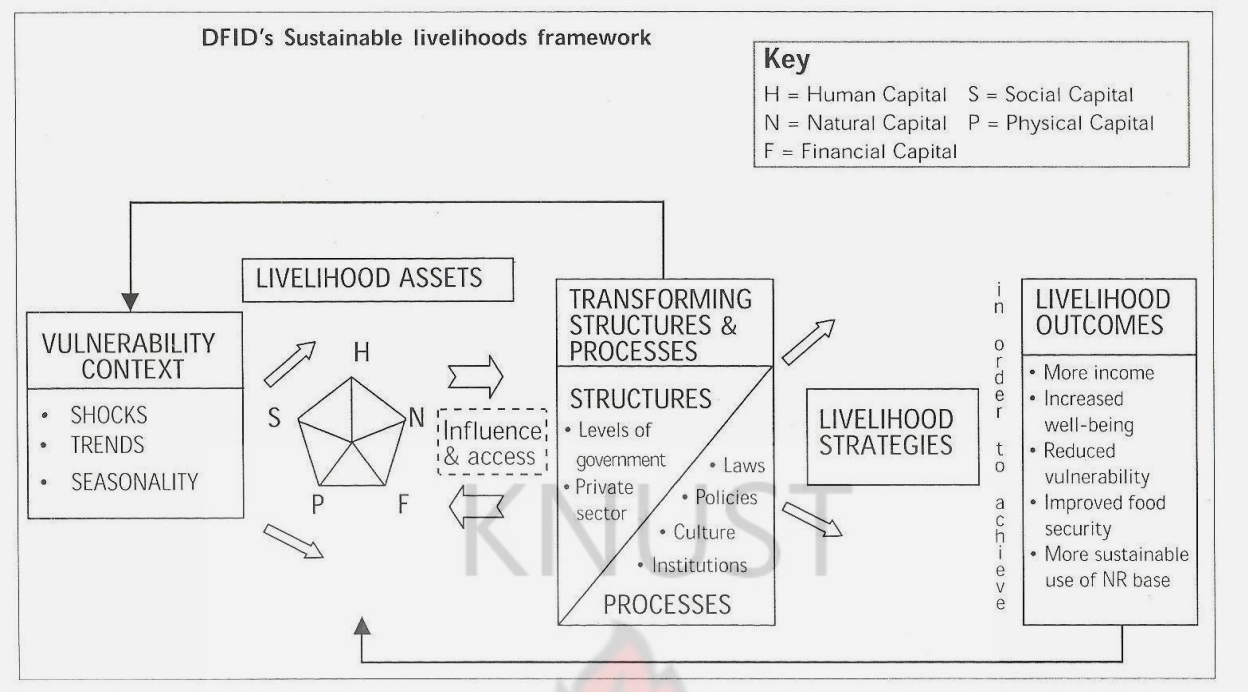

Figure.2.1 A sustainable livelihoods framework

Source: DFID (1999)

2.4. Fisheries as a source of food security

Food security is a condition when all people in a household have at all times physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996). In sub-Saharan Africa, chronic hunger is still rising and 34% of the people in the region are under-nourished, while in other regions of the world, chronic hunger is receding (FAO, 2003). Close to one half (49%) of the total population in sub-Saharan Africa live on less than $1.00 a day, which is the global poverty line (World Bank, 2004). With rising population and demand, expansion of supplies to ensure and maintain food security has emerged as a priority concern for most developing countries ((Briones *et al*., 2004).

Inland fisheries contribute significantly to the total fish supply in most countries; and the major inland water resource, being artificial multi-purpose reservoirs, is subject to far greater

pressures by humans in the developing countries than is the situation elsewhere (Michel and De Silva, 1992).

Fisheries provide the main source of animal protein to about one billion people globally, and in coastal areas the dependence on fish is usually much higher (FAO, 2003). Inland fisheries are fundamental to the livelihoods of many African peoples, and fresh water fish contribute a considerable proportion of the animal protein in their diet, especially in areas close to rivers and streams (Welcomme, 2003). Sustainable capture fisheries are essential for food security particularly in Africa, where fish often constitutes a large proportion of dietary protein as in the following countries: Senegal (47%), Gambia (62%), Sierra Leone (63%) and Ghana (63%) (NAGA, 2005).

Fish caught along the African coast line and waterways are often dried and sent through informal trade routes, serving as a major source of income. However, due to this nature of trade, catch statistics are unreliable and the actual contribution of the fisheries to the local food security and economy is often underestimated (NAGA, 2005). Fisheries can increase food security when high fish landing seasons coincide with the seasonal low availability of other food sources such as agriculture (Allison *et al*, 2002). With rising population and demand, expansion of supplies to maintain food security has emerged as a priority concern for many developing countries (Larsen and van Zwieten, 2002). In Ghana for example, total inland fisheries production in the year 2000 reached 319,000 tons (251,000 tons from the Volta Lake and 68,000 tons from other sources), while marine production was 383,000 tons (Béné, 2007).

2.5 Fisheries as a source of employment

About 38-200 million people are employed in fisheries and aquaculture globally (Bavinck *et al*., 2005), and 95% of them are in the developing countries (FAO, 2004). Allied industries such as processing and marketing also provide employment for approximately 50 million people (FAO, 2004). In rural areas of West and Central Africa where job options are limited, inland fisheries provide employment for several thousands of low-income families (Neiland and Béné, 2003). The coastal region from Mauritania to Angola has over 570,000 artisanal fishers and about 1.8 million people (mainly women) are engaged in fish processing and marketing (Horemans, 1998). Migrant fishers may employ agricultural workers as crew, providing additional employment and contributing to village economies. In Ghana, inland fisheries offer employment to about 30,000 people (FAO, 2004).

2.6 Fisheries as a source of income

Fisheries resources have the potential to generate wealth and improve economic growth (Béné, 2006). In the Zambezi basin, fisheries sometimes generate more cash for households than cattle rearing and crop production, and in Laos, about 30 percent of rural household income is earned through inland fisheries (Lorenzen *et al*., 2000). In Tanzania, between 65 and 90% of fish production is sold for cash income, compared to only 15% of agricultural production in the same communities (Anderson *et al*, 1998). The cash income generated from selling fish is used to invest in other assets or livelihood diversification, which can further reduce vulnerability to poverty (Anderson *et al*, 1998; Allison *et al*, 2002). Some households involved in fishing have had higher incomes than non-fishing households (Allison *et al*, 2002).

Fish is now the fastest growing agricultural trade commodity on international markets, and about 33% of global fish output by value was traded across international borders in 2001 (Dey *et al*., 2005). In 2002 the value of world exports of fish and fish products increased by 5% to $58.2 billion over the 2000 figure, with the main increases recorded in Africa and Asia (FAO 2004). The contribution of freshwater aquaculture has also increased rapidly in recent decades (FAO 2004)

2.7. Fisheries as a wildlife resource

Fish is a popular product of water ecosystems management as bush meat is a popular product of forest or grassland ecosystem management (Brown, 2003). Wildlife plays a significant role in livelihoods of up to 150 million people (Brown, 2003). In general wildlife foods form a significant proportion of household production, but about 90% of it is sold and not consumed, as it is the case with fish and bush meat, (Brown, 2003). The economic value of wildlife consumed by rural populations is very high (Bennett & Robinson, 2000). Exploitation of wild animals is often addressed in terms of levels of consumption and sale, seasonality and poverty (De Merode *et al*., 2003). Consumption of wild animals in the form of fish and bush meat increases significantly during the hungry season (Brown, 2003). For the extremely poor, market sales of wild animals (e.g. fish and bush meat) exceed household consumption (De Merode *et al*., 2003).

2.8. Fisheries management strategies

Many fisheries stocks around the world are overfished or nearly so, and there is an excess capacity of fishing fleets in pursuit of limited stocks, while poverty persists among fishing households (Yew, 1993). Management interventions for aquatic resources may involve restrictions on the magnitude of fishing effort, regulations on the way fishing activity is conducted to reduce environmental damage and other regulations on human activities to

attenuate environmental damage, and finally efforts at restoring destroyed habitats or restocking depleted fisheries (Briones *et al*., 2004b). Changes in policy choices, programme implementation, institutional design or organizational capacity can affect socio-economic and environmental conditions through price and income changes, increased resource stocks and expanded resource access and employment opportunities (Briones *et al*., 2004b).

The most recently pursued governance strategy in fisheries is co-governance, which is a partnership arrangement in which government agencies, the community of local resource users (fishers), non-governmental organizations and other stakeholders (fish traders/fishmongers, boat builders/owners, business people, etc) share the responsibility and authority for the management of a fishery (Pomeroy, 1998; Larsen and van Zwieten, 2002). Co-governance ensures that local communities have more say in the management of their local resource (Welcomme, 2003). Community participation must therefore be encouraged and promoted to lower costs that might otherwise be prohibitive (Brown, 2003).

In co-governance, it is assumed that no one actor is in control, or has all the answers, because the decision on what wildlife resource to retain and what to consume will ultimately be made by those whose lives are directly affected by their day to day contact with the resource (Brown, 2003). By working with local fishing communities to design fisheries management systems that are adapted to the biological diversity, natural productivity and other uses of water there can be a significant opportunity for increasing reservoir fisheries' productivity (Misund *et al*., 2002; Jul-Larsen *et al*., 2003). For example, on the Zambian shore of Lake Kariba, fishers using such approaches have obtained sustainable yields that are four times higher than the catch per unit area in Zimbabwe (Kolding *et al*., 2003a). The lack of communication among various disciplines of limnology, hydrology, aquaculture, fisheries ecology, harvest management and pollution ecology impede the development of management strategies for sustainable utilization (Mitchell and De Silva, 1992).

However, it is important to view the governance of resource exploitation in the light of its benefits to both the poor and animal welfare in the environment (Brown, 2003; Fairhead & Leach, 1998). Mechanisms such as privatization of the common property resources, social exclusion of one part of the community, usually the poorest, re-appropriation by the more powerful (local elite) may annul partially or even totally the potential benefits generated by an adopted enhancement program (Ali and Islam, 1998; Capistrano *et al*., 1994). To be effective, resource governance or management must have both livelihoods guarantees and conservation benefits (Brown, 2003). However, conservation agencies favour alternative income generation strategies (Brown, 1998). The lack of appropriate management or governance systems can drive extraction of resources to crisis proportions, but captive rearing can be a promising strategy to conserve wild animals (Brown, 2003).

Individual transferrable quotas (ITGs) have led to improvements in the management of marine fisheries based on the willingness of people with user rights to adjust yields in line with catch data statistics on a year-on-year basis but this approach is yet to have application in inland fisheries (Brown, 2003). Human dependence on a resource is influenced by factors such as accessibility and abundance levels, for example, the relative importance of fish over bush meat in the Amazon basin is partly explained in terms of the high productivity of the Amazon River systems (Fa and Peres, 2001).

2.9. Accessibility to fisheries

Access to a fishery resource may be classified into two major categories namely, limited access fisheries and open access fisheries (Van Zalinge *et al*., 2000a). In limited access fisheries, restrictions are imposed by civil and traditional institutions and authorities through payment of user rights or license fees, which often tend to exclude the poor and favour the rich (Béné, 2003), but it also denies full-time fishers of their livelihood and income **(**Van

Zalinge, 2000a). In open access fisheries, user rights restrictions and other economic barriers are eliminated, making entry to the resource easy and cheap (Smith *et al*. 2005). Under open access fisheries, a right of access is granted to anyone who wants to use the resource (Baland and Platteau, 2000). The rural poor are usually those who lack access to natural resources (Kremer, 1994). It is therefore appropriate that, to be of high benefit to the poor, entry barriers to the resource must be flexible and capital costs of extraction must be minimal (Brown, 2003). Traditional ownership or user rights are often in conflict with legislative user rights in the sense that traditional user rights are often usurped by legislative principles (Brown, 2003).

2.10. Vulnerability context

There is evidence that aquatic ecosystems throughout the world are negatively impacted by a variety of human activities that persistently degrade and threaten fisheries of many coastal and river habitats (Dugan, 2003). Fisheries resources in many parts of the world are showing signs of vulnerability to severe overexploitation because too many people are employed in fisheries globally (Bavinck *et al*., 2005). The most visible sign of fisheries vulnerability was the leveling off of the total world catch in the 1990s (FAO, 2002).

Long-term maintenance of ecosystem health, which is the current ecosystem approach to fisheries management is in direct conflict with short term interests of many stakeholders and policy makers, because people are concerned about employment and income now, and are often unwilling to defer their present needs for the future (Bavinck *et al*., 2005). Also the long-term protection of ecosystems may directly impact livelihoods of the poor who often have few livelihood alternatives (Bavinck *et al*., 2005). Hence ecosystem considerations are relevant to sustainable livelihoods (Brown, 2003*)*. Vulnerability issues can threaten the base of a resource to local extinctions, and extraction pressure is a significant source of threat for

some wildlife species in many places, including West and Central Africa (Bowen-Jones *et al*., 2001). Vulnerable species, such as slower-reproducing animals, have been wiped out in the more accessible areas and faster-reproducing species now dominate the Ghanaian wildlife trade (Cowlishaw *et al*., 2003 a, b). Regulation of extraction (fishing) effort remains the essential means to avoid tragedies and improve efficiency and peoples living conditions (Larsen and van Zwieten, 2002).

2.11. Fisheries and gender issues

There is a gender bias in many fisheries and aquaculture activities, because in most situations, it is men who do the extraction (fishing), but it is women who take charge of all the downstream processing and commerce, to the point of sale in chop bars and restaurants, which are a familiar feature in urban centres (Shaleesha and Stanley, 2000; Brown, 2003). In Tanga region of Tanzania, as high as 70-80% of males are involved in fishing (Horrill *et al*, 2001)

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In coastal India, for instance, women's participation is mainly confined to marketing of fish, processing, transport, and to some extent, net making and mending, but their share and contribution in terms of employment in fisheries and aquaculture is insignificant (Shaleesha and Stanley, 2000). A large number of poor women, however, engage in traditional forms of aquaculture to make an important contribution to the rural economy, by collecting wild seed of shrimps in backwaters at high tides and raise fish seed in backyard ponds (Shaleesha and Stanley, 2000). To ensure that women utilize their full potential in profitable fisheries and aquaculture, it is necessary to provide capacity building support to rural women, which will eventually lead to women empowerment (Shaleesha and Stanley, 2000).

2.12. Fisheries and the ecosystem

Ecosystem considerations are generally relevant to resource exploitation and biodiversity preservation (Brown, 2003). Sustainable aquatic resource utilization requires a sound understanding of the structure and function of the aquatic ecosystems (Mitchell and De Silva, 1992). For example, extraction levels risking local extinctions may be tolerable within the context of a broader social change and benefit as long as the process is secured (Brown, 2003).

Fish distribution and abundance is associated with availability and abundance of food and substrate types in a particular habitat. For example, in general, cichlids occur in a wide range of habitats from warm water open to the sun to shaded forest waters, clear nutrient poor rivers to brackish estuaries (Lowe-McConnell, 1991) and plant beds and *Eichhornia* fringed areas (Bailey and Bailey, 1987). Inshore fresh waters in the tropics constitute an ideal environment capable of providing enough food, shelter, breeding and nursery grounds for littoral inhabiting fishes like cichlids (Balogun, 2005). Tilapias including *Oreochromis niloticus* occur in a wide variety of fresh water habitats like rivers, lakes, sewage canals, irrigation canals and brackish waters (Trewavas, 1983).

Growth in length and weight reflect climatic and environmental changes, for example growth is affected by water quality, temperature, dissolved oxygen levels and general health of the fish (Pauly, 1984; Luff and Bailey, 2000). Length and weight relationships are therefore of great importance in fisheries research because they provide useful information on population parameters (Krause *et al*., 1988; Samat *et al*., 2008). The size attained by the individual fish may vary because of variations in food supply, and these in turn may reflect variations in climatic parameters and in the supply of nutrients or the degree of competition for food.

Fishes especially in the tropical and subtropical waters experience growth fluctuations due to many factors such as environmental changes, changes in the physical and chemical properties of the aquatic medium, food composition changes and competition within the food chain (Adedeji and Araoye, 2005; Abowei and Davies, 2009). The condition factor is the volume of the fish relative to its length and it is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal, 1978). It is a useful index for the monitoring of feeding intensity of fish in its habitat (Oni *et al*., 1983), and the assessment of the status of the aquatic ecosystem (Abowei, 2010).

2.13. Fisheries and climate change

Climate change reflected in severe drought in the past two decades has reduced water levels in rivers and lakes in some parts of West Africa and lowered fisheries productivity significantly (Panos, 1995: Devalatha, 1994; Neiland and Béné, 2003). During periods of low water flow or low water level, river fisheries, for example, usually experience increased fishing pressure because catch per unit effort is greatest as fish are more concentrated and susceptible to capture (Koeshendrajana and Cacho, 2001). However, the stocks recover during the high water season, when fishing efficiency is typically low due to dispersion of fish in newly inundated areas (Koeshendrajana and Cacho, 2001). Usually it is the poor who suffer more from climate change that results in lower productivity of a resource (Smith *et al*., 2005).

