MOBILE PHONE USE ON ARTISANAL FISHING MARKET EFFICIENCY AND LIVELIHOOD: A CASE STUDY OF DUNGA BEACH KISUMU

BY

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A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS IN COMMUNICATION STUDIES OF THE SCHOOL OF JOURNALISM AND MASS COMMUNICATION, UNIVERSITY OF NAIROBI

NOVEMBER

2013

DECLARATION

This is my original work and has not been presented to any other university for a degree award or anywhere else for academic purposes.

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ACKNOWLEDGEMENTS

I express my deepest gratitude to my Father God Almighty and my Lord and Saviour Jesus Christ without whose grace and mercy I could not have come this far, even in starting and successfully completing this Master's programme.

I owe a special debt of gratitude to my supervisor, Dr. Mogambi, whose excellent guidance has enabled me to produce this work in a unique style.

To the fishermen community in Dunga Beach of Kisumu County and their superiors, I express my appreciation for being used as the unit of analysis in this study.

I say special thanks to my parents Mr. and Mrs. Ogada and all our siblings, especially my brother Felix Ogolla and family, my sisters Lillian and Judith for their prayers and support during my sickness and for the general support throughout my education.

Finally, to all my colleagues whose fine words, encouragement, prayers and support in diverse ways have gone a long way to assist me complete successfully this Master's programme I say our Almighty God bless you and your descendants.

DEDICATION

I specially dedicate this Master's thesis to my dearly beloved parents Mr. & Mrs. Ogada, to all those who have inspired and encouraged me and also to the University of Nairobi, School of Journalism.

ABSTRACT

This project sought to assess and analyze satisfaction with mobile usage in artisanal fishing market efficiencies and improving livelihood. The study was basically a survey that used both qualitative and quantitative approaches. Simple random technique was used to select 10 fishermen using cell phone daily for a focus group discussion for a period of seven days. This gave a total of 70 fishermen that participated in the research. Only fishermen using handset were purposively selected. Data were analyzed using inferential and non inferential statistics. The findings in this study suggest that the availability of mobile phone has facilitated information flow among fishermen in many ways. The study observed a shift in the way fishermen sell their catches, with about a third now selling their catches through mobile phone arrangements to customers instead of the traditional form of selling through face-to-face auctioning at their home landing sites. This arrangement has helped about 12% of the fishermen to bypass middlemen and sell straight to their customers. In particular, the study found that 22% of the fishermen used the phone specifically to access price information from the various markets/landing sites, and the evidence showed a significant increase in the number of landing sites visited monthly after the advent of mobile phones. The survey found four major categories of reasons fishermen gave for using mobile phones: cost reducing factors, safety factors, coordination factors, and market expansion factors. Since it was not feasible in this study to obtain direct data on prices before and after introduction of mobile phones, further research to investigate the impact of mobile telephony on artisanal fishing (or other occupations with variable prices) in other countries could usefully be done on a randomized experimental basis with tracking of prices before and after provision of mobile phones to those selected.

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CHAPTER ONE: INTRODUCTION

1.0 Background information

Economists have long emphasized that information is critical for the efficient functioning of markets. For example, two of the most well-known results in economics, the First Fundamental Theorem of Welfare Economics (i.e., competitive equilibria are Pareto efficient), and the 'Law of One Price' (i.e., the price of a good should not differ between any two markets by more than the transport cost between them) rely heavily on the assumption that agents have the necessary price information to engage in optimal trade or arbitrage. These results reflect some of the most fundamental functioning of, and advantages to, a market economy; when goods are more highly valued on the margin in one market than another, a price differential arises and induces profit-seeking suppliers or traders to re-allocate goods towards that market, in the process reducing the price differential and increasing total welfare. In reality, however, the information available to agents is often costly or incomplete, as emphasized by Stigler (1961).

In such cases, there is no reason to expect excess price differences to be dissipated or the allocation of goods across markets to be efficient. Yet despite the fact that information is both central to economic theory yet so limited in reality, there are few empirical studies assessing the effects of improvements in information. Thus, questions such as how much market performance can be enhanced by improving access to information, how much society gains from such improvements, and how those gains are shared between producers and consumers remain largely unanswered. Beyond its prominent place in economic theory, the effect of information on market performance and welfare is also relevant to the debate over the potential value of information and communication technologies (ICTs) for economic development. Many critics argue that investments in ICTs should not be a priority for low-income countries, given more basic needs in areas such as nutrition, health and education (Gates, 2000).

However, this argument overlooks the fact that the functioning of output markets plays a central role in determining the incomes of the significant fraction of households engaged in

agriculture, forestry or fisheries production in low income countries; for most of the world's poorest, living standards are determined largely by how much they get for their output. Additionally, the functioning of these markets determines the prices and availability of food, fuel and other important consumer goods. However, in most developing countries, markets are dispersed and communications infrastructure is poor. Producers and traders often have only limited information, perhaps knowing only the price in a handful of nearby villages or the nearest town, so the potential for inefficiency in the allocation of goods across markets is great. By improving access to information, ICTs devices such as mobile phones may help poorly functioning markets work better and thereby increase incomes and/or lower consumer prices. In fact, it has become increasingly common to find farmers, fishermen and other producers throughout the developing world using mobile phones, text messaging, pagers and the internet for marketing output (Arnold, 2001).

However, while there is some macro-level evidence that ICTs promote economic growth (Roller and Waverman, 2001), the micro-level evidence has been purely anecdotal. Thus the case study of mobile phones usage in Dunga Beach in Kisumu County will also allow us to examine whether mobile phones can play a role in promoting welfare of the fishermen located at Dunga Beach; while much has been written about how the uneven spread of ICTs has created a 'digital divide' between rich and poor countries, considerably less is known about the benefits such mobile technologies can provide.

Mobile telephony over the past decade has grown rapidly in developing countries. Almost 70 per cent of the world's mobile phone subscribers are in the developing world. Reasonable pricing and easy access have helped make this technology a potential tool for generating economic opportunities and social networking, even in rural areas (e-agriculture.org, 2009).

Africa's "mobile decade", when telephones at last reached most corners of the continent, has meant a huge improvement in the lives of the poor. But quantifying it is hard. How useful can a mobile phone be to someone living on less than $2.50 a day, the World Bank's standard benchmark of poverty? Researchers in Kenya have given a partial answer. They find that people will skip a meal or choose to walk instead of paying for a bus fare so that they can keep their

phone in credit. The weekly value of these sacrifices averages just over 72 Kenyan shillings (84 American cents)—not a trivial amount, seeing that the daily wage of a Kenyan labourer can be as little as a dollar. The report by iHub, an incubator for Kenyan tech start-ups, suggests that discretionary spending by the poor is now influenced greatly by their expenditure on mobile phones. Some would, for instance, forgo meat at meal time, in the hope of making a call or sending an SMS that would enable them to put more food on the table later. Today most people use internet-enabled smart or "feature" phones to browse the internet and do business online. The scratch cards that many Kenyans use to charge their mobiles have recently begun to advertise their value in terms of data rather than talk time. Meanwhile, mobile-phone operators have been giving free access to sites such as Wikipedia to entice customers.

According to Donner (2009) the reasons for this explosive growth include sense of security to users, good leapfrogging technology, the requirement of only basic literacy, extra features (besides voice communication) such as text messaging and data transfer, which can be used for education, commerce, advertising, even banking; increasing competition (especially where open to private investment) and innovative payment methods (e.g., pre-paid, unit transfers such as Mpesa) that make them increasingly affordable to the lower quintile of the population.

In the late 1990s and early 2000, mobile phone services were gradually introduced throughout Kenya especially in the city and larger towns such as Mombasa, Kisumu, Nakuru, Eldoret etc. The real breakthrough in the Kenyan market has been in people's ability to send and receive money, with more than two-thirds doing so by phone. East Africa's biggest success has been M-Pesa, a mobile-based money-transfer system pioneered by Safaricom, a leading Kenyan operator. Its simple interface, which works on any phone, has brought financial services to Kenya's poor majority, enabling the movement of vast sums of money across networks.

Modern technological innovation (mobile telephony) can be made accessible to a largely illiterate, low-income population with positive effects on their ability to manage their businesses profitably and to cope with risks such as those in the fishing business in Dunga Beach. By 2006, over 60 percent of fishing boats and most wholesale and retail traders were using mobile phones to coordinate sales. Base towers were placed close enough to the shore that

service was available 20-25km out to sea, the distance within which most fishing is done. Thus the case of Kisumu provides an ideal setting for exploring the effects of mobile phones on artisanal fishing market performance and improvement of livelihoods.

Fishing is an important industry all over the world. For consumers, fish is a dietary staple (Kurien, 2000); over 70 percent of adults eat fish at least once a day, making it the largest source of many important nutrients such as protein. Further, over one million people are directly employed in the fisheries sector (Government of Kerala 2005). However, a significant limitation to fish marketing is that while at sea, fishermen are unable to observe prices at any of the numerous markets spread out along the coast. Further, fishermen can typically visit only one market per day due to high transportation costs and the limited duration of the market. As a result, fishermen sell their catch almost exclusively in their local market. In addition, there is almost no storage (due to costs), and little arbitrage on land due to poor road quality and high transportation costs; ultimately, the quantity supplied to a particular market is determined almost entirely by the amount of fish caught near that market. There is a great deal of price variation, with some markets having an effective price of zero when fishermen arrive to find all buyers have left. Provided there are no other barriers to arbitrage, if fishermen had price information for all locations, the market should achieve an outcome where price dispersion is reduced, fish are allocated across markets more efficiently, waste is reduced or eliminated and total welfare is increased (though how those gains will be shared between consumers and producers is ambiguous).

Fish is a popular diet all over Africa. A report conducted by the Food and Agriculture Organisation (FAO) on The State of World Fisheries and Aquaculture (2008), states that the fish sector is a source of income and livelihood for millions of people around the world (FAO, 2008). Employment in fisheries and aquaculture has grown substantially in the last three decades, with an average rate of increase of 3.6 per cent per year since 1980. It is estimated that, in 2008, 44.9 million people were directly engaged, full time or, more frequently, part time, in capture fisheries or in aquaculture and at least 12 per cent of these were women (Foeken, Dick W.J and Owuor, 2008). On average, each jobholder provides for three dependants or family members. Thus, the primary and secondary sectors support the livelihoods of a total of about 540 million

people, or 8.0 percent of the world population. Africa is in an area of the world where chronic poverty and malnutrition continues to be widespread (Aguilar Manjarrez and Shree S Nath, FAO, 1998, CIFA Technical Paper 32) (Manjarrez, 1998). Olale, Spencer and Cranefield (2010) state that in Africa, there is strong evidence of high and increasing poverty levels among fish workers e.g. Kenyan Government statistics show that Nyanza province (where Kisumu is based and majority of fish workers reside), has an incidence poverty of about 65%. Further, Africa is the only part of the world where fish supply per person is declining, while at the same time fish supplies are at the lowest level worldwide (World Fish Centre, 2005).

One way to enhance this technological effect on fishing industry is to develop applications suitable for artisanal fisherman, such as readily accessible reports on local weather conditions and prices, or reporting illegal trawling operations. Given that cell phone towers cannot be located at sea, improving coverage should be enhanced by the service providers by developing technologies to extend the signal farther, or locating more towers close to the sea. This study looks at how mobile phone use among artisanal fishermen in Dunga Beach Kisumu County has enhanced the efficiency of input and output markets and improved their businesses relations and livelihoods.

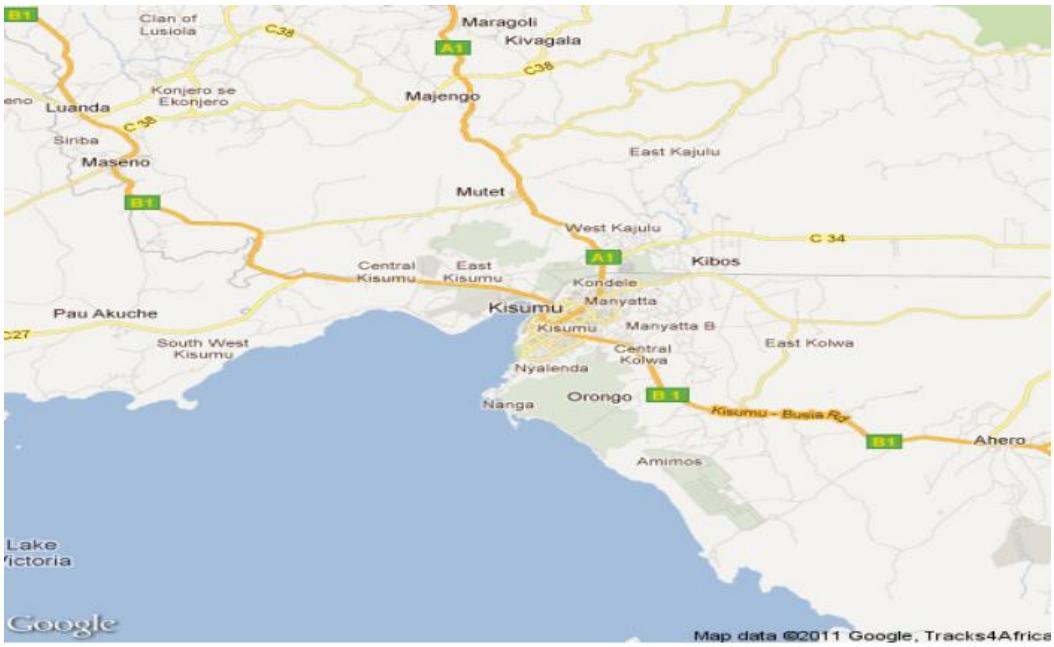
1.1 Background to the study

Kisumu County (formerly Port Florence), is the principal lake port of Kenya. Kisumu County is found on the shores of Lake Victoria. Also Known as Winam Gulf, Kisumu is Kenya's third largest city after Nairobi and Mombasa and is the center of western Kenya. It is more like Mombasa than Nairobi, being hot and a little humid. It serves as a fishing port with a spectacular sight of boats unloading their catch and buyers scrambling for the best price. The economic activities in the County include sugarcane growing, frozen fish, textiles, beer, and processed sisal. Despite advances in economic activity in different parts of Kenya, this lake area is largely neglected and disadvantaged economically.

