

**CAGE FISH FARMING AND ITS EFFECTS ON LIVELIHOODS OF FISHERFOLK  
WITHIN ANYANGA BEACH, SIAYA COUNTY, KENYA.**

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in Partial Fulfilment for award of the Degree of Master in Development Studies.

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## **DEDICATION**

To lovely wife Anne, sons Ian and Jeremy. Your patience, understanding and support made it easy for me. Thank you in a special way.

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## ACRONYMS AND ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
BMU	Beach Management Unit
DN	Daily Nation
EEZ	Exclusive Economic Zone
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
GDP	Gross Domestic Product
ILO	International Labour Organization of the United Nations
IDI	In depth Interviews
KII	Key Informant Interview
KMFRI	Kenya Marine and Fishing Research Institute
LV	Lake Victoria
LVEMP	Lake Victoria Environmental Management Project
LVFS	Lake Victoria Fisheries Service
MOLF	Ministry of Livestock and Fisheries
UN	United Nations
SDGs	Sustainable Development Goals
SLA	Sustainable Livelihoods Approach

## **DEFINITION OF TERMS**

### **Cage culture**

Cages are enclosed facilities on the bottom and the sides by either wooden, mesh or net screens meant for rearing fish. They allow exchange of natural water through the sides and below the cage in most cases. In the cages, juveniles of aquatic animals are stocked, fed and grown to marketable size.

### **Fisherfolk**

Roopchand (2013) defines fisherfolks as individuals performing diverse categories of work and have different roles and responsibilities in the fishing industry. For this study, fisherfolks are people who rely on fishing and related activities to earn a living and includes fish catchers, fish traders, fish farm workers and net weavers and repairers.

### **Livelihoods**

DFID (1999) defines livelihood as encompassing the capabilities, assets, including material and social resources, and activities required for realising a means of living. It involves people's capabilities, assets, income and activities required to secure the necessities of life. However, in most cases, it is often defined from an economic perspective mainly as an occupation, work or other means by which one earns income to offer the necessities of life (Asong et al. 2000). Livelihood is thus about "means of making a living", that let people to secure the basic essentials of life like food, water, shelter and clothing.

### **Sustainable development**

"Management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such sustainable development conserves (land) water, plants and (animal) genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable" (FAO, 1991).

## **ABSTRACT**

Cage fish farming continues to be hailed for the important role it plays in realisation of sustainable development through creation of employment, improving incomes and guaranteeing food security to fishing communities. Millions of fisherfolks globally rely wholly or partly on cage aquaculture and related activities for livelihoods. In Kenya cage fish farming is gaining popularity along the shores of Lake Victoria and is emerging as a preferred form of aquaculture investment. As an emerging economy, there is need to study and document the change narratives within the sector, a commitment that researchers must endeavour to fulfil. The study aimed at understanding cage fish farming within Anyanga beach in Siaya County and how it affects fisherfolk livelihoods in the area. It employed a descriptive study design with a qualitative methodology to understand the livelihood changes from the local fisherfolks' perspective. Sustainable livelihoods theoretical approach was employed to elicit the strategies and actions for adapting livelihood practices to cope with the advent of cage farming along the beach. To address its objectives, the study profiled the socio-economic characteristics of fisherfolks; their motivations for adopting cage fish farming; as well as changes in fisherfolks livelihoods within the beach.

The results shows that the fishing space at the beach is dominated by individuals aged 35 years and below and having a male majority. Women were mainly in fish trading where their numbers were greater than men. For those investing into cage farming the promise of better returns, reliability, predictability of harvest, flexible and limited time requirement, remained the major attractions. The study revealed that most cage farms were owned by non-locals with most locals engaged as cage workers in the farms. The study also demonstrated that the lives of most fisherfolks within the beach have been influenced by cage fish farming as there is emergence of new jobs and income earning opportunities, new businesses and revitalized beach economy that the fisherfolk have benefitted from. The study further demonstrates that some local fisherfolk are adapting to this cage windfall by either embracing it as owners or workers. The study recommends investment in the sector by national and county governments and support for fisherfolk to own cages as well as regulations and effective governance of the Beach Management Unit for sustainable livelihoods.

# **CHAPTER ONE**

## **INTRODUCTION**

### **1.1 Background to the Study**

Fisheries and aquaculture have supported human populations in making significant contributions to socio-economic development through employment creation, securing food supply and poverty reduction in the short, medium and long term. Fish also remains a leading source of quality protein, minerals, fatty acids and vitamins critical for human diet. In developing countries for instance, fish contributes nearly 30 percent of the total animal protein consumption per capita (Wang et al., 2015). It therefore plays an important role in the nourishment of more than a billion consumers, with majority being impoverished, malnourished and individuals staying in middle and low income countries (Thilsted et al., 2016; HLPE, 2014). Fisheries and aquaculture thus act as important drivers of change by mitigating risks to livelihoods and contributing to income generation and poverty alleviation. Fishing has also occupied a special place in the lives of very poor fishers often acting as their primary livelihood source.

The concept of livelihoods is at the center of sustainable development discourse whose vision is to achieve “healthy lives for all” by guaranteeing a planet where everybody consumes food that is “affordable and nutritious” (United Nations, 2015). Today governments, aid agencies, development experts and communities world over are grappling with the challenge of how to harness and use natural resources sustainably amidst scarcity. It is on this context that the United Nation’s (UN) Agenda 2030 Agenda and its entire goals have been hailed for offering a rare, transformative and multidimensional approach geared towards shifting the world into a path of sustainability and resilience (FAO, 2018).

Sustainable Development Goal (SDG) 14 in particular focuses on fisheries and aquaculture role in attaining food security with a call to support renewal of fish stocks to advance safe, diversified and healthy diets. The goal further implores on countries to safeguard and sustainably use the oceans, seas and marine resources for sustainable development. This is consistent with the topical blue economy concept which also emphasizes on wholesome appraisal and sound exploitation of resources associated with rivers, lakes and oceans for economic growth and sustainable development (FAO, 2014).

Today a critical shift in the make-up of the global fisheries sector, from supply dominated by capture fisheries to supply dominated by aquaculture, is occurring (Belton & Thilsted, 2014). Fishing which is often hailed amongst the world's ancient occupations, developed in the period when human societies relied heavily on hunting and gathering (Bavinck, et al., 2014), is today stumbling. FAO (2016a) & Pauly and Zeller (2016) indicates that global capture fisheries production climaxed in the mid-1990s, and has since either stabilized or waned.

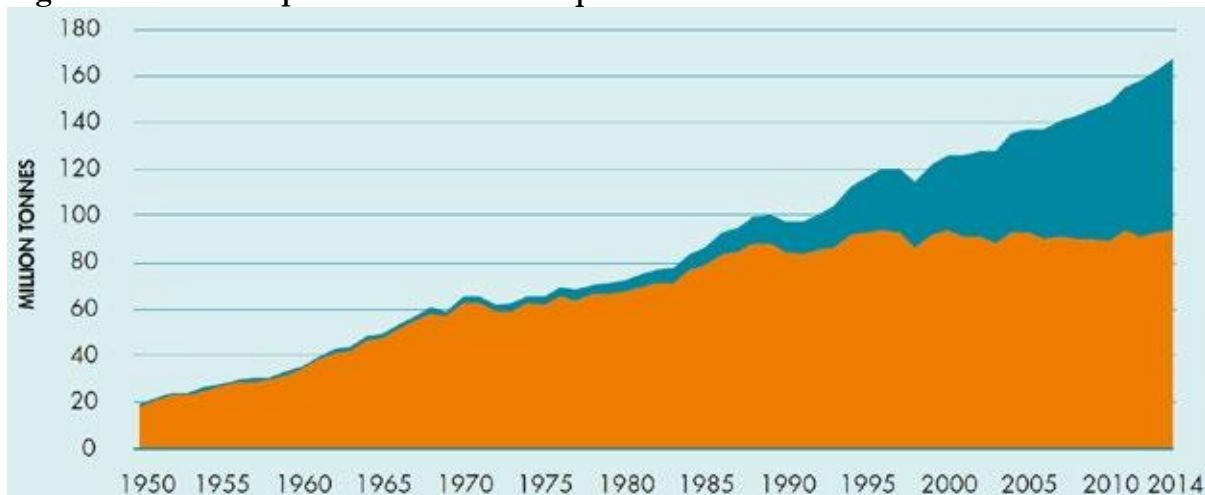
Overfishing has been singled out as one of the most significant factors responsible for this global crisis in capture fisheries, whose exploitation has often been under common pool resource regimes where all fishers engage in a 'race to fish' without incentives to conserve it (Hilborn, et al., 2003). This is what (Gordon, 1954; Hardin, 1968) have often acclaimed as the "tragedy of the commons". This has therefore compromised fisheries sustainability either by ensuring more is harvested than is added via growth in each period or stocks being pushed to levels below the threshold, seriously weakening their ability to regenerate (Elena et. al. 2017). With capture fisheries considered either fully exploited or overexploited and its future uncertain, aquaculture role in meeting fish demand is bound to continue increasing with population growth, expanding incomes and increasing urbanisation. This decline of fish stocks has therefore motivated growth in the role of aquaculture in the fishing industry. As a consequence, more than 50% of the fish destined for direct human consumption is currently provided by fish farming (FAO, 2016b). This has also been reflected through its average growth figure of 8.2% annually over the past three decades. Aquaculture is therefore expected to account for two thirds of the fish consumed by humans in 2030 under similar growth trajectory. Further, projections claim an extra 27 million tons of fish production will be needed to maintain the present level consumption by 2030 (FAO,2018). The report also notes that big part of this aquaculture production growth is to be realised in South, South-east and East Asia continent. In retrospect, aquaculture now offers enduring benefits for stabilizing and replenishing global fish stocks as well as improvement in fishers' livelihoods through enhanced global food security and economic growth. Through this, aquaculture not only succeeds in closing the supply and demand gap of aquatic food, but also in employment generation and poverty alleviation (Srinivasan et al., 2010; Soto-Zarazúa et al., 2011).

Conservative estimates put marine, inland fisheries, and aquaculture as providing food, nutrition and income sources to around 820 million people around the world, spread from

harvesting, processing, marketing and distribution (FAO (2018)). Out of this number, 19.3 and 40.3 million persons were either engaged primarily on full-time or occasional basis in capture fisheries and aquaculture respectively.

The African continent on her part adds a paltry 2.3 percent to the total global production output, with two-thirds of it coming from Egypt (FAO, 2016). Egypt with nearly 1.14 million tons per year therefore emerges as the largest African country and the 10th globally in aquaculture production (FAO, 2016). In Sub Saharan Africa (SSA) where aquaculture initially recorded slow start, rapid progress has been witnessed between 2004 and 2014 in South Africa, Zambia, Nigeria, Ghana, Uganda and Kenya with a 21 percent average annual growth rate (Satia, 2017). This regional growth of aquaculture is buoyed by the recent emergence of a significant middle class population with its diverse diet demands (Tschirley et al., 2015).

**Figure 1.1: World Capture Fisheries and aquaculture**



Source: FAO (2016); Capture fisheries (Orange) and Aquaculture (Blue)

### **Aquaculture in Kenya**

In Kenya the history of fish farming dates back to the early 1900s when the colonialists introduced it solely for sport fishing. In the 1920s it then evolved into static water pond culture of tilapia fish, before getting enhanced by common carp and catfish and later trout which was subsequently introduced as a riverine sport fish. Nearly three decades later, in 1948 two fish farms were set by the colonialists (Sagana Fish Farm (for warm water species) and the Kiganjo Trout Farm (for cold water species) to yield seed for the warm water and cold water species for stocking of rivers, dams and ponds. Other fish farming ventures later followed mostly through fish ponds until the late 1980s when cage culture traces started emerging.



The contribution of fisheries and aquaculture sector to the Gross Domestic Product (GDP) stands at about 0.8 percent. The sector is known for providing direct employment opportunities to over 500,000 people and supporting over two million people indirectly (MOLF 2017). This contribution though below one percent of the country's GDP, plays a very strategic economic value. Kenya enjoys a huge network of aquatic resources covering freshwater lakes and rivers and an extensive ocean resource base. The inland water resources covers an estimated area of 18,029 km<sup>2</sup> with the marine water area (including the EEZ) adding 142,400 km<sup>2</sup> and a continental coastline stretching 640 km supporting diverse fish production activities (Hoof and Steins, 2017).

In Kenya records shows that cage fish farming was pioneered by Lake Basin Development Authority (LBDA) through trials along Dunga beach in Kisumu around 1988. Nearly two decades later in 2005, fish was successfully harvested from cages owned and constructed by Dominion Fish Farms within their expansive Yala farm (Orina et. al 2018). This was followed in 2007 by "BOMOSA", a European Union (EU) financed cage culture project which conducted trials on caging in small water bodies within the Lake Victoria Basin. Between 2008 and 2013, other smaller cage aquaculture trials were recorded in Obenge and Dunga beaches in Siaya and Kisumu Counties respectively by the Fisheries Cooperative Societies under the Beach Management Units (Aura et. al. 2017).

Although most of these early trials were met with several drawbacks, the practice later picked up in Lake Victoria around the year 2010 through a participatory action research approaches by KMFRI and Dunga Beach Management Unit (BMU) in Kisumu County (Munguti et al., 2017). Cage farming has since picked up across several parts of the Lake though at different paces. Such systematic upsurge across many parts of the continent has today seen the African Sub-Sahara's contribution to overall global aquaculture production depending mostly on the tilapia culture (Kaliba et. al., 2007). Kenya is today ranked fourth producer in the continent after Egypt, Nigeria and Uganda with prominence of Nile tilapia (*Oreochromis niloticus*) species culture in Lake Victoria as in many other African countries. Tilapia has been favoured due to its tolerance to a varied environmental conditions, ability to live on a variety of natural foods and formulated feeds, high culture potential, high growth rates under low input costs and disease resistance (Orina, 2018).

Farm Africa (2016) notes that today cage aquaculture is present in all the five counties bordering Lake Victoria; Siaya, Kisumu, Migori, Busia and Migori with the single largest cage fish farming enterprise in Lake Victoria being the Winnie's farm in Anyanga beach which started with 60 cages in 2013 and currently has more than 550 cages together with other groups consisting of 100 farmers. Njiru (2018) adds that the enterprises operating cages in Lake Victoria stands around 43 with over 4000 cages stocked with over 3 million individual tilapia fingerlings.

## **1.2 Statement of the Problem**

With capture fisheries currently choking from overfishing, habitat change, pollution and eutrophication (Aura et al., 2018), cage fish farming is emerging as an extremely important alternative path in achieving sustainable livelihoods among fisherfolks. Lake Victoria which is one of the world's freshest inland fishing waters in Kenya is today a leading frontier for adoption of cage ventures. Though hardly a decade old, cage fish farming along Lake Victoria is known to be attracting significant interest from fishers, businessmen and women and governments both national and counties buoyed by opportunities it promises. However, such growth of aquaculture in most cases do present a wide range of outcomes that must be understood by those involved.

KMFRI (2017) acknowledges the rapid growth of aquaculture in the last 10 years and its rising significant position in national fish supply. However, the agency falls short of delving into specific ways in which cage aquaculture is influencing lives of individuals dependent on fishing activities particularly those living along the shores of Lake Victoria. KMFRI (2016) also alludes to limited baseline data locally to help in decision making within this growing fishing sub sector. Empirical studies on the subject of cage aquaculture have mixed findings mostly influenced by methodological differences and geographical location variations. In Kenya, some studies have acknowledged cage fish farming as a real game changer (Swaibu, 2017; Orina 2018; Opiyo 2018) for securing income and food security. In other quarter's cage fish farming has been castigated for causing serious environmental threats (Masser 2008; Ngupula & Kayanda, 2010; Aura et. al., 2017) thus leading to negative livelihood impacts (Njiru 2018).

It's against this background that this study sets to find out how cage fish farming has affected the livelihoods of fisherfolks living and working along Anyanga beach in Lake Victoria.

Anyanga beach provides a good setting where activities and changes attributable to cage fish farming in the lives of fisherfolks can be documented. This will provide a comprehensive information base that can be relied upon by authorities and researchers in appreciating the role of cage fish farming.

### **1.3 Research Questions**

The study sought to address the following three research questions:

- i. What are the socio-economic characteristics of fisher folks working in Anyanga beach?
- ii. What are the motivations for adoption of cage fish farming by fisherfolks at the beach?
- iii. How has cage fish farming affected the livelihoods of fisher folks at the beach?