Ichtyofuanal biodiversity changes resulting from drought have been reported in Lake Chad (Bukar and Gubio, 1985). It was observed that reduction in lake levels resulted in increased temperatures, nutrients, carbon dioxide, hydrogen sulphide, pH, dissolved oxygen, competition, death and decomposition. Marked lake level fluctuations can have a large impact on the availability of food and nursery grounds for fish species that inhabit littoral

areas, for instance cichlids, and there is a strong correlation between the change in lake level and the recruitment of *Oreochromis mortimeri* (Karenge and Kolding, 1993). A rise in lake level results in flooding of vegetation on the lakeshore, thereby providing food as well as shelter from predators, which in turn may lead to increased recruitment (Mhlanga, 1998).

Abiotic variables related to climate may be much more important to the dynamics of the ecosystem (Larsen and van Zwieten, 2002). Such dynamics can obscure the possibility to perceive trends resulting from human activity and may even outweigh anthropogenic impacts (Larsen and van Zwieten, 2002). Environmental factors such as long-term changes in water levels associated with climate change are often more significant than fishing effort in explaining changes in fish production (Larsen and van Zwieten, 2002). There is a close relationship between fish production and lake levels that strongly suggests that the environment, more than the fishery, is the dominant factor affecting change (Kolding 1995; Larsen and van Zwieten, 2002). The number of potential operators can be reduced substantially by increasing entry fees into the fisheries as it has been done in Lake Malombe fisheries in southern Africa (Larsen and van Zwieten, 2002).

2.1.4. Fisheries and anthropogenic impacts

Human activities that degrade the environment and destroy aquatic habitats and overfishing can lower the productivity of fisheries resources (FAO, 1999). Often, progressive size reduction of individual fish in the harvest is a sign of overfishing (Von Sarnowski, 2004). Farming activities in watersheds have also contributed to the decline in the productivity of many fisheries resources (Béné, 2007). In many countries in Africa, obtaining reliable catch and effort data in small-scale fisheries is problematic, because population-driven changes in catch and effort data have been the dominating characteristic (Larsen and van Zwieten, 2002). Growth of effort relates to population growth and an expanding demand for fish

(Larsen and van Zwieten, 2002).

2.15. Fisheries and Predation

Predation among aquatic organisms is a serious biodiversity problem and Olatunde (1977) has reported that two important fish species in Lake Kainji, *Eutropius niloticulus* and *Schilbe mystus* are heavily preyed upon by Nile perch *Lates niloticus*. The cannibalistic Nile perch introduced into Lake Victoria is threatening the ichtyofuanal populations and many species including cichlids (Haplochromines, *Oreochromis esculentus*, *O. variabilis*) and *Clarias* catfish spp are among the fishes recorded as "endangered" according to the World Conservation Union (WCU) in 1988 (Maithya, 1998). However, the good news is the native food fishes can be restored to the food market through aquaculture, if kept from extinction (Goldschmidt, 1989; Ogutu-Onwayo, 1990; Kaufman, 1992)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

This chapter presents description of the study environment, the research methodologies employed in the conduct of this study. They included population sampling techniques, data collection and analysis procedures. Literature on communities' livelihood dynamics had been reviewed. The reviewed literature formed the bases for the choice of methods and protocols for data collection and analyses. References are made in the text to these documents where necessary and listed in the reference section.

3.2 Profile of the study area: Tono irrigation project (TIP)

3.2.1 Location and features

The Tono Irrigation Project (TIP) is situated within the Kassena-Nankana East District, which is located between latitude 11º 10′ and 10º 3′ North and longitude 10º 1′ West. The district shares boundaries with Burkina Faso to the North, Bongo and Bolgatanga Districts to the East, Builsa and Sissala East Districts to the West and West Mamprusi District to the South (KNDA, 2006). The TIP was started in 1975 and was fully operational in 1985 (Gordon, 2006: ICOUR, 1995). Some relevant features about the irrigation project are summarized (Table 3.1).

Table 3.1 Summary of relevant features about the Tono Irrigation Project

Features	**Facts and figures**
Geographic bearings	Latitude 10^{o} 45″ North and longitude 1^{o} West.
District	Kassena Nankana East
Region	Upper East
Construction: Date started	1975
Date completed	1985
Crest/dam length	3,471 m
Catchment area	650 km^2
Gross project area	3,860 ha
Main access roads	120 km.
Developed irrigable land	2,490 ha
Maximum reservoir storage capacity	93 x 10^6 m^3
Major and feeder canals (total lendgth)	42 km
Maximum surface area of main reservoir	1,860 ha
Total urface area of minor reservoirs (5)	15 ha
Fish ponds (23)	4.8 ha

Source: Author's construct (modified from Gordon, 2006; ICOUR, 1995)

The beneficiary villages of the Tono Irrigation Project are Bonia, Wuru, Yigbwania, Yogbania, Korania, Gaani, Biu and Chuchuliga (Figure 3.1).

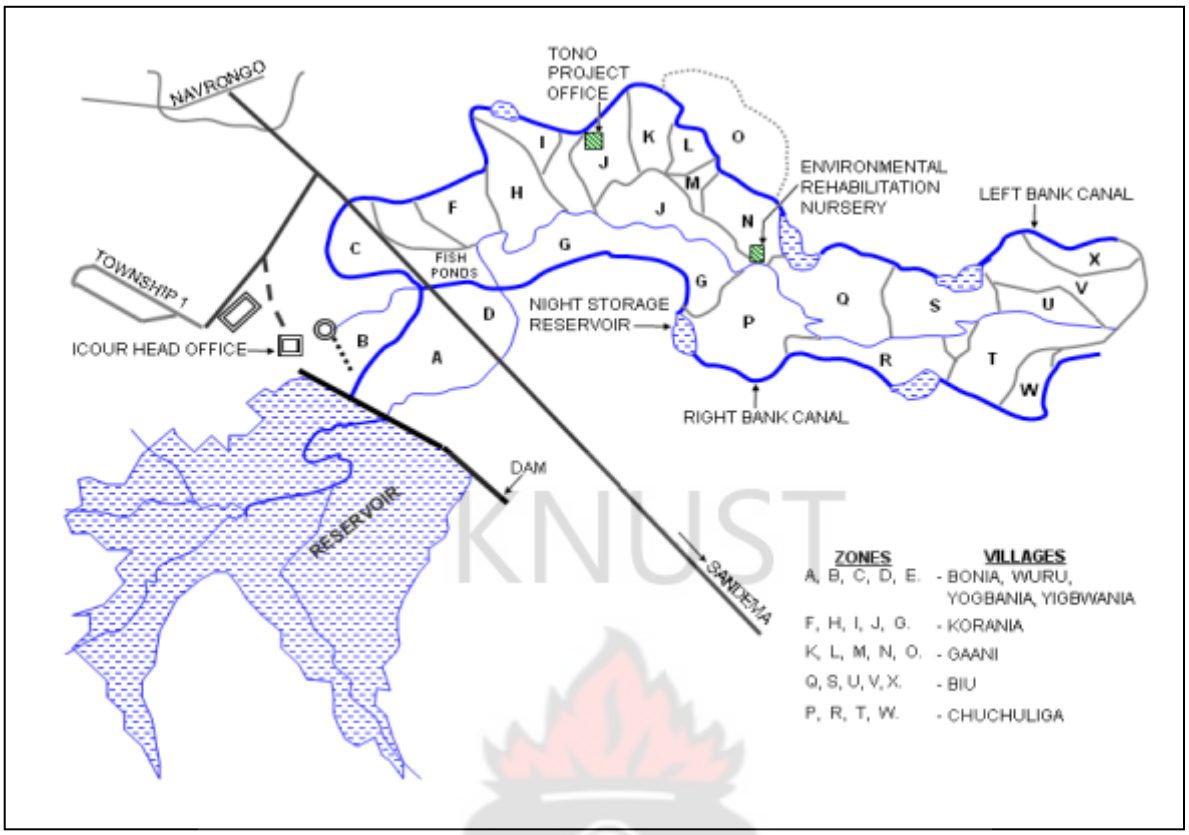


Figure. 3.1 Map of the Tono Irrigation Project (TIP)

Source: DERF Networks, April 2010

3.2.2 The study district: Kassena Nankana East District (KNED)

According to the 2010 population census the current estimated population of the Kassena-Nankana East District was 165,211, with an estimated sex ratio of 48.1% males and 51.9% females. The district has a predominantly agrarian economy. Thus, the Tono Irrigation Project was strategically established to boost food production through irrigated agriculture, animal husbandry and fishing to enhance food security. Agriculture, agro-forestry, animal husbandry and fishing provide livelihoods for 68.7% of the employable population, while 31.3% are public servants, traders, food processors and small-scale artisans (KNDA, 2006).

3.3 Familiarization visit and reconnaissance survey

Prior to the commencement of the actual study, a one month familiarization visit and reconnaissance surveys were conducted to get familiarized with the project environment or the selected communities; The period was also used to identify and establish the needed contacts and rapports with a range of stakeholders namely; the traditional authorities and their communities (including fishermen and fish mongers), district assembly, opinion leaders, key informants and protocols for further communications. Meetings were held with these stakeholders to solicit their voluntary participation in the project. Ideas about the logistics that were needed to execute the study were also obtained and preparations for their acquisition made.

3.4 Sampling and data collection

Five (5) out of the eight villages within the Tono Irrigation Project catchment area namely, Biu, Gaani, Korania, Yigbwania and Yogbania were purposively sampled for the study. Two sets of questionnaire (Appendices 1-7) were designed and administered to collect and analyze data from two categories of respondents:

i) 57 fishers and 35 fishmongers (Table 3.2) interviewed in the vernacular (Plate 3.1) and

ii) 5 local institutions namely, Irrigation Company of Upper Region (ICOUR), Ministry of Fisheries and Aquaculture Development (MoFAD), Kassena-Nankana East District Assembly (KNEDA), Reservoir Management Committee (RMC) and Local Traditional Authority (LTA). Representatives of the local institutions were asked to fill in the questionnaire.

Primary data primary data on parameters such as biographical profiles, occupations, incomes and expenditures, vulnerability to poverty, accessibility and threats to the fisheries resource base, fish production, fisheries management regimes and suggestions to improve the fisheries

the questionnaire administered sought to solicit information on the specific roles of the governance institutions. However, the District Assembly did not respond on the grounds that it does not play any role in Tono Reservoir fisheries management. Where appropriate and possible, personal observations through direct interaction with the communities were also employed to ascertain or verify issues and responses provided.

Fifty-seven (57) fishers and thirty-five (35) fishmongers were randomly sampled from a list of 376 fishers and 104 fishmongers respectively made available by the leader of the RMC.

Table 3.2 Number of fishers and fishmongers sampled from the villages

Community	Fishers	Fishmongers
Gaani	8	4
Biu	35	17
Korania	6	4
Yigbwania	6	6
Yogbania	2	4
TOTAL	57	35

Fish species encountered in fishers' catches were identified the key described by Dankwa *et al*. (1999). Samples of fishing nets being used by fishermen during the study were examined and the mesh sizes (diagonal length) measured to ascertain compliance of law on fishing gears by fishermen. Individual fish samples were also weighed using a spring balance (model) to ascertain compliance with minimum allowable fish size set by the fisheries law. Distances of farms nearest the reservoir were also measured for similar reasons.

Some secondary data was also collected from published journal articles, students' theses and institutional reports to support validate that obtained in the study.

Data analysis

The data collected were analyzed using descriptive statistical techniques with the help of the Statistical Package for Social Sciences (SPSS, version 16.0) and the Microsoft Excel Spreadsheet. In the data analysis, unanswered applicable and inapplicable questions were treated as "missing systems" but were accounted for in the computation of the statistics where they appeared.

Plate 3.1 Researcher administering questionnaire to a fisher in his canoe at a landing bay

3.5 Data reliability and validity assurance

The study undertook measures to ensure the reliability and validity of respondents' data by minimising possible errors in two ways: i) pilot-testing of the questionnaire in the villages, and ii) personal observations. The pilot-testing allowed for restructuring of the questions to obtain consistent responses on repeated trials. The personal observations served to add, verify or refute primary data collected from the respondents. Furthermore, the interviews were not tape recorded, in order to allay the fears of some respondents that their voices could be used

as evidence or testimony against them someday, especially on issues of tax and fisheries regulation offenses.

3.6 Data analysis and presentation

Analysis of the data collected was performed using the Microsoft Excel spreadsheet and the Statistical Package for Social Science (SPSS, version 16.0). The results were presented using descriptive statistics, including percentage frequencies, graphs, charts and tables.

CHAPTER FOUR

4.0 RESULTS

4.1. Introduction

In this chapter, the results from the survey of the contribution of Tono reservoir fisheries to household livelihoods in five selected communities, which either conform to or vary from that of the reviewed literature are organized and presented. The findings of the study are presented in this chapter under major sub-captions describing the set objectives of the study. They are set in the right frame for discussions.

4.2. Demographic data on fishers and fishmongers

4.2.1. Distribution of fishers and fishmongers

The Biu community had majority (52) of the fishers and fishmongers representing 56% of the total sampled population (92) that participated in the study, while Yogbonia had the least (8) representing 9% (Figure. 4.1).

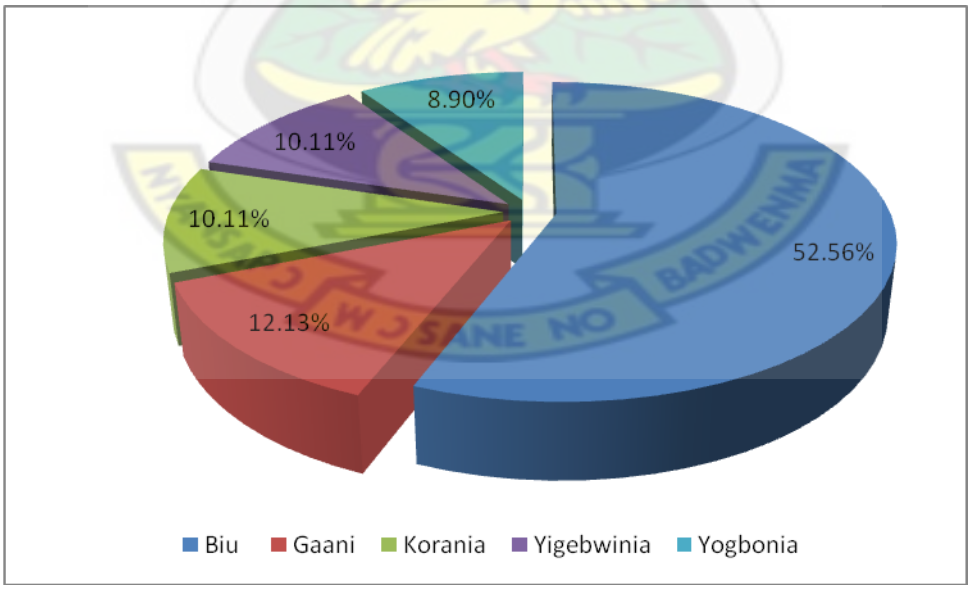


Figure. 4.1 Population distribution of fishers and fishmongers interviewed in the study

4.2.2. Ethnicity and gender distribution

The fishers and fishmongers belonged to three ethnic groups, namely Kassena, Nankana and Builsa. Majority (60) were Builsas and the males (57) were more than females (35) (Table 4.1).

Table 4.1 Ethnicity and gender distribution of the fishers and fishmongers

Ethnicity	Gender		
	Male	Female	Total
Kassena	8	9	17
Nankana	8	7	15
Builsa	41	19	60

4.2.3 Age class distribution

Majority (70) of the 92 fishers and fishmongers were in the active working class of 20-50 years: the rest were 51 years and above (Table 4.2). There was no evidence of child labour (persons under 18 years) involved in both occupations. Three (3) of the respondents could not tell their ages, but they probably belonged to the age class of 51 years and above, by personal estimation.

Table 4.2 Age distribution of the sampled fishers and fishmongers in the selected communities

Age class	Frequency	Valid Percent
20-30 years	30	33.71
31-50 years	40	44.94
51 and above	19	21.35
Total	89	100.0
Missing system	3	

4.2.4 Marital status distribution

Slightly more than one half (50.54%) of the fishers and fishmongers were married, 22.24% were widows, 20.22% were single: the status of the remaining 7% was inadvertently not recorded (Figure. 4.2).