Kenya shares the waters of Lake Victoria with the two neighbouring states of Tanzania and Uganda with the Tanzania having the lion’s share of 52 per cent while Uganda has 42 per cent

leaving Kenya with only paltry 6 per cent mainly along the narrow channel which is commonly known as Kavirondo Gulf.

Figure 1: Map of Kisumu showing Lake Victoria: (Source: www.en.mapatlas.org)

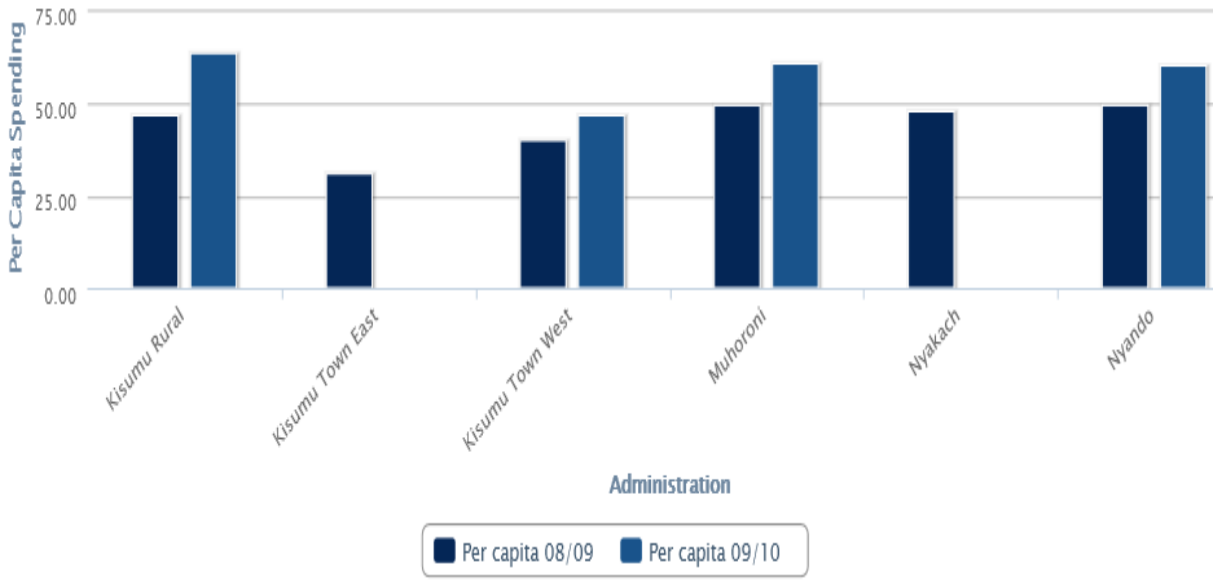


1.1.1 Socio-economic indicators of Kisumu County

Kisumu was a prosperous regional centre but has experienced industrial and social decline over the last 30 years; however, economic activity has increased rece ntly. During the pre-independence years (1963 and before), Kisumu developed as a trading hub in East Africa. Transport infrastructure established to connect Kisumu to rest of Kenya and other East African countries, with the railway being established in 1901 and the first airport in East Africa established in the late 1930s (KPMG, 2008). The period between 1960s to 1970s saw a period of strong economic growth, mirroring the growth phase of the Kenyan economy. The sugar, fishing, cotton and brewing industries grew rapidly. The population in the region also put a lot of emphasis on education (KPMG, 2008).

From the 1980s onwards, exposure to international competition combined with under-investment in infrastructure has led to a decline industrial activity. Trade liberalization led to influx of cheap imports has also exposed the inefficiency of pastoral enterprises. The major economic activities of cotton growing and brewing collapsed. Education suffered as a result of increasing poverty with urbanization becoming a significant problem (KPMG, 2008). The future economic growth in the Kisumu region is essential for Kenya to achieve the 'Vision 2030' plan, which was mooted by the Government in line with the Millenium Development Goals. This Plan calls for annual economic growth of 10 per cent and will focus on value addition in agricultural industries. With the expected trade liberalization through the East African Community, Kisumu is well placed to regain its status as a regional trading hub (KPMG, 2008).

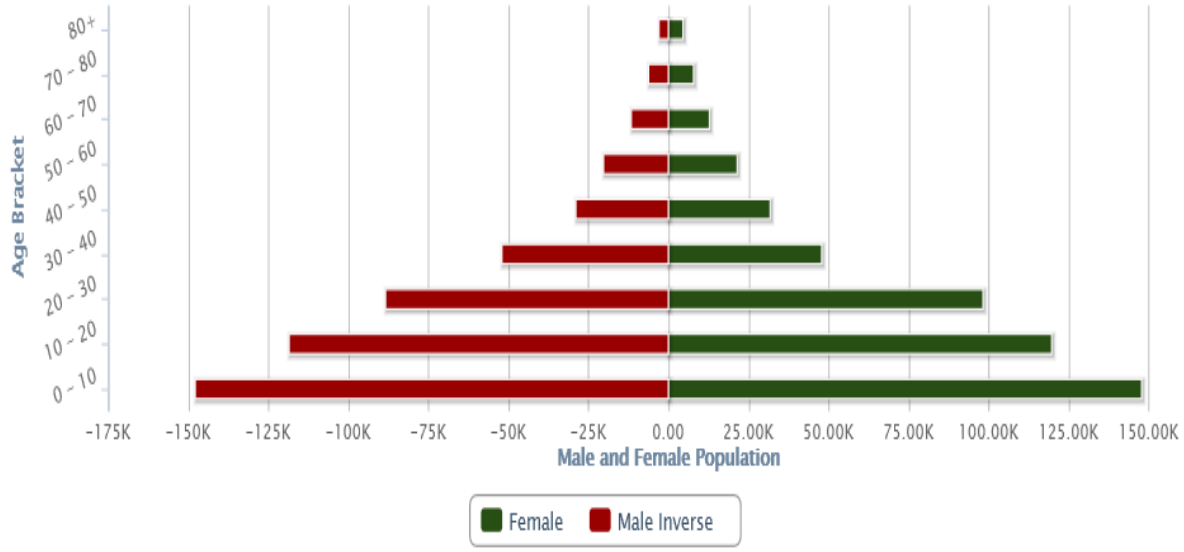
Figure 2: Local Authority and Constituency Development Fund Expenditures (County Estimates in Kenya Shillings)



Source: Opendata 2010

The population of Kisumu County as per 2011 is approximately 340,000. The male and female age groups in the Kisumu County are depicted in Figure 1.3 below.

Figure 3: Male and female populations by age



Source: Opendata 2010

Kisumu County is rich in fishing and fish trade with Kisumu City having close to three fish processing plants. There were more five such plants when the fish trade was booming a couple of years ago, but due to the scarcity of fish, some were forced to close down their business prematurely.

The City is served by four highways, namely Kisumu-Ahero-Kericho road, Kisumu-Kakamega road, Kisumu Bondo road and Kisumu Busia road. In the Port, the Kisumu Pier, though poorly maintained at the moment by the ailing Rift Valley Railways is still serving the landlocked nation in East and central African regions such as Uganda, northwestern Tanzania, Rwanda, Burundi, Eastern DR Congo, and Southern Sudan and beyond. All these facilities could be improved tremendously if the right investment is put in place for the economic benefit of the county (Odera, 2010).

1.1.2 Political governance of Kisumu County

The Government of the Republic of Kenya adopted a new Constitution in August 2010, which changed the political governance of the country. Previous provinces, municipalities, divisions

and locations were done away with and replaced with Counties. The newly created County of Kisumu is expected to be the nerve center of Western Kenya and at the same time the gateway to East and Central African countries of the East African Community member states.

The County, which is created under the new constitutional dispensation, with a City equipped with an ultra-modern newly expanded Airport, is expected to be not only nerve center for the entire Western Kenya, but a major commercial link center between Kenya and other landlocked African states in the Great Lakes region (Odera, 2010). The new County covers six parliamentary electoral constituencies of Nyakach, Nyando, Muhoroni, Kisumu Town East, Kisumu Town West and Kisumu Rural. Two of these constituencies namely Kisumu Town East and Kisumu Town West are cosmopolitan housing in nature and have multiracial and multi-ethnic societies (Odera, 2010). With the advent of the new governance systems in Kenya, the implication is that Counties are now required to be self-sufficient in terms of their economic development and in sustaining income-generating activities.

1.1.3 Registered fishermen in Lake Victoria.

Kenya's portion of Victoria covers about 6% (4 080 km^2) of the total lake area. There are over 200 landing beaches and over 6 000 artisanal fishing craft distributed across four administrative districts bordering the Kenya shoreline. Kisumu Town serves as the major marketing and processing centre for the entire region, although fish can also be transported by refrigerated truck directly from local landing sites to Nairobi. Based on census work carried out in the early 1990s, major local landing sites (50 active fishing craft) include the following: a) Rudacho, Marenga, Nalera Beach, Bukoma, Namabusi, Rukala, and Wayasi Island in Busia District; b) Uhanya, Mahanga Mageta, Sirongo, Ndeda Island, Misori B, Luando Kotieno, and Kopiata in Siaya District; c) Dunga in Kisumu District; and d) Nyagina, Kiumba, Ringiti Island, Remba Island, Nyandiwa, Sori, Kao, Aneko, Got Kachola, Tagache, Nyan'gwina, Ng'ore, Isumba, and Kibro in S. Nyanza District. This study draws its sample from a population of 250 fishermen from Dunga beache in Kisumu County based on the number of registered boats on the beach.

1.2 Statement of the problem

In the recent past, the Lake Victoria region has been particularly characterized by entrenched poverty, recurrent droughts, crop failures and environmental degradation (Abila, 2003). These conditions are partly caused by declining land productivity, soil degradation, and desertification, loss of biodiversity and crop diseases, poor development and trade policies declining fisheries among other problems. As a result, it has become difficult to produce sufficient food, trapping people in a vicious cycle of poverty and food insecurity, a paradox, given that "the people of the Lake" as Kisumu residents are commonly referred to, live next to a lake with such vast resources, yet remain among the poorest and food insecure (Abila, 2003). Given the above reasons, it is imperative that economic interventions be found that can sustain the community around the lake, thereby ensuring their food security, providing employment and, possibly, alleviating the debilitating and undignified effects of poverty. There is therefore need to utilize the resources provided by the lake i.e. fishing as a means of improving livelihoods. However, this cannot be enhanced without employing technology such as mobile telephone to enhance the fishing business.

Today, more than ever before, a business needs to be able to communicate with its partners in a timely fashion. Some businesses also employ cell phones to make conversing easier, the fishing business being one of them. Having a business cell phone allows fishermen to call their fellow business partners at all hours. This enhances the availability and ease in contacting business partners so as to pass or get valuable information. It also allows a closer connection between a business and its customers. Phones with advanced features, such as global positioning systems (GPS), also help fishermen to navigate with ease, making sure that they are able to meet with a new client on time. Therefore, a cell phone provides a constant avenue for communication.

As mobile penetration rates increase rapidly in developing countries, there has also been an increase in the extent of research on mobile phone usage. In general, studies have focused on different aspects of the adoption and use of mobile phones. However, there is still a lack of evidence of usage of mobile phones as a tool to solve development problems, due mainly to the difficulty in measuring their social and economic impacts. The researcher therefore decided to

carry out a study to determine mobile phone use on artisanal fishing market efficiency and livelihood in Dunga Beach, Kisumu County.

1.3 Objectives of the study

This research article investigates the use of mobile phones on artisanal fishing market efficiency and livelihoods in Dunga Beach of Kisumu County.

1.4 Specific objectives of the study

i. Assess the role of mobile phone usage in the supply of inputs and sale of fish by fishermen in Dunga Beach Kisumu;
ii. Determine how mobile phone use facilitates the flow of information among fishermen and their business partners and whether or not fishermen are satisfied with mobile phone use;
iii. Examine the extent to which mobile phone use levels price variation of fish and reducing vulnerability along the landing sites in Dunga Beach and beyond;

1.5 Research questions

i. What is the role of mobile phone usage in the supply of inputs and sale of fish by fishermen in Dunga Beach Kisumu?
ii. How does mobile phone use facilitate the flow of information among fishermen and their business partners? Are fishermen are satisfied with mobile phone use?
iii. To what extent does mobile phone use levels price variation of fish and reducing vulnerability along the landing sites in Dunga Beach and beyond?

1.6 Rationale & Justification of the study

The study is immensely significant in diverse ways to business/marketing practitioners, policy makers and stakeholders. To the management of Fisheries Department, the findings and results that will be reported in this study will provide a more reliable scientific measure and perspective for describing and evaluating the level of mobile usage in artisanal market efficiencies and

livelihood. It will also serve as an invaluable source of information that brings to lime light the market efficiencies and livelihood of fishermen in Kisumu County.

It will essentially uncover dimensions of market efficiencies and livelihood of fishermen in Kisumu County. This will provide empirical support for policy makers in strategic decisions in several critical areas of their operations, and above all, provide a justifiably valid and reliable guide to designing workable service delivery improvement strategies for creating a sustainable business growth in Kisumu County. Particularly, it will facilitate immensely the Ministry of Communications in Kenya in achieving some of its policy goals, which include: enhancing the reliability and efficiency in the provision of communication services. It will also help CCK among other things to facilitate the availability of quality equipment to consumers and operators, to ensure that communications systems operators achieve the highest level of efficiency in the provision of communications services, to ensure that these operators are responsive to customer and community needs, and that customers' interest is protected.

To stakeholders like investors, shareholders, employees, pressure groups, consumer associations, etc., the study will provide invaluable information that will allow them to provide useful suggestions to the improvement in service delivery of their respective mobile industry and network operators in Kenya.

1.7 Scope & Limitations of the study

This study will be limited to the Dunga Beach of Kisumu County, with respondents randomly selected from both male and female respondents. Good research should be valid, important and applicable and it is therefore important that if the research is to be applicable to a wide variety of settings then one will want to produce research that is generalizable. Hence validity and generalizability are two key concepts in research methodology.