### **1.4 Study Objectives**

The overarching study objective for this study is to understand effects of cage fish farming on fisherfolk livelihoods within Anyanga beach in Bondo Sub County, Siaya County in the Republic of Kenya.

To achieve the above general objective, the study focused on the following three specific objectives.

1. To profile the socio-economic characteristics of fisherfolks in Anyanga beach
2. To understand the motivations behind the adoption of cage fish farming by the fisher folk in the study area.
3. To assess the changes brought about by cage fish farming on the livelihoods of the fisher folks in Anyanga beach.

### **1.5 Justification of the Study**

Kenya is currently making strategic investment under the blue economy concept to mainstream aquaculture into an important driver of economic growth through job creation and as a medium for ensuring food security.

Achieving sustainable, productive fisheries and aquaculture is pivotal in food and nutrition security, increased incomes and improved livelihoods, as well as the advancement of economic growth and protection of environment and natural resource bases. Its contributions to livelihoods, national economic development, and food security thus remains critical. Nevertheless, the benefits and dependence of the riparian communities around the lake is

significant but remains poorly understood. The study findings will therefore help fisheries researchers, county and national governments officials, and development practitioners with important information for managing sustainable cage aquaculture management in Kenya.

Being a relatively new venture in Kenya, need for evidenced based response in terms of regulations and policies is critical so that the country can properly harness the gains from cage aquaculture and also actively address any challenges it can bring forth.

### **1.6 Scope of the Study**

The study was conducted in based in Anyanga beach and targets fishermen, current cage farmers, fish traders and boat owners, with BMU officials and other fisheries stakeholders in the area involved as key informants.

### **Organization of the study**

The research project is organized into five chapters. Chapter 1 is the introduction of the study which consists of the study background and definition of significant terms; statement of the problem; objectives of the study; the study research questions; justification and scope of the study. Chapter 2 is the literature review and theoretical frameworks. It begins with a theoretical literature review, followed with discussion on empirical literature with an aim to identify the research gap(s) that anchor the study. A conceptual framework is presented at the end of this chapter where the competing variables are diagrammatically related. Chapter 3 covers research methodology which comprises the research design, target population and how it was sampled, sampling technique involved, processes involved in data collection and how data was analysed. Challenges experienced during the data collection and ethical considerations are also covered in this section. A summary of the data needs table is provided as a last item on this chapter. Chapter 4 presents the study results and discusses the findings. This is done along the three specific objectives the study sought to address. Chapter 5 has the study summary, followed by a conclusion of the findings with a final part presenting recommendations the study would wish adopted by various actors within the fisheries sub sector.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

The chapter has three major sections, with the first discussing the theoretical literature, the second covers empirical literature and the third section has the conceptual framework of the study. Theoretical literature here outlines the main elements of Sustainable Livelihoods Approach and further provides concrete linkage between cage fish farming and livelihood changes among the fisherfolk.

The empirical literature covers changes that cage fish farming has caused from global, sub Saharan African and the Kenyan contexts in a bid to locate the attendant livelihood impacts on those dependent on fisheries. It offers a careful analysis of literature from previous studies on the cage fish farming effects so as to locate the gap that the study intends to fill.

#### **2.2 Theoretical Literature Review**

Sawson & Richard (2013) defines theoretical framework as a collection of interrelated ideas that explain a phenomena under research. It further sets out different categories of issues to be factored for analysis and draw attention to key issues to be explored. The study employs the Sustainable Livelihood Approach credited to the works of Chambers and Conways in the early 90s in order to lens through the lives of fisherfolk in Lake Victoria and understand how cage fish farming is impacting their day to day lives.

##### **2.2.1 Fisherfolk adaptation and diversification**

Societies today are confronted with the enormous challenge of providing food and livelihoods to its people amidst a fast degrading natural resource base. Rising demand for seafood and fish mostly generated by developed countries, aided by a globalized economy, is fast depleting fish stocks in several developing countries, while threatening local livelihoods, food security and human rights (Elena M. et al. 2017). Traditionally fisherfolks have always been adaptive and flexible in their fisheries (Vestergaard, 1997). They are perpetually in situations where they have to adapt to either weather conditions, changes in fish prices and migration of the fish stocks, or changes in management schemes.

Fisherfolk effectiveness is thus determined by his or her ability to respond to the changes in his external environment (Hart and Pitcher 1998). Critical questions that arise concerns what they must do in case of such eventuality. Edward and Frank (2001) while studying scale fisheries in a number of developing countries over the last 25 years concludes that they have often exhibited small-scale fisherfolks' resource dependence and the open-access nature of fisheries that together lead to resource depletion, poverty and marginalization.

With this level of uncertainty, practical adaptation and diversification schemes thus forms the heart of alternative livelihoods for the fisherfolks. These responses can either be instituted at individual, household or community level depending what is at play at a given time. Livelihoods diversification among fishing households thus becomes an important household coping strategy, critical in responding to such the resource variation effects.

### **2.2.2 Understanding Livelihoods Framework**

A livelihood framework function as an instrument that helps in defining the scope of and provide the analytical basis for livelihoods analysis. It further identifies the key factors influencing livelihoods and relationships between them by helping those concerned with supporting the livelihoods of vulnerable people to recognise and manage such complexities. Isaacs (2006) contends that livelihood approach also promotes specific outcomes for households, with resilience to external shocks being a critical component. This framework thus offers a common reference point for everyone concerned with supporting livelihoods, through sufficient assessment of complementarity of contributions and ensuing trade-offs between outcomes.

### **2.2.3 Sustainable Livelihood Approach**

With heavily depleted wild fish stocks, sustainable aquaculture thus serves a central role in transiting to a more environmentally and economically viable fish production (Cressey, 2009). Achieving sustainable aquaculture development thus requires consolidation of both socio-economic and environmental costs on affected communities, as well as fisheries health. As a result, this sustainable livelihoods framework by Chambers and Conway (1992) has therefore come to inform the socioeconomic analysis of fisheries communities from the early 2000s (Allison and Ellis 2001; Allison 2003; Allison and Horemans 2006).

A livelihood is therefore assumed as sustainable when it can cope with and recover from the stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base (Schoones, 1998, p.5). Capture fisheries world over have been weighed down by population stress and environmental socks and need for refocussing on sustainability a necessity. Critical to this framework too, are the assets from which the households or individuals draw so as to build their livelihoods (Carney cited in Rakodi 2002:9). Fishers depending on fisheries unable to migrate or move to alternative adventures in the face of stocks decline must therefore model newer and more sustainable options to enable them continue their work. Introduction of cage fish farming within Lake Victoria is thus one of the coping mechanisms to adapt such changes.

This concept of Sustainable Livelihood traces its roots to the 1992 Earth Summit held in Rio, where the idea of permitting everyone with an opportunity to enjoy sustainable livelihoods emerged as a key conference outcome (Morse & McNamara, 2013). Through cage culture, the aquaculture sub sector is expected to register positive gains in employment, food security and incomes for those directly or indirectly involved in the fisheries value chain. While becoming an important commercial venture, studies have isolated a number of factors affecting the commercialization process in aquaculture including rapid economic growth, technological adoption and adaptation, market expansion and liberalization, urbanization and infrastructural growth, increased demand for food against decreasing farming population, liberalized and open economic policies, bilateral and multilateral economic agreements as well as government agricultural policies (Tschirley et al., 2015; Kassam and Dorward 2017).

Bad governance, weaker regimes for fisheries management, disputes over utilization of natural resources, enduring use of inferior fishery and aquaculture practices, inability to prioritise the rights of small-scale fishing communities, gender discrimination and related injustices and child labour are also topical issue that must also be taken note of. In addition, the climate change impacts posing immense threat to sustainable aquaculture development must also be addressed with well thought mitigation and adaptation approaches. Individuals engaged in fishery-related livelihoods therefore end up engaging in fishing either part-time or as a form of mixed farming-fishing-livestock livelihood. FAO (2014) insists that it's fundamental to ensure fisheries development is economically, environmentally and socially sustainable in order to ensure sufficient supply of fish and aquatic products is guaranteed.

This research project adopts SLA particularly for its robustness and ability to enhance the understanding of livelihoods, through multiple dimensions. The SLA offers an interdisciplinary approach keen on individual, household, or community access to five important forms of capital from natural, social, financial, physical, to human capital (DFID, 1999; Institute for Development Studies, 1998). Although early proponents like DFID (IDS, 2008) have been shifting from SLA in response to factors such as the increasing influence of economists who favor attending to national scale transformation rather than preferring approaches suited for local-level analysis, it remains as vital as ever for use in the context of natural resources administration and local development like in this livelihoods study. SLA is therefore useful approach for local-level assessments rather than for assessments at the national level (Thulstrup 2015), thus the preference in studying fisherfolk livelihoods along a single beach like Anyanga in this study. This approach therefore necessitates a broader understanding of the socio-economic context in which livelihoods operate and escalate the analysis to appreciate new and emerging dynamics beyond known concerns like ‘employment.’

### **2.3 Empirical Literature Review**

This section has two parts with the first exploring literature on the history, growth and impacts aquaculture and cage fish farming from global to the local context.

The second part reviews empirical studies on effects of cage fish farming across different locations in the world before concluding which the Kenyan cases.

#### **2.3.1 History of Aquaculture**

Ancient China, Egypt, and Rome have been known for practicing aquaculture for an entire millennia (Costa-Pierce, 2010; Smith, 2012). These countries therefore harbour long and rich history of the aquaculture journey which in China dates back to between 2000–1000 BCE (Rabanal, 1988). Egypt however, carries one of the most ancient evidences of aquaculture with tilapia harvesting during 2500 BCE (Bardach et al., 1972), with the discovery of a drawing on the walls of pharaoh’s tomb of a crew harvesting tilapia fish from earthen pond.

Today much of the growth and development of aquaculture has however occurred in continental Asia, which commands the highest variety of cultured species and systems globally. Asia is thus today perceived as the ‘home’ of aquaculture, as fish culture has a long history in several areas of the region and knowledge of traditional systems is most widespread.



Asia currently dominates aquaculture production with over 90% of the total production measured by volume and 79.6% by value (FAO, 2012). Leading aquaculture producers include China, Chile, India, Vietnam, Japan, Indonesia, Thailand, Burma, and South Korea all in Asia with Norway as the only exception. Africa is also emerging with Egypt as the largest producer accounting for 71.38% of overall production in the continent. A number of developing economies in Asia and the Pacific including Myanmar and Papua New Guinea and in Africa from Ghana, Nigeria, Zambia, Uganda to Kenya, as well as Ecuador, Peru and Brazil in South America have equally made quick progress to become major aquaculture producers (FAO, 2012).

Aquaculture today's sits as the fastest growing and prominent global fish production technology, with nearly 180 countries recording some level of aquaculture production. It has also pushed the demand for, and consumption of, species to shift from being primarily wild-caught to being primarily aquaculture-produced. Aquaculture is now the leading producer of fish products and more significant than capture fisheries in terms of fish consumption globally.

### **2.3.2 Cage fish farming**

Cage fish farming, a prominent form of aquaculture production too, can be traced back many centuries from China (Bao-Tong, 1994). However, in the 1970s Norway pioneered industrial cage culture with salmon farming (Tacon & Halwart, 2007). In later years it grew throughout the world, with China, Japan, Chile, Indonesia, Vietnam, Canada, Turkey, Greece and the Philippines emerging as major producers (El-Sayed, 2006; Tacon & Halwart, 2007). In Africa cage culture also began in the 1970s, with high levels of productivity subsequently recorded in countries like Ghana, Côte d'Ivoire, Malawi, Uganda and Zimbabwe (Halwart & Moehl, 2006).

This success of cage aquaculture over other forms of aquaculture have also ignited great scholarly attention and from as far back as four decades ago, Coche (1978) had vouched for cage aquaculture since it allowed for easy observation of reared populations and better predation control. Beveridge (2006) also adds in his study that due to its apparent practicability, cage technology may be a viable alternative to traditional rearing techniques.

Today cage farming has expanded everywhere and is currently taking the fishing industry by storm. De Silva (2007) & EL-Sayed (2006) while reviewing previous studies on cage farming notes a number of advantages it boasts above other methods of fish farming. It cites very high production per water volume: high profitability potential; comparatively low investment per production unit; the utilization of existing natural water bodies that lowers pressure on land surface; relatively minimal capital expenditure requirements; ease of movement and relocation; the reduced drought consequences on production relative to water availability ; and overall flexibility in management.

Orina (2018) also affirms this high profitability potential mantra and attributes that to it gaining prominence in the aquaculture production matrix. Cage fish farming has thus emerged as the most popular of the aquaculture production technologies which also entail the use of liner material in porous soils, use of concrete and plastic tanks and indoor re-circulating facilities.



*Figure 2.1 Floating Cage in Lake Victoria*

### **2.3.3 Institutional Framework for Aquaculture in Kenya**

Fisheries management in Kenya has over the years been regulated by a number of laws and Regulations. A summary of the laws that have been central to the fisheries sub sector from the colonial times to date is shown in Table 2.1. The Fisheries Management and Development Act (2016) which succeeded the Fisheries Act (Cap 378) of 1989 currently govern management

and utilization of fishery resources in Kenya. This legislation consolidates all existing laws on fisheries to allow for the development of fishing industry and the sustainable exploitation of the fisheries resources in the Country. It attempts to streamline sector to respond directly to a series of emerging issues and to conform to the national and international fishery resource development and management strategies.

**Table 2.1 Primary fisheries laws in Kenya from 1900 to the present**

<b>Law/Regulations</b>	<b>Year enacted</b>	<b>Focus</b>
Fisheries Management and Development Act	2016	Consolidation of everything fisheries from management and conservation, aquaculture and fish processing and marketing into one piece of legislation.
Fisheries Act (Cap 378) (Act No.5 of 1989; revised 1991)	1989	Giving powers to the Director of Fisheries, with the approval of the Minister, to issue regulations to promote the development of fisheries and aquaculture and to ensure the proper management of specific fisheries.
Maritimes Zones Act (CAP 371) of 1989	1989	Establishment and delimitation of the exclusive economic zone and to provide for the exploration, exploitation, and management of maritime zone resources.
Trout Ordinance (CAP 380)	1948	To regulate exploitation of trout and also hinder local communities from competing with the settlers for trout.
The Fish Protection Act (Cap 379 of the Laws of Kenya) in 1902	1902	Sport fishing enjoyed by settler communities and troops was the main emphasis for this piece of legislation.

The 2016 Act provides for the conservation, management and development of fisheries and other aquatic resources to enhance the livelihood of communities that depend on fishing. It also establishes the Kenya Fisheries Services and the Kenya Fisheries Advisory Council with the former charged with the role of ensuring appropriate conservation, development of standards on management, sustainable use and protection of the country's fisheries resources.

Sections of the Act dealing with aquaculture are springing from Article 117. Registration of aquaculture establishment under Article 117, obtaining aquaculture permits in Article 118 as well as other elements in the succeeding articles. Cage aquaculture practiced within fresh water bodies like Lake Victoria, however needs to be given more attention through more explicit regulations because it special features beyond other common forms like the pond culture. Issues of water quality, water pollution, feeds quality and potential resource conflicts must be given due attention by any proposed regulatory regime.

Even though the Beach Management Unit (BMU) plays a co-management role with other government agencies and stakeholders, it has for a long time responded to the plight of capture fisheries only. The coming of cage fish farming therefore presents new dimensions into their scope of operations. Careful reflection and due attention to these intricacies is of essence if fishing and fish farming is to co-exist side by side in the same fishing waters.

The lack of explicit regulations on aquaculture is what stakeholders have always blamed for the problems cage farming have encountered especially in Lake Victoria. This is further corroborated in an interview by the Chairperson of the newly formed Cage Fish Farmers' Association in Kenya, Mr. Oketch, who decried the current state of affairs where cage investors were operating in the Lake without any legal or regulatory regime (DN January 2019). He added that such a lacuna is laying grounds for all manner of mess and wished that a framework should be fast-racked to manage cage aquaculture in Kenya.

#### **2.3.4 Cage culture intensification**

Aquaculture is often represented by mode of cultivation. Aquaculture systems can either be extensive, where fish are kept in low densities and require no external resources or nutrients, or intensive, where fish require nutrient-rich feed pellets to support production at higher fish densities (Tidwell, 2012). While extensive aquaculture is still practiced in some parts of the world, the development of intensive cage aquaculture continues to expand globally due to its low cost of production (Tidwell, 2012). Kenyan aquaculture production is primarily based on semi-intensive culture systems using ponds to culture fish (Orina, 2018).