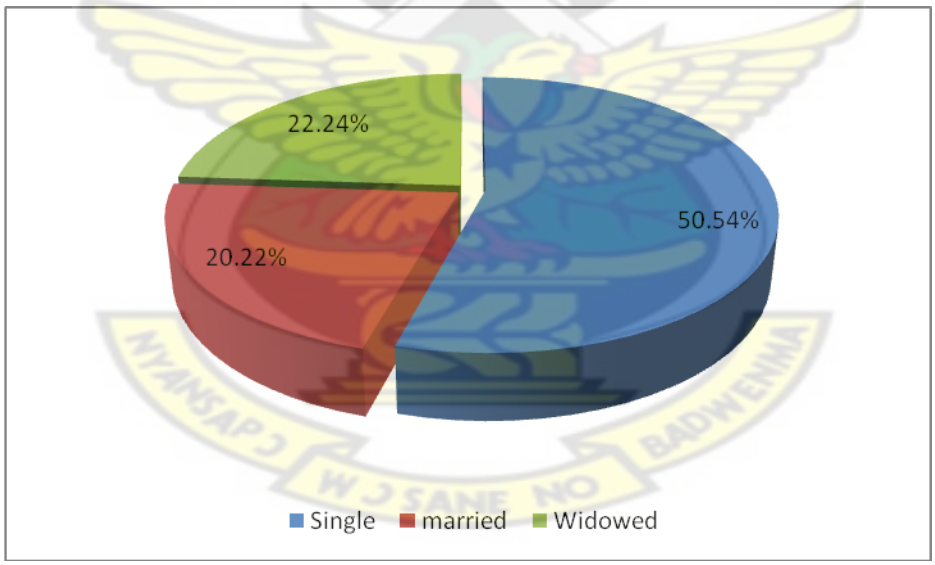


Figure. 4.2 Marital status of the fishers and fishmongers

4.2.5 Religious faiths distribution

The participants in the study belonged to three recognized religious faiths in the country, namely, Christianity (65.2 %.), Islam (30.4%) and traditional religion (3.3 %). However, there were some persons (1.1%) who did not belong to any religion (Figure 4.3).

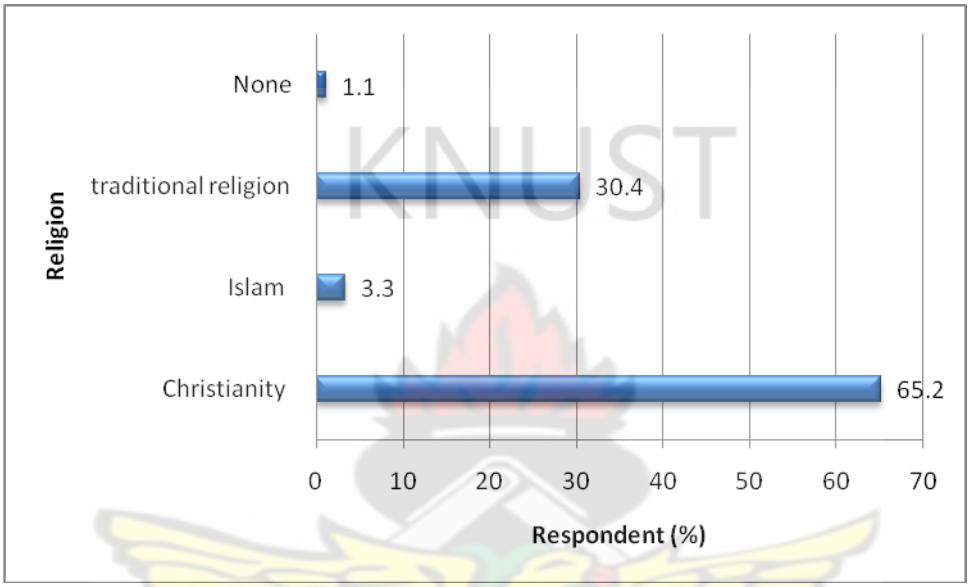


Figure 4.3 Religious faiths distribution of the fishers and fishmongers

4.2.6 Educational levels distribution

Majority (69) of the fishers and fishmongers were illiterate (i.e. they lacked formal educational attainment): the rest had basic education (18) and tertiary education (2) (Table 4.3). However, the education of three of them was not indicated.

Table 4.3 Levels of educational attainment of the fishers and fishmongers in the study

Level of education	Frequency	Valid Percent
None	69	77.53
Basic	18	20.22
Tertiary	2	2.25
Missing system	3	

4.2.7 Gender distribution

No female fisher was encountered in the study, but there were as many as 18 male fishmongers (Table 4.4).

Table 4.4 Occupation and gender distribution

Occupation	**Gender**	
	Male	**Female**
Fisher	43	0
Fishmonger	18	31

4.2.8 Occupational time stream distribution

Forty-six (50%) of the fishers and fishmongers said they operate full time, while 40 and 6 of them respectively said they are part-time and seasonal operators (Table 4.5).

Table 4.5 Time stream of fishers and fishmongers

Time stream	Occupation	
	Fisher	**Fishmonger**
Full time	19	27
Part time	28	12
Seasonal	4	2

4.2.9. Housing occupancy status

Majority (74) representing 80% of the fishers and fishmongers said they dwell in family houses by free use (i.e. they do not pay rent), while the rest (18) representing 20% said they live in their own houses.

4.2.10 Housing units: wall types

Walls of housing units in which majority (83) of the fishers and fishmongers dwelled were built of mud or mud, while houses of the rest (9) were built of cement blocks (Figure 4.5).

4.2.11 Housing units: roof types

Three different materials, namely, thatch (grass/straw), mud and corrugated zinc sheets were used in roofing the housing units in which fishers and fishmongers dwell. The respective distribution frequencies were 45.7%, 21.7% and 32.6% (Table 4.6).

Table 4.6 Materials used in roofing housing units

Roofing materials	Frequency	Percent
Thatch (grass/straw)	42	45.7
Mud	20	21.7
Corrugated zinc	30	32.6

4.2.12 Assets ownership distribution

The commonest household assets owned by the fishers and fishmongers were radio, bicycle and cell phone. Those who owned these assets were 58, 48 and 46 respectively. Only 11, 5, and 4 respectively owned boats, motor bikes and television sets. Motorbike owners were all women who were classified as not poor in the wealth ranking process. Surprisingly, the refrigerator which is essential for fish storage and preservation happened to be one of the rare household items. None of the respondents owned a car.

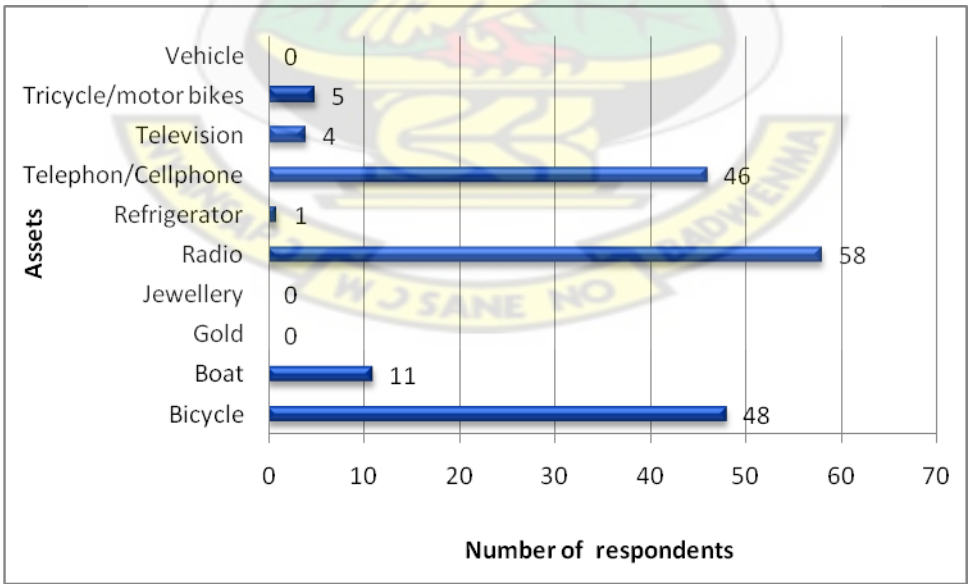


Figure 4.6: Distribution of assets owned by the fishers and fishmongers

4.2.13. Wealth ranking

The respondents were of four wealth categories: extremely poor, very poor, poor and not poor, using criteria such as household size, income, type of dwelling units, possession of fishing gear, household appliances and means of transport (Table 4.7). The respective calculated *per capita* income from fisheries activities for the various groups were, GH¢0.90/d (US$0.45/day), GH¢ 4.30/day (US$2.30/day), GH¢5.70/d (US$2.85/d) and GH¢8.60/d (US$4.30/d).

Table 4.7 Wealth ranking criteria

Criteria	Extremely poor	Very poor	Poor	Not poor
Household size	3-5	4-6	5-8	6-9
Dwelling unit	Rented	Rented,	Rented, owned	Owned,
Wall type	Mud,	Mud,	Mud, Brick	Cement block
Roof type	Thatch,	Thatch,		Zinc sheet,
Fishing gear	Nets (hired),	Nets (hired),	Nets (hired),	Nets (owned), Canoe
	canoe (hired),	canoe (hired),	Canoe (hired)	(owned),
Means of	Bicycle,	Bicycle,	Bicycle,	Bicycle,
transport			Donkey cart	Motorbike/tricycle,
Household	Radio,	Radio,	Radio, Cell	Radio, Cell phone,
appliances			phone,	Refrigerator, Television,
Per capita income	GH¢0.90/pers/d	GH¢4.30/pers/d	GH¢5.70pers/d	GH¢8.60/pers/d

4.3 The Tono artisanal fisheries: access, fisheries activities, production levels and impacts on livelihoods structures (food security, employment and income)

4.3.1 Adoption of fisheries occupations

Three major factors motivated the villagers to engage in fisheries occupations as either fishers or fishmongers, namely:

i) no alternative job opportunities (49 respondents),

ii) fisheries activities are lucrative (27 respondents) and

iii) friends' influence (13 respondents).

Reasons for the three (3) remaining respondents were not recorded inadvertently (Table 4.8).

Table 4.8 Distribution of factors that motivated the adoption of fisheries occupations.

Motivating factors	Fisheries occupation	
	Fisher	Fishmonger
No alternative job	31	18
Lucrative	11	16
Friends' influence	6	7
Missing system	1	2

4.3.2 Fisheries training

Majority (63.04%) of the fishers and fishmongers indicated that they did not acquire any organized training before adopting the occupations: they learned from friends on the job. However, 32 said they received some training once from MoFAD after adopting the occupations (Table 4.9). Two of the respondents did not indicate whether or not any form of training has been acquired.

Table 4.9 Distribution of respondents based on whether or not they have acquired some basic training in their occupations

Any training?	Fisheries occupation		
	Fisher	Fishmonger	Total
Yes	20	12	42
No	31	27	58
Missing system	1	1	2

4.3.3 Fishing methods

The following fishing techniques were employed by the fishers to harvest fish from the reservoir during this study: gill net fishery (Plate 4.1), cast net fishery trap fishery, magic hook and line fishery and simple hook and line fishery in that order of importance. The fishers said gill net fishery is both less labour intensive and time consuming.

Plate 4.1 A fisher preparing his gill nets for setting in the reservoir

The magic line and hook consists of a battery of lines and hooks stringed together at intervals and fixed in the water with baits attached to the hooks to catch fish. The cast net and simple

hook and line fisheries are examples of active fishing while the gill net, trap and magic hook and line fisheries are examples of passive fishing. In active fishing the gear is moved manually or mechanically to harvest the fish. In passive fishing on the other hand, the gear is set and allowed to catch the fish by itself. Gill nets, traps and magic hook and line were usually set in the evening from 5:00 to 6:00 pm and harvested in the following morning from 7:00 to 9:00 am, while cast net and simple hook and line fisheries were performed in the day time, mostly in the afternoon.

4.3.4 Fishing efforts

Approximately 69% of the fishers said they fish 6-7 days a week, while the rest (31%) said they fish 1-5 days a week (Table 4.10). During cold weathers however, about 50% reduce the number of days of fishing by 1-3 days a week, 25% reduce the number of nets set in a day while another 25% delay harvesting of the nets till it is warm as a caution against the effect of the cold weather. The number of fishing gear employed depends on the financial standing of the fishers and/or the women who sponsor them. For example many of the fishers set up to 6 gill nets a day.

Table 4.10 Frequency of fisheries activities

Working days/ week	Fisheries occupation	
	Fisher	Fishmonger
1	0	4
2	7	11
3	5	0
4	2	1
5	1	1
6	6	13
7	27	8

4.3.5 Fisheries production levels

The Ministry of Fisheries and Aquaculture Development (MoFAD), Navrongo District, and ICOUR provided catch data for this study. Analysis of the 2008-2012 data expressed in abundance (numbers) did not show any definite pattern of exploitation (Figure.4.7). However, three peak harvests emerged in 2008, 2009 (both in the 4th quarter, October–December) and in the 2nd quarter (April-June) of 2012. The respective peak harvests were approximately 53,000, 75,000 and 58,000 individual fish.

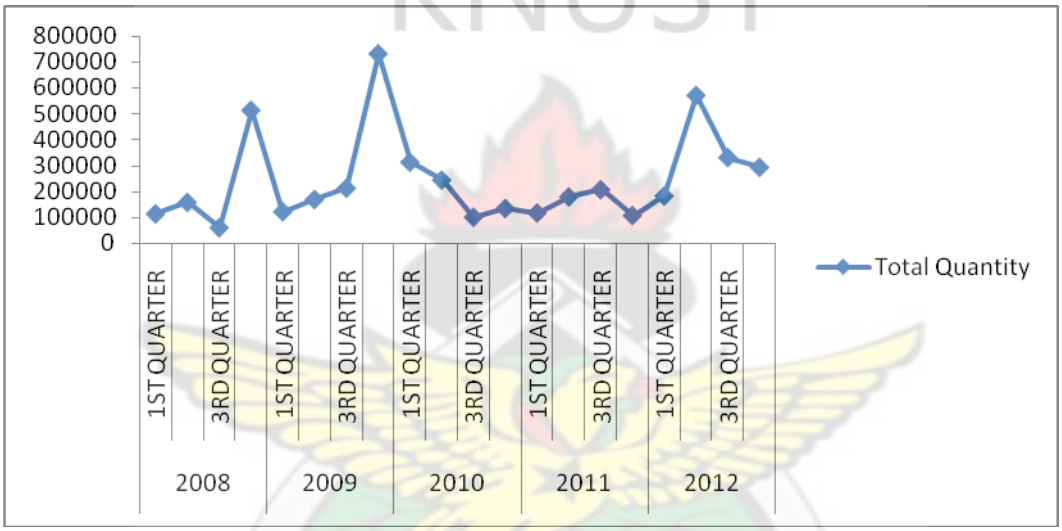


Figure 4.7 Quarterly fish harvests in numbers from the Tono reservoir from 2008 to 2012

Fish harvests in weight (metric tons) showed two peaks: 45 mt and 35 mt in 2008 and 2009, both in the fourth quarter (Figure 4.8). The respective lowest harvests in numbers and weight were 50.00 fish and 4.7 mt, in the 3rd quarter (July-September) of 2008. Harvests of tilapias in general have shown declines over short periods of 3-5 years since 1997. *Oreochromis niloticus* harvests declined from 9.6 mt in 1997 to 4.2 mt in 2002, *Sarotherodon galilaeus* from 13.2 mt in 1999 to 4.5 mt in 2002 and *Tilapia zillii* from 11.2 mt in 2000 to 3.3 mt in 2003. In terms of fish size, *T. zillii* decreased significantly from 68.0 g to 39.9 g, *O. niloticus* decreased slightly from 200.2 g to 197.2 g, while *S. galilaeus* increased from 109.0 to

133.9g.

In general, fisheries production during a seven-year period from 2001-2007 varied according to the seasons: the annual average harvests in the dry (November-April) and wet seasons (May-October) were respectively 125.21 mt and 82.71 mt. Closed seasons also influenced fisheries production statistics, but the effect was not significant.