The main limitations of this study are constraints of resources, access, and time. The finance and material resource needed for a larger sample size for this study is inadequate. It is also not likely the researchers would have access to every locality of Kisumu and its suburbs for respondents to take part in focus group discussions. Language is another access limitation as it is difficult

translating some questions and statements into the local dialects perfectly because of the limited vocabulary of the local dialects. This limitation, in particular, accounted for delimiting the study to literate respondents. This study is also constrained by time. It is conducted within very limited academic time frame, approximately two months instead of the proposed four months. Unfortunately that did not also allow us to use a larger sample which is a pre-requisite for reliability of surveys that aim at generalizing findings and making inferences from a sample about the population of study.

CHAPTER TWO: LITERATURE REVIEW & THEORETICAL FRAMEWORK

2.0 Introduction

Chapter Two makes a critical assessment of relevant literature related to mobile phone use in improving livelihood especially in fish farming by different authors who have dealt with the subject. The works cited have covered different aspects of the impact of mobile phone usage in improving efficiency and livelihoods of businessmen, the perceived attitudes of people towards mobile phone usage in business, the importance of mobile phone network coverage and the improvement realized with mobile phone usage, an insight into the potential benefit of employing mobile phones as an integrated component in industry. The literature also covers how mobile phone use among fishermen has enhanced the efficiency of input and output markets for artisanal fishing and improved their businesses relations and livelihoods. A framework for analyzing challenges in accessing the necessary services from phone service providers is also discussed in this chapter.

Aquaculture entails the growing of aquatic organisms including fish, molluscs, crustaceans and aquatic plants in a controlled environment. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated.

2.1 Role of information in overcoming market inefficiencies

In developed countries markets function efficiently because the prices of goods and services are known or can be accessed cheaply, widely, and readily (Eggleston et al. 2002, cited in Davis and Ochieng, 2006). On the other hand, in rural Africa markets function inefficiently because information flow on the prices of goods and services is largely difficult and mal-distributed, especially among artisanal fishermen and smallholder farmers. This condition in rural Africa is attributable to lack of cheap, timely, and readily accessible information, poor information delivery mechanisms and infrastructure, and a private sector attitude that typically views smallholders as commercially unattractive (Phlips, 1988; Eggleston et al.,

2002).

Many studies have concluded that access to telecommunications has a fairly strong impact on growth and economic development, as well as poverty reduction. Recently, some studies have focused on the relationship between access to telecoms and economic well-being of the poorer segments of society in several countries at the micro-level, as does this study (Abraham, 2006; Aker, 2008; Galperin and Mariscal, 2007; Jensen, 2007). In theory, lowered transaction costs, inter alia through faster access to more accurate information, should help the poor to increase their incomes directly or indirectly through the more productive use of the time saved by placing a call. While empirical evidence of such impacts at a generalized level is sparse, studies do show concrete empirical evidence of the benefits at this micro-level in specific markets or for certain groups of people. Mobile phone ownership has boomed throughout Sub-Saharan Africa, accounting for about 9% of subscriptions worldwide, with "Africa and Asia-Pacific the main drivers of growth, accounting for 80% of global net additions in the first half of 2010" (engineeringnewsonline, 2010). Nevertheless, there have been few reliable studies on the social and economic implications of mobile phone use in African countries.

The use of mobile phones can correct market inefficiencies through affordable access to information. The Palliathya help line in Bangladesh is a successful example in this direction. Palliathya (cited in Bhavnani et al. 2008) uses mobile phones to increase access to information on the part of men and women living in Bangladesh's rural areas, as well as to stimulate economic opportunities for underprivileged women. The Palliathya initiative concluded that:

> *"the helpline services: (a) prevent exploitation by middlemen; (b) provide employment opportunities (particularly for rural women); (c) reduce information gaps; (d) save cost and time; and (e) strengthen access of service providers to rural people."*

This initiative uses face-to-face contact, together with ICT, to empower women economically, as well as to share community-relevant information on education, emergency

situations, markets, weather, etc. The Palliathya case shows that lack of relevant and timely information is a major bottleneck to rural development. Overall, these cases demonstrate the importance of information for the functioning of markets and that well-functioning markets have a positive impact on welfare.

Aker (2008) studied grain traders in Niger and concluded that '*mobile phones reduce grain price dispersion by a minimum of 6.4%".* The study provided evidence that mobile phones reduce grain price dispersion across markets and reduce intra-annual price variation. This means that mobile phones have a maximum impact and ability to level price dispersion when the markets are far away from each other and with poor road network quality. According to Aker this effect becomes larger as a higher percentage of markets have mobile phone coverage because traders reduce their search costs, as grain traders operating in markets with mobile phones coverage search over a greater number of markets and sell in more markets. In summary, it implies that mobile phones improved consumer and trader welfare.

2.2 Application of mobile phones in fishing

The introduction of mobile telephony in fishing has been seen as a boon to artisanal fishermen, by giving them access to information on alternative prices from different buyers at different markets, as well as on locations of shoals at different points in the sea. Jensen's (2007) study of fishermen in Kerala state in India argues that mobile phone use by fishermen was associated with a great reduction in price dispersion, elimination of waste, and almost near-perfect adherence to the Law of One Price:

> *"Both consumer and producer welfare increased: waste (6% of the fish were unsold before cell phones) has been eliminated; fishermen's profits are up 8% and consumer prices are down 4%, directly driving a 20 rupee/person/month consumer surplus, the equivalent of a 2% increase in per-capita GDP from this one market alone.."*

Similarly, Abraham (2007) reported the results of a series of focus groups discussions conducted at 12 locations in Kerala, India, and interviews with nearly 200 local people associated with the fishing industry. He concluded that "*with the widespread use of mobile*

phones, fishermen are able to respond quickly to market demand and prevent wastage". He asserts that mobile phones enable fishermen to respond quickly to market demand and reduce or prevent wastage of catch, which was a common phenomenon before the adoption of phones. At the marketing end, mobile phones help coordinate supply and demand, and merchants and transporters are able to take advantage of the free flow of price information by catering to demand in undersupplied markets. There is also far less wastage of time and resources in all segments of the fishing community. Fishermen spend less time idling on shore and at sea, whereas owners and agents go to the landing centres only when they receive information (via mobile phones) that their boats are about to dock. He finds that with the widespread use of mobile phones, markets become more efficient as risk and uncertainty were reduced. There is greater market integration and price dispersion, and price fluctuations are reduced.

Newspapers have recently reported that African fishermen are a part of these new users (BBC News, The Economist and Washington Post, cited in Myhr and Nordström, 2006). Preliminary investigations for the present study in the Winneba Municipality of the Central Region of Ghana found pervasive use of mobile phones at sea by fishermen in the community. This is reasonable given the nature of their occupation. Fishermen often spend a lot of time away from families and away from their customers. Furthermore, fishermen are vulnerable out at sea, where a broken engine in rough weather can be a life threatening experience. Fortunately, the wireless nature of the mobile phone has availed itself for fishermen to place and receive calls while on the water. But has this new access to communication improved their wellbeing? Reduced their vulnerability? Transformed their businesses for the better? Has the mobile phone helped coordinate supply and demand in respect of marketing? Are the fishermen satisfied with the quality of the services rendered by mobile phone service providers?

2.3 Mobile phone adoption in Africa

Sub-Saharan Africa has some of the lowest levels of infrastructure investment in the world. Merely 29 percent of roads are paved, barely a quarter of the population has access to electricity, and there are fewer than three landlines available per 100 people (ITU, 2009; World Bank, 2009a). Yet access to and use of mobile telephony in sub-Saharan Africa has increased

dramatically over the past decade. There are ten times as many mobile phones as landlines in sub-Saharan Africa (ITU, 2009), and 60 percent of the population has mobile phone coverage. Mobile phone subscriptions increased by 49 percent annually between 2002 and 2007, as compared with 17 percent per year in Europe (ITU, 2008).

Mobile telephony has brought new possibilities to the continent. Across urban– rural and rich–poor divides, mobile phones connect individuals to individuals, information, markets, and services. In Mali, residents of Timbuktu can call relatives living in the capital city of Bamako—or relatives in France. In Ghana, farmers in Tamale are able to send a text message to learn corn and tomato prices in Accra, over 400 kilometers away. In Niger, day laborers are able to call acquaintances in Benin to find out about job opportunities without making the US$40 trip. In Malawi, those affected by HIV and AIDS can receive text messages daily, reminding them to take their medicines on schedule. Citizens in countries as diverse as Kenya, Nigeria, and Mozambique are able to report violent confrontations via text message to a centralized server that is viewable, in real time, by the entire world (Jensen, 2007; Aker, 2008; Aker, 2010; Klonner and Nolen, 2008).

These effects can be particularly dramatic in rural Africa, where in many places mobile phones have represented the first modern telecommunications infrastructure of any kind. Mobile phones have greatly reduced communication costs, thereby allowing individuals and firms to send and to obtain information quickly and cheaply on a variety of economic, social, and political topics. An emerging body of research shows that the reduction in communication costs associated with mobile phones has tangible economic benefits, improving agricultural and labor market efficiency and producer and consumer welfare in specific circumstances and countries (Jensen, 2007; Aker, 2008; Aker, 2010; K lonner and Nolen, 2008).

As telecommunication markets mature, mobile phones in Africa are evolving from simple communication tools into service delivery platforms. This has shifted the development paradigm surrounding mobile phones from one that simply reduces communication and coordination costs to one that could transform lives through innovative applications and services. The rapid adoption of mobile phones has generated a great deal of speculation and optimism regarding its

effect on economic development in Africa. Policymakers, newspapers, and mobile phone companies have all touted the poverty-eradicating potential of mobile phones (Corbett, 2008).
At the Connect Africa Summit in 2007, Paul Kagame, President of Rwanda, said: "In 10 short years, what was once an object of luxury and privilege, the mobile phone, has become a basic necessity in Africa." An article in The Economist (2008) similarly reported: "A device that was a yuppie toy not so long ago has now become a potent force for economic development in the world's poorest countries." Such sentiments and slogans reflect the reality of the consequences of the mobile phone for economic development in Africa.

2.3.1 Mobile phone coverage in Africa

Mobile phone coverage in Africa has grown at staggering rates over the past decade. In 1999, only 10 percent of the African population had mobile phone coverage, primarily in North Africa (Algeria, Egypt, Libya, Morocco, and Tunisia) and South Africa (GSMA data for 2009). By 2008, 60 percent of the population (477 million people) could get a signal, and an area of 11.2 million square kilometers had mobile phone coverage—equivalent to the United States and Argentina combined. By 2012, most villages in Africa will have coverage, with only a handful of countries—Guinea Bissau, Ethiopia, Mali, and Somalia—relatively unconnected (GSMA data for 2008).

There have been huge disparities in the geographic rollout of this coverage, prompting concerns over an intra-African digital divide (ITU, 2008). In 1999, most African countries had no mobile phone coverage, and only Egypt, Morocco, Senegal, and South Africa had coverage rates of over 40 percent. By 2008, however, over 65 percent of the African population had access to mobile phone service, with 93 percent covered in North Africa and 60 percent in sub-Saharan Africa. Overall, the expansion of mobile phone coverage has been the lowest in Ethiopia, Somalia, and the landlocked countries of Central and West Africa. While the telecommunications industry in the United States, Canada, and Europe invested in landlines before moving to mobile phone networks, the mobile phone has effectively leapfrogged the landline in Africa. After all, landlines require that wires be installed on every road and into every community, with smaller lines into every household. A full landline network can be prohibitively expensive, especially in countries with poor roads, vast distances, and low population densities. Mobile phone coverage in sub-

Saharan Africa, by contrast, is primarily provided via a network of specialized base stations, which can provide service to a 5–10 kilometer radius. Due to unreliable electricity supplies across Africa, the base stations are primarily powered by diesel generators.

The growth of mobile phone coverage across Africa has shown a strong positive correlation with population density, but other factors matter as well. Using a spatially disaggregated dataset of mobile phone coverage and geographic characteristics, Buys, Dasgupta, Thomas, and Wheeler (2009) find that the probability of having a mobile phone tower in a particular location is strongly and positively associated with potential demand factors, such as population density and per capita income, as well as the competitiveness of the mobile phone sector within the country. They also find that factors associated with higher costs—namely, higher elevation, steeper slopes, and distance from a main road and major urban centers—are negatively associated with mobile phone coverage. Empirical evidence suggests that these factors partially explain the rollout of mobile phone service within countries as well.

2.3.2 Cost of adoption of mobile phones

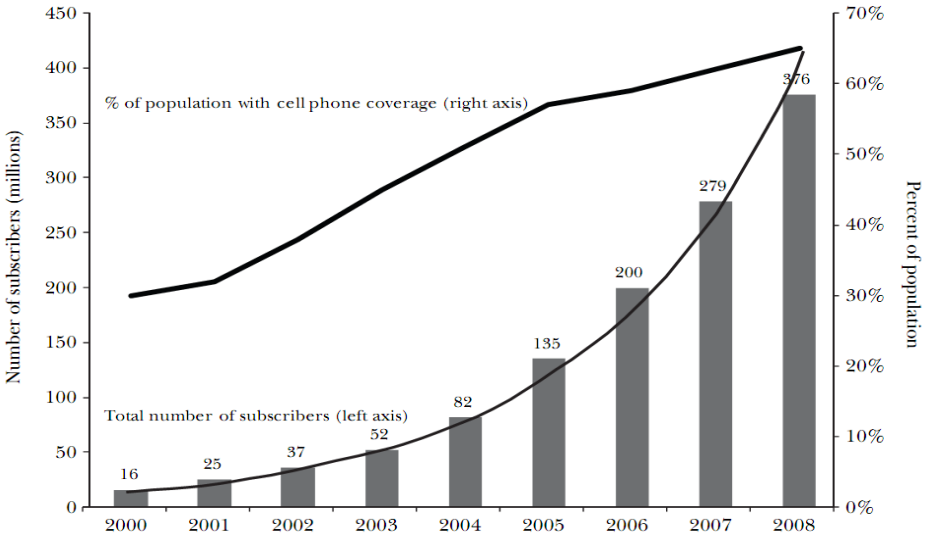
The rapid adoption of mobile phones in some of the poorest countries in the world has far exceeded expectations. In 1999, for example, the Kenyan-based service provider Safaricom projected that the mobile phone market in Kenya would reach three million subscribers by 2020. Safaricom, alone, currently has over 14 million subscribers (Safaricom, 2009).