## **2.4 Effects of cage fish farming**

### **2.4.1 Human and Ecological effects**

Frank Asche (2009) notes that although the development of cage technology has substantially raised aquaculture's production potential, it has also raised serious concerns about environmental effects and sustainability of aquaculture. He argues that, just like other biological production processes, aquaculture too interacts with the proximate environment leading to challenges evidenced through increased fishing pressure on species harvested for aqua-feed, and the environmental carrying capacity. On ecological front, several other studies have also explored negative impact of this innovation on the environment (Buschmann et al. 2006; Aguado-Giménez et al. 2007; Forchino et al. 2011; Grigorakis and Rigos 2011; Dimitriou et al. 2015) as highlighted in Fafika et.al (2017).

Masser (2008) on the other hand details the outcomes linked with cage farming to involve dissolved nutrients and particles discharged through uneaten waste feed, faecal matter and excretory products. Ngupula & Kayanda (2010) further sees the potential of such consequences causing anoxic conditions in sediments beneath the cage farms, thus changing invertebrate abundance and composition resulting in negative environmental impacts. Ngupula et. al., (2012) on his part affirms the likelihood of eutrophication of the water piers from ensuing nutrient enrichment. They confirm that caged fish sometimes do escape and interact with other wild fish resulting in the spread of illnesses and parasites (Aura et. al., 2017). The result of all these is a situation of ecological simplicity, limited genetic diversity, and growing mortalities of the wild stocks. Appreciating the ecological impacts is important because compromised fisheries environments have direct relationship with volumes of wild fish catches and a potential direct effects on those fishing in the natural waters. Resource conflicts between cage fish farmers and fishermen for instance thus becomes inevitable. Such competition for lake-space as in the case of cage farming and other users of Lake Victoria thus poses a similar threat and must be attended to just like other cage fish farming effects.

#### **2.4.2 Socio-economic and livelihoods effects**

Many researchers and scientists have studied various influences of cage fish farming especially how it affects the fishing ecosystem and the aquatic life, with some going further to link how the fish farmer has been impacted by it too. Some have also attempted to examine effects it has on those dependent on fisheries for their livelihood, however, the focus has been skewed on the fishermen especially those who transitioned to cage ventures. Even those which have come close to understanding the effects on various fishers, the different fishing regimes across countries have not permitted ease of correlation with what is happening within Lake Victoria in Kenya. This research project has highlighted several outcomes of cage fish farming on fisheries from increased fish stocks, employment opportunities, incomes and assets, with each of these likely vary depending on how cage fish farming is practiced from one location to another. This section therefore reviews studies that have reflected on these variables and related indicators in understanding cage fish farming effects on livelihoods.

The contributions of fisheries and aquaculture as sources of foreign exchange earnings, employment, and food and nutrition security to economies in Asian countries is acknowledged in the 2017 ASEAN<sup>1</sup> report. The food security angle is also pursued by Towfique & Belton (2014) whom while using nationally representative data from Bangladesh to analyse changes in fish consumption from 2000 to 2010, concluded that the likelihood of aquaculture contributing to poverty reduction and food security all depends on its ability to expand fish supply and its effect of dampening fish prices, and the extent to which growth processes in the wider economy will interplay to reduce inequality. It therefore concludes by cautioning that actions must be taken to sustain the contributions of both capture fisheries and aquaculture, rather than relying on aquaculture alone to meet future demand. This captures the situation in Kenya where capture fisheries though dwindling, still operate along the cage ventures in Lake Victoria.

In Egypt too, aquaculture has been credited for creating huge number of jobs opportunities for farm technicians and skilled laborers as well as employment in new industries and financial services emerging to help the sector (Soliman, 2017). Across the country several semi-intensive aquaculture systems are practiced including excavated earthen ponds, pens and enclosures, concrete and raceways ponds, circular tanks and floating fish cages are used (Ghanem and

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<sup>1</sup> ASEAN is a membership bloc consisting of Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

Haggag, 2015). Egypt has very limited water resources and the aquaculture sector is not allowed to use irrigation/Nile water thus mostly dependent on water from agricultural drainage channels and groundwater, which is a complete departure from what happens in other African countries like Ghana, Kenya, Malawi, Uganda, Zambia and Zimbabwe practicing freshwaters cage culture.

Swaibu (2017) on the other hand looks at harnessing cage technology to increase fish production as a subject. He underscores that beyond creation of jobs, cage culture offers a better alternative fish production technology with minimal fishing efforts. This is in Uganda where cage fish farming began in early 2006 in natural waters of Lakes Victoria and Kyoga (Blow & Leonard 2007). The study however relied on KIIs with technical and policy level officers as the primary data with most secondary sources and two case studies from China and Egypt in drawing its conclusions. In West Africa, while conducting a comparative assessment of the poverty impacts of pond and cage aquaculture in Ghana, Laila (2016) concurs with Swaibu that cage culture has the ability to increase fish production critical in helping tackle poverty, however the scale at which it is practiced also plays an important role.

Other studies have pursued the economic contribution argument. Opiyo et al., (2018) for instance while assessing the production and health management systems of farmed fish in Kenya, concludes that cage aquaculture has a huge potential to increase aqua-culture production and support economic growth around the Lake Victoria region. This shows potential impact of cage farming but does not isolate the effect on individual fisherfolks. Aura et al., (2017) equally assesses the economic as well as social effects of cage farming in Lake Victoria and concludes that in as much as the current caging activities in the Lake constitute early stages of the industry, results indicate that it is a viable economic activity. FAO (2016c) also reflects on the general overview of the fisheries sector in 2013 and notes that nearly 130,000 Kenyans drew their livelihood directly from fishing and fish farming activities with around 67,900 involved fish farming. It adds that communities living along Kenyan lakes and coastlines have always relied on small-scale fishing for their general household well-being, by providing both income and nutrient-rich food. Beyond these contributions, fisheries have also provided raw material bases for production of animal feeds, fish oil and bioactive molecules for the pharmaceutical industry.

Macuiane (2015) however takes a different route and assesses how cage aquaculture impacts fish species within Lake Malawi. The study looked at the possible changes in fish structure associated with cage aquaculture in Lake Malawi, where cage culture of the native Chambo species was introduced in the south-east arm of Lake Malawi in 2004. In Malawi only Maldeco Aquaculture Limited was allowed to manage cages at a commercial scale by the Government of Malawi in Lake Malawi and the farm was dedicated to the monoculture or polyculture of Chambo species in 16 metres diameter and 6 metres deep circular cages with a total of 51 cages at the time of the study. The study findings established that Maldeco Aquaculture farm had a near field impact on fish community structure in the particular of Lake Malawi where it was practiced. This cage aquaculture model used in Malawi is however different to what has been documented to operate in Lake Victoria where multiple companies and other independent investors have laid cages. This study looked at the cage culture effects on the natural fish species in the Lake and not the fishers themselves. Although changes in fish structure might have effects on the activities of those depending on fishing in Lake Malawi, the study never pursued that link or inferred a relationship between the two.

Other scholars have also looked at the effects of cage culture, but concentrated on how the fish consumers are impacted. Beveridge et al. (2013) hypothesizes that “aquaculture producers in developing countries tend to target the production of larger-sized fish, aimed at middle-class urban regional and international markets, presumably in the expectation that the higher absolute and relative prices such fish command increase profits”. (McIntyre et al., 2016; Ponte et al., 2014) in putting forward the economic geography narrative challenges positive outcomes arguments by noting that aquaculture largely failed to meet the needs of poor and undernourished Southern consumers because most farmed fish produced in those countries is set for export to Northern markets and the remaining quantities in domestic markets is consumed majorly by wealthy urban dwellers (Beveridge et al., 2013). This in a big way locks the fish from local consumers and traders who cannot access it from the farming sites.

Njiru (2018) in his study titled, “Cage fish culture in Lake Victoria: A boon or a disaster in waiting”, paints a more progressive picture of cage farming in Lake Victoria which he claims offers an opportunity to improve livelihoods, especially to ex-commercial fishers and lakeside communities. His only caution is that the unregulated growth of cages currently witnessed is likely to cause conflict with other users.



**Table 2.2 Studies on cage fish farming with various livelihoods aspects as variables**

<b>Study</b>	<b>Findings</b>	<b>Research Gap</b>
Aura (2017)	Results of cage fish farming in Lake Victoria constitute infant stages of the industry, though it is a viable economic venture	This focused 100% on cage farmers for socio-economic data and did not involve other fisherfolks who are likely to be impacted in some way.
Swaibu (2017)	Assessing cage farming in Uganda concludes that it guarantees jobs and is a reliable alternative for fish production with minimal fishing efforts	The findings were drawn from case studies from other countries and other secondary sources and expert voices.
Orina (2018)	Cage culture in Lake Victoria has created over 500 jobs directly and over 4000 indirect income opportunities to people in rural and urban settings	This was a result obtained from overall mapping exercise of the cages within the Lake and not focussed on day to day happenings across respective beaches which this study did set to realise through assessment of activities in one beach.
FAO (2016c)	Shows that 67,900 derived livelihood directly from fish farming in Kenya	This is a cross sectional study of both the fisheries sector giving overall accounts of fish farming and fishing in Kenya.
Baticados, D. B. (2015)	Results showed that aquaculture is a profitable business venture when either done individually or collectively through an association, if managed properly.	The study reflected on adoption pathways that can guarantee success to beneficiaries.
Opiyo et. al.,(2018)	Cage farming has a huge potential to increase aqua-culture production and support economic growth	Though potential relationship is inferred, no fisherfolk interviews were involved.
Soliman (2017)	Aquaculture including created jobs to skilled labourers and farm technicians	The study focused on fish farm labourers only.

Source: Author's summaries from literature review

## 2.5 Literature Review Overview

From empirical literature it is clear that most of these studies never occurred in environments where primary capture fisheries resided side by side along cage fish farming like in the Case for Anyanga beach. Although aquaculture has been shown to impact livelihoods directly by

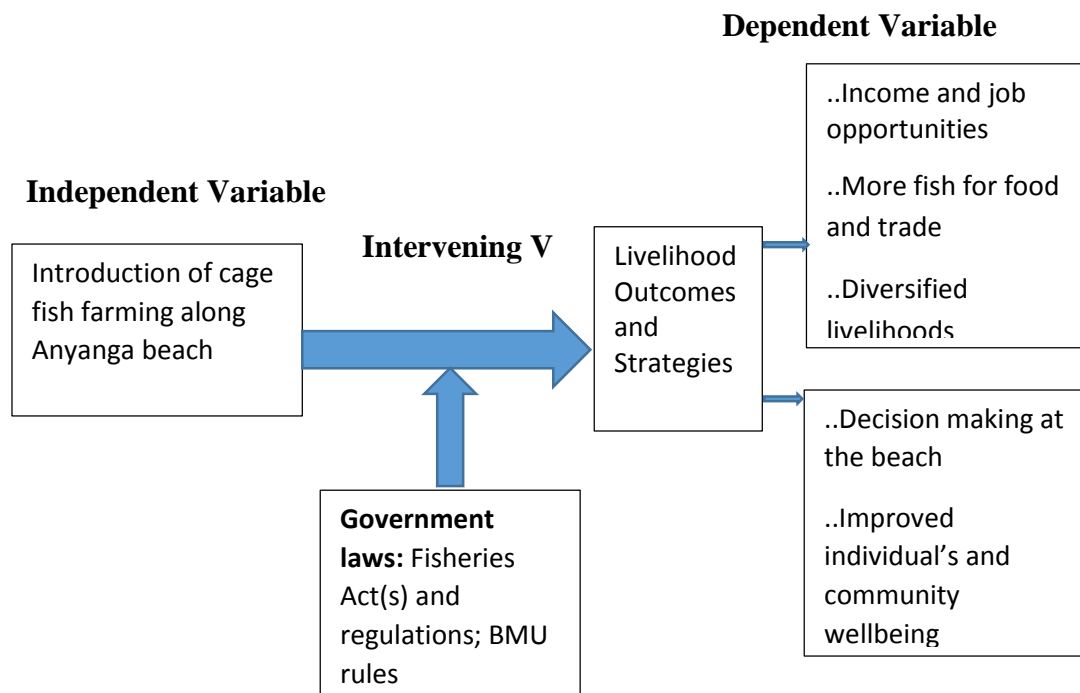
increasing income and food security of poor fish farming households, and indirectly by generating economic growth the situation in the study site presents a unique that can help prove the resilience and adaptability of local fisherfolks too. With cage fish farming in its early years along Lake Victoria and operating under no clear regulatory regime, the study sets out to find out the ways in which local fisherfolk are changing their livelihood activities operating under a framework of local BMU rules and fisheries laws that have previously guided capture fisheries activities only. This leaves room to investigate the changes cage fish farming is having on livelihoods of fisherfolks within the beach and how they are coping with this new development.

## 2.6 Conceptual Framework

There are various ways of conceptualising the components of a livelihood and the influences upon it, and various representations have been suggested by studies utilizing the critical livelihood variables and their interconnections.

This conceptual framework draws elements from Ellis (2000) SLA, but modelled to capture livelihoods strategies of typical fisherfolk in situations of declining natural resource like those prevalent in Lake Victoria today.

**Figure 2.2: Conceptual Framework**



**Author's own conceptualization (2019)**

### **2.6.1 Variables**

#### **Independent Variables**

Introduction of cage fish farming in Anyanga beach is the independent variable for this study. The existence of cage fish farming activities in the said beach is the subject matter of the study and it shall focus on individuals involved in cage fish farming (owners and workers), where they are coming from, as well as where they trade their fish harvest.

#### **Dependent Variable**

Dependent variables for this study are the livelihood practices, both social and economic of the fisherfolks in the study area. Of concern is how the fishermen, traders and boat owners means of earning a living has transformed since the introduction of cage fish farming in the area.

#### **Intervening Variables**

Though environmental shocks and population growth stress have been blamed for the decline of fish stocks in most of the natural water bodies, cage fish farming poses new institutional intricacies which the fishing sector must accord due attention.

Rules and regulations have the ability to mediate potential changes that the fisherfolk are likely to experience. National and local government laws and policies are critical in defining engagement rules for fishers and can either facilitate or constrain their livelihood strategies. Ashley and Carney (1999) notes that the influence assets might exert on choices of livelihoods strategies is often mediated by transforming structures and processes of institutional and organizational contexts that determine access to these livelihoods assets.

The notion of lack of a regulatory framework for cage aquaculture that has featured prominently among the issues raised by various fisheries stakeholders in Kenya therefore cannot be ignored. FAO (2018) sees illegal, unreported and unregulated fisheries as one of the greatest threats to the sustainability of global fishery resources. Charro- Karisa et al., (2010) & Njiru et. al., (2018) agrees and further opines that this lack of proper policies and guidelines on cage farming may prove unproductive in the long run if not addressed. The study therefore assumes that absence of a regulatory framework could act to moderate outcomes of cage fish farming practice among the fisher folks.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1 Introduction**

Methodology provides clarity of the process and instruments used for gathering information to answer a particular research question(s). It focuses on how the researcher goes about generating knowledge. This chapter therefore presents the process through which the research was conducted. It comprises the study design, description of the study site, population and sampling procedures, data sourcing and collection, data analysis and ethical considerations.

#### **3.2 Study Design**

This study employed a descriptive research design. According to Gay (1992: 217), descriptive research involves collecting data in order to test hypotheses or to answer questions concerning the current status of the subject of the study. As an operating model or blueprint for a research project, a research design is intended to offer the general strategy for conducting the study. Babbie (2004: 112) defines research design as “involving a set of decisions regarding what topic is to be studied among what populations with what research designs for what purpose”.

A descriptive study therefore determines and reports the way things are. Descriptive research therefore describes events, phenomena or facts systematically within certain area or population. In this study, focus was on understanding the effects of cage fish farming on livelihoods of fisherfolk in Anyanga beach. The study employed qualitative approaches using semi-structured questionnaire interviews, key informant interviews (KIIs), in-depth interviews (KIIs) and focus group discussions (FGDs). Cage fish farming is in its early years in the Kenyan side of Lake Victoria and building a body of information on it remains an important scientific preoccupation. To ensure rigor, elicitation of personalised accounts from practitioners promises a more robust outcome in record time. Qualitative methodology was thus ideal and preferred option of netting experiences and opinions of the fisherfolk covered in this study. Qualitative methods allowed the researcher to ask key questions and also to get deeper understanding of the fisherfolk experiences and everyday fisheries activities. Semi structured questionnaires (Appendix 1) were the primary research tool used to get insights on socio-demographic features and livelihood changes of fisherfolks. Data from FGDs(Appendix 2), IDIs (Appendix 3) and KIIs (Appendix 4) added deeper accounts of existing issues because of their ability to generate rich, in-depth responses on individual experiences and perceptions (Punch 2014) regarding cage fish farming.