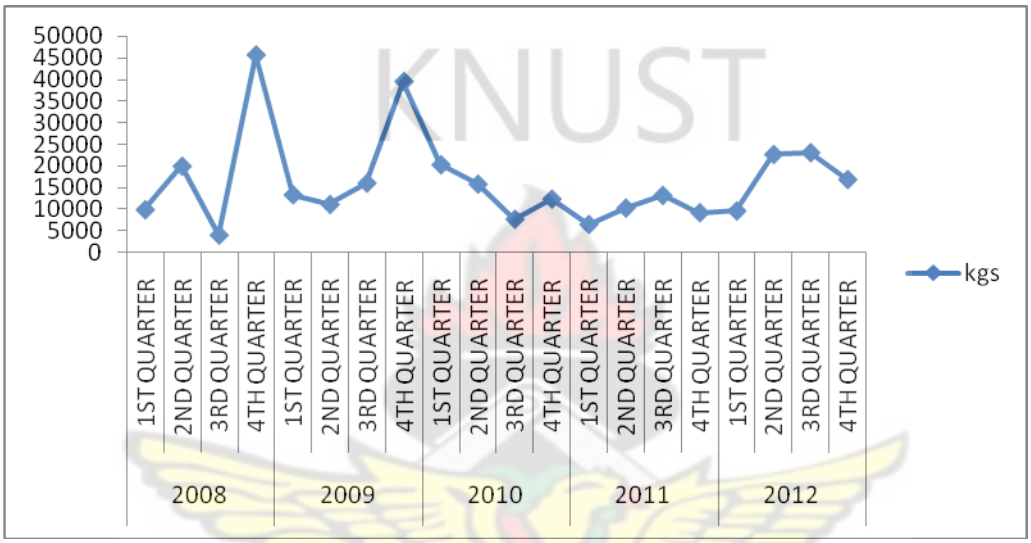


Figure 4.8 Quarterly fish harvests in weight (kg) from the Tono reservoir from 2008 to 2012

4.3.6 Post-harvest handling and marketing

The fishmongers (mostly women) removed the scales and gut of the fish and washed them with water from the reservoir at the landing bays (Plate 4.2).

Plate 4.2 Women (fishmongers) dressing fish at a bay. In attendance is the researcher (extreme left) examining the species richness of a sample of the catch.

It was however strange to see some men (fishers) in this study engaged in this type of predominantly feminine activity too (Plate 4.3).

Plate 4.3 A man (fisher) doubling as fishmonger dressing his fish catch at a landing bay

The fish were then packaged in plastic baskets or aluminium bowls and covered with pieces of jute bags or similar materials. The packaged fish were transported on bicycles (the

commonest means of transport) (Plate 4.4), motorbikes or on the head to market centers in the district, the most popular being the Navrongo fish market about 6-8 km away, depending on the position of the landing bay. Ice was added later on the way to the markets or upon arrival at the markets.

Plate 4.4 A woman (fishmonger) transporting fresh fish on a bicycle from the reservoir to the Navrongo fish market, about 6-8 km away

During this study, the women who converged at the fish markets to retail the fish. Others also did wholesale marketing. The rest hawked from place to place selling the fish to regular customers including fish processors, food venders at chop bars (Plate 4.5), restaurants and hotels.

Plate 4.5 Fried tilapia from the Tono Reservoir being served at a popular chop bar in Navrongo

4.3.7 Household food and nutrition security

For majority (72 %) of the fishmongers, fish that is not bought at the end of the daily sales is sent home to prepare meals for the households. The others (28 %) and all the fishers set aside preferred fish species for consumption at home. In general fish sent home for family consumption was estimated at 0.5-1.5 kg day^{-1}. This is usually sufficient for 1-2 days, depending on the household size to improve food and nutrition security. Household average per capita fish consumption was estimated at approximately 84-167 g $person^{-1}$ day^{-1}. The overall average was 125 g $person^{-1}$ day^{-1}.

4.3.8 Incomes from the fisheries

The estimated average weekly incomes of the fishers (GH¢150.00) was lower than that of the fishmongers (GH¢200.00). No one earned less than GH¢100.0 and 34 of them exceeded that amount (Table 4.11). Fifteen of them were unable to estimate their incomes. Calculated per capita incomes of fishers' and fishmongers' households averaged GH¢0.90-GH¢8.60 /person/day. Fishers' incomes were directly related to the fishing effort. In general the fishers

and fishmongers appeared satisfied with their income levels, but they wished that they could earn more.

Table 4.11 Estimated incomes from fisheries

Weekly income (GH¢)	Fishers	Fishmongers	Both	Percentage (%)
100	19	8	27	29.35
101-150	10	6	16	17.39
151-200	2	8	10	10.87
201-250	1	8	9	9.78
251-300	1	7	8	8.70
>300	2	5	7	7.61
Missing system	6	9	15	16.30

4.3.9 Incomes outflow pathways

The cash income generated from selling fish is used to invest in other assets or livelihoods. The principal outflow pathways of incomes earned by the fishers and fishmongers in order of importance were identified as clothing, food, school fees, farm inputs, fishing inputs and savings (Table 4.12). It is significant to note that those who invest incomes from fisheries in farm inputs do so with the view to take up crop cultivation to diversify their livelihoods during the closed seasons to reduce vulnerability to poverty.

Table 4.12 Frequency distribution of incomes outflow pathways

Spending outlets	Frequency	Percentage
Clothing	88	95.62
Food	87	94.57
School fees	80	86.05
Farm inputs	74	80.43
Fishing inputs	71	77.17
Savings	23	25.00

4.3.10 Economic status of fishers' and fishmongers' households

Except for three fishmongers, all the respondents placed themselves into one of four wealth classes: extremely poor, very poor, poor and not poor (Table 4.13). The respective estimated household per capita income from fisheries activities were GH¢0.90/d (US$0.45/day), GH¢4.30/day (US$2.30/day), GH¢5.70/d (US$2.85/d) and GH¢8.60/d (US$4.30/d). Other criteria used for the ranking were type of material used in constructing housing units, household size and assets owned.

Table 4.13 Economic status of fishers' and fishmongers' households

Economic status	Occupation	
	Fisher	Fishmonger
Extremely poor	7	1
Very poor	21	16
Poor	20	18
Not poor	0	3

4.4 Vulnerability context: poverty and anthropogenic impacts on the reservoir fisheries

4.4.1 Anthropogenic impacts

The major anthropogenic factors believed to have impacted negatively on the Tono reservoir fisheries were given by the respondents as

i) unapproved fishing methods,

ii) uncontrolled fishing efforts,

iii) farming too close to the reservoir (Plate 4.6) and

iv) application of agrochemicals.

The factors were subjectively ranked as very severe, severe or not severe (Table 4.14).

Plate 4.6 A woman in her cultivated vegetable (pepper) farm located within 50 m distance of the reservoir in violation of the fisheries regulation

Table 4.14 Human activities perceived to render the reservoir fisheries vulnerable

Human activities	Ranking frequency (%)		
	Very severe	Severe	Not severe
Unapproved fishing methods	37.0	22.2	_
Uncontrolled fishing efforts	34.4	53.1	12.5
Farming too close to reservoir	39.3	14.3	_
Agrochemicals	26.7	33.3	20.0

4.4.2 Climate change impact

The fishers were unanimous in their opinions on the impact of water level changes due to climate change on the fisheries. Fishers indicated that fishing is easy, harvests are plentiful and incomes are high when drought is prolonged because the water levels are low and that fishing effort is generally increased in the dry season. Consequently, 59.1% of both fishers and fishmongers expressed some concerns that the fisheries business drops after a prolonged drought. Some respondents (40.9%) also noted that excessive rainfall is another major concern because fishing is difficult in high water levels, and harvests and incomes are low (Table 4.15). The fishers acknowledged that cold weather in December and January affects their activities because they are generally wary of cold conditions; fishing frequencies are reduced by 1-3 days/week depending on the severity of the cold and disposition of the fisher. Some of the fishers, when they are under pressure from the women who sponsor their activities, drink strong alcoholic beverages in order to stay warm and active to fish in the cold.

Table 4.15 Climate change impacts on the fisheries

Climatic factor	Frequency	Percentage
Excessive rainfall	36	40.9%
Prolonged drought	52	59.1%
Excessive cold weather	-	-
Missing system	4	

4. 4.3 Accessibility to the fisheries resource

Majority (84) of the respondents representing 96.6% of the fishers and fishmongers indicated that access to the reservoir fisheries is open and free: only 3 of them said they obtained permission to access the reservoir fisheries for the first time (Table 4.16).

Table 4.16 Accessibility of fishers and fishmongers to the fisheries resource

Accessibility to resource	Frequency	Valid Percent
Permission	3	3.4
Open (no permission)	84	96.6
Missing System	5	

4.4.4 Constraints to the fisheries

Forty-six (50%) of the respondents complained about the high costs and unavailability of fishing net and canoes at the time of need as the biggest constraint to the fisheries (Figure 4.9). A total of 47.83% of the respondents indicated that management issues greatly affect the fisheries, while pollution of the reservoir was identified by 34.78% respondents as another

serious problem. No respondent complained about inadequate fish stocks in the reservoir or absence of cold storage facilities.

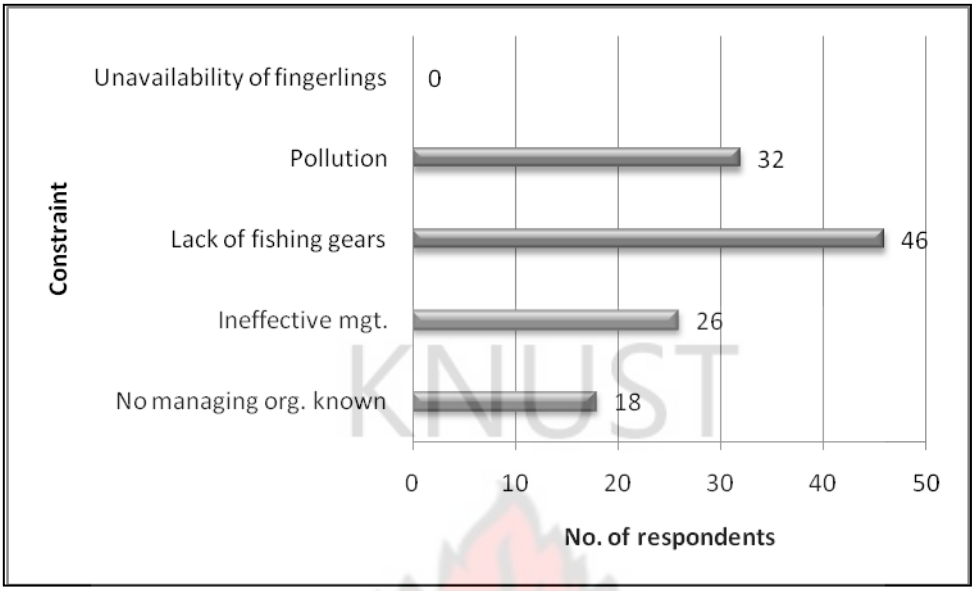


Figure 4.9 Problems encountered by fishers and fishmongers

4.4.5 The communities' evaluation of benefits from Tono reservoir

Majority (90.22%) indicated that the Tono reservoir has increased food production through capture fisheries, while 80.43% and 34.78% respectively said the reservoir has generated employment and helped farming and animal husbandry through irrigation and livestock watering (Figure 4.10).

All (100%) of the respondents indicated that the development of the Tono irrigation project has impacted on the general standard of living in the communities. They submitted that the reservoir fisheries in particular have created opportunities for alternative occupations for the hitherto predominantly farming communities. Fishing and allied activities were at a low profile before the advent of the project, but there has been an intensification of fisheries activities lately. They said increased food production and income has helped many respondents to better cater for their households, especially the welfare of the vulnerable (children and the aged).

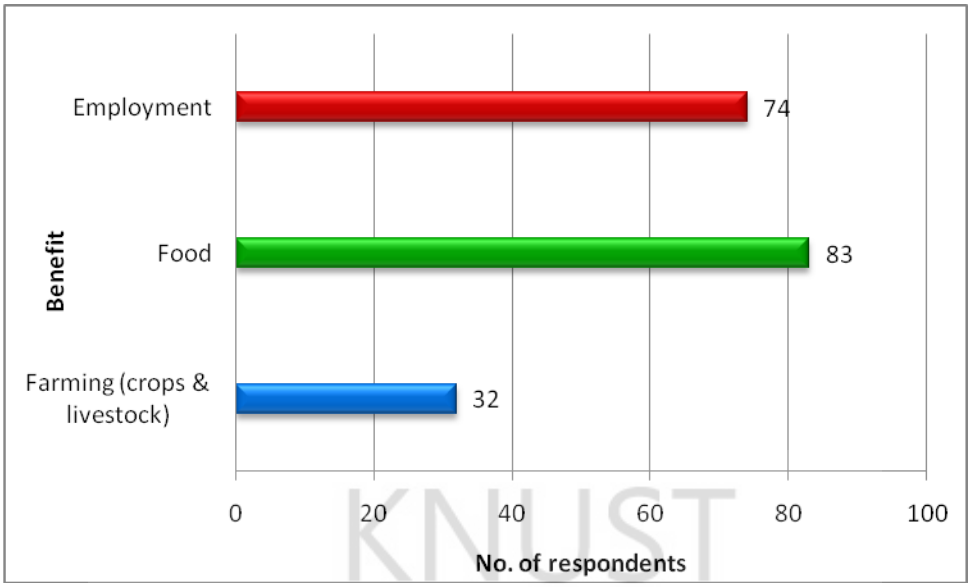


Figure 4.10 Major benefits derived from the fisheries

4.6 Fish stocks in the reservoir and fisheries management regimes

4.6.1 Fish stocks in the reservoir

Cichlids consisting of tilapias (*Oreochromis niloticus*, *Sarotherodon galilaeus* and *Tilapia zillii*) and *Hemichromis fasciatus* (Plate 4.7) constituted the predominant group of fish landed by the fishers during this study.

Plate 4.7 Some fish species harvested from the reservoir: left: Cichlids (*Hemichromis fasciatus*, tilapias (*Sarotherodon galilaeus*, *O. niloticus* and *T. zillii*) and right: *Auchenoglanis occidentalis*.

Other common types of fish encountered in the fishers' catches were Mormyridae (Plate 4.8) and Schilbeidae (Plate 4.9).

Plate 4.8 A harvest of Mormyridae (a common fish stocks) in the Tono Reservoir

Plate 4.9 A harvest of Schilbeidae (one of the commonest fish stocks in the reservoir) being dressed by a fishmonger at a landing bay

Three species which were reported by the fishers and mentioned in literature as endemic species in the reservoir, namely *Brycinus* (*Alestes*) *nurse*, *Labeo sp* (African carp) and *Malapterurus electricus* (electric fish) were always absent in the catches.

4.6.2 Fisheries management regimes

The Tono Reservoir fisheries management is based on modern conventional management systems set out for the management of all Ghanaian inland and coastal water resources. ICOUR and MoFAD (Navrongo District Office) are jointly mandated to ensure compliance of the management systems outlined:

i. Farmlands should be located at a minimum distance of 200 m away from the shoreline.
ii. Fishing nets should have a minimum mesh size of 75 mm diagonal length.
iii. A closed fishing season (1st June to 31st August) should be imposed annually and enforced.
iv. Fishing nets should be set in the evening and harvested in the following morning.
v. No other fishing activity should be done in the night.
vi. Seine fishery should not be allowed anywhere in the reservoir, except for the purposes of research investigations.
vii. Fishing gear usage is restricted to 5 gill nets, 1 cast net, 2 traps and 2 hook and line per fisher per day
viii. Minimum harvestable size is limited to only two types of fish: tilapia (300 g) and *Clarias* catfish (is 600 g).
ix. The conventional hatchery, nursery and production pond facilities attached to the irrigation project must be used to produce fingerlings to regularly restock depleted

fish stocks in the head reservoir and night storage reservoirs for enhanced fisheries production.

Closed seasons were imposed annually from 2001-2007 except for 2005. The duration of the closure varied from year to year and lasted 2-3 months from July-August, July-September or August-October. The average subsequently fish harvest in the years closed fishing was imposed (167.8 mt) was bigger than the harvest (141.5 mt) in the year that there was no ban on fishing (Table 4.17).

Table 4.17 Comparison of the effects of closed fishing and absence of closed fishing on fish harvests from 2001-2007.

Year	2001	2002	2003	2004	**2005**	2006	2007
Closed fishing	Aug-Oct	Jul-Aug	Jul-Sept	Jul-Aug	**No ban**	Jul-Aug	Jul-Aug
Harvest (mt)	161.10	166.97	248.30	132.30	**141.50**	153.80	144.30

4.7 Institutional governance structures and processes

Responses to the questionnaire administered to the various local institutions have been summarized in this section. It represents the responses given by the official representatives of Irrigation Company of Upper Region (ICOUR), Ministry of Fisheries and Aquaculture Development (MoFAD), Reservoir Management Committee (RMC), Kassena Nankana East District Assembly (KNEDA) and Local Traditional Authority (LTA).

4.7.1 Irrigation Company of Upper Region (ICOUR)

ICOUR is a government of Ghana Company under the Ministry of Food and Agriculture (MOFA) responsible for the management of both the Tono and Vea irrigation projects located in Navrongo and Bolga in the Upper East Region. Access to the fisheries resource is open and free to all. The biggest problem ICOUR faces, however, is that fishers are reluctant to comply with measures set out to regulate the fisheries to ensure sustainable exploitation. The fishers do not observe the closed seasons (ban on fishing) when they are imposed from 1st June to 31st August to allow for uninterrupted natural recruitment of the fish stocks. ICOUR does not have the resources to monitor and restrain fishers from using unapproved fishing gears and methods, such as the use of fishing nets with stretched (diagonal) meshes less than 75 mm.