Mobile phone subscriptions on the continent have risen from 16 million in 2000 to 376 million in 2008 as shown on the left axis of Figure 1. This is one-third of sub-Saharan Africa's population. However, these figures potentially overestimate the actual number of mobile phone users, because many individuals own several handsets or have multiple subscriber identity module (SIM) cards. At the same time, there could potentially be more than 376 million mobile phone users, as sharing mobile phones is a common practice in Africa. The increase in mobile phone subscriptions is all the more surprising considering the prevalence of poverty in sub-Saharan Africa and the price of mobile phone handsets and services. Approximately 300 million Africans are classified as poor (living on less than US$1 per day), with 120 million classified as "ultra-poor" (living on less than US$0.50 per day) (Ahmed, Hill, Smith, Wiesmann, Frankenberger,

Gulati, Quabili, and Yohannes, 2007). The price of the cheapest mobile phone in Kenya, for example, costs half the average monthly income, whereas the price of the cheapest mobile phone in Niger is equivalent to 12.5 kilograms of millet, enough to feed a household of five for five days.

Figure 4 below shows the number of subscribers as a percentage of the population, by country. The countries are sorted in ascending order by their ranking on the UN's Human Development Index (HDI) (which combines measures of income, health, and education), from 182nd (Niger) to 81st (Mauritius) (UNDP, 2009). Even in those countries with a HDI ranking lower than 160th (denoted by the dotted line in Figure 2), where the GDP per capita is less than US$761 (in purchasing power parity), an average of 23 percent of the population has mobile phone subscriptions.

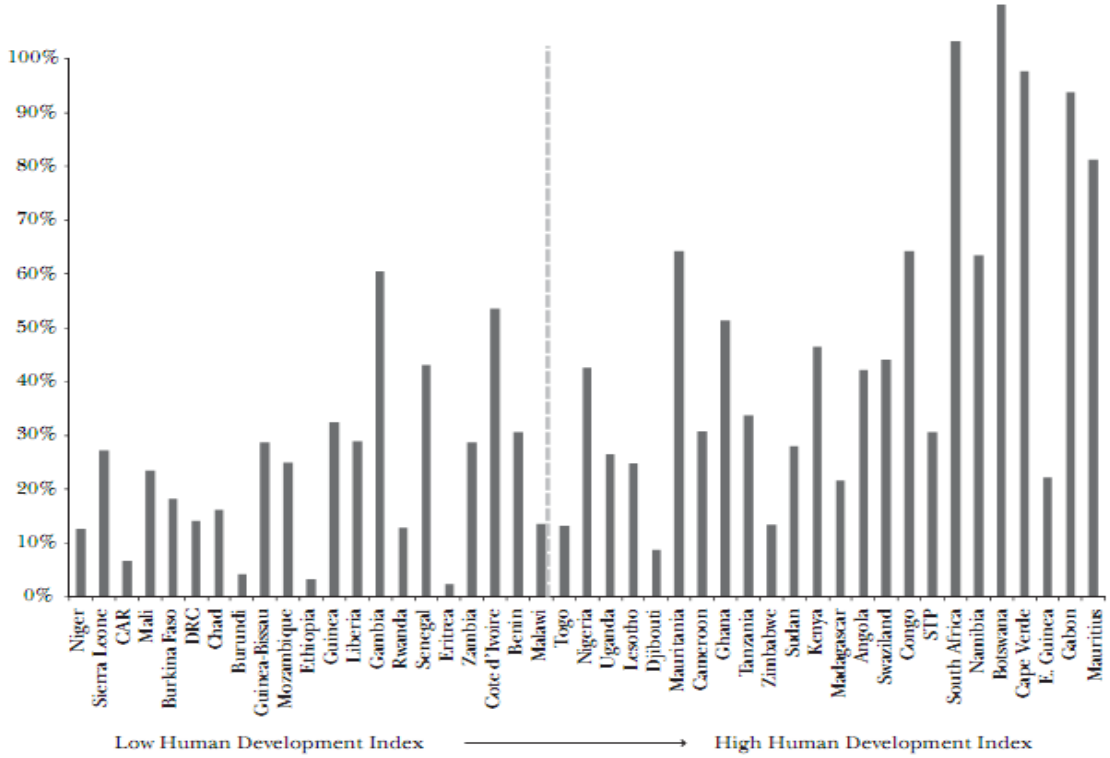
Figure 4: Number of cell phone subscribers and cell phone coverage in Sub-Saharan Africa (2000 –2008)



Sources: Mobile phone subscription data are provided by Wireless Intelligence. The percentage of the population with mobile phone coverage is provided by GSMA.

Note: The graph reflects the percentage of mobile phone subscribers as a function of the total population in the country (2008). Countries are sorted by ranking on the UN's Human Development Index, from a high of 74 (Mauritius) to 182 (Niger). CAR is the Central African Republic, DRC is the Democratic Republic of Congo, and STP is Sao Tome and Principe.

Figure 5: Number of Mobile Phone Subscribers as a Percentage of the Population, 2008 (countries arranged by Human Development Index, from low to high)



Source: Data on the number of mobile phone subscribers by country provided by Wireless Intelligence.

2.3.3 Mobile phone penetration in Africa

Coinciding with the growth in mobile phone coverage and adoption in developing countries over the past decade, a rich body of literature has emerged examining the determinants of mobile phone adoption. However, as Donner's (2008) survey shows, very little of this research has been conducted by economists, and economic studies of the subject have often focused on diffusion rather than individual adoption (Baliamoune-Lutz, 2003; Kshetri and Chung, 2002).

The relative lack of economics literature on mobile phone adoption appears to be related to two factors: First, mobile phone adoption data are often limited or inaccurate, as they report subscriptions rather than individual handset or subscriber identity module (SIM) ownership, which can result in serious measurement error. Second, finding credible estimation strategies to

address the omitted variable bias, particularly when estimating the effect of neighbors and peers, is a significant challenge (Manski, 1993).

Despite these constraints, data from East Africa can be used to gain further insights into individual and firm-level mobile phone adoption. Using firm-level data from the World Bank Enterprise Surveys for Kenya, Tanzania, and Uganda, we find that a large percentage of firms had already adopted mobile phones in 2003, ranging from 83 to 93 percent across these countries. This high level of adoption appears to be correlated with the poor quality of landline services. For example, Kenyan firms reported an average of 36 days of interrupted landline service per year, with interruptions lasting an average of 37 hours. This was also the case in Tanzania and Uganda. Many firms also faced challenges in even obtaining landline service. On average, Kenyan firms had to wait 100 days to obtain landline service, with a majority of firms paying bribes to facilitate this connection. (The average bribe was reported to be worth US$117, compared with a GDP per capita of US$780). Thus, explicit and implicit landline costs could have provided powerful incentives for firms to adopt mobile phones.

While Kenyan firms rapidly adopted mobile phones, the individual adoption rate has been significantly lower. Using data from the FinAccess surveys, we examine some basic patterns of individual mobile phone adoption in Kenya. Between 2006 and 2009, the percentage of the Kenyan population with mobile phone coverage remained relatively static, but the number of subscriptions tripled—reaching 17 million by 2009 (GSMA data for 2009).

The adoption of mobile phone handsets increased by 74 percent during this period, from 27 percent in 2006 to 47 percent in 2009, as shown in Table 1. One-third of Kenyans shared their mobile phones with friends or relatives, supporting qualitative evidence of free riding and the use of mobile phones as a common property resource in sub-Saharan Africa. At the same time, such patterns could also reflect cost-sharing, especially among poorer rural households for whom the cost of handsets and services is still prohibitively expensive. For these reasons, reported data on mobile phone subscriptions could significantly underestimate the number of mobile phone users; in fact, while only 47 percent of individuals owned a phone, 80 percent reported having access to a mobile phone through direct ownership or sharing.

Looking at Table 2, we see that the first mobile phone adopters were primarily male, educated, young, wealthy, and urban populations; this is because the initial costs of handsets and services were relatively high. But secondary adopters span the demo-graphic spectrum—young and old, rich and poor, urban, and rural. By 2009, mobile phone ownership included more poor, elderly, and rural individuals, in part facilitated by the introduction of lower-priced handsets and lower-denomination airtime cards.

Table 1: Summary of mobile phone adoption and use in Kenya

	2006 Mean	*2009 Mean*
Has mobile phone	0.272	0.467
Shares mobile phone	0.266	0.334
Has mobile phone access	0.537	0.801
Has landline	0.028	0.021
Has multiple SIM cards	–	0.081
Transfers airtime	0.208	0.350
Sends text messages	0.292	0.411
Buys ringtones	0.079	0.090
Uses phone to surf Web	–	0.050
Pays bills by phone	–	0.036
M-Pesa user	–	0.383
M-Pesa recipient	–	0.339
M-Pesa sender	–	0.291
Age 25 to 39	0.393	0.375
Age 40 to 54	0.213	0.224
Age over 55	0.145	0.183
Male	0.440	0.413
Married	0.610	0.602
Completed primary school	0.314	0.315
Completed secondary school	0.161	0.165
Completed college	0.089	0.085
Has bank account	0.165	0.244
Urban	0.319	0.285
Number of observations	*4,418*	*6,598*

Sources: Data from FinAcess 2006 and 2009 Surveys in Kenya.

Note: *"–" implies that the service was not available in 2006, and therefore there were no adopters. A SIM card is a subscriber identity module card. M-Pesa is Kenya's mobile money service.*

2.4 Mobile phones as an economic tool

There are five potential mechanisms through which mobile phones can provide economic benefits to consumers and producers in sub-Saharan Africa. First, mobile phones can improve access to and use of information, thereby reducing search costs, improving coordination among

agents, and increasing market efficiency. Second, this increased communication should improve firms' productive efficiency by allowing them to better manage their supply chains. Third, mobile phones create new jobs to address demand for mobile-related services, thereby providing income-generating opportunities in rural and urban areas. Fourth, mobile phones can facilitate communication among social networks in response to shocks, thereby reducing households' exposure to risk. Finally, mobile phone-based applications and development projects—sometimes known as "m-development"— have the potential to facilitate the delivery of financial, agricultural, health, and educational services (Arker J. and Mbiti M., 2010).

Table 2: Adoption and use of mobile phones and M-Pesa

	Own mobile phone		*Use M-Pesa*	*Receive money with M-Pesa*	*Send money with M-Pesa*
	2006	*2009*	*2009*	*2009*	*2009*
Wealth					
Not poor	42.0%	64.6%	52.4%	46.0%	43.2%
Poor	7.0%	21.6%	18.7%	17.1%	9.4%
Gender					
Female	23.0%	41.6%	35.5%	32.1%	24.7%
Male	32.4%	53.9%	42.5%	36.6%	35.3%
Residence					
Rural	16.8%	35.9%	28.8%	25.9%	18.8%
Urban	49.2%	73.7%	62.2%	54.1%	54.8%
Education					
Less than primary	8.9%	22.8%	16.4%	14.1%	9.4%
At least primary school	41.1%	65.0%	55.2%	49.2%	44.3%
Age					
Under 55	29.3%	50.9%	42.4%	37.4%	32.9%
Over 55	14.5%	27.7%	20.2%	18.4%	11.9%
Financial access					
No bank account	18.2%	33.9%	27.5%	23.9%	17.8%
Bank account	72.7%	86.3%	71.9%	65.2%	64.0%
Sample size	*4,418*	*6,598*	*6,598*	*6,598*	*6,598*

Source: Data are from FinAcess 2006 and 2009 Surveys in Kenya.

Note: *M-Pesa is Kenya's mobile money service. "Poor" is defined as individuals in the bottom two wealth quintiles of an asset index.*

In all of these cases, the evidence on mobile phones in Africa is quite recent, and so the available studies necessarily focus on specific sectors, countries, and examples. In this section, the researcher presents existing literature. Later in the paper, the research will offer some thoughts about the research aim that will unfold as mobile phones usage continue to spread their medium

and long-term effects become more apparent especially to the artisanal fishing community in Kisumu County.

2.4.1 Mobile phones in costs reduction and improvement of markets

Examples of imperfect and asymmetric information abound in markets in Sub-Saharan Africa. As a result, households and firms use numerous avenues to search for information in a variety of areas: input prices, output prices, jobs, potential buyers and sellers, natural disasters, new technologies, politics, and the status of friends and family members. Traditional search mechanisms include personal travel, radio, and, to a much lesser extent, landlines, letters, newspapers, and television. Of these, personal travel has often been the most common mechanism used—primarily due to limited access to other alternatives. In Niger, for example, 89 percent of grain traders surveyed preferred obtaining price information by visiting weekly grain markets, rather than listening to the weekly radio program (Aker, 2008). However, personal travel requires transport and opportunity costs, which can be relatively high with a combination of long distances and poor roads.

The rollout of mobile phones in sub-Saharan Africa over the past decade has introduced a new search technology that offers several advantages. First, mobile phones greatly reduce search costs. While mobile phones require an initial fixed cost, the variable costs associated with their use are significantly lower than equivalent travel and other opportunity costs. In Niger, for example, an average trip to a market located 65 kilometers away can take 2–4 hours roundtrip, as compared to a two-minute call. Using a local daily wage of 500 CFA francs (US$1) per agricultural laborer in Niger, mobile phones reduce search costs by 50 percent as compared with personal travel. Mobile phones can also allow people to obtain information immediately and on a regular basis, rather than waiting for weekly radio broadcasts, newspapers, or letters. Furthermore, rather than being passive recipients of information, mobile phones allow individuals and firms to take an active role in the search process, enabling them to ask questions and corroborate information with multiple sources (Arker J. and Mbiti M., 2010).