### 3.3 Study Site

The study was conducted in Anyanga beach located in Usenge Sub-Location, West Yimbo ward of Siaya County. Anyanga beach lies in the larger Bondo Sub County. The beach is one of the 83 fish landing points along Lake Victoria in Siaya County<sup>2</sup>. The County has a total land area of 253,000 ha and a water area of 100,500 ha.

Siaya County's population is predominantly rural, with 93 % of the population residing in rural areas. This is also typical of the beach area which also had a rural setting. Food insecurity in the entire County is high and past reports classified 80.7% of its households as food insecure (GoK, 2014). The County is therefore characterised by high poverty levels (47.56%) and food insecurity<sup>3</sup>. Most households within the County either depend on crops, livestock or fishing for livelihoods. Agriculture thus contributes about 60% of the household income and provides almost 61% of all employment opportunities<sup>4</sup>. Although the sector is beset by many challenges that are exacerbated by climate variability and change, agriculture still plays an important role in addressing food security and livelihoods of the county's population.

The study targeted fisherfolks working along Anyanga beach. According to the 2017 mapping of cages in Lake Victoria by KMFRI, Anyanga beach had the highest number of sited cages at over 2000. Geographically it offered a more ideal place where the study could be done than neighbouring beaches because of the dominant profile cage farming enjoyed there. Anyanga has along successful history of traditional capture fisheries which is also being practiced along cage fish farming. This offers an environment where the fisherfolk are mediating between these competing practices to survive and earn a living.

According to a suitability mapping by KMFRI captured in Figure 3.2.1, it indicates that out of 4,100 km<sup>2</sup> available lakes-cape, the maximum suitable area for cages is 362 km<sup>2</sup> or approximately 9 percent of the Kenyan portion of Lake Victoria. Anyanga beach is marked as one of the suitable locations for cage farming according to this mapping.

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<sup>2</sup> County Integrated Development Plan (CIDP) 2018-2022, Siaya County.

<sup>3</sup> MoALF. 2016. Climate Risk Profile for Siaya. Kenya County Climate Risk Profile Series. The Kenya Ministry of Agriculture, Livestock and Fisheries (MoALF), Nairobi, Kenya.

<sup>4</sup> GoK. 2014. Agricultural Sector Development Support Programme (ASDSP). Ministry of Agriculture Livestock and Fisheries. Government of Kenya, Nairobi, Kenya.

Figure 3.1: Source: KMFRI Website: [www.kmfri.co.ke](http://www.kmfri.co.ke) accessed 02.11.2019)

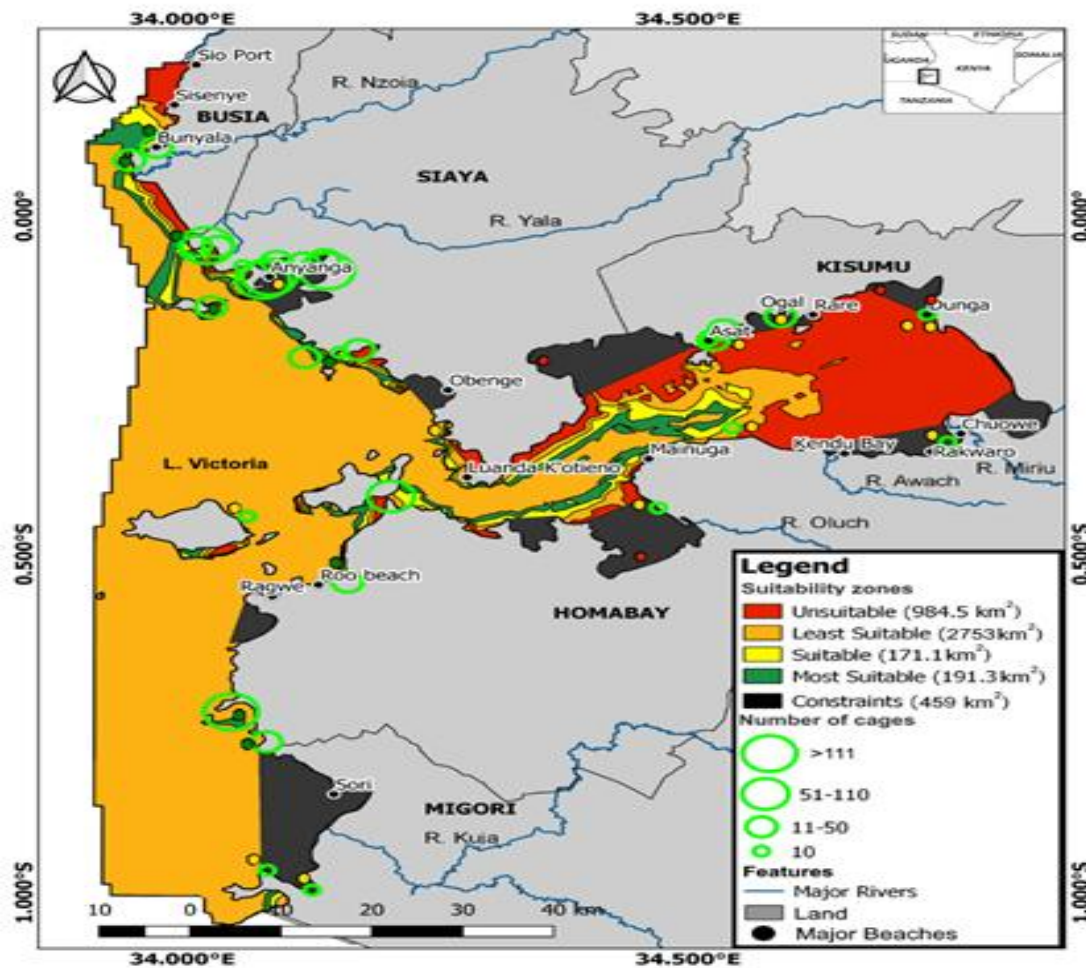


Figure 3.1: Source: KMFRI website: [www.kmfri.co.ke](http://www.kmfri.co.ke).

### 3.4 Population and Sampling

#### Sample Selection for Key informants

The sampling approach involved a mix of purposive sampling (for the fisheries stakeholders and BMU officials). Five key informants were purposively sampled on the basis of their expertise and knowledge on issues being sought by the study. They included 3 BMU officials (Chairman, Secretary and 1 Committee member), 1 pioneer cage farmers in the area and a Sub County fisheries official. Tremblay (1957) affirms that randomization within the study area normally cannot guarantee knowledgeable and observant expert informant needed. It therefore allowed for selection of participants meant to serve a distinct “purpose” of competently sharing on matters cage fishing and current state of fisheries in the area.

Two FGDs with one group of fish traders (4 women and 1 man) and another with fishermen (6 males) were conducted. These helped in bringing out issues around changes witnessed and building consensus on emerging issues.

### Sampling fisherfolks

Convenience sampling within a stratified framework was employed for the other respondents. The process first involved stratification of the fisherfolks into fishermen, cage farm workers, fish traders and net artisans. A list of total numbers (Table 3.2.2) was provided by the BMU office for these four strata. To obtain the required sample a calculation of 10% was done and a total of 49 interviewees (sample population) obtained. The researcher and the BMU Chairman then explored possible ways to get the numbers and it was clear that convenient sampling was most appropriate.

A randomization approach was not feasible due to the irregular work schedules of the fisherfolks making it difficult to get hold of them easily. Fishermen for instance who go fishing at night were not available during the day as many were reported to be sleeping. Fish traders operating at the beach also visited early morning and not settled before getting fish and also left as soon as possible to start preparation for market.

The researcher was mainly stationed at the beach office and also visited the other two adjacent small landing points within the beach's control on two separate occasions. The study therefore conducted one to one interviews with those landing fish at the beach, those buying fish and stakeholders visiting for different reasons. Individuals presenting in groups and insisting on being interviewed together were involved in group discussions. This worked for the fishermen's focus group discussion. The other sets of interviews went on until the desired numbers were reached and response saturation attained. With fisherfolks mostly having little or no variation in terms of their socio-economic backgrounds, it was assumed that those interviewed represented nearly similar views as the rest.

**Table 3.1: Sample size**

<b>Semi-structured interviews</b>	Numbers	10% of total population
Fishermen (Boat owners and crew)	267	27
Traders	120	12
Others (cage workers/net weaving and repair)	97	10
<b>Totals</b>		<b>49</b>

Source: Monthly fish data record for Anyanga (June/July, 2019)

The determination of the survey sample size was informed by Mugenda and Mugenda (2013) assertions that with a study population of less than 10,000, a sample size of between 10 and 30% is a good representation of the target population and hence 10% is adequate for conducting analysis. Gay (1992) further suggests that, for descriptive studies, ten percent of the accessible population is enough for a sample size.

### **3.5 Data Sources and Collection**

The study targeted the fisher folk within Anyanga beach as well as other stakeholders who worked closely with the BMU on matters related to cage fish farming and general fisheries matters. They included fishermen, fish traders, cage farm workers, net artisans and cage farmers. A section of the BMU officials (Chairman, Secretary and Organising Secretary) were interviewed as key informants. They were instrumental in sharing the journey of cage fish farming along the beach having seen it unfold over time. One pioneer cage farmer in the area was also included as key informants. Cage farmers having cages along the beach were interviewed using the in-depth interview guide. They particularly responded to the questions about motivations for going into cage fish farming and the change narrative from their perspective.

### **3.6 Data Analysis**

All the data obtained were in two strands-qualitative and quantitative in nature. Data from structured parts of the survey tool were analysed using simple descriptive statistics through SPSS (Version 25) in form of frequency count, graphs, pie-charts and cross tabulations. Descriptive statistics allowed for description of the socio demographics and daily activities of the fisherfolks. Further livelihood changes that had occurred among the fisherfolks were also summarised into various sets of numerical data.

Transcripts from FGDs, IDIs and KIIs were checked for accuracy before being coded and then subjected to content analysis. Responses from the open-ended parts of the questionnaires were also included. According to Creswell (2009), in content analysis, a classification system is developed to record the information. In interpreting results, those issues that appeared in high frequencies were interpreted as a measure of importance or attention. They then informed the objects for illuminating the fisherfolks ideas in this study. Other responses were reported verbatim through quotes to support related findings.



There results from the two sources were also triangulated to allow consistency and accuracy of reported findings as shown in various sections of the findings.

### **3.7 Challenges encountered during fieldwork**

The study experienced a number of challenges that either worked to slow the data collection process and make it difficult to get interviews from some respondents. The study period coincided with the low fishing season between May and September and fisheries activities were low key along the beach. The beach therefore was not very active with fewer number of fisherfolks than during peak moments. Another challenge experienced was the inability to reach some key informants for interview, especially the Sub County Fisheries officials even after several follow ups. This could have denied the study some critical information related to the study subject. A lot of expectations by the respondents which could not be met. Some asked for compensation for time while other demanded money to buy drinks or food before they could be interviewed. Other respondents were hesitant in participating claiming they have been part of similar undertakings and gained nothing from it. Some even alluded to several promises made by previous researchers that have never been met.

### **3.8 Ethical Considerations**

Necessary approvals were sought from respective authorities. A letter authorizing field visit from the Director's office at the Institute was obtained. During the field data collection which took 9 days (June 22<sup>nd</sup> to 30<sup>th</sup> 2019), the local BMU office was properly briefed on the study and about their supposed involvement. After discussions with the BMU officials it was agreed that I be stationed at the office due to its centrality and convenience in meeting targeted fisherfolks.

Informed consent was sought from all the respondents before they were interviewed using the questionnaire and key informant interviews. The process of consenting involved sharing the objectives of the study and why they had been chosen to take part. The anticipated benefits and potential risks of participating in the study were also explained to the participants. They were assured of confidentiality and their identity remaining anonymous. They were then given an opportunity to ask questions resulting from the information shared before the interview began. Two copies detailing the above information was provided to respondents for signing as a confirmation of informed consent process. One copy was then retained by the researcher and another one given to the respondent as a record of the same.

### **3.9 Data Needs Table**

A data needs table (Appendix 5) was developed showing a summary of data sources, tools to be used and possible questions to ask across the different instruments. Under research question one on socio-demographic characteristics of the fisherfolks; age, gender, educational attainment, income sources were sought. On the second question on motivation for adopting cage farming the issues covered were on suitability of the beach for caging and what was required for one to invest in the same. This was to be provided by the cage farmers in-depth interviews. It also covered the benefits associated with cage fish farming. The last research question on how cage fish farming was impacting on livelihoods, data on opportunities created by cage farming at the beach was of primary concern as well as changes in activities of fisher folk at the beach.

## **CHAPTER FOUR FINDINGS AND DISCUSSION**

### **4.0 Introduction**

Cage fish farming is fast becoming a valued alternative livelihood source for the fisherfolk and riparian communities along Lake Victoria. Today caged fish is occupying a prominent role in fish value chains and also a vital addition to the local fisheries narrative. This chapter presents the study findings together with a robust discussion on the same. The outlay of the chapter is guided by the three specific objectives that the study sought to address as follows: profile the socio-demographic characteristics of fisher folks; inquiry on the motivation behind the adoption of cage fish farming by the fisher folk in the study area; and finally to adduce the changes brought about by cage fish farming on the lives of the fisher folks in the study area. Potential changes on the governance of the Beach Management Unit in the wake of cage fish farming operations at the beach are also presented in this last section of the study results.

The findings draw from data obtained from interviews conducted with fisher-folks including fishermen, fish traders, cage owners and workers within Anyanga beach using a semi-structured interview guide, in-depth interviews and focus group discussions. Key informant interviews with fisheries stakeholders, and related secondary data were also used.

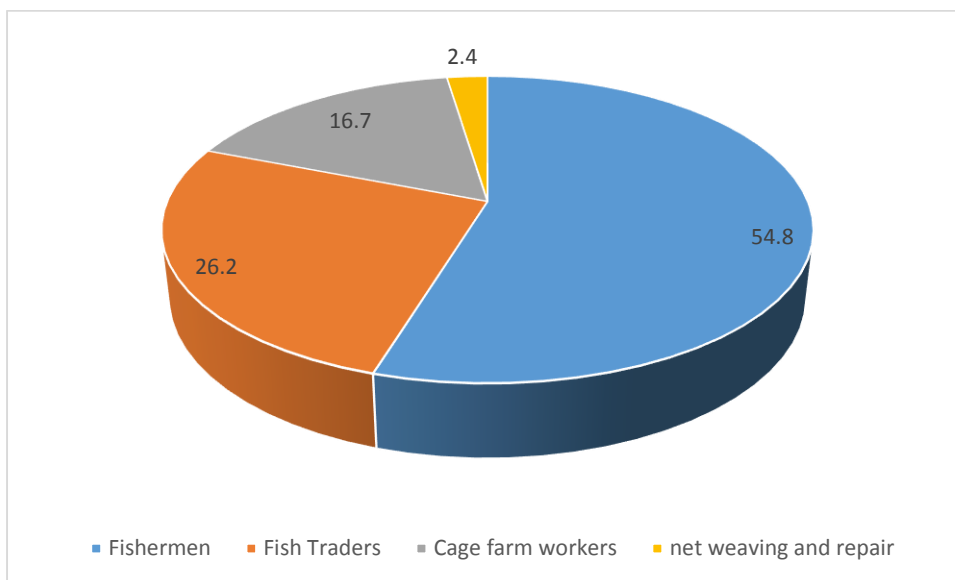
### **4.1 Demographic characteristics of fisher-folks in Anyanga beach**

#### **4.1.1 Profiles of fisher folks**

Aquaculture is today one of the most important contributors of livelihood opportunities within the fisheries sector globally. Buoyed by falling wild fish stocks along major fishing waters, fish farming is now offering reliable alternative sourcing of fish. This sorry state of capture fisheries has therefore turned into another major driver of aquaculture growth. In Kenya just like other Sub Saharan Africa (SSA) countries cage aquaculture is being practiced alongside other forms of fisheries in most fishing waters. Within Lake Victoria for instance, fish catches have shown a general downward trend. According to the CIDP 2018-2022 (Siaya County) fish landings have fallen from 39 thousand metric tons in 2010 to about 28.3 thousand metric tons in the year 2016. These figures are also bound to go down further with the overfishing experienced. The report cites climate change, introduced alien species, over-fishing, poor harvesting technologies and changing breeding patterns as some of the factors that have caused decline in fish stocks in Lake Victoria. Fisherfolk in Kenya especially those living along the shores of

Lake Victoria have increasingly turned into cage aquaculture to provide employment, nutrition and spur growth of local economies among other advantages.