4.7.2 Ministry of Fisheries and Aquaculture Development (MoFAD)

MoFAD plays a significant role in fishers' access to the resource through registration of new entrants. It constituted a fishers task force (FTF) from all the five landing sites or bays to assist in monitoring and policing duties to ensure fishers' compliance of the fisheries regulations, such as closed seasons (1st June to 31st August), fishing effort restriction (e.g. 5 gill nets, 1 cast net, 2 traps and 2 hook and line per fisher a day), and net mesh size restriction (75 mm diagonal length), and fish size restriction (e.g. tilapia: 300 g, 9 cm TL; catfish: 600g). Offenders' nets are confiscated as a sanction to deter others and force compliance. MoFAD does this in concert with the Reservoir Management Committee (RMC) and ICOUR. However, there is no restriction on the number of canoes permitted on the reservoir in a day because of the open and free access to the resource.

MoFAD provides fishing nets to fishers through an arrangement with the Social Security Bank (SSB). MoFAD has engaged the services of a canoe builder to train natives on how to build and mend boats in Navrongo, in addition to training in fishing nets construction and

repair, swimming lessons and fish preservation and processing techniques. MoFAD has not been able to restock the reservoir with fingerlings since the aquaculture facilities came under the control of ICOUR some eight years ago, and ICOUR has not done it either.

4.7.3 Reservoir Management Committee (RMC)

The RMC is mandated by ICOUR to take levies from the fishers, but it said that monitoring of access to the resource is the mandate of ICOUR and MoFAD. The RMC in concert with MoFAD monitors gear restrictions, closed seasons (ban on fishing) and landed fish size.

The RMC receives supply of fishing nets from MoFAD and ICOUR, and canoes from MoFAD. There is a good working relation between the RMC, ICOUR and MoFAD. However, the RMC suspects that the working relation between ICOUR and MoFAD is unhealthy, and this is seriously impeding growth of the fisheries, and the fortunes of the fishers and fishmongers. The RMC suggested the separation of governance responsibilities and called for an immediate improvement in the working relation between ICOUR and MoFAD for the benefit of the communities whose lives depend on the fisheries resource.

4.7.4 Local Traditional Authority (LTA)

The Local Traditional Authority (LTA) is represented by the local community chiefs. The chiefs give fishers in the villages permission to fish in the reservoir. The local chiefs employ the authority vested in them by tradition to restrain fishers from engagement in illegal fishing, especially chemical fishing and the use of unapproved fishing nets and methods. The local chiefs also assist MoFAD in organizing the fishers for fisheries training. Furthermore, the local chiefs often meet with ICOUR management to discuss fisheries management issues with the view to promoting sustainable fisheries for the benefit of their communities. The

local authority relates with Kassena Nankana East District Assembly by taking instructions from them.

The major problem the local chiefs face is that some fishers do not observe the fisheries regulations. The LTA's suggested solution to this problem is that the staff strength of MoFAD should be increased to ensure effective enforcement of the laws governing fishing in the reservoir.

4.7.5 Kassena Nankana East District Assembly (KNEDA)

The District Assembly did not respond to the questionnaire on the grounds that it does not exercise any direct or indirect role in the governance of the Tono reservoir fisheries.

4.8 Resources in the villages and proposed livelihoods analysis framework

4.8.1 Resources in the villages

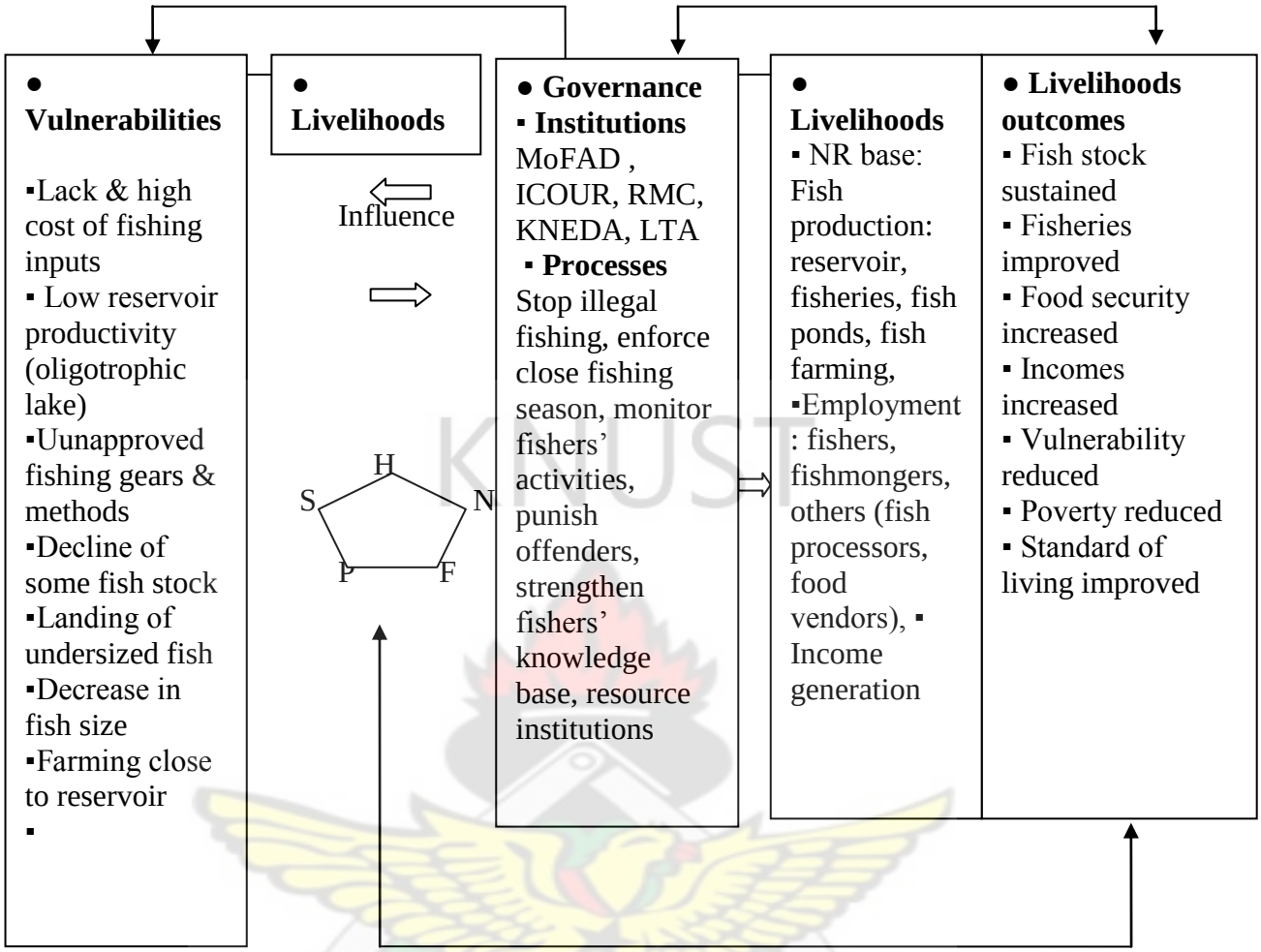
Five major resources identified in the villages were grouped under human, physical, natural, social and financial capital assets (DFID, 1999) (Table 4.17).

Table 4.18 Major resources identified in the villages

Resource	Detailed list
Human	Chiefs and elders, Assembly men/women, farmers, school teachers, nurses/midwife, boat maker, tailors, cobblers, carpenters, masons, hairdressers, civil servants, church pastors and elders, apprentices of various trades/professions.
Physical	Roads (laterite), dam and canals, schools (nursery, primary, JHS), community nursing training, private hostels, community FM radio station, electricity, boreholes, drinking spots, Police station, churches, mosques, shrines/idols/groves, corn and rice mills, tailoring shops.
Natural	Rivers, reservoirs/dugouts, irrigation canals
Social	Reservoir Management Committee (RMC), Fishmongers' Associations, Farmers' Association, Christian religion, Islam religion, traditional religion, drinking spots
Financial	Food vending, sale of agricultural and fisheries inputs and produce, livestock and poultry, milling grains (rice, corn, groundnut etc), petty trading, sale of labour.

4.8.2 Proposed livelihoods analysis framework

The identified resources were reorganized to construct conceptual sustainable livelihoods analysis framework to explain how they either constrain or enhance livelihood opportunities, and show how they relate to each other in poverty analysis in the present study area (Figure, 4.11).



KEY
H – Human capital N – Natural capital F – Financial capital S –Social capital P-Physical capital
NR-Natural Resource FC-Fisheries Commission RMC-Reservoir Management Committee
ICOUR- Irrigation Company of Upper Region DA- District Assembly TA-Traditional Authority

Figure.4.11 Proposed conceptual sustainable livelihoods analysis framework

CHAPTER FIVE

5.0 DISCUSSION

This chapter highlights and discusses the major findings of the study of fisheries livelihoods in the Tono Irrigation Project (TIP) site near Navrongo in the Upper East Region of Ghana. The findings were derived from interviews, personal observations and literature sources. During discussions, the reviewed literature in chapter three is set as the background and the results of the present study viewed against it. Scientific explanations are then assigned to any variations or similarities that emanate.

5.1 Anthropogenic impacts

5.1.2 Household size, marital status and religion

The married fishers and fishmongers constituted 50.54 %. Boadu (2011) recorded respectively 60% and 71.4 % married fishers and fishmongers operating at bay 5. Married fishers at bay 4 were 80%, but no figure was given for fishmongers (Appiah, 2011). Antwi-Boasiako (2011) recorded respectively 82.6% and 100% married fishers and fishmongers at bay 3, while Ofosu (2011) recorded 75 % married fishers and 100% married fishmongers at bay 1. All the females interviewed at bay 2 were married (Laar, 2011). In the study of the role of women in Tono fisheries, 85.7% of the women interviewed were married (Takyi *et al*., 2011).

The household size of the fishers and fishmongers involved in the present study averaged approximately five. Antwi-Boasiako (2011) also reported five for those operating at bay 3, three to six was reported for bay 4 (Appiah, 2011), while four to eight was reported for bay 1 (Ofosu, 2011). Seven years ago the household size for the entire district averaged eight (KNDA, 2006). Apparently, the household size in the fishing communities was generally smaller than the district average. Holding all other factors constant, the married are more likely to raise families of larger sizes and therefore explore the advantage of the family

labour. The result is the likelihood to impact the reservoir to a greater extent than the singles. One would therefore not be wrong in suggesting that larger family size offers some advantage at the expense of the resource itself. This highlights the concepts, the tragedy of the commons (Hardin, 1968).

Different reasons were assigned to this trend, but the most important seemed to be the monogamous marriage that is practiced among the predominantly Christian population in the fishing villages. Monogamous marriage commonly restricts the size of the family by reducing the stress of child bearing on the mother. In contrast, polygamous marriage encourages the raising of a large family size as the stress of child bearing is shared by many mothers, and it is characteristic of Moslems, but Moslems are a minority in the study communities. In the Dang Tong community in Cambodia, however, fishers' household sizes increase with social status: 4-8, 6-10 and 6-13 members in the very poor, poor and medium families respectively (STREAM, 2002). This relationship was also observed in this study. It is worth noting that large households usually put more stress on the bread winner(s) to work extra hard in order to provide adequately for the rest of the members, and it is a common source of vulnerability to poverty among rural families.

5.1.3 Age and gender impact

Age and gender of the active work force are important in economic assessment of the future development and well being of a people or a community. The largest population (66.2%) of both fishers and fishmongers actively engaged in Tono reservoir fisheries in the first quarter of 2013 belonged to the age class of 31-50 years and older: the rest (33.8%) were 20-30 years old. The ages of the women in Tono reservoir fisheries have been variously reported as 25-55 years at all the five landing bays (Takyi *et al.*, 2011), 21-50 years at bay 1 (Ofosu, 2011), 21-

44 years at bay 3 (Antwi-Boasiako, 2011), 21-32 years at bay 4 (Appiah, 2011), and 18-43 years at bay 5 (Boadu, 2011). Similarly the ages of the men have been variously reported as 18-40 years and above at bay 2 (Laar, 2011), 21-50 years at bay 1 (Ofosu, 2011), 18-50 years at bay 3 (Antwi-Boasiako, 2011), 20-50 years at bay 4 (Appiah, 2011), and 19-43 years at bay 5 (Boadu, 2011). No fisher or fishmonger below the age of 18 years has been reported, indicating the absence of child labour, although there is no existing local law prohibiting this practice in the fishing villages. The popular north-south migration of the youth under 18 years for greener pastures was suggested as the most probable reason**.** In contrast, nearly 50% of the fishers and fishmongers engaged in Lake Bosomtwe fisheries in the Ashanti Region two years ago belonged to a comparatively younger age class of 18-29 years and only 15% were 50 years and above (Oppong and Agyeibi, 2012). Apparently, the lake fisheries have potentially higher future prospects, in the sense that a comparatively larger proportion of the current work force would be available to work in the next 31-42 years before attaining the retirement age of 60 years when their productivity is expected to be minimal.

The work force engaged in the Tono fisheries in general consisted of less women than men Although, women perform housekeeping and childcare duties in the home, their resilience enables them to effectively combine the traditional roles with livelihood activities, albeit at an overall lower level of productivity. The females were endowed with substantial knowledge pertaining to the reservoir and its resources. Based on this, the fair representation of females in this study could generate vital information for the achievement of the research goal. However, most of the married women in Tono fisheries suggested that some support from the men in housekeeping and childcare responsibilities can reduce the stress on them and improve their level of productivity. The men were not in favour of this suggestion simply because it is not a traditional practice in the rural economy of this area. Although fish mongering is traditionally all female occupation, some men (fishers) in the Tono reservoir

fisheries have adopted it. Adoption of fishmongering as an extended fisheries occupation of fishers may be one convenient way to circumvent traditional opposition and barriers to offer the help the women have suggested.

The population density of fishers in the Tono reservoir fisheries is 9 fishers km^{-1}, which is higher than the national average of 6 fishers km^{-1} (Okrah, 2010). If the pressure from this national fishers' population density has resulted in overfishing in Ghanaian waters, then the relatively higher local fishers' population density at Tono suggests a higher risk of overfishing in this reservoir.

5.1.4 Fisheries management lapses

Closed seasons when fishing is prohibited are not regularly imposed and enforced. In general the observance is poor when the closed seasons are imposed. Similar observations have been reported by previous workers (Takyi *et al*., 2011; Okrah, 2010; Egwedimma, 2013). The worst offenders of the reservoir fisheries regulations are the full-time fishers, who are pushed by pressures from the women financiers to violate the regulations. The average of fish harvested in the six years (2001-2004 and 2006-2007) fishing was closed exceeded the harvest in the year (2005) fishing was not banned by 26.3 mt. It is difficult to explain what actually accounted for this difference. Closed fishing is a necessary management intervention to facilitate natural recruitment of fish stocks for sustainable fisheries, but variations in unrestricted fishing efforts probably masked the effect of the ban, given that the Tono fishers were notorious in flouting fishing regulations including closed seasons.

5.1.5. Ethnicity

The open access status of the Tono reservoir fisheries allowed unrestricted access to whosoever wanted to benefit from the resource. However, the beneficiaries were all local inhabitants belonging to three closely associated ethnic groups, the Kassenas, Nankanas and

Builsas. Strangely, migrant fishers and fishmongers from the Fante and Ewe tribes in southern Ghana were not involved in the Tono Reservoir fisheries during this study, and had not been mentioned by any previous study, although were conspicuous everywhere else within and outside the country.

5.1.6. Educational impact

Majority (69) of the fishers and fishmongers engaged in Tono reservoir fisheries were illiterate: had no formal education. Illiteracy can impede training programmes intended for fishers and fishmongers, if the facilitators are not skillful in communicating fisheries technical terminologies and concepts effectively in the vernacular. It can also impede business development, organization, monitoring and evaluation which require the ability to keep records. Weir (1999) is of the view that education may help individuals and groups to adjust to disequilibrium and the propensity to successfully adopt innovations. Collection of fisheries statistics from the illiterate participants was more difficult and time consuming than from the participants with basic formal education. In comparison, all the fishers and fishmongers engaged in Lake Bosomtwe fisheries have had some formal education at the primary to tertiary levels (Oppong and Agyeibi, 2012). This was a positive sign for the future of the lake's fisheries, because they are in a better position to appreciate the need to observe fisheries regulatory measures, whether traditional or conventional to sustain the industry.