Finally, mobile phones are more accessible than other alternatives in terms of cost, geographic coverage, and ease of use. While radios can be used across all segments of the population (over

55 percent of sub-Saharan African households listen to the radio weekly), they generally provide a limited range of information. Newspapers are primarily concentrated in urban areas, are expensive (the cost of private newspapers in Mozambique average US$1), and are inaccessible to illiterate populations. Less than 19 percent of individuals in sub-Saharan Africa read a newspaper at least once per week, with a much smaller share in rural areas. Landline coverage has been limited, with less than one landline subscriber per 1,000 people in 2008 (ITU, 2009).

Access to other search mechanisms, such as fax machines, e-mail, and Internet, is similarly low, primarily due to their dependence upon landline infrastructure. On average, less than 4.2 percent of the African population has access to Internet (ITU, 2009). There are a number of challenges to the development of the fixed broadband in Africa and hence Internet usage. Installation of broadband Internet access via Asymmetric Digital Subscriber Lines (A DSL) is constrained by the limited number of fixed telephone lines on the continent. 3G mobile cellular networks may hold greater potential for many countries in the region. For example, 98 percent of Kenya's 1.7 million Internet subscribers access the Internet using the mobile phone network (CCK, 2009).

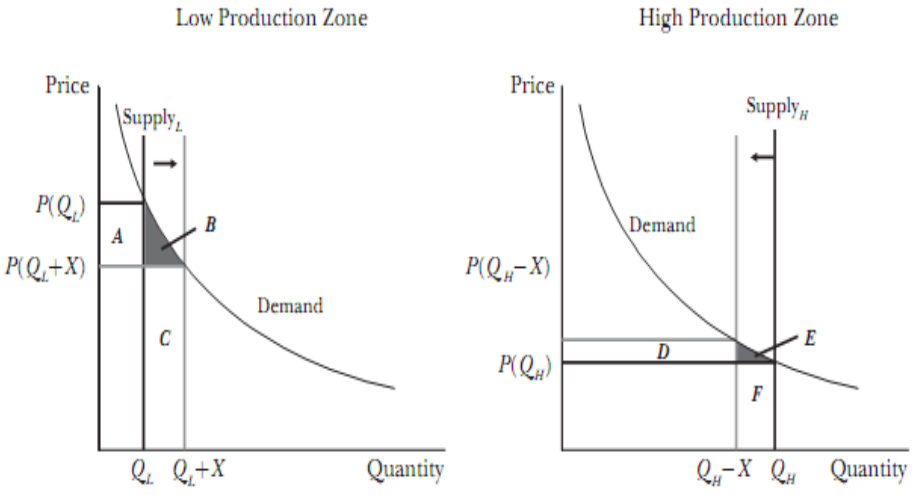
Search theory predicts that lowering search costs for output prices will change the reservation prices of market agents and increase the number of markets over which consumers and producers search (Baye, Morgan, and Scholten, 2007; Reinganum, 1979; Stahl, 1989; Aker, 2008). The market equilibrium results of these models can be ambiguous, depending upon different assumptions with respect to consumers' demand and the fixed or sequential nature of search and firm cost heterogeneity (Baye, Morgan, and Scholten, 2007).

Nevertheless, in general, the sequential search models of Reinganum (1979), Stahl (1989), and Aker (2008) predict that a reduction in search costs will decrease the variance of equilibrium prices, thereby improving market efficiency. While improvements in information will result in net welfare gains under standard assumptions, how these gains are distributed among consumers, producers, and firms is theoretically ambiguous. For example, lower search costs could improve traders' welfare in the short term as they take advantage of spatial arbitrage opportunities, but reduce some of their welfare in the longer term as markets approach the law of one price. Similarly, in markets where traders have local monopoly pricing power, increased access to

information could improve consumer welfare by disrupting this monopoly power, but reduce traders' welfare.

Figure 6 provides the intuition for effects of mobile phone coverage (and hence lower search costs) on price dispersion and welfare under the assumption of perfectly inelastic supply.

Figure 6: The intuition for effects of mobile phone coverage (and hence lower search costs)



Prior to the introduction of mobile phones, search costs are prohibitively high and traders (or farmers) do not engage in arbitrage between high (H) and low (L) production areas. Once mobile phones are introduced, traders are able to learn about prices in each region and begin trading. In the low-production region, consumers gain A + B while traders/producers lose A and gain C. This is a net gain of B + C, a transfer of A from traders/producers to consumers. In the high-production region, consumers lose D + E, while traders/ producers gain D and lose F, representing a net loss of E + F and a transfer of D from consumers to traders/producers. The sum of consumer and producer surplus rises with the reduction in search costs—suggesting that the overall net change is positive—but the distributional effects are ambiguous. In a market with

a highly perishable commodity, such as fish or vegetables, lower search costs would also coincide with less wastage, which is Pareto-improving as well.

Although the evidence on Africa is quite recent, an emerging body of literature assesses the role of information technology on market efficiency in developing countries, primarily in agricultural markets (Abraham, 2007; Jensen, 2007; Aker, 2008; Aker, 2010; Muto and Yamano, 2009; Goyal, forthcoming). These studies primarily focus on the relationship between mobile phone coverage and specific outcomes, such as price dispersion across markets (Overå, 2006; Jensen, 2007; Aker, 2010), market agents' behavior (Aker, 2008; Muto and Yamano, 2009), and producer and consumer welfare (Jensen, 2007; Aker, 2008).

A central concern in estimating the effect of mobile phones on market efficiency is omitted variables bias, because it can be difficult to attribute changes in the outcomes of interest to mobile phone coverage rather than to unobservable factors. In addition, estimates can be subject to reverse causality as changes in the dependent variable could influence the geographic location or speed of mobile phone coverage. To address these concerns, existing economic studies typically rely upon panel data and the quasi-experimental nature of the rollout of mobile phone service to identify the effect of mobile phones on development outcomes.

Jensen (2007) and Aker (2008, 2010) both exploit the staggered introduction of mobile phone coverage to estimate the impact of mobile phones on agricultural markets in developing countries. Examining the effect of mobile phones on the fisheries sector in Kerala, India, Jensen finds that the expansion of mobile phone coverage leads to a significant reduction in the dispersion of fish prices across markets as well as a decline in waste. He shows that this leads to important welfare improvements for both fishermen and consumers; fishermen's profits increased by 8 percent, consumer prices declined by 4 percent, and consumer surplus increased by 6 percent. With improved access to information via mobile phones, fishermen are better able to take advantage of spatial arbitrage opportunities, thereby improving allocative efficiency.
Examining the impact of mobile phones on grain markets in Niger, Aker (2010) finds that the introduction of mobile phones reduces dispersion of grain prices across markets by 10 percent. The effect is stronger for those market pairs with higher transport costs, namely, those that are

farther apart and linked by poor-quality roads. The effect is also stronger over time, suggesting that there are networks effects similar to those found by Brown and Goolsbee (2002). While the effect is smaller in magnitude as compared to Jensen (2007), it is perhaps more surprising, because grains are a storable commodity. The primary mechanism through which mobile phones improve market efficiency is a change in traders' (middlemen) marketing behavior: grain traders operating in mobile phone markets search over a greater number of markets, sell in more markets and have more market contacts as compared with their non-mobile phone counterparts (Aker, 2008).

Aker (2008) also finds that the introduction of mobile phones is associated with increased trader and consumer welfare. The introduction of mobile phones led to a reduction in the intra-annual coefficient of variation, thereby subjecting consumers to less intra-annual price risk. Mobile phones also increased traders' welfare, primarily by increasing their sales prices, as they were able to take advantage of spatial arbitrage opportunities. The net effect of these changes was an increase in average daily profits, equivalent to a 29 percent increase per year. However, the effects of mobile phones upon farmers' welfare were not measured.

Muto and Yamano (2009) similarly estimate the impact of mobile phones on agricultural markets in Uganda, focusing on farmers' market participation rather than market efficiency. Using a panel dataset on farm households between 2003 and 2005, they find that mobile phone coverage is associated with a 10 percent increase in farmers' probability of market participation for bananas, although not maize, thereby suggesting that mobile phones are more useful for perishable crops. This effect was greater for farmers located in communities farther away from district centers. While the authors do not empirically explore the specific mechanisms behind their results, they suggest that improved access to price information reduced marketing costs and increased farm-gate prices, increasing productive efficiency.

Mobile phones should similarly reduce search costs in labor markets. Labor market search theory predicts that a reduction in search costs should increase workers' reservation wage, increase the job arrival rate, and reduce unemployment. Mobile phones should therefore decrease the equilibrium dispersion of wage offers and could potentially increase equilibrium wages and

productivity if they raise the reservation match quality of both employers and workers (Autor, 2001).

To date, there is limited empirical research assessing the linkages between mobile phones and labour market outcomes in Africa. As one example, Klonner and Nolen (2008) assess the effect of mobile phone coverage on rural labor market outcomes in South Africa.

2.4.2 Mobile phones as a tool for coordination among firms

Information technology has the potential to increase productivity growth in Africa, especially of small-scale firms. In the literature from industrialized countries, Litan and Rivlin (2001) found that the Internet improved management efficiency of U.S. firms. By improving communication between firms and their suppliers, mobile phones can enable firms to manage their supply chains more effectively, streamline their production processes, and engage in new activities (Hardy, 1980; Roller and Waverman, 2001). This would reduce stock-outs and interruptions in production, which are of particular concern for small-scale firms in rural areas with limited supply options. While there are no empirical studies of the impact of mobile phones on supply chain management in Africa, qualitative research in South Africa and Egypt suggests that mobile phones were associated with increased profits, significant time savings, and improved communication with suppliers for small-scale firms (Samuel, Shah, and Handingham, 2005).

Muto and Yamano (2009) also estimate the effect of both household-level mobile phone adoption and village-level mobile phone coverage on household participation. To correct for the endogeneity of the adoption variable, the authors use village-level mobile phone coverage and household time-invariant characteristics as instruments. One of the household-level instruments used is farm assets, which could be strongly correlated with mobile phone adoption and market participation, the dependent variable. Thus, the validity of the instrument is of some concern for household-level results.

2.4.3 Mobile phones and employment creation

One of the most direct economic impacts of mobile phones in Africa is through job creation. With an increase in the number of mobile phone operators and greater mobile phone coverage,

labor demand within these sectors has increased. For example, formal sector employment in the private transport and communications sector in Kenya rose by 130 percent between 2003 and 2007 (CCK, 2008), suggesting that mobile phones have contributed to job creation. The mobile phone sector has also spawned a wide variety of business and entrepreneurship opportunities in the informal sector.

While we would expect job creation in any new growth sector, many of these employment opportunities are directly related to the specific business strategies of mobile phone companies in Africa. For example, because most Africans use prepaid phones (or "pay as you go"), mobile phone companies had to create extensive phone credit distribution networks in partnership with the formal and informal sector. Thus, small shops that have traditionally sold dietary staples and soap now sell mobile phone credit (airtime), particularly in small denominations. Young men and women are often found selling airtime cards in the streets.

Numerous small-scale (and often informal) firms have also opened shops to sell, repair, and charge mobile phone handsets, either using car batteries or small generators. In the early years of mobile phone usage, entrepreneurial individuals started businesses to rent mobile phones, especially in rural areas. While Klonner and Nolen (2008) suggest that mobile phone coverage has been successful in generating employment opportunities, to date, there have not been studies examining the impact of mobile phones on both formal and informal job creation.

2.4.4 Mobile phones and risks reduction

Mohammed Ibrahim, the Sudanese businessman who established Celtel, a pan-African mobile group now owned by Zain, stated: "Mobile phones could not work in Africa without prepaid because it's a cash society" (The Economist, 2009). Sub-Saharan Africa is an inherently risky environment. Covariate shocks, such as natural disasters, conflicts, and epidemics, routinely affect households. Kinship ties play both important social and economic functions in African society, specifically in creating informal insurance networks, increasing access to credit and savings, and reducing risk (Grimard, 1997; De Weerdt and Dercon, 2006).

At a basic level, mobile phones improve communications among members of a social network both within a country and across international boundaries. The reduction in communication costs can increase the speed of information flows within the network, thereby allowing them to respond better to shocks. Mobile phones also allow households to obtain information about potential shocks, allowing them to use such information to make planting and harvesting decisions, which can have important effects on yields (Rosenzweig and Binswanger, 1993).

Finally, improved communications among members of a social network can also affect social learning, which can in turn influence the rate of technology adoption, especially of cash crops (Bandiera and Rasul, 2006; Conley and Udry, 2010). Existing economic evidence on the impacts of mobile phones and social networks is limited, but this has been extensively discussed in the field of sociology (de Bruijn, Nyamnjoh, and Brinkman, 2009).

2.5 Mobile phones in service provision and innovation

2.5.1 Development projects

Arker J. and Mbiti M. (2010) argues out that the potential for using mobile phones as a tool for economic development has not gone unnoticed by African governments, donors, mobile phone companies, and non-governmental organizations. An emerging trend is the development of mobile phone-based services and products that go beyond basic voice calls and text messaging. While these services have often focused on entertainment applications ("apps") in wealthier countries, these applications are providing opportunities for disseminating agricultural price information, monitoring health care, and transferring money in poorer countries.

Some mobile-based services are being provided entirely by the telecommunications sector, some entirely by the public sector, and some through partnerships between the two. We do not provide a comprehensive examination of mobile phone services and development projects in Africa, but rather explore some current initiatives in key thematic areas. Many of the innovations in these contexts are quite new, and so available information focuses on emerging research in specific countries. As mobile phone networks evolve to third-generation (3G) and fourth-generation (4G) systems and more advanced yet inexpensive phones become available, the scope, sophistication,

and impact of mobile application and services will continually expand (Arker J. and Mbiti M., 2010).

2.5.2 Mobile money banking

Since 2005, mobile financial applications (known as "m-money" or "m-banking") have emerged in a variety of developing countries. The systems usually involve a set of applications that facilitate a variety of financial transactions via mobile phone, including transmitting airtime, paying bills, and transferring money between individuals. There are also currently a few m-money systems in developing countries that allow international money transfers. Different institutional and business models provide these services; some are offered entirely by banks, others entirely by telecommunications providers and still others involve a partnership between a bank and a mobile phone service provider (Porteous, 2006).