Fishing just like other industry is further organised across several work specializations with individuals involved orienting towards one or more categories. The study categorised the fisher-folk along four main groups as presented in Figure 4.1.1. Fishermen were the majority at 54.8%, fish traders were 26.2% of the entire workforce at the beach, cage farm workers were 16.7% with those involved in net weaving and repair being the smallest group at 2.4%. Some fishermen used to the daily fishing routines still resisted cage farming and remained etched to their old trade. They believed that the lake still had fish and could not fathom a different life in the fisheries scene. The fisher folks however intimated that these areas of work were never cast on fines lines since individuals at times cross to work in other areas depending on prevailing circumstances. When net fishing is low, some fishermen end up seeking work in cage farms while some are involved in both activities at the same time, though one always singled out their main occupation. This works well as a coping mechanism in response to the erratic nature of capture fisheries which had been the mainstay of many along the beach.



**Figure 4.1: Fisher folk categories**

#### 4.1.2 Socio-economic characteristics of the fisherfolk

Gender of a population forms the basic definitive demographic of every human population. Beyond other ascribed orientations, the dichotomy of man and woman remains the most fundamental social differentiation of any creation. The study explored gender distribution of the fisher folks (Table 4.1) with the male and female distinction. It was evident that the fish landing area had a gendered occupational culture. Males (83.3%) were the majority. The females occupied the remaining 16.7% of those involved in the fisheries activities at the beach. Although the beach is definitely a man's domain, the few women present also played important roles especially in fish trading. This is what Bennett (2015) captures when he notes that there is a symbiotic relationship between men and women in the fishing sector and neither could manage without the other. Reflecting on the Kenyan employment scene, it was also apparent that the statistics were also skewed towards the male gender. Kenya's 2017 Economic Survey<sup>5</sup> for instance indicate that men dominate employment in the agricultural (fisheries included) sector at 67% with females at 33%. The slight difference however can be as a result of the aggregation across several sub sectors potentially with different numbers.

**Table 4.1: Gender of fisherfolks**

Variable	Frequency	Percentage (%)
<b>Sex</b>		
<b>Male</b>	35	83.3
<b>Female</b>	7	16.7

Source: Field Survey, 2019.

Kenya's Constitution prohibits the entry of children into industrial workforce. The law under the Employment Act, 2007, and the Children Act, defines a child in Kenya as a person below the age of 18 years. The Employment Act, Part VII provides for protection of children including protection from the worst forms of child labour. The BMU also requires all those working at the beach to be holders of a national identification card. The study therefore had its lower age limit for respondents set at 18 years. The study explored the fisher folk ages across five age categories from the youngest being between 18-25 years and the oldest between 56-65 years (Table 4.2). The results showed that over 70% of all fisher-folks were falling between the ages of 18 and 35, the first two age categories in this study. The highest concentration was however

<sup>5</sup> KNBS, Economic Survey 2017.

between ages 26 and 35 (42.9%). Young people therefore dominate the fisheries workforce, a clear case of its great traction to young people faced by high unemployment across the Country. There are always very few formalities to join fisheries work and this easy entry make it a likely occupation for those looking for job opportunities.

**Table 4.2: Age of fisherfolks**

Age	Frequency	Percentage (%)
18-25 years	15	35.7
26-35 years	18	42.9
36-45 years	6	14.3
46-55 years	1	2.4
56-65 years	2	4.8

Source: Field Survey, 2019

Cross tabulation between gender and fisherfolk categories shows that all fishermen (n=23) interviewed were males with fish trading having women majority (n=11 out of 15). The other work categories were however dominated by men. The discussions also revealed that the type of fish trading practiced along Anyanga beach was typically small scale in nature. Most traders the coming to the fish band every morning were seen buying in smaller quantities with small troughs as their carrier baskets. According to one of the traders:

*We buy fish from as low as 200 shillings and sometimes up to around 1000. We are many and each person has to get something to go and sell. That's why you see us share fish this way. (Trader, 24/10/2019)*

These small quantities are either sold directly to consumers after processing or raw while sometimes exchanged for a “small” profit to visiting “bigger” traders. This trade mostly involved tilapia fish and middle sized Nile perch not bought by the processors. Small sized Nile perch were mostly sold to local consumers and local hotels. Another trader stated:

*We sell to him (pointing at a trader carrying a huge woven basket on a motorbike) get something small. 5 or 10 shillings from each fish (tilapia) and that's how things happen here. (Trader, 23/10/2019)*

Marriage remains a pivotal transitional step in people’s lives across many communities around the world. Most people marry for reasons ranging from love, economic status, religious beliefs, and social acceptance. Regardless of the reason, marriage remains an important institution through which societies reproduce themselves and get glued together. Most fisherfolk at the beach were of Luo ethnic group which considers marriage as the most significant event in their lives. This is because through marriage the adult world of a Luo begins, is controlled, nurtured and lived (Miruka, Nathan, and Obongo, 2015). They also get their roots, stability and sense of responsibility through the marriage rites they also partake. Table 4.1.4 shows that nearly two thirds of those interviewed (61.9%) were in marriage unions. Those reporting singlehood were 31%. Reasons cited included young age, low economic ability to provide for partner while some were still searching for prospective suitors. The economic wellbeing question was a fundamental one, with some holding longer before marriage until they can able provide for their partners as noted by this statement;

*You must be ready to provide for your wife (msupa). Otherwise you lose her. Am not ready now (Fisherman, 25/06/2019)*

According to the 2009 Kenya Population and Housing Census, about 45 percent of the Siaya County’s population were below age 15 though expected to decline to about 35 percent in 2030<sup>6</sup>. The County thus recorded one of the highest dependency ratios of 101. With a fertility rate of 4.3 and a high dependency ratio, lie the need to provide subsistence and other necessities to these many dependants.

**Table 4.3: Marital status of fisher folks**

<b>Marital status</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Married</b>	26	61.9
<b>Single</b>	13	31.0
<b>Widow/Widower</b>	1	2.4
<b>Separated</b>	2	4.8

Source: Field Survey, 2019

Education is very important gateway to realizing human progress. Education has been a hallmark of civilization and an important tool for inspiring social change. Local fisherfolks generally had low levels of educational attainment. In Table 4.4. Only 14.6% reported having

<sup>6</sup> National Council for Population and Development (NCPD). 2017.

completed secondary education. Majority reported having only received upper primary education with another 17.1% terminating at lower primary. None of the fisher-folks interviewed had attained post-secondary education indicating low literacy levels across the fisher folk categories interviewed. Though contrary to a recent study (B. Utete et. al., 2017) among fisherfolks in Zimbabwe, the findings confirm a long held proposition that fishing communities in the world have always recorded low participation in education (Vimala 2010). For the Zimbabwean study however, more than 60% of the fisherfolks had attained formal education with some even attaining university education. This was among highly urbanised fisherfolks of Lakes Chivero and Manyame unlike most fishing areas which are predominantly rural based. Low literacy rates like the ones exhibited in Anyanga more often limit the agency of fisherfolks to diversify, improve their fisheries activities and benefit from support programs by government and other partners. This study however had interviewed 42 which was way below a sample of 87 for the Zimbabwean study, thereby giving more credence to the latter’s conclusions.

**Table 4.4: Education levels**

Highest Education Level	Frequency	Percentage
Lower primary	7	17.1
Upper primary	20	48.8
Secondary incomplete	8	19.5
Secondary complete	6	14.6

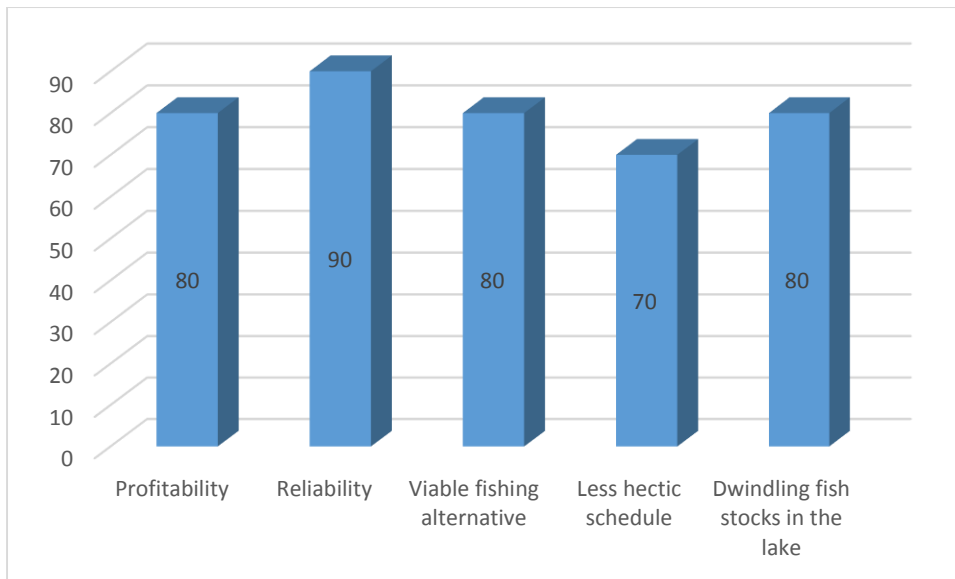
Source: Field Survey, 2019.

## **4.2 Motivation for adoption of cage fish farming by the fisherfolk**

### **4.2.1 Reasons for adopting cage farming**

With most of world’s marine fish stocks either fully exploited, overexploited or depleted, alternative sourcing of fish becomes very critical. Cage aquaculture is fast becoming an important frontier in turning the tide across the fisheries sector. Cage fish farming offers several advantages over other forms of aquaculture as highlighted by responses in Figure 4.2.1. Most fisher-folks interviewed were equally convinced that cage farming offered better returns and was quite definitive in terms of expected harvest unlike capture fisheries which was a chance and luck disposition.





**Figure 4.2: Reasons for investing in cages**

A multiple answer question was posed to the fisher folks asking why investors opted for cage fish farming and the results showed various pull factors discussed as follows. Cage farming assured investors of reliable fish supply whenever they needed it because it is closed and can be harvested when need arises. 90% were in agreement that cage farming is a more reliable fishing approach. This reliability has a lot to do with the predictability of the harvest unlike the capture fisheries which is quite erratic. The question of time schedules involved in cage farming was juxtaposed against the time spent for a single fishing expedition which most likely last a whole night or several hours. Cage farming emerged as less hectic (70%) with routine tasks like feeding and supervision always taking lesser minutes or hours. Jansen et al., (1999) concurs that fishermen do leave the beach in the dark of the night and work all night long hauling up the fish which have been caught by the nets. Cage aquaculture therefore offers a superior alternative for fish production with fewer fishing efforts consistent with what Swaibu (2017) notes in Uganda. This concurs with what one cage farm worker said:

*“...In the past I used to go fishing the whole night and encountered many problems. Sometimes you get rained or even robbed while there, unlike cage farming which you spend less time in a day mainly feeding time” (Cage worker 22/06/2019).*

The issue of profitability also featured prominently at 80%. This is always a top consideration for any nature of investment and those caging also held similar sentiments. In his reasons for increase in cage investments along Lake Victoria, Ombwa (2018) asserts that better income prospects prompted by high demand for fish as another advantage that cage culture offers.

Siaya (2013-2017) CIDP<sup>7</sup> confirms that over the last ten years fish landings from Lake Victoria in the county has been declining while the demand for fish steadily increasing. With this state of affairs cage fish farming is bound to further its appeal among potential investors because of a ready market of consumers and good returns.

#### **4.2.2 Suitability of Anyanga beach**

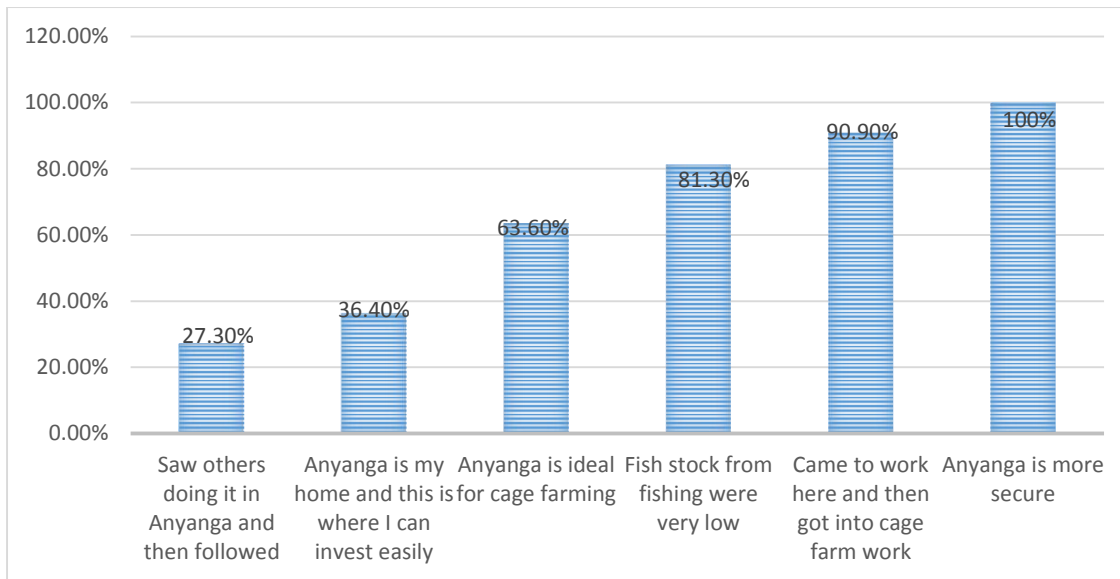
Although cage fish farming has emerged as the most favoured form of aquaculture globally due to its inherent advantages, siting of cages is also an important element that an investor must take into consideration. KMFRI (2017) notes that the number of cages in Kenyan part of Lake Victoria increased from 1,663 cages in December 2016 to 3,398 cages in July 2017 with most of these cages being in Anyanga beach. The natural positioning of the beach which allows for limited disruptive winds is therefore one of the major pull factors luring cage investors. The fisher-folks noted that the beach harbours a water frontier with cool waters and little turbulence, which is ideal for caging. Karnatak (2014) adds that during the summer or rainy seasons, cages may be damaged by strong winds or flooding. Cage farmers are therefore saved from constant expenses from damages incurred when anchored within areas prone to strong currents. The fact that Anyanga beach is insulated from strong winds thus places the beach as most suitable destination for locating cage farms. A BMU official also supported the good location of the beach location noting that;

*We are blessed here in Anyanga beach. The way this beach is placed, it offers very little disturbance on cages placed in the Lake. Winds are not bad here like in other open places. (BMU official 02/07/2019)*

The fact that the beach was more secure was also seen as a very important factor by those wishing to invest. All those interviewed cited it as most critical among other factors such as being a home beach, low fish stocks and just the desire to do what others are doing (Figure 4.2.2). Cage farming is capital intensive venture where lots of money get invested. Accounts from cage farmers pointed to huge expenditures in the initial stages of siting. Other costs like buying feeds, paying workers' wages also followed through the entire period till harvesting. With 100% agreement that the beach is more secure, investments were guaranteed cover from any potential threats like theft and other illicit activities. Anyanga beach had cultivated great trust among potential cage farmers since incidences of insecurity were rare occurrence.

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<sup>7</sup> CIDP 2013-2017, Siaya County.



**Figure: 4.3: Reasons for caging along Anyanga Beach**

### 4.3 Cage fish farming and changing livelihoods of fisherfolk

#### 4.3.1 Cage fish farming in Anyanga

Cage fish farming along Anyanga beach attracted both local and outsiders as investors. Though dominated by outsiders at over 80%, the owners were rarely involved in the day to day running of their cages. Cage agents and workers were in charge with the owners visiting once in a while for supervision. Those interviewed indicated they used amounts ranging from Kshs.25, 000 to 80,000 to set up a single cage. The expenses covered buying of nets, fabricating the cages, buying fingerlings, feeds and workers' wages. Nets were the most costly of all the items bought to launch a cage. The variation of cost of setting up a cage was explained by those buying used cages and nets or getting them donated by other owners thus cutting on what to buy. This was typical of workers who were transitioning into cage ownership. Some cage workers explained that after harvest before the cages are re-stocked they sometimes stock the cages with their own fingerlings as they make arrangement to get a cage where they later transfer them when the owner is ready. This is how some ended up starting cage ownership.