5.2 Fisheries production impacts on food security

The Tono reservoir is one of the major freshwater fish supply baskets for the people of Kassena Nankana East District of the Upper East Region. Analysis of fish catch data obtained from ICOUR and MoFAD shows that annual fish harvests from the 1,860 ha Tono reservoir between 2001 and 2010 have fluctuated around an average production of 61.2 metric tons and

yield of 0.03 mt ha^{-1} (Tenkorang, 2001; Mbugri, 2002; Gyimah, 2003; Agyemang, 2004; Saeed, 2005; Zuyela, 2006; Boto, 2007; Maanyogr, 2008; Acheampong, 2009; Forkuo, 2010). The lowest and highest production levels were respectively 20.4 mt in 2002 and 147.9 mt in 2005, while the lowest and highest yields of 0.01 and 0.05 mt ha^{-1} occurred in 2001 and 2004 respectively. Both the fishers and fishmongers interviewed in this study were of the belief that fish stocks in the Tono reservoir have been dwindling progressively in the last one and half decades, but the recorded statistics did not seem to support the claim.

The Tono reservoir is rich in ichtyofuanal (fish) biodiversity consisting largely of cichlids (*Oreochromis niloticus, Sarotherodon galilaeus, Tilapia zillii and Hemichromis fasciatus*), *Auchenoglanis occidentalis*, *Clarias* catfish, Schilbeidae, Mormyridae, *Brycinus* (*Alestes*) *nurse*, *Malapterurus electricus* and *Labeo* species (Obodai and Waltia, 2003). The cichlids dominate the fisheries in terms of abundance (numbers) and weight, followed by Schilbeidae and *Clarias* catfish (Ayimbire, 2008; Obodae and Waltia, 2003). Certain species, notably *Brycinus* (*Alestes*) *nurse, Malapterurus electricus, Clarias* catfish and *Labeo species* which were once caught in abundance, are now scarcely harvested (Ayimbire, 2008; Obodae and Waltia, 2003), suggesting that these species are endangered. According to the fishers and fishmongers, the *Brycinus* (*Alestes*) *nurse* fishery was as important as the tilapia fisheries until quite recently. The last time the species was encountered by the fishers was 3-4 years ago, suggesting that the stocks have become seriously depleted and probably suffered local extinction or about to do so. But it is possible to restore endangered species to the food market through aquaculture, if kept from extinction (Goldschmidt, 1989; Kaufman, 1992). This highly valued fish should be saved from local extinction and restored to its former place in the reservoir fisheries through a carefully planned restocking programme.

Combined anthropogenic and intrinsic abiotic factors were certainly responsible for the current state of the Tono Reservoir fisheries. The local inhabitants interviewed in this study submitted that human population in the area has increased in the past two decades. Also many of the fishers raised their fishing efforts, particularly the number and size of fishing nets, to increase catches and income from fisheries and improve the standard of living of their households, which set the stage for overfishing. Evans *et al*. (1997) have reasoned that a rise in human population eventually increases the need for fish which can only be met through intensified exploitation.

5.3 Governance impact on the fisheries

5.3.1 Accessibility

Access to the Tono Reservoir fisheries was open and unrestricted: any person who desired to use it was granted the right to do so, and its exploitation followed the pattern of a common property that was regulated. A common property may be regulated or unregulated (Heltberg, 2001; Baland and Platteau, 1996, 2000). Open access fisheries exploitation is characteristic of many inland fisheries in Africa (Van Zalinge *et al*., 2000a). This type of fisheries is believed to be the endogenous origin of poverty among fisheries-dependent households (Yew, 1993) and leads eventually to stocks depletion (Bene, 2003).

Although it was accepted that new entrants reduced the expected potential benefits and further impoverished the fishers, it was difficult to restrict them because of the underlying socio-economic implications (Ostrom, 1990; Bavinck *et al*., 2005). In the case of the Tono Reservoir fisheries it was revealed that political leanings, to some extent, have influenced access to some aspects of the fisheries. Any attempt to restrict new entrants into the Tono Reservoir fisheries was resisted, but if this can be done successfully through the purchase of licenses or imposition of user levies, it would control exploitation. Tetteh (2004) has also

suggested this approach to curtail uncontrolled influx of new entrants, but would deny many people (especially the poor) access to the fisheries. Locally based access-regulating mechanisms can effectively control the intensity of fisheries exploitation, and regulation of fishing effort remained essentially the means to achieve it (Jul-Larsen and van Zwieten, 2002). However, fishers in general were notorious in finding ways around fishing regulations, and poverty is believed to be the main force that drives them to overfish (Bavinck *et al*., 2005).

This situation was also typical of Tono reservoir fisheries, and the refusal of the fishers to observe fishing regulations such as restrictions on fishing efforts, net mesh size, landed fish size, as well as closed fishing is influenced by two major factors: i) economic reasons and ii) poor and irregular monitoring and surveillance by the grossly constrained local fisheries governance institutions. Some of the institutional constraints identified in this study included limited resources such as trained personnel and logistics, and low motivation and work ethics emanating from unattractive working conditions. It seemed natural that the fishers simply take advantage of the constraints of MoFAD and ICOUR to do illegal fishing. Restriction on the magnitude of fishing effort is an effective management intervention (Briones *et al*., 2004b; Brown, 2003) and must be enforced by setting catch quotas. In the absence of effective and applicable management systems, the current excessive harvests would continue and push the endemic fish stocks already in crisis into local extinction and jeopardize not only the rich ichtyofuanal **(**fish**)** biodiversity, but also a dependable source of rural livelihoods.

The management of the Tono Reservoir fisheries did not include traditional systems. This was strange because fisheries in many parts of Africa were regulated effectively by

traditional systems that generally restricted access and fishing efforts (Johannes, 1978, 1982; Ruddle 1988, 1994). For example, Lake Bosomtwe fisheries in the heart of Ashanti Region were effectively managed traditionally for centuries by the imposition of taboos to ensure sustainable production, until the collapse of most of the traditional laws as a result of Western influence, and now the lake fisheries show signs of overexploitation (Oppong and Agyeibi, 2012). Volta Lake fisheries have also been overexploited for the past 30 years (Bene, 2004), probably for similar reasons. It has been predicted that breakdown of traditional fisheries management systems and barriers to entry will lead to fisheries overexploitation in Africa (Brainerd, 1995), but recovery is possible by the declaration of closed seasons and closed areas (FAO, 1999).

5.4 Employment and income

5.4.1 Fisheries impact on household poverty

It is generally believed that poverty persists among fishing households (Yew, 1993) and people living on less than US$1.00 a day are universally considered poor (World Bank, 2004). The villagers involved in the Tono Reservoir fisheries ranked themselves into four poverty classes namely, extremely poor, very poor, poor and not poor with respective estimated household per capita incomes from fisheries activities of GH¢0.90/d (US$0.45/day), GH¢4.30/day (US$2.30/day), GH¢5.70/d (US$2.85/d) and GH¢8.60/d (US$4.30/d). Only less than 30% of the households that lived on less than US$1.00 a day could be considered poor: the rest lived above the global poverty line. Judging by this universal definition of poverty, the majority (70%) of the Tono fishers' and fishmongers' households are not poor. Okrah (2010) also reported that in 2009 most of the fishmongers earned less than the minimum daily wage of GHC2.65 which was then slightly higher than US$2.00. The estimated average daily income of fishmongers during the present study exceeded that of the fishers. Oppong and Agyeibi (2012) also made a similar observation in

the study of Lake Bosomtwe fisheries: the fishmongers earned more. A livelihood study in Dang Tong, a village in Cambodia, ranked fishers and farmers as very poor, poor and medium, and all the three categories lived on less than US$1.00/day.

5.4.2 Fisheries impact on district employment and revenue

The Tono Reservoir fisheries provided livelihoods opportunities for a good number of people in the district. According to the RMC, the total number of registered community members employed in Tono Reservoir fisheries in 2013 was 480 (376 fishers and 104 fishmongers). The figure for the fishmongers was probably an underestimation because unregistered women in the enterprise and those who processed fish from the Tono Reservoir for sale at chop bars, restaurants and hotels in and outside the district were not taken into consideration. The above statistics break down to 75 fishers/bay and 21 fishmongers/bay. However, personal observations made at the 1st quarter of 2013 in this study revealed an average of only 10 active fishers/bay and 15 active fishmongers/bay. The average of active fishmongers recorded by Takyi *et al.* (2011) was 11/bay in their study of women in Tono reservoir fisheries. Women take charge of all the post harvest fisheries enterprises including processing and commerce to the point of sale in chop bars and restaurants (Shaleesha and Stanley, 2000; Brown, 2003) and were therefore likely to be more than the men who do the actual fishing. A full study is needed to take census of all women employed in the Tono reservoir fisheries in the district in order to establish realistic fisheries employment and income statistics.

This study also revealed that the communities who derive their livelihoods from the Tono reservoir fisheries refuse to pay taxes or prescribed levies for using the resource, although the fishmongers paid daily market tolls to KNEDA whenever they sold fish at the approved fish markets. Okrah (2010) reported that in 2009 the District Assembly collected a total revenue of GHC1,128.00 as market tolls from the fishmongers. It is important to note that

fishmongers who sell outside the approved fish markets anywhere in the district evade the payment of market tolls and deny the Assembly a potential source of revenue. The fishers on the other hand did not contribute to revenue generation in the district in any form, because the District Assembly had probably not made any effort to target them for revenue collection, although it was easy to be reached through ICOUR and MoFAD. Okrah (2010) suspects that the Assembly has not targeted them for the simple reason that it does not make any inputs in the management of the fisheries resource to justify collection of revenue from them. Virtually all the fishers in the present study confirmed this suspicion, which has been the reason why they refuse to pay anything to the District Assembly as taxes or levies.

In general, incomes estimated for the fishers operating in the Tono reservoir in the present study were lower (GHC150/week) than incomes of the fishmongers (GHC200.00/week). A similar trend was reported for Lake Bosomtwe fisheries: fishers earned less (GHC147.00/day) than fishmongers (GHC245.00/day) (Oppong and Agyeibi, 2012). Okrah (2010) reported annual cash incomes from fisheries ranging between GHC100 and GHC1,099 in 2009. Antwi-Boasiako (2011) estimated incomes ranging from GHC105.00/month to GHC900.00/ month at bay 3 while Laar (2011) estimated GHC300-600.00/month for bay 2, with Ofosu (2011) reporting incomes of GHC100-300.00/week for bay 1. The variations in the estimated incomes, especially in the same year, could be due primarily to factors such as fishing efforts and rates of fish harvests, among others.

The current study and previous ones (Okrah, 2010; Takyi *et al.*, 2011) showed that it was a common practice for fishmongers to finance the activities of fishers through the provision of fishing gears such as boats and fishing nets under three different agreements. Gear ownership influenced both the right of fishmongers to purchase fish landed by the fishers and the price of the fish. Takyi *et al.* (2011) reported that the women enter into informal trade agreement

with the fishers they sponsor to buy their fish at 50% discount. In the present study, three systems of gear ownership were identified, namely 1) fisher owned both the boat and nets, 2) fishmonger owned both the boat and nets and 3) fisher owned the boat and fishmonger owned the nets or fishmonger owned the boat and fisher owned the nets (shareholding). On the other hand, fishmongers who are the sole financier sold the catch at half the prevailing price. In the shareholding enterprise, the fisher sells the fish to the fishmonger at three quarters the prevailing price. Shareholding investment or 100% investment from the fishmonger entitles her the right to purchase all the fish from the sponsored fisher(s). This elaborate system of traditional fisheries investment and trade was first documented by (Laar, 2011), when he studied the state of Tono reservoir fisheries at bay 2. The system is an example of the relationship between active fishers and gear owners for whom they work (Jul-Larsen and van Zwieten, 2002). The problem with the arrangement is that the women gear owners complained that it is very difficult to monitor and control the fishers, while the fishers also complained that the women exploit them. Both parties made these revelations in confidence in order not to mar the age long working relations.

5.5 Vulnerability context

5.5.1 Climate change impacts

The rainy season (May-October) and dry season (November-April) experienced in the Kassena Nankana East District subjects the Tono reservoir to seasonal variations in water levels: high levels in the rainy season and low levels in the dry season. In general, recorded fish harvests from the reservoir in the erratic rainy season are usually lower than in the dry season (Ayimbire, 2008). The reason could be that in periods of low water level, fisheries usually experience increased fishing pressure because catch per unit effort (CPUE) was greatest as fish are more concentrated and susceptible to capture, but harvest rates decline during high water levels due to dispersion of fish in newly flooded areas (Koeshendrajana

and Cacho, 2001; Jul-Larsen and van Zwieten, 2002). The flooded vegetation provides food and shelter from predators, which may eventually lead to increased recruitment (Mhlanga, 1998).

According to both ICOUR and the fishers the bed of the reservoir rose steadily over the years due to siltation associated with rainfall. Siltation had probably exerted a profound impact by degrading spawning and nursery grounds in the littoral zones where the sediment load is greatest. Since cichlids are generally littoral inhabiting (Balogun, 2005), the endemic cichlids in the reservoir are at the greatest risk.

In general the fishers reduced fishing frequency when it is very cold in the months of December and January because they were wary of the cold weather. Thus, this climate-anthropogenic interaction can be a minor seasonal management intervention exerting its effect through fishing effort restriction.

5.5.2 Anthropogenic impacts

The depth of the reservoir has decreased over the years due to silt deposits carried from extensively cultivated agricultural lands close to the reservoir when it rains. Although farming within 50 m distance of the reservoir is prohibited (Egwedimma, 2013), it has become difficult for the managers of the reservoir to enforce the law because of socio-economic reasons: the fishers themselves engaged in crop cultivation as an offseason livelihood activity every year. This situation was a potential threat to the life of the reservoir and its fisheries.

The pressure on tilapia fishery in the Tono Reservoir and other inland water systems in the country has increased in recent years because of the sudden increase in the value and demand

for this fish. Hitherto, tilapia had generally been regarded as a low-value fish for the rural and urban poor. This of course has resulted in i) large harvests of tilapia, especially *Oreochromis niloticus and Sarotherodon galilaeus* from the wild and ii) increased aquaculture production in cages and ponds. Both species are the most important in the Tono Reservoir fisheries, both in terms of harvests (66.9% of the total catch) (Ayimbire, 2008) and demand. The concern however was that, uncontrolled harvests caused by increased value of a fish species can be the initial cause of overfishing of the stocks (Evans *et al*., 1997). This will then be followed by poor harvests and eventual collapse of the stocks, if timely remedial measures are not taken to recover the fishery. One practical way to go round this problem is a planned restocking programme using pond-based hatchery-bred fingerlings. This remedial measure was, in fact, built into the Tono reservoir fisheries project at its inception, but it failed along the way to achieve the desired results. Currently, the pond hatchery facilities attached to the project are under private management on lease for commercial aquaculture production because it remained dysfunctional for a long time. To sustain the Tono Reservoir fisheries, ICOUR can enter into an agreement with the private company (if it has the expertise) or with the Applied Biology Department of the University for Development Studies to produce fingerlings of depleted species to replenish the stocks.

5.5.3 Fish spoilage impacts

The Tono reservoir fisheries supply predominantly fresh fish to the market, but fresh fish trade carries a high risk of fish spoilage that leads to rapid deterioration of the biological quality of the fish and substantial reduction of its economic value, in the absence of proper post-harvest or post mortem handling and treatment. The underlying reason may be that fish is an extremely perishable commodity (Clucas, 1981; Bavinck *et al*., 2005) but refrigeration can minimize fresh fish spoilage. In this study only one fishmonger owned a deep freezer

which was uses to store excess or unsold fish to minimize spoilage. Other respondents did not own a deep freezer engage in wholesale trade to avoid spoilage of their fish, but admitted that it is less profitable than the retail trade. One solution to the problem is for the fishmongers to consider joint ownership by pooling resources to purchase this essential equipment in order to stay in good business.

The current practice of icing the fish later in transit to the markets or until arrival at the markets and not at the bay is bad, especially when the means of transportation is slow, because it exacerbates spoilage which starts immediately the fish is captured or dies. The women who ride motorbikes reach the fish markets faster to catch the early customers who invariably prefer high quality fresh fish. Apparently, the motorbike owners were at a competitive advantage over those who rode bicycles or walked to the same fish markets.

The predominantly gill net fishery was identified as a major contributor to fish spoilage. Fish caught by gill entanglement struggle vigorously for long hours and died by the time the nets were harvested the next morning. Since fish are extremely perishable, spoilage processes begin immediately after death. The usually high ambient temperature regimes (18-42 ^{o}C) characteristic of the Navrongo District favoured activities of intrinsic enzymes and bacteria responsible for fish spoilage. Some of the fish landed during this study were already in various stages of spoilage according to the time of capture. This apparently led to economic loss because the fishmongers refused to buy fish that showed signs of spoilage, such as pale gills (instead of blood red gills characteristic of freshly dead fish). Fish caught using the other types of gear (e.g. cast net, trap, and simple hook and line) remained alive or fresh much longer probably because of the minimal time of post-capture struggle.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

The following list summarizes the important and relevant conclusions drawn from the findings of this study, and suggested recommendations to be considered for adoption and implementation to effectively protect, manage and conserve the fisheries of the Tono Reservoir for sustainable exploitation for greater benefit of the communities whose livelihoods depend on the reservoir.