Most m-money systems allow the user to store value in an account accessible by the handset, convert cash in and out of the stored value account, and transfer value between users by using a set of text messages, menu commands, and personal identification numbers (PINs). A "pseudo account" can be established by purchasing "electronic money" (e-money) from an agent, usually a third party or someone who works for the mobile phone operator or bank. The user can then send e-money to another recipient with a phone, who then withdraws the e-money from their local transfer agent. Fees are generally charged for each transaction.

M-money applications have emerged in Asia, Latin America, and Africa. The Kenyan mobile money service, M-Pesa, has probably received the most attention. Introduced in 2007, M-Pesa ("M" for mobile, "Pesa" for "money" in Swahili) is a mobile phone application that facilitates a variety of financial transactions for its users, such as purchasing airtime, transferring money, and paying bills. As of September 2009, M-Pesa had 8 million subscribers and a network of 13,000 agents, with almost 40 percent of Kenyans ever having used the service to send and receive money (as shown earlier in Table 2). Since its inception, the cumulative value of the money transferred via M-Pesa was over US$3.7 billion—almost 10 percent of Kenya's annual GDP (Safaricom, 2009).

Although M-Pesa has been touted as "banking the unbanked," on average, M-Pesa users are wealthier, better educated, urban, and "already banked" (again, see Table 2). Moreover, the data suggest that most of the transfers are occurring within urban areas. M-Pesa and other m-money systems have recently transitioned from a pure money transfer system into a payment platform that allows non-governmental organizations, schools, hospitals, and firms to send and receive payments. The rapid uptake of M-Pesa and similar m-money services is not surprising when one considers the level of financial development in Kenya and in sub-Saharan Africa. Less than 30 percent of the population in East and Southern African has a formal bank account, ranging from 9 percent in Tanzania to 63 percent in South Africa (FinMark Trust, 2008).

In 2006, Kenya had only 450 bank branches and 600 automatic teller machines, or less than two bank branches per 100,000 people (Vaughan, 2007). In the absence of formal financial systems, Kenyans primarily sent money by one of three mechanisms: via Western Union or post office, via inter-mediaries (such as bus drivers), or via friends or relatives. Wire transfers via Western Union are secure but often prohibitively expensive, and are not always available in remote rural areas. Sending money via transport services or friends and relatives is more accessible, but carries a high risk of theft. By contrast, the cost of sending 1,000 Kenya Shillings (US$15) from Nairobi to the western provinces via M-Pesa in 2008 was two-fifths the post office rate and one-fifth the cost of sending it via bus (Morawczynski, 2009).

A variety of qualitative studies provide some insights into the characteristics, patterns, and potential impacts of M-Pesa usage. For example, Morawczynski and Pickens (2009) find that users often keep a balance on their M-Pesa accounts, thereby using the system as a rudimentary bank account. M-Pesa users also send smaller but more frequent remittances compared with users of other transfer services or methods, suggesting that the system might allow informal insurance networks to function more effectively.

Jack and Suri (2009) suggest that the inconspicuous nature of M-Pesa transfers could allow individuals to increase their personal savings, because friends and relatives would be less likely to know about the timing or amount of transfers. Wilson, Harper, and Griffith (forthcoming) find

that members of informal savings groups in Nairobi are using M-Pesa to deposit individual savings into their group account.

What are the consequences of m-money systems for economic development? A large body of theoretical and empirical literature suggests that the expansion of banking and financial systems can have significant impacts on economic growth and poverty in developing countries (Burgess and Pande, 2005; Levine, 2005). Yet many m-money systems in developing countries are not technically banking from either a financial or legal perspective: they do not provide interest on savings or facilitate access to credit from formal financial institutions, nor do they insure the value stored in the mobile account. While m-money systems have effectively expanded the breadth and reach of money transfer systems for the rural and urban poor—as well as provided a gateway to formal financial services—questions remain regarding the nature and extent of m-money's effect on the welfare of poor users in developing countries.

2.5.3 Other mobile phone development projects (m-Development)

In response to increases in mobile phone coverage and adoption in Africa, mobile phone-based development projects have proliferated in a variety of sectors, including agriculture, health, education, emergency response, and governance. The objective, target group, and use of mobile phones in each project differ significantly, but the underlying belief is that mobile phones can offer a useful platform for providing information and services.

Health practitioners have often been at the forefront of using mobile phones as a development tool in Africa, with a variety of mobile health (m-health) projects on the continent. These projects range in variety and scope, from monitoring measles outbreaks in the Zambia, to supporting diagnosis and treatment by health workers in Mozambique, to sending health education messages in Benin, Malawi, and Uganda. In Kenya, Malawi, and South Africa, mobile phones are being used to send several reminders a day to HIV-positive patients about their anti-retroviral therapy schedule, as well as allow community health workers to send information about HIV patients' status. Mobile phones are also extending the reach of medical workers and medical services. In the Democratic Republic of Congo, mothers can call a hotline to ask questions about their child's health status. Mobile phones have been used in the collection,

measurement, and monitoring of health data, such as monitoring and tracking epidemics. For example, low-cost medical imaging systems have used mobile phone technology to transmit data and images to a central processor (Granot, Ivorra, and Rubinsky, 2008).

Granot et al (2008) expands this view by observing that mobile phones are facilitating access to agricultural market information, in many cases replacing the message boards and radio programs of traditional market information systems. In the francophone countries in West Africa, for example, consumer prices for staple grains are broadcast weekly via radio for the largest markets in the country. Yet in many cases, farmers live tens of kilometers from the nearest large market and the data is up to six days old. Farmers in countries as diverse as Niger, Senegal, and Ghana can now type in a code, send a text message, and receive the price of a variety of goods immediately. Mobile phones are also extending the reach of agricultural extension services; in Kenya, Uganda, and India, farmers can call or text hotlines to ask for technical agricultural advice.

Mobile phones have also been used as a regular part of election campaigns around the world, from the United States to Thailand and Spain. Yet they have served as a powerful tool to assist with election monitoring on the continent, often overcoming logistical challenges of organizing volunteers and verifying results. Prior to 2005, so-called "parallel vote tabulation" systems—an electoral observation methodology that uses a representative sample of polling stations to monitor and verify election results independently—received information from trained observers via phone calls, radio, or messengers on motorbikes. In countries with limited infrastructure and communications systems, this verification process could take days, even weeks. During the elections in Ghana, 1,000 locally trained observers in a parallel vote tabulation system were able to transmit voting results via text message to a central system, resulting in almost instantaneous independent verification of the election. It has been argued that the absence of parallel vote tabulation and the timely and credible independent information it provides contributed to the recent post-election violence in Kenya.

Mobile phones have been used in other ways to foster good governance, mainly via voter education and citizen-based monitoring often called "crowdsourcing." Crowdsourcing—the idea

of outsourcing a task to a large community or group of people—allows regular citizens to report election abnormalities and violent confrontations via text message or calls to a centralized server. In Kenya, such citizen-based monitoring was mapped via a software called "Ushahidi" ("testimony" in Swahili) to allow Kenyans to report post-election unrest via voice, text message, and Internet and to map it, in real time, to the entire world. However, such systems depend primarily upon verification by other users, which raises possible questions about their accuracy (Arker J. and Mbiti M., 2010).

Simple and affordable mobile phones are being used as a means to promote literacy for adults in Africa (Aker, 2009). Despite the fact that text messages are one-seventh the price of voice calls in Niger, the use of text messages has been relatively limited, in part due to high illiteracy rates. In addition to the normal literacy curriculum, adult learners in Niger are taught where to find letters and numbers on a mobile phone and how to send and receive text messages. Within one cycle of classes, students are able to send text messages in local languages to their friends and family, thereby allowing them to practice their newly acquired literacy skills. In a country without local language newspapers and village-level libraries, text messaging makes literacy functional. Preliminary results suggest that the mobile phone-based literacy students have higher test scores than students in normal literacy classes, and these results are maintained six months after the end of classes (Aker, Ksoll, and Lybberty (2010). Similar mobile literacy projects are starting in Senegal, and others in India are using smart phones and mobile games for children.

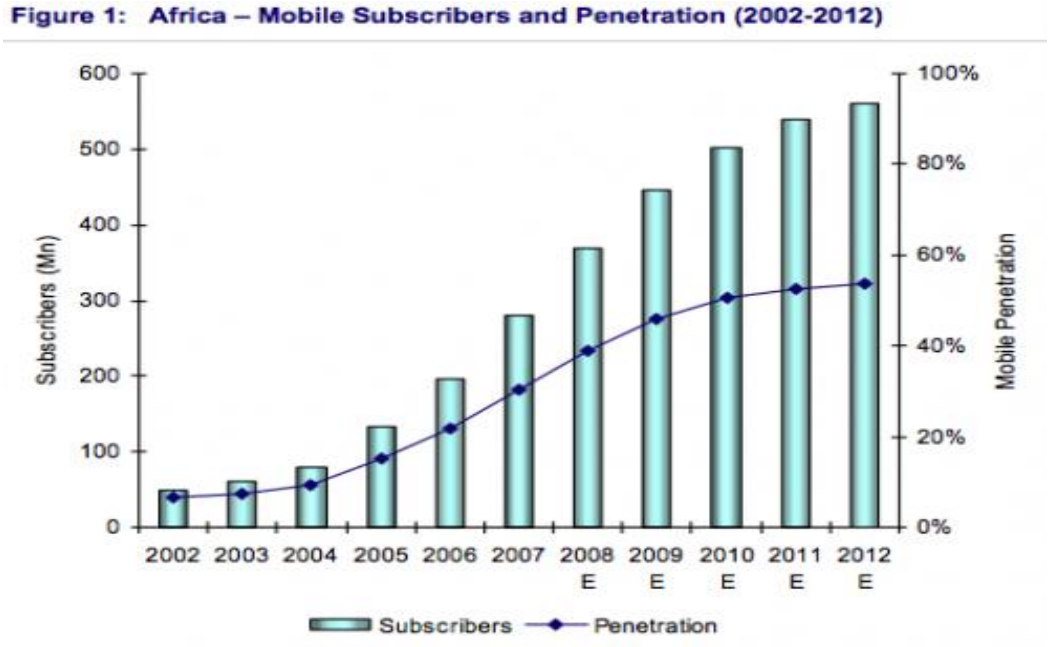
2.6 Theoretical framework

This theoretical framework outlines the discourse on African mobile phone use and describes the relation between mobile phones and livelihood issues in developing countries. This research is based on the Technological Determinism Theory proposed by Marshall Mcluhan in 1962. It states that media technology shapes how we as individuals in a society think, feel, act, and how society are operates as we move from one technological age to another.

The mobile phone diffusion has had enormous growth in the previous years especially in developing countries Kenya being one of them. This evolvement is not restricted to Kenya, Africa in large has faced a similar scenario. In 1994 there were 1.76 telephone subscribers (land

line and mobile) per 100 inhabitants. This number had increased to 12.2 per 100 inhabitants in 2004. Mobile phones accounted for 75% of these in 2004 but only 3.4% in 1994 (Gray, 2005).

Figure 7: Number of mobile subscribers and penetration, 2002 – 2012 (ITU, 2013)



Research has shown that more people are having access to mobile phones than persons subscribing due to a widespread sharing of mobile devices (Kaplan, 2006). This fact, along with growth in mobile phone subscribers, imply that many people that earlier were excluded from the telecommunication system are now being able to communicate. What impacts on society can be derived from this massive spread of mobile phones in developing countries?

Professor Waverman (2005) of the London Business School has shown that ten extra phones per hundred inhabitants can lead to 0.59% extra annual GDP growth in a typical low-income country. This was made in a study examining 92 countries, both rich and poor. The data derived from Waverman's studies are at macro-level and some work has been done to link individual mobile phone use among poor people to societal effects. The British Department for International Development (DFID) conducted a large study in India, Mozambique and Tanzania in 2005 (Souter, Scott, Garforth, Jain, Mascarenhas, & McKemy, 2005) and found that people in the their sample perceived mobile phones to have a great impact on social networking and for

reducing vulnerability but only to have mixed economical value. The economical impact was perceived to be greater for saving money than for earning money. The samples used were 2300 persons in three countries without focus on any specific group.

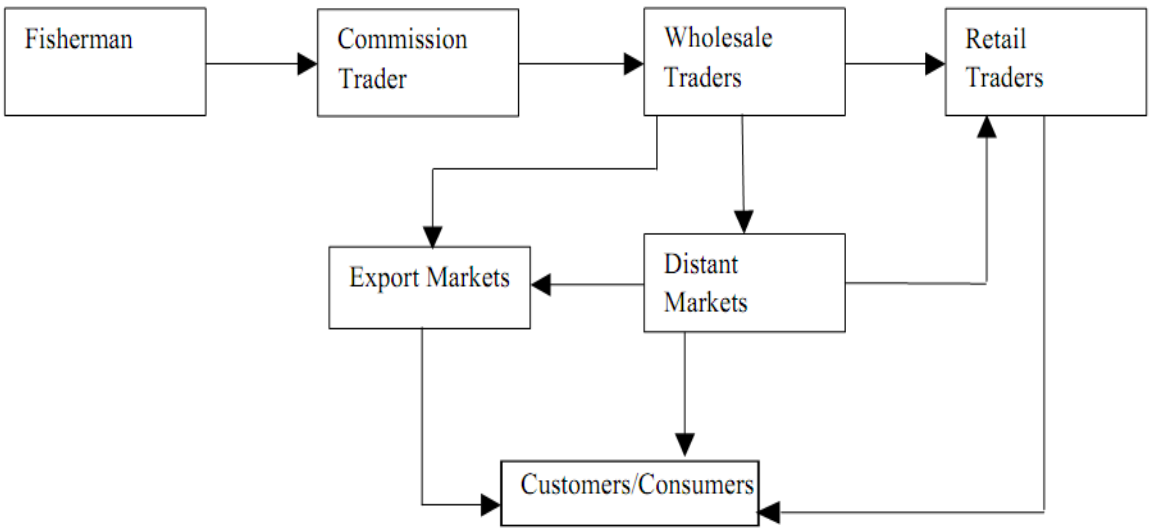
The group focused on in this report is Kenyan fishermen at Dunga Beach in Kisumu County. The relation between fishermen and mobile phone use has mostly been covered by newspapers and no scientific reports on this group are available, from what the researcher has experienced. According to Cracknell (2000), many researchers have confirmed that controls rarely work satisfactorily. Therefore, the obvious direct method for carrying out this research is the 'before and after' theory, which simply compares the situation at the time of the assessment with what it was before the intervention (i.e. mobile phone use) started.