Tilapia was the species of choice for caging along the beach, just like other studies (Orina, 2018; Swaibu 2018 and Aura 2017) have confirmed it as a preferred species for most cage farmers in Lake Victoria. Cages sizes used varied in sizes from 2metres by 2metres to larger ones like the 3m by 6ms Size 2.5 by 2.5 was the most popular with all the cage farmers interviewed at least having one or more.

### 4.3.2 Changes among the fisherfolks

Millions of people around the world are drawing incomes and livelihood means from the fisheries and aquaculture sectors. The latest official statistics (FAO, 2018) indicate that in 2016, 19.3 million people were directly engaged in aquaculture with the number set to grow further with growing popularity of cage culture.

Among fisher folks in Anyanga beach, the changes cited mostly stemmed from their personal experiences, those observed in others as well as in overall community's wellbeing. This study documented changes across six major areas as shown in Table 4.3.1 below. The most significant change felt was in the job arena where majority (97.6%) alluded to the fact new jobs were created at the beach by cage farming. There was no doubt that cage fish farming had touched the lives of almost every fisher folk working along the beach in some way with most being directly impacted through full time work as cage workers and others on short-term engagements related duties. This is similar to findings in Egypt and Uganda (Soliman 2017& Swaibu, 2017 respectively) who also observed that aquaculture sectors in the two countries benefitted through job creation for skilled and non-laborers as well as employment opportunities in new supportive industries.

**Table 4.5: Major changes witnessed at the beach**

	Frequency	Percentage
<b>New jobs created by cage farming for locals</b>	40	97.6%
<b>Fishermen crossing to cage fish farming</b>	11	26.8%
<b>More fish harvest at the beach</b>	10	24.4%
<b>Low incidences of crime involving youth</b>	1	2.4%
<b>Capture fisheries going down</b>	1	2.4%

Young people who formed the bulk of workforce within the beach therefore reaped big from this new order of job opportunities. Those who were previously idle and unemployed as well as those pushed off net fishing were now absorbed into this fresh stream of waged work. This is captured through a local official who remarked that:

*Cage fish farming has empowered people here in terms of employment (BMU official 29/06/2019)*

Cage fish farming venture has also opened new set of opportunities that never existed before within the local fisheries ecosystem. Cage fabrication, cage net weaving, selling jerricans and plastic drums, making of sinkers and floaters (Figures 4.3.1) are some of the cage specific opportunities that locals can now cherish courtesy of cage fish farming at the beach.

*Net fishing is still present but have declined. Percentage of those engaged in capture fisheries are few and those working in cages are many. (BMU official 28/06/2019)*

Locals also intimate that menial jobs also exist at the beach from moving cages in and out of the lake, painting of cages to prevent rust and also feeding of fish in cages and during harvesting. These are important income earning opportunities that fisher folks can engage in regularly. This position was affirmed by a fisher folks who added that:

*“.....this community is now different, we have iron sheet houses being built here easily. This area was dominated by grass thatched houses but things have since changed with cage farming now bringing more money to the beach. (Fisherman, 22/06/2019)  
Many have built houses in this community, these nice buildings were not there five years ago (Fish trader (23/06/2019)*



**Figures 4.4: New cage opportunities**

*Ready blocks of sinkers for anchoring cages (top left) and team of net artists weaving a net to be used in a cage (top right).*

*Within the lake : The process of feeding fish in cages (bottom left) and Cage frame floating from installed plastic jerricans (bottom right) (Images Source: Author, 2019).*

The presence of cage fish farming at the beach has also prompted some locals to adjust in order to embrace this new venture. This has been witnessed by others moving away from net fishing work to take up jobs in cage fish farming full-time while others continue taking jobs as feeders and net weavers along their routine net fishing. Several fishermen (26.8%) had also crossed into fish farming which still support the proposition of them reeling from low fishing stocks. With cage fish farming the average fish collection from the beach have also been impacted. Other respondents (24.4%) noted that currently there were more fish harvest at the beach than before. There is now growing numbers of fish landing at the beach from both cage and captured

fish from the lake. These multiple sources of fish at the beach are captured through this official's remarks:

*Today a number of fishermen have crossed into cage fish farming with most employed working in the cages and some having own cages. Those who've crossed to cage fishing mostly are the ones who used to fish tilapia which is the fish grown in the cages (BMU Official 28/06/2019).*

With tilapia fish stocks having dropped in the Lake as a result of overfishing, those who had earlier specialized in tilapia fishing have found a fall back into cage fishing. Table 4.3.2 shows a cross tabulation between fisher folk categories and alternative livelihood. Fishermen and fish traders are shown as those mostly engaging in alternative incomes earning activities. This is a clear indication of how their core fisheries occupation are no longer adequate in providing for all their needs. A position reflected by this fish trader who noted that:

*I leave this place (beach) at around 10 am and then go to open my retail shop at home. I have children in school and this (fish trade) is not enough. (Fish Trader, 25/06/2019)*

**Table 4.6: Cross tabulation of fisherfolk and involvement in alternative activities**

	Alternative economic activities	
	Yes	No
Cage fish farm worker	3	4
Fishermen	11	12
Fish trader	6	5
Net weaving and repair	0	1

### **4.3.3 Business environment at the Beach**

Business environment has the potential to either threaten or boost to the general business wellbeing. Certain key fundamentals must therefore be fulfilled in the internal and external environment for businesses to thrive. With more money coming into the beach thanks to cage fish farming, businesses along the beach have also received a great boost. With 17.1% of the respondents acknowledging rise of new businesses, it was indicative of an improved environment that could now accommodate more opportunities than in the past. This concurs with Soliman (2017) findings that documented emergence of new industries and services

supporting the aquaculture sector in Egypt. Retail businesses, hotels, rental houses were growing in numbers and flourishing at the same time along the beach. A local fisherman remarked that;

*“....we now have shops selling fish feeds and jerricans that are supporting cage farmers here as well as new shops in the new buildings locals have recently built here”  
(Fisherman interview 26/06/2019)*

#### **4.3.4 Fish Trade**

Fish remains one of the most traded food commodities worldwide (FAO, 2018), and 54% of this trade is coming from developing countries like Kenya. Fish trading is one of the areas which has also been positively impacted by cage fish farming along Anyanga beach. Some of the fish traders interviewed narrated that without cage fish today, they would be out of business since nearly all the tilapia fish they trade in are from cage farms.

Cage fish farming therefore is emerging as the mainstay of fish trade at the beach. Most of the net fishing today targets Nile perch which is booked by the processors and only few small pieces sold to traders. Accounts from fish traders point to cage fish farming offering a life line as captured in the following quotes,

*Fish trade has gone down drastically especially with the slump in fishing operations “lake fish is rare”. We now depend purely on cage fish for our business. Previously fish traders refused to buy caged fish but now they have no choice. But it is real trouble since cage farmers do not want to sell their fish to us. “they dilly dally”. We beg them so much to have them sell to us. It is not very nice state of affairs. (IDI, Trader 24/06/2019)*

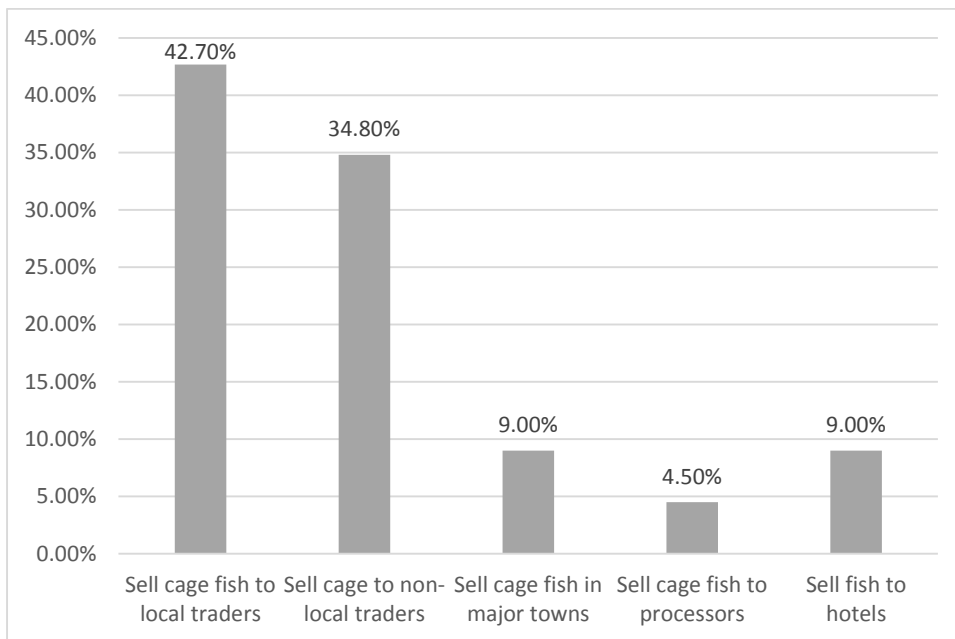
*Cage fish is what is sustaining our business nowadays. Though sometimes you can go without fish, we mostly get something small to take to the market. (FGD, Traders 26/06/2019)*

*Cage fish farming has had positive influence on our businesses. Without cage fish we’ll be out of business now (Trader 28/06/2019)*

Even though the issue of some cage farmers not willing to sell fish to local traders was well pronounced, local traders still remained the customers of choice for many at 42.7% followed by traders from nearby markets (34.8%) as shown in Figure 4.3.3. In most cases witnessed, the harvesting happens when the cage owner is present and those who own one or fewer cages or



get low harvest do prefer selling at the beach. This helped them in cutting other expenses likely to be incurred in moving to other distant markets. Some cage farmers however took their harvest to far-flung towns where they claim it attracted better prices. Some respondents claimed some investors did own hotels which they themselves supplied with fish, though specific information or cases were not provided to confirm this.



**Figure 4.5: Selling of caged fish**

#### 4.3.5 Fish availability and fish prices

With fish stocks especially tilapia going down in the Lake waters, a glaring gap has been left that needed something to fulfil. Tilapia rearing in cages have therefore come in handy to close this rising demand for tilapia fish by consumers. When asked about the availability of fish after the introduction of cage fish farming in the area, near all the fisher folks (97.6%) reported that more fish was now available than before the coming of cage fish at the beach. This is consistent with the global shift in fish production which has been taken over by aquaculture as supply from wild-caught fish stagnates (FAO, 2018). Along the beach caged tilapia formed the bulk of tilapia fish traded. Some also preferred it for consumption, however it costed more than the tilapia sold by fishermen which was also very rare. Nile perch were however priced lower than either type of tilapia.

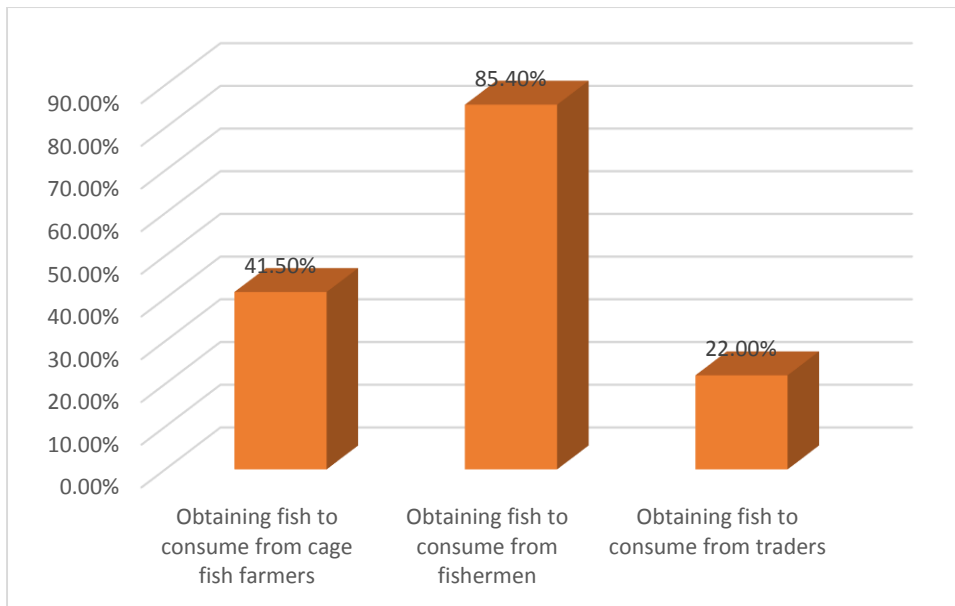
**Table 4.7: Fish availability at the beach**

	Frequency	Percentage (%)
Disagree	1	2.4
Agree	11	26.2
Strongly Agree	30	71.4

Prices of fish was also looked into in the wake of this increased volumes at the beach. Fisher folks interviewed held the view that although more fish was now available at the beach, cage fish was relatively priced higher than fish from fishers. With cage investors largely driven by the need to maximize profits and to have balanced books of accounts from their investments, the prices reflected an array of considerations. All the expenses accrued over the entire period from preparing a cage to harvesting were therefore factored in determining selling prices.

#### **4.3.6 Fish consumption and sourcing**

Due to its unique nutritional properties, fish plays an important part in the health of billions of consumers in both developed and developing countries. Fish today provides more than 4.5 billion people with at least 15 % of their average per capita intake of animal protein (Béné, 2015). Fish consumption by members of the local community especially the fisher folks were also impacted by the caged fish. Even though most of the fish consumed came from fish catches by fishermen, cage fish also had a fair share and contributed directly 41.5 % of fish consumed (Figure 4.3.5). Most of the affordable fish locals majorly consume was Nile perch which mostly came from capture fish by fishermen. Caged tilapia was mostly preferred by traders who added value for selling in nearby markets.



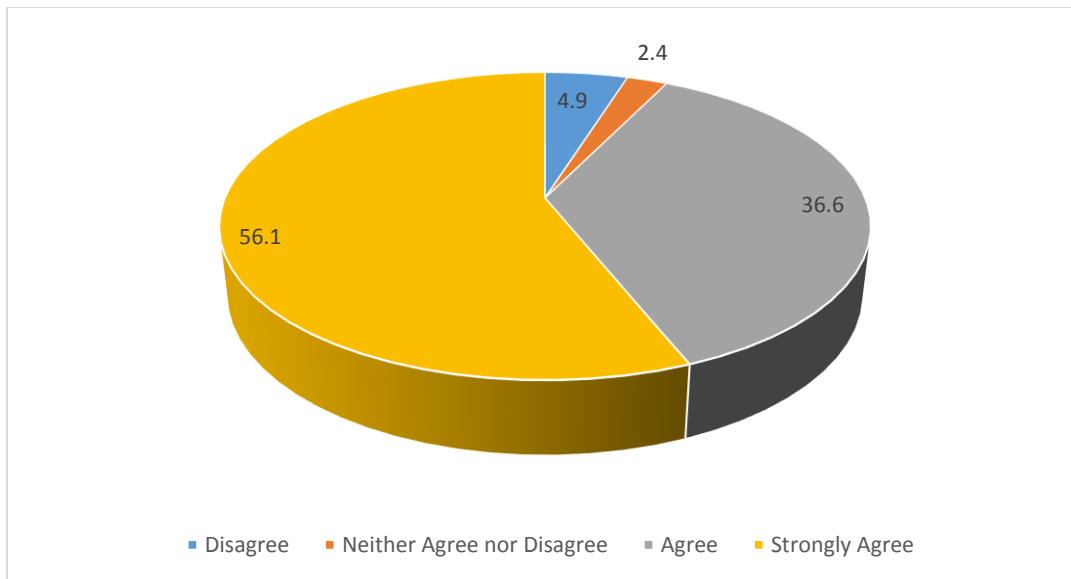
**Figure 4.6: Sources of consumed fish**

#### **4.3.7 Community's wellbeing**

Cage fish farming has had transformational effect across many communities where it is practiced and the story in Anyanga was not any different. A question posed to respondents on whether cage farming had improved their wellbeing got a resounding affirmation with majority (92.7%) in agreement that indeed their lives have been impacted positively. However, a small number 4.9% were of a contrary opinion. Only 2.4% could not tell whether or not their wellbeing had improved (Figure 4.3.7). A lot of testimonials shared by the fisher-folks conveyed real life changing stories as captured by these two fisherfolks ;

*It is worth noting that lives of individuals have really improved here (Fish trader 23/06/2019)*

*I have seen those with grass thatched housed transform them to iron sheet roofs, some moving from rental houses to building homes and some from owning bicycles to owning motorbikes. Some are also supporting their siblings to go back to school all from the money cage farming has brought to this beach (Cage farm worker 23/06/2019)*



**Figure 4.7: Has cage fish farming improved your wellbeing?**

Areas reported to have been influenced in a big way by the advent of cage fish farming along the beach waters in Anyanga are captured in Table 4.3.7 below. In terms of general security of the area a lot of gains had been experienced. Previous cases of theft of fishing items and household items by idle individuals drenched in drugs and hopelessness have gone down drastically since more are now involved. A situation confirmed by this local fisherman’s statement;

*Security has improved. Previous incidences of crime which were associated by youths have gone down. (Fisherman 23/06/2019)*

**Table 4.8 Changes witnessed in community**

	Frequency	Percentage
<b>Locals building houses and homes</b>	15	36.6%
<b>Locals buying boats and cars</b>	4	9.8%
<b>Locals now taking children to better schools</b>	3	7.3%
<b>Locals now owning cage farms</b>	3	7.3%
<b>Some have managed save money and gone back to school</b>	3	7.3%

The respondents also confirmed that iron sheets roofs have now replaced the grass thatched houses that dominated the area in the past before the arrival of cage farming. Some have also built houses in their homes having lived in rental houses before at the beach centre while others moved out of their parents' homes to build own homesteads too. All these changes have been made possible by earnings from cage involvement as workers and owners too. This is evident through remarks by fisherfolks:

*I managed to go back to school and now am pursuing my master at JOOUST, all because of cage farming (Local cage farmer 26/06/2019)*

*I used to live in a rental house in this centre, but have moved back to our home where I build a house and got married and now with children. Cage fish farming has helped change my life. (Cage farmer, 24/06/2019)*

*Cage fish farming has changed this place (Anyanga beach), you can see many businesses and new buildings which have only been built after coming of cage farms in this beach. (25/06/2019)*

*Some have built homes and houses from salaries they get from working in cages and they are living good lives (Fish Trader 23/06/2019)*

*Some have paid bride price. Cage fish farming has ensued locals have money to do a lot of personal issues (Cage Farmer 25/09/2019)*

The education arena has also been touched with some now giving school special focus with their children being sent to better schools. Few respondents (7.3%) also indicated that they have managed to resume formal education, thanks to the money they are paid from working in cages. Education is important in building essential human capital key for opening other opportunities for an individual beyond fishing. This can also help boost literacy levels for the local fisherfolk, thereby enhancing capacity to engage more meaningfully in the fisheries activities as well as related matters.