6.1 Conclusions

▪The fisheries of the Tono Reservoir has made positive impact on the lives of the people in the Kassena Nankana East District:

i) employed an estimated 480 indigenous households

ii) improved the current status of food security in the district by annual average fish production of 61.2 metric tons.

iii) increased household per capita income of the fishers and fishmongers from GH¢0.90 to GH¢8.60/person/day (equivalent to US$0.45 to US$4.30).

▪The current threats to the reservoir fisheries originate from the open access exploitation without restrictions to new entrants.

▪Many of the fish stocks in the reservoir show of slight to serious overexploitation due to the following additional factors:

i) persistent, extensive farming activities around the reservoir pose threats to the fisheries production through siltation and increased colloidal turbidity that damage fish spawning grounds and reduce light penetration and photosynthetic activity, as well as potential fish mortality due to long term effect of agrochemical toxicity.

ii) irregular imposition and poor observance of closed seasons or the lack of it have contributed to signs of overexploitation exhibited by some fish stocks in the reservoir.

▪ The observed prolonged declines in the rates of fish harvests and fish size are vivid signs of overfishing threatening possible local extinctions of endangered fish stocks such as *Brycinus* (*Alestes*) *murse Malapterurus electicus* and *Labeo sp*) and potential loss of the reservoir's rich endemic ichtyofuanal (fish) biodiversity.

▪ Inability of MoFAD and/or ICOUR to supply the approved fishing nets regularly compels the fishers to purchase and use prohibited nets from illegal supply sources, which result in the landing of undersized fish.

▪Weak policies to arrest and sanction offenders of fisheries regulations due to inadequate logistics and trained personnel of MoFAD and ICOUR has negatively impacted on the fisheries production.

▪ The inability of MoFAD and ICOUR to restock vulnerable or depleted fish species in the reservoir over the yeras has aggravated the results of the general breach of the fisheries regulations. This situation is even more worrying now because the pond facilities to be used to produce fingerlings for restocking are currently in private hands on lease for commercial operations.

▪ In general, obtaining reliable catch and effort statistics and socio-economic data from the artisanal fishers and fishmongers were very challenging for the following reasons: high illiteracy rate, lack of record-keeping, a lot of guessed responses, and some level of insincerity.

In the light of these observations, the study concludes that:

The fisheries of the Tono Reservoir has made positive impact on the lives of the people in the Kassena Nankana East District but with a high degree of threats of losing its potential for sustainability due to lack of weak policy interventions and hence overexploitation and loss of biodiversity.

6.2. Recommendations

▪ The Kassena Nankana East District Assembly should register fishers through MoFAD and ICOUR for purposes of taxation to generate revenue for the district. To make this feasible, the District Assembly should also consider, as a matter of urgency, to commit funds through MoFAD and ICOUR to assist in the management of the reservoir fisheries, as part of its social responsibility to the fishing communities.

▪ MoFAD, ICOUR and RMC should pool resources to support the District Assembly in the provision of effective policing to ensure fishers compliance of the fisheries regulations.

▪ Supply and sale of fishing nets could be made an exclusive responsibility of MoFAD and/or ICOUR to curtail illegal acquisition and use of unapproved nets. The nets should be made available as and when the fishers need them and at affordable (subsidized) prices to encourage patronage.

▪ Farming close to the shoreline of the reservoir should be discouraged through strict enforcement of laws to reduce the rate of sedimentation and pollution with agrochemicals, which can reduce productivity of the water and affect fish yield.

▪ Reasonable levies should be imposed on fishers and fishmongers to generate funds to provide logistics for effective surveillance duties by MoFAD, RMC and/ ICOUR.

▪ MoFAD and ICOUR in collaboration with RMC should declare a closed fishing area to serve as a permanently uninterrupted "refugia" for natural recruitment to enhance the fisheries and conservation of fish biodiversity.

▪ Serious attempts should be made by ICOUR and MoFAD to restock depleted fish stocks in the reservoir regularly, especially *Brycinus* (*Alestes*) *murse*.

▪ The District Assembly should assist fishmongers association to procure storage facilities including cold store for the storage and preservation of fish to prevent post-harvest losses.

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APPENDICES

APPENDIX 1: FISHERS' PROFILES AND ACTIVITIES

This questionnaire is an academic exercise to collect data for an M.Phil. Research study at the KNUST, Faculty of Renewable Natural Resources, Department of Fisheries and Watershed Management, titled "The Contribution of Tono Reservoir Fisheries to Household Livelihoods in the Kassena Nankana East District of the Upper East Region of Ghana".

You are kindly requested to answer the questions that follow. Please note that the information you give will be treated private and confidential. Your participation in this academic exercise is voluntary and would be highly appreciated.

1.

Community/village…….

2. **Fisher's household profile**

i. Name of fisher (optional): ……PIN .....

ii. House number (0ptional): ……

iii. Sex: Male [ ] Female [ ]

iv. Age: …….

v. Marital status: Married [ ] Single [ ] Divorced [ ] Widowed [ ]

vi. Religion: Christianity [ ] Islam [ ] Traditional/Pagan [ ] Others (specify)……

vii. Education: Primary [ ] JHS [ ] SHS [ ] Tertiary [ ] Non- formal [ ] Illiterate [ ]

viii. Number of dependants/size of household [ ] Minors [ ] Adults [ ]

3. **Wealth ranking: Extremely poor [ ] Very poor [ ] Poor [ ] Not poor [ ]**

i. House wall type: Mud [ ] Sandcrete [ ] Burned brick [ ] Cement [ ]

ii. House roof type: Thatch [ ] mud [ ] Zinc [ ] Tiles [ ]

4. **Fishing activities**:

i. Type of operation: Full time [ ] Part time [ ] Occasional [ ] Hobby [ ]

ii. Which of the listed fishing gears do you use? Gill net [ ] Cast net [ ] Hook and line [ ] Trap [ ] Others (specify)…….. [ ]

iii. How many days in a week do you fish? Gill netting [ ] Cast netting [ ] Hook and line [ ] Trapping [ ] Others (specify)……. [ ]

iv. Average time spent in fishing in a day? Gill netting [ ] Cast netting [ ] Hook and line [ ] Trapping [ ] Others (specify)…….[ ]

v. How many gill nets do you set in a day? [ ]; When do you set them? [AM/PM] and when do you inspect/harvest them? [AM/PM]

vi. Give the catch per day: Gill net [kg] Cast net [kg] Hook and line [kg] Trap [kg] Others (specify)…….. [kg]

vii. What proportion of the landed catch do you find spoiled? Gill net [kg] Cast net [kg] Hook and line [kg] Trap [kg]

viii. Did you obtain any training before you started fishing? Yes [ ] No [ ].

ix. If yes, name the person/organization who gave the training……., duration…….. , location……. and cost if any [GH¢.....]

x. And since you began fishing in the Tono reservoir, have you had any training?

xi. If yes, name the person/organization who gave the training……., duration……. , location……. and cost if any [GH¢.....]

5. **Operational expenses**

i. <u>Transportation</u>

a. Means of transport from your house to the reservoir: Bicycle [ ] Motorbike [ ] Walking [ ]

b. Cost price of the item named [GH¢]

c. Total running cost in a week [GH¢]: Fuel [GH¢] Maintenance/wear and tear [GH¢]

ii. <u>Fishing nets</u>: unit cost price [GH¢]

a. Seine net: [GH¢] Maintenance cost/year [GH¢] Total/year [GH¢]

b. Cast net: [GH¢] Maintenance cost/year [GH¢] Total/year [GH¢]

c. Trap: [GH¢] Maintenance cost/year [GH¢] Total/year [GH¢]

d. Hook and line: [GH¢] Maintenance cost/year [GH¢] Total/year [GH¢]

iii. Ice blocks: cost/week [GH¢] Cost/year [GH¢] Total/year [GH¢]

iv. Fish carriers: unit cost in [GH¢] Cost/year [GH¢] Total/year [GH¢]

6. **Financing**

i. How do you finance your fishing activities? Give details of funding: Bank loans [GH¢] Personal funds [GH¢] Remittances from friends/relatives [GH¢] Credit union [GH¢] NGO(s) [ ] SUSU [GH¢]

ii. Do you receive funding from the fishmonger(s) who buy fish from you? Yes [ ] No [ ]

iii. If Yes, how? Purchase of canoe [ ] Purchase of nets [ ] Net mending [ ] Canoe repair [ ]

7. **Fish catch and income**

i. What quantity of fish do you harvest in a day? [kg] In a week? [kg] In a year? [kg]

ii. What quantity do you consume in a day? [kg] Give value in cash if you were to sell it [GH¢]

iii. What quantity do you sell? [kg] Give value in cash if you were to sell it [GH¢]

8. **Income outflows**

i. State part of income allocated to: School fees [GH¢]

ii. Food [GH¢]

iii. Clothing [GH¢]

iv. Drinking [GH¢]

v. Fishing inputs GH¢]

vi. Farm inputs [GH¢]

vii. Rent [GH¢]

viii. Savings [GH¢]

ix. Funeral donations [GH¢]

x. Church donations/offering/tithes [GH¢]

xi. Taxes [GH¢]

xii. Others (specify)……

9. **Income from other livelihoods**: Farm produce [GH¢] Livestock [GH¢] Poultry [GH¢] Casual labour [GH¢] Petty trading [GH¢] Food vending [GH¢] Others (specify)…… [GH¢]

10. **Vulnerability to the fisheries resource**

i. Which of your activities do you think negatively affect the reservoir fishery resource? List them……

……

ii. Which other human factors/activities do you think negatively affect the reservoir fishery resource? Population increase [ ] Pesticides [ ] Unapproved nets [ ] Unapproved fishing methods [ ] Overfishing [ ] Farming activities in the catchment area [ ] Others (specify)……

ii. What climatic events/factors do you think affect fisheries productivity? Rain [ ] drought [ ]

11. **Accessibility to the fisheries resource**

i. How did you get access to the reservoir fisheries? License [ ] Permit [ ]
Free [ ] Quota [ ] Others
(specify)……

iv. List the problems you usually encounter in fishing? ..……..

……

v. List other opportunities the resource offers for a livelihood……..

……

vi. Do you pay taxes? [Yes] No [ ]

vii. If yes, to which organization? District Assembly [ ] ICOUR [ ] MOFAD [ ] RMC

viii. How much do you pay as tax per day [GH¢] Per week [GH¢] Per month [GH¢] Per year? [GH¢]

APPENDIX 2: FISHMONGERS' PROFILES AND ACTIVITIES

This questionnaire is an academic exercise to collect data for an M.Phil. research study at the KNUST, Faculty of Renewable Natural Resources, Department of Fisheries and Watershed Management, titled "**The Contribution of Tono Reservoir Fisheries to Household Livelihoods in the Kassena Nankana East District of the Upper East Region of Ghana**". You are kindly requested to answer the questions that follow. Please note that the information you give will be treated private and confidential. Your participation in this academic exercise is voluntary and would be highly appreciated.

1.
Community/village……

2. **Fishmonger's household profile**

i.Name of fishmonger: (surname): ……Others: ……ID #.....

ii. House number: ……

iii. Sex: Male [ ] Female [ ]

iv. Age: ……

v. Marital status: Married [ ] Single [ ] Divorced [ ] Widowed [ ]

vi. Religion: Christianity [ ] Islam [ ] Traditional/Pagan [ ] Others (specify)……

vii. Education: Primary [ ] JHS [ ] SHS [ ] Tertiary [ ] Non- formal [ ] Illiterate [ ]

viii. Number of dependants/size of household [ ] Minors [ ] Adults [ ]

3. **Wealth ranking (very poor, poor rich)**

i. House type: Mud [ ] Sandcrete [ ] Burned brick [ ] Cement [ ]

ii. Roof type: Thatch [ ] Zinc [ ] Tiles [ ]

4. **Fishmongering activities**:

i. Type of operation: Full time [ ] Part time [ ] Occasional [ ] Hobby [ ]

ii. How often in a week do you go to the reservoir to buy fish? [days]

iii. When do you leave home to the reservoir? [ ] And when do you reach there? [ ]

iv. How long do you wait to get your fish from the fisher(s)? [hours]

v. How many fishers do you buy fish from? [ ]

vi. Give the quantity of fish you buy from each fisher:

Fisher 1: Gill net [kg] Cast net [kg] Hook and line [kg] Trap [kg]

Fisher 2: Gill net [kg] Cast net [kg] Hook and line [kg] Trap [kg]

vii. What proportion in kg of the fish you buy in a day do you sell? [ ]

viii. What quantity do you consume in the house? [kg]

ix. Did you obtain any training before you started fishmongering as livelihood? Yes [ ] No [ ].

ix. If yes, name the person/organization who gave the training……., duration……..

, location……. and cost, if any [GH¢.....]

x. Since you began fishmongering work, have you had any training? Yes [ ] No [ ]

xi. If yes, name the person/organization who gave the training……., duration……,

location……. and cost, if any [GH¢.....]

5. **Operational expenses**

i. Transportation:

a. State means of transport from your house to the reservoir: Bicycle [ ] Motorbike [ ]
Taxi [ ] Walking [ ]

b. Cost price of item named [GH¢]

c. Running cost of means of transport in a week: Fuel [GH¢] Repair cost [GH¢],
Total cost [GH¢]

ii. Financing

a. How do you finance your fish mongering activities? Bank loans [GH¢] Personal funds [GH¢] Remittances from friends/relatives [GH¢] Credit union [GH¢] NGO(s) [ ] SUSU [GH¢] Others (specify)…… [GH¢]

b. Do you partly/fully finance the fisher(s) who sell fish to you? Yes [ ] No [ ]

c. If Yes, explain: Purchase of fishing nets [ ] Purchase of canoe [ ] Net mending [ ] Canoe repair [ ]

d. Gill nets supplied:# [ ] Unit cost [GH] Repair cost/year [GH¢] Total cost/year [GH¢]

e. Cast nets: # [ ] Unit price [GH¢] Repair cost/year [GH¢] Total cost/year [GH¢]

f. Hook and line: #] Unit price [GH¢] Repair cost/year [GH¢] Total cost/year [GH¢]

Traps: # [ ] Unit price [GH¢] Repair cost/year [GH¢] Total cost/year [GH¢]

Canoes: # [ ] Unit price [GH¢] Repair cost/year [GH¢] Total cost/year [GH¢]

iii. Fish processing in the field

a. Do you remove the scales? Yes [ ] No [ ]

b. Do you remove the gut? Yes [ ], No [ ]

c. Do you wash/clean the fish? Yes [ ], No [ ]

d. How long does it take you to do all the above? [hours]

iv. Icing:

a. Do you put ice on your fish? Yes [ ] No [ ]

b. If Yes, when? At the bay [ ] At the fish market in town [ ]

c. Cost of ice used in a day [GH¢] Total/year [GH¢]

v. Fish carriers:

a. In what type (s) of carriers do you transport the fish?

Metal bowls: Number. [ ] Unit cost [GH¢] Total cost/year [GH¢]

Plastic bowls: Number. [ ] Unit cost [GH¢] Total/year [GH¢]

Ice chest: Number [ ] Unit cost [GH¢] Total cost/year [GH¢]

b. With what do you cover the fish for transportation? Insulating jute fibre [ ] Plastic bowl] metal bowl [ ]

c. Give cost of the item named [GH¢]

vi. Fish transport:

a. By what means do you transport the fish to the market? Bicycle [ ] Motorbike [ ] Taxi [ ] Carried on the head [ ]

b. How long does it take you to reach the fish market? [hours]

vii. Fish sales:

a. Do you sell fish at the bay? Yes [ ] No [ ] If Yes, how much of it? [GH¢]

b. How much fish do you sell a day at the Navrongo fish market? [ ]

c. Where else do you sell your fish in Navrongo? Chop bars [ ] Restaurants/hotels [ ] Food vendors [ ] At the UDS campus [ ] At ICOUR residence [ ] [ ] Cold stores [ ]

d. Do you sell fish outside Navrongo? Yes [ ], No [ ]

e. If Yes, name the town(s)…….

f. Are you able to sell all your fish in a day? Yes [ ], No [ ]

g. If No, what do you do with the rest? Store in deep freezer and sell next day [ ] Smoke and sell later [ ] Deep fry and sell later [ ] Salt and sell later [ ] Sun dry and sell later [ ] Consume [ ]

6. **Income from fishmongering**

i. Income from fish in a day: Fresh [GH¢] Smoked [GH¢] Fried [GH¢] Sun-dried [GH¢] Consumed [GH¢]

ii. Total income in a day [GH¢] In a week [GH¢] In a year [GH¢]

7. **Income outflows**

i. State income allocated to:

Child education/school fees [GH¢]

Food [GH¢]

Clothing [GH¢]

Drinking [GH¢]

Fishing inputs [GH¢]

Farm inputs [GH¢]

Rent [GH¢]

Savings [GH¢]

Funeral donations [GH¢]

Church donations/offering/tithes [GH¢]

Taxes [GH¢]

Lotto [GH¢]

Entertainment [GH¢]

Others (specify)…… [GH¢]

8. **Incomes from other livelihoods**: Farm produce [GH¢] Livestock [GH¢]

Poultry [GH¢] Casual labour [GH¢] Petty trading [GH¢] Food vending [GH¢]

Others (specify)…… [GH¢]

9. **Vulnerability to the fisheries resource base**

i. List your activities you think negatively affect the reservoir fishery resource

base…… ……

ii. Which of the following other human factors/activities do you think negatively affect the

reservoir fishery resource base? Population increase [ ] Pesticides [ ] Unapproved nets [ ]

Unapproved fishing methods [ ] Overfishing [ ] Farming activities in the catchment area [ ]

others (specify)……

ii.Indicate which of the ff climatic events/factors negatively affect fisheries productivity?