Cracknell (2000), however, cautions that although this approach is used to carry out many assessments, it still suffers from a major defect. That is, if the intervention under study has spanned over a period of several years, a number of changes might have taken place during the life of the intervention, whose effects might incorrectly be attributed to the intervention. Hence, if a control is not used, it is desirable to use published statistics and other available information about trends related to the project under study, if possible to the region of intervention.

2.6.1 Conceptual framework

Given the lack of a suitable control group (due to the pervasive use of mobile phones) and the absence of systematic statistics on artisanal fishing markets, the research had to rely on the 'before and after' approach, coupled with a conceptualized structure of the fish market in Kisumu County. A stylized representation of the supply chain expressed in Figure 3 enabled the researcher to examine very closely how fishermen use the mobile phone to carry out their business and the impact it exerts on the artisanal fishing industry in Kisumu.

Figure 8: Conceptual framework of the fish marketing in Kisumu



Source: Adapted from Abraham Reuben (2006)

Fresh fish is a highly perishable commodity which, in principle, requires the shortest possible supply chain with as little involvement of intermediaries as possible (Figure 3). In reality, the catch goes through a complex distribution chain from the producer/fishermen to the end consumer. The owners of the canoes hire fishermen to man their canoes. In some cases, the fishermen or fishermen's co-operative could themselves be the owners. In most of the cases, the canoe also has an investment from the commission agent, who thereby ensures control over the sale of the catch. On landing the catch, the commission agents auction the fish to both retail and wholesale traders, who then sell the fish to consumers either directly, in the case of retail traders, or through other retail traders, in the case of wholesale traders. The agents then pay the owners after subtracting between 5–10% of the total value as their commission. The owners pay for the variable costs of the trip, including ownership fee and split whatever remains among the fishermen.

2.7 Summary

Mobile phone usage in sub-Saharan Africa has grown significantly over the past decade and now covers 60 percent of the population. Empirical evidence shows that mobile phones have the potential to benefit consumer and producer welfare, and perhaps broader economic development. As the prices of both handsets and airtime continue to fall, the mobile phone will complete its transformation from an elite status symbol to a necessity for adults at nearly all income levels. Indeed, mobile operators are continuing to innovate in their push to reach more subscribers. The price of handsets has also fallen and new solar-powered phones have recently been introduced into the market. The challenge is now to ensure complementary access to public goods and the development of appropriate policies to evaluate and propagate the benefits of mobile phones throughout the continent.

Existing empirical evidence on the effect of mobile phone coverage and services suggests that the mobile phone can potentially serve as a tool for economic development in Africa. But this evidence, while certainly encouraging, remains limited. First, while economic studies have focused on the effects of mobile phones for particular countries and markets, there is little evidence showing that this has translated into macroeconomic gains. Second, while the proliferation of mobile-based services and projects has the potential to promote economic development, there is a tendency for development agencies and donors to "jump on the information technology bandwagon" without properly assessing its effects. Finally, communications technology cannot replace investments in public goods such as education, power, roads, and water—especially when access to mobile phones and services still remains out-of-reach for the poor. Existing micro and macro-level evidence suggests that mobile phones can improve consumer and producer welfare in developing countries (Jensen 2007, Aker 2008, Klonner and Nolen, 2008). Yet can mobile phones serve as an engine for economic growth? The effect of mobile phones on changes in GDP and growth, especially in sub-Saharan Africa, is still relatively unexamined.

Finally, mobile phone-based development projects are often based upon the assumption that mobile phones can improve communication, coordination, and service delivery. Yet the use of

mobile phone technology in these contexts may not always be Pareto-improving. Some nongovernmental organizations have begun using mobile phones as a mechanism for distributing cash transfers. While this approach could be more efficient, it is not without risks: it could potentially target the wrong populations (if the individuals one would wish to target do not have mobile phones) or increase beneficiaries' risk (if they must travel to find an agent to withdraw the cash). This suggests that the mobile-based approach might have higher costs and lower benefits than the "low-tech" approach. Thus, rigorous impact evaluations of m-development projects, in some cases using randomized evaluations, are needed to determine whether, how, and under what conditions mobile-based solutions are superior to their traditional counterparts.

To ascertain whether and how mobile phones can be an effective tool for increasing livelihood in Africa, researcher needs to identify the current knowledge, unanswered questions, and potential areas in this research. There are two primary challenges to addressing this research agenda: data and identification. To measure the determinants of mobile phone adoption as well as its impacts on social networks, access to financial services, and remittances, reliable and accurate data at the individual, household, and village-level are needed. Yet obtaining access to mobile phone coverage and usage data, even at aggregate levels, is notoriously difficult and often bound by strict rules of nondisclosure and privacy concerns. In such cases, researchers will need to partner with mobile phone service providers and local institutions to collect such data.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter examines in detail the methodology adopted in carrying out the study. It covers the following aspects; research design, location of the study, population of the study, sample and sampling method, instruments for collecting data, procedure for collecting and analyzing data. The researcher has discussed these aspects by highlighting the reasons why some techniques were selected for the research design.

3.1 Research design

Research design (methodology) defines the systematic and scientific procedures used to arrive at the results and findings for a study against which claims for knowledge are evaluated (Nachamias et al., 1996; Saunders et al., 2007). A methodology is therefore shaped by the perspectives the researcher chooses to approach a study. The perspectives that usually shape a research work can be broadly grouped under five umbrellas (Saunders et al., 2007).

The research design used in this study is a descriptive survey that sought to find out mobile phone usage in improvement of market efficiencies and livelihoods among the artisanal fishing community of Dunga Beach in Kisumu County. According to Orodho (2003), a study concerned with obtaining information by interviewing or administering a questionnaire to a sample of respondents is a descriptive survey.

Copper and Emory (1994) remark that a descriptive design is used to determine the who, what, when, where, and the how of a research topic. From a mass media research point of view, Rubin (1981) asserts that survey research is a predominant uses and gratifications method that has been consistently validated by past studies. This underscores the choice of a descriptive survey design in conducting the present study.

This study has significant combination of explanatory, descriptive and exploratory purposes. Firstly, the researcher sought to assess the role of mobile phone use in supply of inputs and sale of fish by the fishermen, so it was descriptive. Secondly, the study sought to

determine how mobile phone use facilitates the flow of information among fishermen and their customers and their satisfaction with the service provided by mobile phone, therefore it was explanatory. These strategies can be combined in a single study for a particular purpose (Saunders et al 2007).

In this study the researcher chose basically a survey strategy because it sought the opinion of a population about a specific subject matter and it combined the use of qualitative and quantitative techniques. However, it has significant aspects of grounded theory since one of the objectives for the study was to examine the relationships that existed between the use of mobile phones on market efficiencies and improvement of livelihoods; the results could be used to derive a model for determining fishermen satisfaction in the use of mobile phones in improving efficiency in the fishing industry.

3.2 Data collection

3.2.1 Primary data

Primary data is a data originated by the researcher for the specific purpose of addressing the research problem (Malhotra N. K. & Birks D. F. 2007, p. 94). It is what the researcher originally collects from the sample or target population. In this study the primary data used were those that were got from the focus group discussion and the structured questionnaire.

3.2.2 Secondary data

Secondary data are data collected for some purpose other than the problem at hand (Malhotra & Birks 2007, p.94). In this study secondary data were collected from the websites of organizations used for the study, online articles and journals.

3.3 Population

Olive and Abel Mugenda (2003) define population as a complete set of individuals, cases or objects with some common observable characteristics. The target population for the study comprised all 250 registered fishermen within Dunga Beach of Kisumu County.

3.4 Sampling

3.4.1 Sample size

Out of the sample frame of 250 registered fishermen within Dunga Beach of Kisumu County, a sample size of 70 (Seventy) respondents were selected based on researchers' judgment because of cost and time constraints. Using a larger sample in this survey would require large financial resources which the researcher could not afford. Again, the time limit within which the research was to be completed would not permit the use of larger sample size.

3.4.2 Sampling techniques

When choosing respondents, some restrictions were made in order to find respondents that could contribute to the research purpose. Fishing as an economical activity includes both buyers and sellers that must communicate in some way, the researcher therefore chose to use only people working on boats that fish for economical outcome and not micro-scale artisans fishing for subsistence. From this restriction the researcher chose purposive sampling to conduct a group discussion with only those respondents who have owned or owned mobile phones since they were presumed to understand best the benefit of using mobile phones for conducting business and obtaining related information in relation to both customers and the market.

Secondly, a simple random method was used to select respondents for each of the focus group discussions. In selecting the sample of 70 (Seventy) respondents, a stratified simple random sampling was used. This technique was chosen because the population consists of several operating canoes and fishermen, each being a stratum. This was done by, first of all, identifying all the canoe present on the landing site on the specific day of research within the target population as a stratum. This was done for each of the seven days of the week.

The researcher ensured that no respondent was used more than once for the study.

Table 3: Stratified random sampling by composition

Stratum (Days)	Sample Size	Percentage (%)
Monday	10	14.2857
Tuesday	10	14.2857
Wednesday	10	14.2857
Thursday	10	14.2857
Friday	10	14.2857
Saturday	10	14.2857
Sunday	10	14.2857
TOTAL	**70**	**100**

Source: Field data, 2013

3.5 Data collection procedure

3.5.1 In-depth focus group interview

It can be possible to generalize findings from a low number of observations, what really matters is the comprehensiveness of the measures. Comprehensiveness allows us to reach a fundamental understanding of the structures and processes we study (Normann, 1970). The researcher therefore decided to hold focus group discussions with different groups on separate days and different respondents from each other in order to find similarities and disparity between them and in order to get a comprehensive picture with a broad spectrum of respondents.

In this study a preliminary focus group interview was conducted to clarify on the dimension of mobile phone usage for improving market efficiencies and improving the fishermen's livelihood in Kisumu County. This was because in an exploratory study where certain constructs need to be clarified, most researchers recommend that qualitative techniques are appropriate, notably the use of projective techniques, focus group, in-depth individual and group discussion, as well as observational techniques (Saunders et al 2000; Cooper and Schindler 2006; Malhotra N. K. & Birks D. F. 2007). Since the researcher wanted to be clear as to whether mobile phone is a significant dimension in "market efficiencies and improving livelihood" in the fishing industry, a focus group interview was used. The focus group was used to discuss dimensions of market efficiencies and livelihood improvements that matter to fishermen in Dunga Beach.

According to Cooper & Schindler 2006; Malhotra & Birks 2007, the appropriate number of a focus group should be between five (5) and twelve (12) people; the people should be purposefully selected, and the discussion or interview last for usually an hour or two hour. In view of this, ten (10) participants were selected using purposive sampling technique. This was because the participants had to satisfy the criteria of eligibility before they could be selected.

We invited two (2) fishermen from each canoe in the landing site, five (5) canoes were selected and a total of ten (10) individual fishermen were therefore available for the discussions each day for the seven day period. An interview guide was developed and used to direct focus group discussion, which lasted for seventy (30) minutes (**see Appendix**). The outcome of the focus group interview was that mobile phone is a significant dimension in "market efficiencies and improving livelihood" in the fishing industry.

3.5.2 Structured questionnaire

According to many scholars, in the use of survey strategy, the main instruments used are self-administered/interviewer administered or structured/unstructured interviews and questionnaire or a combination of both (Saunders et al 2000; Cooper and Schindler 2006; Malhotra N. K. & Birks D. F. 2007). They further agree that generally the questionnaire can be used for descriptive or explanatory study, and must have a good layout, unambiguous questions, complete items, non-offensive but relevant items, logical arrangements of items, and the ability to elicit willingness to answer in respondents. As a result, questionnaire was used.

The interview scheme was semi structured with questions leading in to larger areas of interest in relation to mobile phones and livelihood impacts (**see Appendix**). In addition to every start up question the researcher decided which important areas were to be covered within the timeframe of the interview. The interview questions are all thematic and based on the theoretical framework and arranged in order to achieve a good dynamic in the conversation and also to gain the confidence of the respondents. In order to make the respondents feel comfortable in the interview situation, we first informed them that their names would be treated confidentially. This leads to a

higher reliability since the respondents hopefully don't fear being troubled and can speak more freely.

3.5.3 Pilot testing and final administration

Saunders et al 2000; Cooper and Schindler 2006; and Malhotra N. K. & Birks D. F. 2007 agree that in any research, it is expedient as a matter of reliability and validity check that the questionnaire should be pre-tested before final administration. A preliminary draft of the questionnaire was given to three (3) translators to test the clarity and meaningfulness of the questions. After that the final questionnaire was pre-tested on a sample of ten (10) fishermen selected by simple random method. This small size was guided by the suggestion by Fink (2003b in Saunders et al 2007) that the minimum of ten (10) members for pre-testing is adequate. Each of them was told the purpose of the questionnaire and assured of anonymity before they were given the questionnaire to respond to.

Finally, after adjustments were made to get more effective instruments, the questionnaire was administered to the target population through personal contact by researchers. They were first informed of the purpose, assured anonymity and confidentiality of responses. In all, respondents were given the questionnaire to fill; we left it to them, after which they submitted the questionnaire to us. This was between the periods of 28th August and 30th August 2013. In order to get a more representative sample of the entire target population, the questionnaire was administered to respondents in three days of August.