Locals have also moved into owning cages which is good for both the beach as well as their economic wellbeing. With local cage investors the local community is set to benefit from the entire chain of cage operations from jobs created to fish eating. Though at a low percentage of 7.3% this is a beginning that can be harnessed further to grow the number of locals in cage ownership.

Earnings from cage work and investments have also helped others acquire personal belongings from household goods to boats, motor bikes and even cars. Acquisition of boats is vital in growing once influence in the fishing circles since it allows one to also actively engage in net fishing with great advantage. Boat owners can employ crew who work for them on a daily basis

without accompanying the employee to the lake. Through this one is able to grow their income bases more sustainably.

Change comes with other changes attached and in the case of the local community where the fisher folks were hailing from, several marked transformations were recorded. These were from individual fisherfolks owning new tangible assets like boats, motor cycles, cars to building new houses and homes. Such assets played important roles in household welfare from providing living spaces, means of easy mobility and ways of earning incomes like in riding motor bikes and using boats. Results show that 36.6% had managed to build new dwellings which ensured they lived more comfortable lives than before. Other fisherfolks (7.3%) were now able to enrol their children into better schools, showing a growing consciousness on the importance of education for the betterment of their children’s futures.

*I managed to build my own house using money coming from monthly wages from working in a cage farm. For a long time I was staying in a small rented house in this centre (Anyanga). But life has changed for better now. (Cage farm worker, 27/06/2019)*

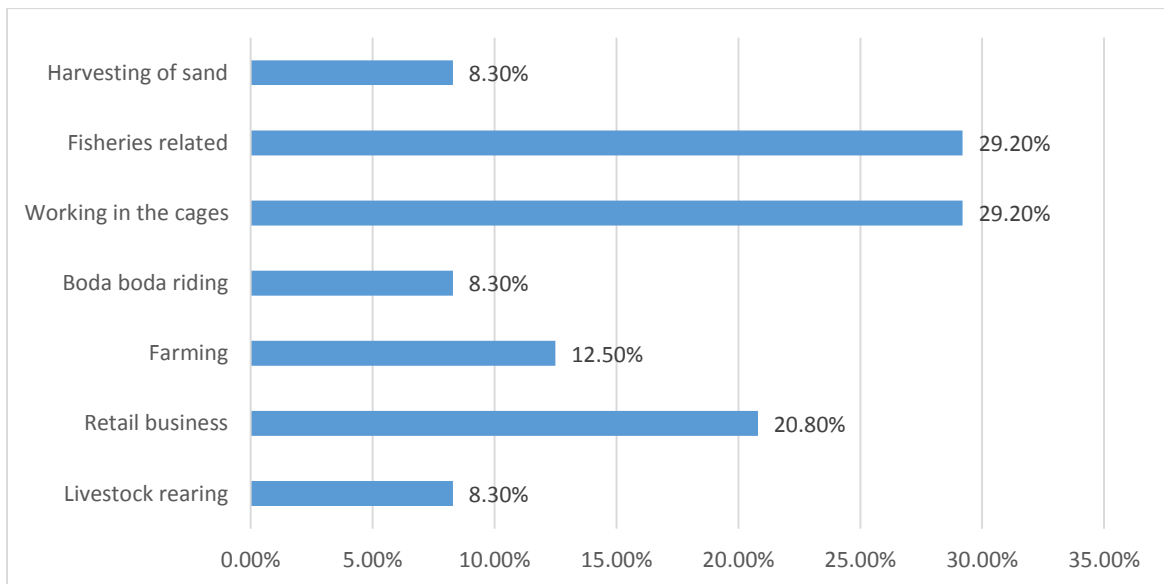
The question on changing fortunes was further broken down to specifically focus on incomes. When asked whether their incomes status had grown since the introduction of cage fish farming at the beach, the results (Table 4.3.6) shows a total of 56.1% in agreement with 30.9% thinking otherwise. A significant percentage (21.4 %) remained undecided on how things have changed for them and which way to attribute it. The results were therefore indicative of important contributions both capture fisheries and cage aquaculture were making in fisherfolk incomes.

**Table 4.9a: Changing income status**

	Frequency	Percentage (%)
Strongly Disagree	4	9.5
Disagree	9	21.4
Neither Agree nor Disagree	5	11.9
Agree	5	11.9
Strongly Agree	19	45.2

#### 4.3.8 Alternative economic activities

Activities in the fisheries sector have heavily slumped as a result of the overexploitation of the fish resources in most of the natural waters. This phenomenon has seen fisherfolks in many parts of the world facing immense pressure to cope with these inadequacies. The reality of low fortunes from conventional fishing was clearly noted in this study with nearly all fisher-folks interviewed being engaged in other complementary economic activities (Figure 4.3.6). These multiple sources helped in supporting their main line of work. The fishers interviewed opined that earnings from their main occupation have since fallen and need to bolster with other alternative sources critical. Adaptation of the fisherfolk to the changing times therefore formed a critical way of living though the present circumstances. Though some fisherfolk reported venturing into non-fisheries undertakings to beef up their main earnings, a number were already absorbed into the cage economy. Cage fish farm work (at 29.2%) formed the core of alternative economic activities that fisherfolks were engaged in. Adoption of cage farming by some and turning as cage farm workers by other formed the most important ways individual fisherfolks were coping with the coming of cage farming to the area. This further affirms the growing influence of cage fish farming as a formidable alternative livelihood strategy for the local fisherfolk.



**Figure 4.8: Alternative economic activities**

#### **4.4 Governance of Fisheries at the beach**

The journey of co-management of the beaches started in earnest in 2004 with most of the BMUs getting formed thereafter. Their establishment built on the beach committee arrangements that had existed since the early 1960s (Abila et al. 2009). The passing of the Fisheries (Beach Management Unit) Regulations, 2007, under the Fisheries Act (Cap 378) gave BMUs the rights to manage resources at a particular landing site (GoK 2007), together with guidelines for their constitution and operations. This was an important shift away from the state centralized management of fisheries by the state which did not succeed much in addressing the plight of those dependent on fisheries for their livelihoods.

Currently the management of BMUs is anchored within the Fisheries Management Act of 2016 which succeeded the old legislation, Cap 378. The day to day activities at the beach are run by the BMU officials. This arrangement seems organized and run informally in response to the needs and wishes of the local fisher-folks and agreed management priorities. Though the management structure conformed to what the law required, the running of beach affairs was normally mediated within wider socio-cultural orderlies of the community. Need to preserve cohesion and dignity of the community, and mutual respect guided most actions of the officials. The overall goal of the management is to ensure smooth running of activities at the beach. In terms of structure, Anyanga BMU has a Management Committee of 13 members as its decision making organ. These elections occur at regular intervals under the supervision of the Sub County Fisheries Officer. The officials were voted in by the local fisherfolk community and at present did not include any outsider. Locals still had control of the beach management even after the coming of cage investors from outside the community. This gave them great capital to bargain their way easily without any interference as in the past before cage farming influx at the beach.





**Figure 4.9: Anyanga BMU's Office and Fish Banda (Source: Author, 2019)**

Although Lake Victoria remains a shared resource with its fisheries management influenced by national policies and legislation as well as regional agreements, the place for sound local management arrangements is critical. For a long-time the existing institutions mostly focused on capture fisheries, but with the emergence of cage aquaculture new approach had to be adopted. As much as environmental concerns always dominate aquaculture processes, studies like (Brigolin et al., 2016) concludes that cages have minimal environmental impact on environment that extends only extends 5 meters around the cage. In Anyanga for instance some respondents claimed that some of the feeds are spilling into the Lake and may end up polluting the waters. Necessary safeguards are therefore needed to control whatever level of environmental footprint that might occur especially in places where there are no clear regulatory prescriptions.

At the BMU level there were existing local arrangements taken to ensure smooth operations. For instance there was great effort put to ensure records were kept albeit challenges stemming from irregular fishing schedules and limited capacities. It was therefore not possible to note exact volumes of harvested stocks across cage and captured fish landing at the beach. Nile perch landing at the beach and destined for processing was however given special attention. It was revealed that for every kilogram taken away by processors, 10 shillings was paid back to the BMU to support its operations, a fact that could explain this hawk-eyed attention. These

funds mostly supported the beach acquire patrol engines for routine supervision and also for other office logistics. Though actual figures were never shared, the officials confirmed being resource strained and unable to execute several planned activities like fencing the beach and getting a better patrol engine.

In terms of operating a cage farm along the beach, a loose system existed with cage farmers confiding that no standard or formal processes were involved before anchoring a cage in the beach waters. It's a kind of free for all system where all that is required is getting ready then contacting an agent attached to the beach who is a BMU member and the cage is mounted. A cage farmer confirmed that, "here you only get ready with your cages and if you know any of the officials then you just take your cage into the waters, no office or certificate is required and no one has such here". This style of operation ended up benefitting those individual officials but not ultimately for the good of the entire BMU as an entity which could be starved legitimate funds in the process. At the moment it seems to work for both the concerned officials and the investors with no complains recorded of anyone getting a raw deal. The new BMU office also acknowledged to no exiting process of registration of cage farmers at the beach. They however noted that they were currently engaging cage agents and owners to institute a registration process for any cage being installed along the beach so as to guard against such previous lapses.

At the beach a monthly reporting schedule (Appendix 6) from the Sub County Fisheries office did exist, it was however not clear how the details entered were arrived at. It reported fish landings at the beach for the entire month. For instance in the month of July it reported 864 kg of tilapia which I confirmed mostly came from cage harvest, while at no point in nearly 2 weeks of my stay did I spot any weighing process for harvested cage fish, thereby raising integrity questions on the data shared from the beach. I was only Nile perch bought by a processor through their agent that was weighed at the beach. Obiero (2015) while studying the efficacy of BMUs along Lake Victoria, confirms this anomaly when he offers that BMUs have remained successful at activities of a social nature, but have dismally undertaken their core mandate relating to enforcement and conformity with fishing rules. This current state of affairs thus exhibit a very weak institutional system not capable of managing beach affairs as well as the new cage farming issues effectively.

On management of the beach it emerged that the local fisher folks were still in control. Although membership to the BMU was open to even non-local cage fish farmers, they were not present in the leadership of the beach especially the 13 member management committee.

Overall control of the beach operations and activities therefore still remained in the hands of locals. Efforts made by the County government of Siaya through the enactment of County's Fisheries and Aquaculture Act, 2016 to organise and consolidate the fisheries activities in the county is critical. To achieve more however, need to operationalize several sections of the Act like constitution of the Fisheries Development Trust Fund, the provision of a robust framework for extension and training services and strengthening of linkages along the fish market value chain.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This study was designed with the overall objective of finding out the effects of cage fish farming on livelihoods of fisherfolks, due to the dearth of knowledge in the area of cage fish farming in Kenya. The cage aquaculture sub sector is comparatively new, with minimal local theoretical and practice knowledge. To realise the above main objective the study specifically sought to understand the socio-demographic profiles of fisherfolks, their drive to adopting cage fish farming as well as changes in their livelihood activities arising from the cage windfall at the beach.

This section presents a summary of the study findings, followed by concluding remarks before giving recommendations relevant for advancing cage fish farming in Kenya.

#### **5.2 Summary**

The study had the opportunity to interact with a wide range of fisher-folk categories from fishermen, fish mongers, cage farm workers, net artisans together with cage farmers. They were distributed in age from 18 years to 65 with concentration between ages 26 to 35 at 42.9%. Those between 18-25 years were 35.7%. The fishing sectors had a clear male face with a super majority being males. Areas like net fishing were entirely dominated by men and even in areas like fish trading that had many women, several men were still present.

Education levels among the fisher folks were generally low with only 14.6% having completed secondary education. Those having lower and upper primary schooling were the majority at 65.9%.

The study also revealed that several reasons motivated investors to go into cage farming. Matters relating to potential returns, reliability, predictability of harvest, being viable alternative to faltering capture fisheries were cited. The ideal positioning of Anyanga beach that allowed sited cages to be insulated from bad winds was also another factor that made cage investors troop towards Anyanga beach. Another revelation was the fact that most of the cage investments were owned by outsiders (80%) with a paltry 20% being under the ownership of local community members who included fisher folks as well as others non fisher folks like teachers. The locals however were the ones involved in the day to day management of the cage farms on behalf of the investors largely as wage workers.

The coming of cage fish farming at the beach also caused a lot of effects on livelihoods of fisherfolks in terms of offering alternative source of fish for food and business as well as creating job opportunities. New jobs included those that supported cage infrastructure from cage fabrication, construction of sinkers and floaters and weaving of cage nets. In the business front, those selling plastics and fish feeders had also set shop at the beach. Fish traders who were previously negatively impacted by the low fish volumes from capture fishing to appoint of moving out, are now enjoying a new lease of life with fish harvested from cages offering the much needed relief. Over 90% of the respondents agreed that there was increased availability of fish at the beach and consumers have an array of options on where to obtain fish for consumption, albeit with limitations on cost. Cage fish also boosted the fish consumption basket with 41.5% of respondents confirming to consuming it.

The changes have been felt by those involved in fishing operations at the beach. Records from those interviewed also revealed incidences of transformations by individuals with some having moved from owning no houses to building houses and homes, opening new businesses, taking children to better schools, buying motorbikes, boats and cars as well as paying dowry. Some fisher folks have also managed to return to school to complete studies which they left midway or were unable to continue due to financial difficulties.

### **5.3 Conclusion**

The study results indicate that cage fish farming is gaining popularity and is fast growing with a potential to impact job opportunities and food security in a big way. The practice of cage fish farming within Lake Victoria is therefore on an upward spiral and is bound to continue attracting more investors and interests.

This study noted that cage fish farming has had positive contribution to the lives of fisher folks living and working along Anyanga beach through job creation, improved incomes and food security. All categories of fishers interviewed had been impacted by the cage farming fortunes in some way with fish traders being the most affected. Their businesses were now restored after near collapse from declining capture fisheries that wholly fueled their fish trade previously. Though the lake fishing still played a significant role in the entire fisheries arrangement, there was no doubt on the positive livelihood changes that the coming of cage aquaculture had on fisherfolks.

Although participation of locals as cage owners was still low, a number had transitioned. Most of these locals who started as cage workers were now having own farms. Cage investment being capital intensive sometimes limited involvement of local fisherfolks who could not marshal the huge amounts needed at once.