Rain [ ] drought [ ] cold [ ]

10. **Accessibility to the fisheries resource**

i. How did you get access to the reservoir fisheries as a fishmonger? License [ ] Permit [ ]

Free [ ] Quota [ ] Others

(specify)……

ii. List the problems you usually encounter in fishmongering as a livelihood…….

....…… ….

iii. List other available opportunities the resource offers for a livelihood…….

iv Do you pay taxes on your income from fishmongering? [Yes] No [ ]

vii. If yes, to which organization? District Assembly [ ] ICOUR [ ] MOFAD [ ] RMC

viii. How much tax do you pay? Per day [GH¢] Per week [GH¢] Per month [GH¢] Per year [GH¢]

APPENDIX 3: RESERVOIR MANAGEMENT COMMITTEE (RMC)

This questionnaire is an academic exercise to collect data for an M.Phil. research study at the KNUST, Faculty of Renewable Natural Resources, Department of Fisheries and Watershed Management, titled "The Contribution of Tono Reservoir Fisheries to Household Livelihoods in the Kassena Nankana East District of the Upper East Region of Ghana".

You are kindly requested to answer the questions that follow. Please note that the information you give will be treated private and confidential. Your participation in this academic exercise is voluntary and would be highly appreciated.

1**. Responding officer**

i. Name……Position……

ii. Sex: Male [ ] Female [ ]

iii. Number of years served in the institution……..

2. **Accessibility to resource**

i. List RMC's role in determining **fishermen's** accessibility to the resource; Registration of applicants [ ] Issuance of Licenses [ ] Issuance of Permits [ ] No role [ ] Renting of water []

ii. List RMC's role in determining **fishmongers'** accessibility to the resource; Registration of applicants [ ] Issuance of License [ ] Issuance of Permit [ ] No role [ ]

iii. If no specific role, what institution has the mandate to determine access to the resource?

MOFAD [ ] Local Chiefs [ ] KNEDA [ ] No idea [ ]

vi. Do the **fishermen** pay levies/taxes to RMC for fishing in the water? [Yes] No [ ]

vii. If yes, how much? Per day [GH¢] Per week [GH¢] Per month [GH¢] Per year [GH¢]

viii. Do the **fishermongers** pay levies/taxes to RMC for their operations? [Yes] No [ ]

ix. If yes, how much? Per day [GH¢] Per week [GH¢] Per month [GH¢]

Per year [GH¢]

3. **Governance Issues**

Which of the following roles does RMC play in regulating/managing the fisheries?

i. Setting limits on mesh sizes of fishing nets [ ]

ii. Setting limits on the number of fishing nets a fisherman can use in a day [ ]

iii. Setting limits on the total number of canoes permitted for fishing in a day [ ]

iv. Setting limits on the number of fishermen permitted to fish in a day [ ]

v. Setting limits on the number of nets to be used by a fisherman in a day [ ]

vi. Monitoring of daily catches: Total weight of fish landed/fisherman [ ] Recording of individual fish weight [ ] Recording of individual fish length [ ]

vii. Monitoring of maturity stages of landed fish [ ]

viii. Determining closed fishing season [ ]

ix. Determining closed areas [ ]

4. **Linkages**

i. Is RMC linked with any other institution(s) in the performance of any of the roles mentioned above? Yes [ ] No [ ]

ii. If Yes, list the function(s) and name(s) of the institution(s)

5. **Services**

Does RMC provide the following services/inputs (to fishers/fish farmers/fishmongers)?

i. Fishing nets: Yes [ ] No [ ] Give details……..

ii. Canoes/boats: Yes [ ] No [ ] Give details……

iii. Fingerlings: Yes [ ] No [ ] Give details……

iv. Fish feeds: Yes [ ] No [ ] Give details……

v. Fertilizers: Yes [ ] No [ ] Give details……

vi. Training: Yes [ ] No [ ] Give details……

vii. Technical advice/support: Yes [ ] No [ ] Give details……

6. List the problems and challenges (if any) facing RMC in relation to its role in the fisheries**:**

……

…..

APPENDIX 4: IRRIGATION COMPANY OF UPPER REGION (ICOUR LTD)

This questionnaire is an academic exercise to collect data for an M.Phil. research study at the KNUST, Faculty of Renewable Natural Resources, Department of Fisheries and Watershed Management, titled "The Contribution of Tono Reservoir Fisheries to Household Livelihoods in the Kassena Nankana East District of the Upper East Region of Ghana".

You are kindly requested to answer the questions that follow. Please note that the information you give will be treated private and confidential. Your participation in this academic exercise is voluntary and would be highly appreciated.

1**. Responding officer**

i. Name……Position……

ii. Sex: Male [ ] Female [ ]

iii. Number of years served in the institution……..

2. **Accessibility to resource**

i. List ICOUR's role in determining **fishermen's** accessibility to the resource; Registration of applicants [ ] Issuance of License [ ] Issuance of Permit [ ] No role [ ] Renting of water [ ]

ii. List ICOUR's role in determining **fishmongers'** accessibility to the resource; Registration of applicants [ ] Issuance of License [ ] Issuance of Permit [ ] No role [ ] Renting of water [ ]

iii. If no specific role, what institution has the mandate to determine access to the resource?

MOFAD [ ] RMC [ ] Local chiefs [ ] KNEDA [ ] No idea [ ]

vi. Do the **fishermen** pay levies/taxes to ICOUR for fishing in the water? [Yes] No [ ]

vii. If yes, how much? Per day [GH¢] Per week [GH¢] Per month [GH¢] Per year [GH¢]

viii. Do the **fishermongers** pay levies/taxes to ICOUR for fishing in the water? [Yes] No [ ]

ix. If yes, how much? Per day [GH¢] Per week [GH¢] Per month [GH¢] Per year [GH¢]

3. **Governance Issues**

Which of the following roles does ICOUR play in regulating/managing the fisheries?

i. Setting limits on mesh sizes of fishing nets [ ]

ii. Setting limits on the number of fishing nets a fisherman can use in a day [ ]

iii. Setting limits on the total number of canoes permitted in a day [ ]

iv. Setting limits on the number of fishermen permitted to fish in a day [ ]

v. Setting limits on the number of nets to be used by a fisherman in a day [ ]

vi. Monitoring of daily catches: Total weight landed/fisherman [ ] Recording of individual fish weight [ ] Recording of individual fish length [ ]

vii. Monitoring of maturity stages of landed fish [ ]

viii. Determining closed fishing season [ ]

ix. Determining closed areas [ ]

4. **Linkages**

i. Is ICOUR linked with any other institution(s) in the performance of any of the roles mentioned above? Yes [ ] No [ ]

ii. If Yes, list the function(s) and names of the institutions

5. **Services**

Does ICOUR provide the following services/inputs (to fishers/fish farmers/fishmongers)?

i.Fishing nets: Yes [ ] No [ ] Give details……..

ii. Canoes/boats: Yes [ ] No [ ] Give details……

iii. Fingerlings: Yes [ ] No [ ] Give details……

iv. Fish feeds: Yes [ ] No [ ] Give details……

v. Fertilizers: Yes [ ] No [ ] Give details……

vi. Training: Yes [ ] No [ ] Give details……

vii. Technical advice/support: Yes [ ] No [ ] Give details……

6. List problems and challenges facing ICOUR in relation to its role in the fisheries**:**

……

……

APPENDIX 5: MINISTRY OF FISHERIES AND AQUACULTURE DEVELOPMENT (MOFAD)

This questionnaire is an academic exercise to collect data for an M.Phil. research study at the KNUST, Faculty of Renewable Natural Resources, Department of Fisheries and Watershed Management, titled "The Contribution of Tono Reservoir Fisheries to Household Livelihoods in the Kassena Nankana East District of the Upper East Region of Ghana".

You are kindly requested to answer the questions that follow. Please note that the information you give will be treated private and confidential. Your participation in this academic exercise is voluntary and would be highly appreciated.

1**. Responding officer**

i. Name……Position……

ii. Sex: Male [ ] Female [ ]

iii. Number of years served in the institution……..

2. Give the roles of MOFAD in determining accessibility to the Tono fisheries resource……

3. Give the roles of the MOFAD in the resource governance and management…….

……

4. How is MOFAD related to other institutions in its functions?

i. RMC..…….

ii. ICOUR…….

iii. KNEDA……

iv. Local Chiefs……..

5. Regulatory/management processes/practices:

i. List types of prohibited nets (a)……(b)…… (c)……(d)…….

ii. State prohibited mesh size(s)……

6. Give number of nets a fisher is allowed to use in a day: Gill net [ ] Cast net [ ] Traps [ ] Hook and line [ ]

7. Give number of fishers allowed to fish at a bay in a day [ ]

8. Give total number of nets allowed at a Bay in a day [ ]

9. Give number of canoes allowed at a Bay in a day [ ]

10. Give fish catch allowed by a fisher in a day [kg]

11. Give individual size of fish allowed to be landed: Tilapia [……g; ……cmTL], Catfish [……g; ……cmTL] Others (specify)……..[……g; ……cmTL]

12. What period in a year is fishing prohibited/banned [from……..to……..]

13. What do the fishers do during this period?.....

……

14. How are the regulations enforced?

.....

……

15. Who enforces the regulations?

.....

16. Do the fishers comply with the regulations? Yes [ ] No [ ]

17. If No, give

reasons……...

……

18. Sate prescribed sanctions for

noncompliance……..

19. Suggest solutions to the

noncompliance……..

20. State challenges and problems facing MOFAD in the discharge of its

responsibilities……..

……

……

……

APPENDIX 6: KASSENA NANKANA EAST DISTRICT ASSEMBLY (KNEDA)

This questionnaire is an academic exercise to collect data for an M.Phil. research study at the KNUST, Faculty of Renewable Natural Resources, Department of Fisheries and Watershed Management, titled "**The Contribution of Tono Reservoir Fisheries to Household Livelihoods in the Kassena Nankana East District of the Upper East Region of Ghana**". You are kindly requested to answer the questions that follow. Please note that the information you give will be treated private and confidential. Your participation in this academic exercise is voluntary and would be highly appreciated.

1**. Responding officer**

i. Name……Position……

ii. Sex: Male [ ] Female [ ]

iii. Number of years served in the institution……..

2. **Accessibility to resource**

i. List **KNEDA's** roles in determining **fishermen's** accessibility to the resource; Registration of applicants [ ] Issuance of License [ ] Issuance of Permit [ ] No role [ ] Renting of water [ ]

ii. List **KNEDA**'s roles in determining **fishmongers'** accessibility to the resource; Registration of applicants [ ] Issuance of License [ ] Issuance of Permit [ ] No role [ ] Renting of water [ ]

iii. If no specific role, what institution has the mandate to determine access to the resource? MOFAD [ ] RMC [ ] Local Chiefs [ ] [ ] No idea [ ]

vi. Do the **fishermen** pay levies/taxes to **KNEDA** for fishing in the water? [Yes] No [ ]

vii. If yes, how much? Per day [GH¢] Per week [GH¢] Per month [GH¢] Per year [GH¢]

viii. Do the **fishermongers** pay levies/taxes to **KNEDA** for fishing in the water? [Yes] No [ ]

ix. If yes, how much? Per day [GH¢] Per week [GH¢] Per month [GH¢] Per year [GH¢]

3. **Governance Issues**

Which of the following roles does **KNEDA** play in regulating/managing the fisheries?

i. Setting limits on mesh sizes of fishing nets [ ]

ii. Setting limits on the number of fishing nets a fisherman can use in a day [ ]

iii. Setting limits on the total number of canoes permitted in a day [ ]

iv. Setting limits on the number of fishermen permitted to fish in a day [ ]

v. Setting limits on the number of nets to be used by a fisherman in a day [ ]

vi. Monitoring of daily catches: Total weight landed/fisherman [ ] Recording of individual fish weight [ ] Recording of individual fish length [ ]

vii. Monitoring of maturity stages of landed fish [ ]

viii. Determining closed fishing season [ ]

ix. Determining closed areas [ ]

4. **Linkages**

i. Is **KNEDA** linked with any other institution(s) in the performance of any of the roles mentioned above? Yes [ ] No [ ]

ii. If Yes, list the function(s) and names of the institution(s)

5. **Services**

Does **KNEDA** provide the following services/inputs (to fishers/fish farmers/fishmongers)?

i.Fishing nets: Yes [ ] No [ ] Give details……..

ii. Canoes/boats: Yes [ ] No [ ]

Give details……

iii. Fingerlings: Yes [ ] No [ ] Give details……

iv. Fish feeds: Yes [ ] No [ ] Give details……

v. Fertilizers: Yes [ ] No [ ] Give details……

vi. Training: Yes [ ] No [ ] Give details……

vii. Technical advice/support: Yes [ ] No [ ] Give details……

6. List problems and challenges facing KNEDA in the discharge of its responsibilities**:**

……

APPENDIX 7: LOCAL TRADITIONAL AUTHORITY (LTA)

This questionnaire is an academic exercise to collect data for an M.Phil. research study at the KNUST, Faculty of Renewable Natural Resources, Department of Fisheries and Watershed Management, titled "The Contribution of Tono Reservoir Fisheries to Household Livelihoods in the Kassena Nankana East District of the Upper East Region of Ghana".

You are kindly requested to answer the questions that follow. Please note that the information you give will be treated private and confidential. Your participation in this academic exercise is voluntary and would be highly appreciated.

1. Responding chief/chief's representative

i.Name……Position……

…

ii. Sex: Male [ ] Female [ ]

iii. Number of years of service …….

2. **Accessibility to resource**

i. List the local chief**'s** roles in determining **fishermen's** accessibility to the resource;

Registration of applicants [ ] Issuance of License [ ] Issuance of Permit [ ] No role [ ]

Renting of water [ ]

ii. List the chief's roles in determining fishmongers' accessibility to the resource;

Registration of applicants [ ] Issuance of License [ ] Issuance of Permit [ ] No direct role [ ]

Renting of water [ ]

iii. If no specific role, what institution has the mandate to determine access to the resource?

MOFAD [ ] ICOUR [ ] RMC [ ] KNEDA [ ] No idea [ ]

vi. Do the fishermen pay levies/taxes to you for fishing in the water? [Yes] No [ ]

vii. If yes, how much? Per day [GH¢] Per week [GH¢] Per month [GH¢] Per year [GH¢]

viii. Do the fishermongers pay levies/taxes to you for fishing in the water? [Yes] No [ ]

ix. If yes, how much? Per day [GH¢] Per week [GH¢] Per month [GH¢] Per year [GH¢]

3. Governance Issues

Which of the following roles do you play in regulating/managing the fisheries?

i. Setting limits on mesh sizes of fishing nets [ ]

ii. Setting limits on the number of fishing nets a fisherman can use in a day [ ]

iii. Setting limits on the total number of canoes permitted in a day [ ]

iv. Setting limits on the number of fishermen permitted to fish in a day [ ]

v. Setting limits on the number of nets to be used by a fisherman in a day [ ]

vi. Monitoring of daily catches: Total weight landed/fisherman [ ] Recording of individual fish weight [ ] Recording of individual fish length [ ]

vii. Monitoring of maturity stages of landed fish [ ]

viii. Determining closed fishing season [ ]

ix. Determining closed areas [ ]

4. **Linkages**

i. Are you as a local chief linked with any institution(s) in the performance of any of the roles mentioned above? Yes [ ] No [ ]

ii. If Yes, list the function(s) and names of the institution(s)

5. **Services**

Does the chieftaincy as a traditional institution provide the following services/inputs (to fishers/fish farmers/fishmongers)?

i.Fishing nets: Yes [ ] No [ ] Give details……..

ii. Canoes/boats: Yes [ ] No [ ] Give details……

iii. Fingerlings: Yes [ ] No [ ] Give details……

iv. Fish feeds: Yes [ ] No [ ] Give details……

v. Fertilizers: Yes [ ] No [ ] Give details……

vi. Training: Yes [ ] No [ ] Give details……

vii. Technical advice/support: Yes [ ] No [ ] Give details……

6. List the problems and challenges facing the local chief/chieftaincy in the discharge of its responsibilities**:**

……

……