With the glaring challenges of governance in light of the introduction of cage fish farming, the local BMU must improve their record gathering and keeping to accord to the changing times and more organised management. Registration of cage investments and taking of their harvest records are some of the important areas that need urgent action. Need for networking and seeking collaborations that can help build capacity to sustainably manage the beach is very critical.

#### **5.4 Recommendations**

Arising from the above conclusions, the study proposes the following recommendations:

- To ensure the gains realised from cage farming are maintained, the local Beach Management Unit must continue guaranteeing security and other safeguards to existing investment so as to encourage more investments and maintenance of those already at the beach.
- Fisherfolks along Lake Victoria and other inland water bodies in Kenya should be supported with resources to allow those willing to go into cage farming to do so. This can be an important step in promotion of sustainable aquaculture practices that protects the fishing ecosystems for all users. Such support can guarantee more locals venturing into cage fish farming and thereby growing their capacity to cope with falling fish stocks from the Lake.
- With the process of enacting Fisheries Regulations in line with the Fisheries Act of 2016 in top gear, the government must give specific attention to cage fish farming done within the inland water bodies and institute necessary safeguards that promote, secure and grow cage farmers investments but at the same time being conscious of the plight of other fisherfolks who depend on the same water resources. The proposed regulations must therefore give prescriptions that ensures cage farming is done in the most sustainable way without leaving negative socio-economic and environmental consequences.

- The question of sustainability of aquaculture is critical since many livelihoods especially those in developing countries depend on fisheries and aquaculture. National and county governments must take advantage of the opportunity to promote cage fish farming to allow recovery of natural stocks in areas like Lake Victoria. This allows those dependent on fishing to get alternative means to earn a living during such restoration periods. The result is a win-win outcome for the entire sector and its players.
- Proposal in the Siaya County's Fisheries and Aquaculture Act, 2016 to constitute Board of Trustees to actualise the operations of Fisheries Development Trust Fund to facilitate capacity building of fishers and cage farmers on best practices for cage aquaculture must be made a reality.

### **5.5 Suggested Further Research**

This study used a descriptive study design and targeted fisherfolk in one fish landing site (beach). A cross-sectional research of similar nature covering several beaches to get a wider picture on how cage fish farming is impacting livelihoods of fisherfolk as well as the riparian communities along Lake Victoria can be considered. It will also be interesting to carry out research to find out how fishermen have been affected by cage fish farming practiced along the fishing waters where they work within the Lake.

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## APPENDICES

### APPENDIX 1: FOCUS GROUP DISCUSSION GUIDE

#### DATA COLLECTION TOOLS

##### Introduction

My name ..... I am a Masters Student from the Institute for Development Studies, University of Nairobi conducting a fisherfolks livelihoods assessment study. The aim of this study is to understand the effects of cage fish farming on the livelihoods of the fisherfolk in this area, Dunga beach and it is in fulfilment of my Masters Degree program.

I would like to request permission to talk to you all about cage fish farming and ask questions on how your livelihood have been affected by it. The information you'll share with me will be kept confidential and only used for the purposes of this study. No contacts or names will be revealed or used in reporting the findings.

You are free to stop the interview at any time if you feel you are unable to continue and no victimization or condition is attached. No compensation is given for participation, but a shared sense of gratitude with the hope that the findings will contribute in some way in sustainable management of the fisheries resources in Lake Victoria.

Do you have any questions? Yes      No.

Researcher's Name: ..... Signature: .....

Participants Representative Name: ..... Signature.....

Interview Site	
Date	
Type of group	
No of participants	
Sex of participants	
Start time	
Stop time	

1. What activities are you involved in here at Anyanga beach? For how long?
2. Why did you choose this particular activity and not something else? Probe: livelihood activities supported by the engagement?
3. Do you know about cage fish farming? When did it start here? Who are doing it here? Where are they from? Are they former fishermen or traders?
4. What must one do before starting a cage fish farm here at Anyanga beach?
5. How is cage fish farming done in this beach? What is your opinion about it? Is it a good thing or a bad thing and why?
6. Where do the cage farmers sell their fish?
7. What changes have occurred here at the beach attributed to cage fish farming?
8. How has cage fish farming influenced people's ways of life here at the beach?
9. What do you like about cage fish farming?
10. What don't you like about cage fish farming in this beach?
11. Are cage fish farmers members of the local BMU?
12. What can be done to improve the current situation in Lake Victoria?

## APPENDIX 2: KEY INFORMANT INTERVIEW GUIDE

### Introduction

My name ..... I am a Masters Student from the Institute for Development Studies, University of Nairobi conducting a fisherfolks livelihoods assessment study. The aim of this study is to understand the effects of cage fish farming on the livelihoods of the fisherfolk in this area, Dunga beach and it is in fulfilment of my Masters Degree program.

I would like to request permission to talk to you about cage fish farming and ask questions on changes that have been witnessed here since the introduction of cage fish farming. The information you'll share with me will be kept confidential and only used for the purposes of this study. No contacts or names will be revealed or used in reporting the findings.

You are free to stop the interview at any time if you feel you are unable to continue and no victimization or condition is attached. No compensation is given for participation, but a shared sense of gratitude with the hope that the findings will contribute in some way in sustainable management of the fisheries resources in Lake Victoria.

Do you have any questions? Yes ..... No.....

Researcher's Name: ..... Signature: .....

Respondent's Name: ..... Signature.....

Location	
Date	
Name of Respondent	
Job Title of Respondent	
Sex of Respondent	
Start time	
Stop time	



## Questions

- 1) What is your role in the current position you are holding? What is your day to day work in this office/ place?
- 2) What is the current situation of fishing in this area? Are there any challenges fisheries is facing in this area?
- 3) What is the plight of capture fisheries here? Who is doing it? Where are they from ?
- 4) Is cage fish farming practiced in this area/ beach? Who are doing cage fish farming? Are they men or women and where are they from?
- 5) What does it take to start a cage fish farm in this beach/ Lake? Probe: institutional framework--regulations or guidelines one has to follow to start a cage fish farm?
- 6) How long has cage fish farming been practiced here?
- 7) What changes has cage fish farming brought to this community/ area? Probe: Changes in incomes; job opportunities; lost income opportunities among others.
- 8) Is cage fish farming good for this Lake/ Beach or area? Reason for your answer?
- 9) What can be done to ensure better utilization of this Lake? Probe for laws/ regulations or any other prescriptions?

**APPENDIX 3: SEMI STRUCTURED QUESTIONNAIRE (Fishermen, Fish traders,  
Cage farm workers and Boat owners)**

**Informed Consent**

My name ..... I am a Masters Student from the Institute for Development Studies, University of Nairobi conducting a fisherfolks livelihoods assessment study. The aim of this study is to understand the effects of cage fish farming on the livelihoods of the fisherfolk in this area, Dunga beach and it is in fulfilment of my Masters Degree program.

I would like to request permission to talk to you about cage fish farming and ask questions on how your livelihood have been affected by it. The information you'll share with me will be kept confidential and only used for the purposes of this study. No contacts or names will be revealed or used in reporting the findings.

You are free to stop the interview at any time if you feel you are unable to continue and no victimization or condition is attached. No compensation is given for participation, but a shared sense of gratitude with the hope that the findings will contribute in some way in sustainable management of the fisheries resources in Lake Victoria.

Do you have any questions? Yes      No.

Researcher's Name: .....Signature: .....

Fisherfolk Name: .....Signature.....

**Section 1: Demographic characteristics**

Location

Date

Occupation

Sex of participants

Marital status

Start time

Stop time

1. What is the highest level of school completed? (Tick one)

Lower Primary

Upper Primary

Secondary

College

University

None at all

2. Main occupation at the beach (tick one or more, e.g. note morning and afternoon)		Age bracket(tick one)	
Cage fish farm worker		Below 18	
Fisherman		19-25	
Fish Trader		26-35 years	
Boat Owner		36-45 years	
		46-55 yrs	
Boat Crew		56 yrs and above	

**Section 2: Socio economic activities**

3. Do you use this occupation to meet the following needs	
Pay for school fees for dependents	
Buying food	
Build a house	
Investments	
Savings	
Other. (specify)	

4. How many members of your household do you support using this work?	
---	--

5. Are there other alternative economic activities that you are involved in? Yes No

If yes which ones (Tick all that apply)

Livestock rearing

Shopkeeper

Factory work

Farming

Poultry keeping

Other....(specify)

6. What is the reason for this engaging in alternative economic activity, outside being a fisherfolk?

.....  
.....  
.....  
.....

7. What initial capital did you use to start you current occupation, business or work?

.....

8. What was the source of above funds?

- Own Savings
- Family savings
- Donations from relatives
- Bank/Mobile banking loans
- Group lending
- Other (Specify)

9. What is your current average monthly income bracket?

- Below 5000
- 5001-10000

10,001-20000

20,001-50000

50,000 plus

10. What were you doing before engaging in your current work/business?.....

11. Would you say, your economic fortunes are now better than before you started this work/business? Yes..... No.....

Reasons for your answer above

.....  
.....  
.....  
.....

12. In the last one month, how many times have you consumed fish? .....times.

If Yes, where did you obtain the fish from?

a) From cage fish farmer    b) Fisherman

13. Is it easy to obtain fish for consumption here at the beach since the introduction of cage fish farming here? Yes..... No.....

14. Would you say the prices of fish have gone down in this beach, since cage fish farming started? Yes..... No.....

15. Are there job opportunities that have been created by cage farming which never existed before? Yes..... No.....

If Yes, which opportunities are these?

.....  
.....  
.....

If No, kindly explain your answer

.....  
.....  
.....

16. Kindly answer “True” or “False” to the following statements?

	True	False
I am consuming more fish than before since the introduction of cage fish farming in this beach because of reduced prices?		
I get more income from fishing activities since cage fish farming started here at the beach?		
There is increased availability of fish for traders and consumers at the beach with cage fish farming than before		
Cage fish farming is employing more people than capture fisheries		
Are cage workers paid better wages than capture fisheries workers		
Cage fish farming has improved the status of businesses at the beach		
Cage fish farming has improved fish trade in the area		
Cage fish farming is interfering with fishing activities at the beach		
Cage fish farms are too many at the beach		
Cage fish farming should be stopped at this beach		
Cage fish farming has improved wellbeing of the local community here		

**Section 3: Cage Fish Farming**

17. Do you know about cage fish farming? Yes      No

18. What do you know about cage fish farming?

.....  
 .....  
 .....  
 .....

19. Where does the cage fish farmers in this beach comes from?

Local Community	
Not from this community	
Foreigners	
Don't know	
Others (Specify).....	

20. Who are the majority?

.....

21. Where do cage fish farmers sell their fish?

To local traders here at the beach

To non-local traders

In major towns

To processors at the beach

Others..(specify)

22. Would you say the prices of fish are.....since cage fish farming was introduced here?

Remained the normal	Prices of fish lower than before	Prices are more expensive than before

23. How has your life changed since the introduction of cage fish farming in this beach?

.....

.....

.....

.....



**Section 4: Beach Management Unit**

24. Are you a member of the local BMU? Yes      No (If No, skip to # “iv”)

i.      How long have you been a member?

Years	Tick appropriately
0-1 years	
2-4 years	
5-7 years	
Over 7 years	

ii.      What services do you get from the BMU?

.....

.....

.....

.....

iii.      Are you part of the decision-making committee? Yes      No

iv.      Are cage fish farmers also members of the BMU? Yes      No

v.      Are cage fish farmers part of the BMU leadership? Yes      No

vi.      What changes have you seen happen within the BMU since the introduction of cage fish farming here?

.....

.....

vii.      What are the reasons such changes?

.....

.....

viii.      What can be done to improve the work of the BMU?

.....

.....

25. What are your recommendations on how the fishing sector can be improved here and in the entire Lake Victoria?

.....

.....

**APPENDIX 4: IN-DEPTH INTERVIEW GUIDE FOR CAGE FISH  
FARMERS/OWNERS**

**Informed Consent**

My name ..... I am a Masters Student from the Institute for Development Studies, University of Nairobi conducting a fisherfolks livelihoods assessment study. The aim of this study is to understand the effects of cage fish farming on the livelihoods of the fisherfolk in this area, Dunga beach and it is in fulfilment of my Masters Degree program.

I would like to request permission to talk to you about cage fish farming and ask questions on your journey into cage fish farming. The information you'll share with me will be kept confidential and used for the purposes of this study only. No contacts or names will be revealed or used in reporting the findings.

You are free to stop the interview at any time if you feel you are unable to continue and no victimization or condition is attached. No compensation is given for participation, but a shared sense of gratitude with the hope that the findings will contribute in some way in sustainable management of the fisheries resources in Lake Victoria.

Do you have any questions? Yes      No.

Researcher's Name: .....Signature: .....

Name of cage owner: .....Signature.....

**Section 1: Demographic characteristics**

Location	
Date	
Sex of participants	
Marital status	
Highest education level	
Start time	
Stop time	

**Section 1: Cage operations at the beach**

1. When did you start your cage operations in this beach? (Probe whether done full time or not and what was he/she doing before starting fish farming at the beach)

2. What were your motivations for investing in cage fish farmers?  
.....  
.....  
.....

3. What processes are involved before setting a cage fish farm in the lake? (Probe: for offices and licences involved)

.....  
.....

4. How many cages did you start with at the beginning? (Probe for initial capital used to start the venture and source of such funds and amounts used)

.....  
.....

5. What is your current average monthly income from the cage farm at the beach? (Probe for expenses incurred; people employed)

.....  
.....  
.....  
.....

6. Have you received any formal training on cage fish farming? (Probe for the institutions doing the trainings)

**Section 2: Beach Management Unit**

7. Are you a member of the local BMU? (Probe for length of time as a member and privileges of membership)

.....  
.....  
.....  
.....

8. Are you part of the decision-making committee of the BMU

9. What changes have you seen happen within the BMU since the introduction of cage fish farming here?

.....  
.....  
.....

10. What are your recommendations on how the fisheries sector can be improved here at the beach and in the entire Lake Victoria?

.....  
.....

**APPENDIX 5: DATA NEEDS TABLE**

<b>Research Questions</b>	<b>Data Needed</b>	<b>Technique</b>	<b>Data Source</b>	<b>Instrument</b>
What are the socio-demographic characteristics of fisher folks at the beach?	Age Gender Education background Fisher folk category	Quantitative	Fisher folks  Cage fish farmers	Semi-structured interview guide  KIIs  FGDs
What are the motivation for adopting cage fish farming?	Why caging in Anyanga; Benefits of cage fish farming; What is required to invest in cage farming;	Quantitative and qualitative	Cage farmers	In depth Interviews  KIIs
How has cage fish farming affected the livelihoods of fisher folks at the beach?	Opportunities created by cage farming at the beach; Changes in activities of fisher folk at the beach; Food sources	Quantitative and Qualitative	Fisher folks	Semi structured interview guide/  FGD  KIIs

**APPENDIX 6: MONTHLY FISH DATA FOR JULY 2019.**

THE SUB COUNTY FISHERIES OFFICER  
P.O BOX 328  
BONDO

MONTHLY FISH DATA RECORD FOR 51 7 / 20 19  
The following table shows how fish landed during the month of July

SPECIES	KG	PRICE PER KG/KISAUJO	VALUE
NILE PERCH	521	210	109410
OMENA	—	97 KISAUJO'S (1130)	11640
TILAPIA	864	180 PRICE	155520

**TOTAL NUMBER OF BOATS – TARGETED SPECIES**

SAILING	PADDLING	OUTBOARD	TOTAL	OMENA	NILEPERCH	TILAPIA	SAND HARVESTING	OTHERS
8	82	22	112	3	32	38	—	39

**TOTAL NUMBER OF STAKEHOLDERS:**

	CREWS	BOAT OWNERS	TRADERS	OTHERS
MALE	204	55	38	51
FEMALE	—	8	82	46

**NILE PERCH PRICES**

VERY SMALL (1-2 KG)	SMALL (3-4KG)	MEDIUM (5-9KG)	LARGE (10-19KG)	EXTRALARGE (20-29KG)	XX (30AND ABOVE)
150	200	230	350	400	430

**FISH CAGES**

INDIVIDUAL	GROUPS	NGO	GOVT	MEASUREMENT	TOTAL
1783	219	1	—	2.5x5	2003

**INCIDENTS:**

1. "Kariro" Current occurred.

**PATROLS:**

1. — No Patrol

**PROBLEMS**

1. Net theft occurred once

DATE OF LAST EXECUTIVE COMMITTEE MEETING 13/7/2019

Prepared by:

Secretary: GORDON D. AULD

Sign: Gordon

Contact: 0714308333

Authorized by Chairman

sign [Signature]

Stamp \_\_\_\_\_