3.6 Statistical measurement methods

A detail of the statistical methods used in this study are:

3.6.1 One sample t - test

This is a statistical procedure that tests whether a single variable deviates from a specified constant or a cut-off point. The cut- off point may be a known population mean or a hypothesized value. It assumes that the sample is normally distributed; it is a fairly robust test that tests departure from normality. This chosen procedure was deemed appropriate because the researcher wanted to find out fishermen who were certain with the market efficiency and improvement of livelihood generated from mobile phone usage. The researcher

needed to specify a constant or cut off point to determine dimension considered by fishermen as important and those not important. One sample t-test was used to answer research question one and three.

3.6.2 Regression analysis

A regression analysis is a statistical method used to estimate the strength of a relationship between one or more dependent variable and one or more independent variables. It assumes that the relationship between the dependent and independent variables is linear; that these variables have equal variance (homoscedasticity); that there is no correlation between two or more of the independent variable (multicollinearity); and the data is normally distributed (Cooper and Schindler 2006; Saunders et al 2007).

Regression analysis can be simple involving one dependent variable and one independent variable, or multiple involving one dependent variable and two or more independent variable. This procedure was used because the researcher wanted to find out how desire and expectation individually impact overall fisherman's satisfaction with mobile phone usage and how impacts behaviour intentions: improvement of livelihood and market efficiencies, all in simple regression model.

3.7 Ethical Issues

Permission to conduct research was considered with the aid of an introductory letter form (**Appendix).** Permission was sought for the use of professional and academic articles and other published papers. The researcher introduced himself to the respondents as a student conducting the study and sought permission from them before asking them to respond to the questionnaire and hence participate in the focus group discussion. Respondents were also assured of anonymity and confidentiality of their responses.

3.7.1 Credibility and validity of the research

Scientific methodology needs to possess the characteristic of credibility. Thus both the end and the means must not only be sincere but right (Saunders et al 2007). In this study efforts were made to ensure credibility in terms of validity and reliability, which are important at every stage of the research work.

Validity refers to whether the statistical instrument measure what it is intended to measure, i.e. accuracy of measurement (Sullivan T.J. 2001; Saunders et al., 2000; 2007). Validity can be internal or external. The following are the relevant forms of internal validity ensured in this study:

Face validity: involves assessing whether a logical relationship exist between the variables and the proposed measure. This type of validity is highly subjective, and does not provide enough proof of validity. For face validity in this study, it was logical to the researcher to measure the market efficiency and improvement of livelihood generated from mobile phone usage through focus group discussion.

Content validity: content validity or sampling validity refers to whether a measurement instrument has adequate and representative coverage of the concepts in the variables being measured. It is usually achieved by seeking opinion of other investigators or experts. The questionnaire for this study was given to two lecturers from Inoorero University to review its content validity.

Criterion validity: This refers to ensuring validity by showing a correlation between the measurement instrument and some other criterion or standard that is believed to accurately measure the variable being considered. If the instrument is measured some other similar instrument that has been developed and tested to be valid, then such comparison is termed con-current validity. Thus in this study, the questionnaire developed was compared with other similar validated instruments that have been used in previous studies in other parts of the world. This was to ensure that the items in the questionnaire match up with the validated ones.

Construct validity: This has to do with measuring an instrument to an overall theoretical framework in order to determine whether the device confirms a series of hypothesis derived from an existing theory. Thus, the instrument must have existing conceptual or theoretical bases in the literature. In this work, this construct validity was ensured by deriving the determinants of mobile phone usage to the technology determinism theory model.

External validity: This refers to the extent to which the results of a study could be generalized. In this work, to ensure external validity, the findings and results will be generalized to the fishermen of Lake Victoria within Kisumu County settings and specifically to the fishermen along Dunga Beach landing used in this study.

3.7.2 Reliability

Reliability refers to whether a measurement instrument is able to yield consistent results each time it is applied. It is the property of a measurement device that causes it to yield similar outcome or results for similar inputs. Statistically, reliability is defined as the percentage of the inconsistency in the responses to the survey that is the result of differences in the respondents. This implies that responses to a reliable survey will vary because respondents have different opinions, not because the questionnaire items are confusing or ambiguous. It could be estimated using stability or equivalence approaches. In this study the researcher did pilot test the questionnaire to strengthen its reliability.

In addition to the above the following steps were also taken to ensure valid and reliable data collection and analysis process:

1. The right target population was identified, i.e. individual fishermen along Dunga Beach.
2. The representativeness of the sample was ensured since the sample was made up of adequate representation of fishermen along Dunga Beach and selected at random.
3. The sampling method was appropriate since respondents were selected through stratified simple random method to remove participant errors and biases.
4. The data sources were all reliable since the researcher used published academic and professional journal articles.
5. In administering the instruments, the respondents were assured of anonymity and confidentiality so they could express their real feelings to remove subject/participant biases.
6. Data was entered using SPSS with much care. Missing values were discarded because they were significantly small.
7. It has been suggested that to ensure validity and reliability of instrument, the researchers must have adequate knowledge on the context (industry) being studied

(Saunders et al 2007). For this, the the researcher have been very active subscribers and have been using most of the services delivered by the mobile networks for at least ten years.

3.8 Summary

According to Cooper & Schindler (2003), good research generates dependable data, derived by practices that are conducted professionally and can be used reliably for making decisions. Therefore, the purpose of the research must be clearly defined, the research design thoroughly planned, high ethical standards applied, limitations frankly revealed, adequate analysis done for the decision maker's needs, findings must be presented unambiguously and conclusions justified.

CHAPTER FOUR: DATA ANALYSIS PRESENTATION AND INTERPRETATION

4.0 Introduction

This chapter consists of data analysis, presentation and interpretation. Data presentation covers data on respondents' characteristics, customer satisfaction measurement, and satisfaction with mobile phone usage for improving livelihood, relative importance of mobile use, and intension of use. The discussion is an analysis of the objectives, results and findings to answer the research questions.

4.1 Sample characteristics

4.1.1 Sex and age distribution

All of the 70 fishermen involved in the focus group discussion were males, consistent with the researcher's preliminary observation that all those involved in canoe fishing and going to sea were males. Table below shows the age distribution of fishermen by age bracket, with 76% falling between 30 and 49 years of age.

Table 4: Age distribution of fishermen

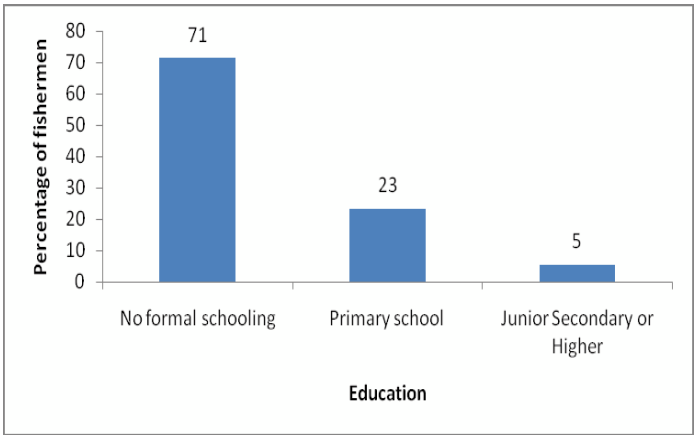
Age-group (years)	Frequency	Percent	cumulative
15-29	5	7.1	7.1
30-39	21	30.0	37.1
40-49	31	44.3	81.4
50-59	12	17.2	98.6
60+	1	1.4	100.0
Total	**70**	**100**	

(*Source:* Field data, 2013)

4.1.2 Educational attainment

Of the 70 fishermen, 95% had only primary education or no formal schooling at all (Figure below), and only 1.2% of these could read and write. These findings are not consistent with the high literacy rate of 87.38% in the country, as indicated by the World Bank report of (2010). Despite functional illiteracy, respondents indicated no difficulty using mobile phones.

Figure 9: Educational attainment of fishermen

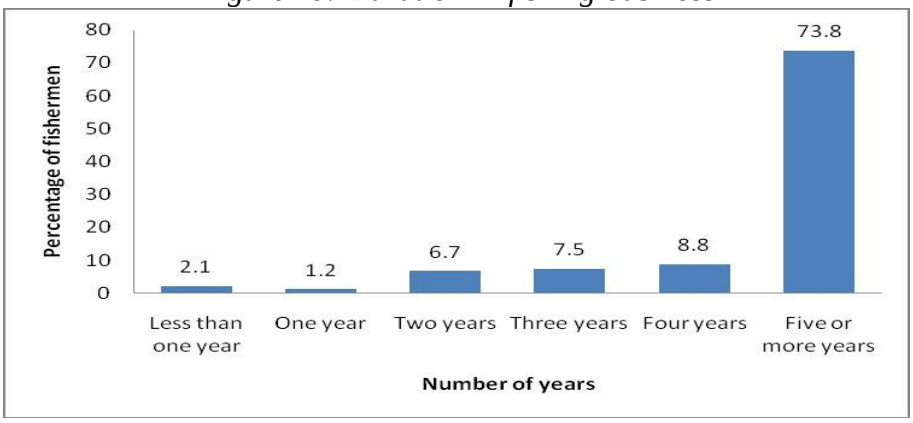


(*Source:* Field data, 2013)

4.1.3 Duration in fishing business

Fishermen had substantial experience in fishing, with 90% in the business for three or more years (Figure 10 below).

Figure 10: Duration in fishing business



Source: Field data, 2013

4.1.4 Secondary occupation

The majority of the fishermen had no job apart from fishing; less than a quarter were also engaged in other occupations such as carpentry, petty trading, farming, lumbering and carpentry (see table below).

Table 5: Secondary occupation of fishermen

	Frequency	Percent
Carpentry	8	11.4
Trading	4	5.7
Farming	3	4.3
Lumbering	2	2.9
No other job	53	75.7
Total	**70**	**100**

Source: Field data, 2013

4.2 Purchase of inputs before and after mobile phones adoption

Fishermen were asked to indicate how they ordered inputs such as premix fuel, ice blocks, mending twine, bait, and kerosene/diesel before and after they acquired mobile phones. The dominant mode before mobile phones (74.3%) was to walk or travel to the source of the input to order the supply, while 19.8% indicated that they contracted local agents to order the inputs for them and 5.9% engaged their relatives to purchase or order the supplies on their behalf.

After the introduction of mobile phone into the county, the people who walked or travelled to the sales point of the inputs fell to 44.2%, while 31.5% used mobile phones to arrange the purchases of inputs from their suppliers.

Table 6: Ways fishermen purchase inputs before and after mobile phone acquisition

Ways of Purchasing Inputs	**Before** (%)	**After** (%)
Walk/travel to source of inputs to buy	74.3	44.2
Contract local agent (middleman) to buy inputs	19.8	18.4
Others help me to buy inputs (e.g. relatives, friends)	5.9	5.9
Arrange by mobile phone to buy inputs	-	31.5
Total	**100**	**100**

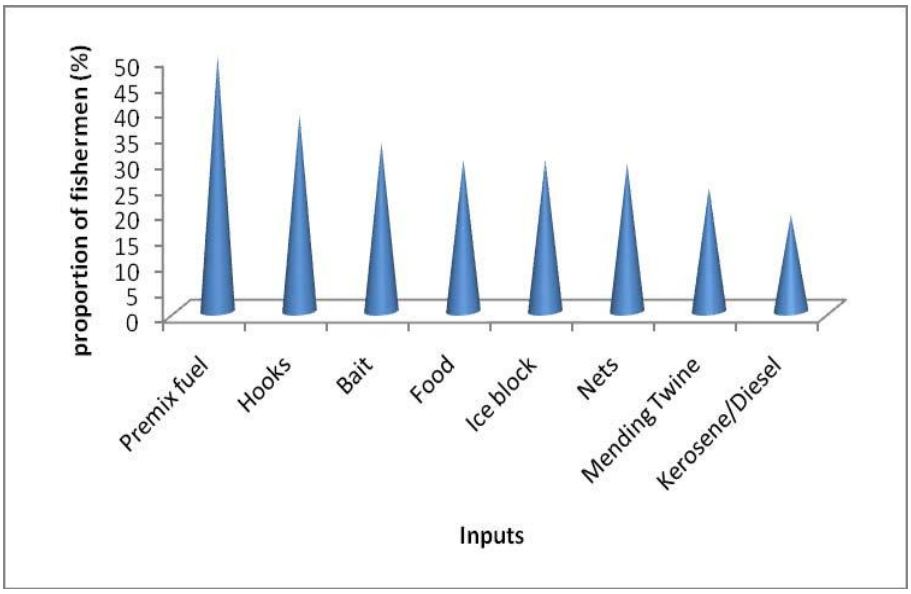
Source: Field data, 2013

The 31.5% of fishermen who indicated that they used mobile phones to arrange purchase of inputs were further broken down by the types of inputs they used the mobile phone to purchase. Half used their phones to purchase premix fuel, and hooks, bait, food, ice blocks and nets were also frequently purchased over the phone (Figure below).

The improved efficiency in input purchase made possible by mobile phones is illustrated by the following comment by one of the respondents:

> "*…these days the phone has saved me from walking about unnecessarily either to the fuel station or to find out anything about my job. Sometimes I call the fuel station to see if there is fuel. I also used to buy my net from one supplier in Kisumu town, but now I just call him to supply any time I need some*".

Figure 11: Proportion of fishermen using mobile phones to purchase specific inputs



Source: Field data, 2009 (Multiple responses were permitted)

4.3 Mobile phones in facilitating flow of information

In a multiple response question, fishermen were asked to indicate the ways in which mobile phone use has facilitated the flow of information in the fishing business. Three-quarters of the fishermen indicated that the mobile phone has enabled them to stay in touch both with their suppliers and with their customers, and two-thirds found new customers via the phone (Table below).

Table 7: How mobile phones facilitate the flow of information

	Responses	
Information Flow	**N**	**Percent**
Stay in touch with suppliers	54	77.1
Stay in touch with customers	53	75.7
Get price information from other markets	50	71.4
Give access to new customers	47	67.1
It helps cut out middlemen	27	38.6

Source: Field data, 2013 (Multiple responses were permitted)

Getting price information from other markets was important for 70.8% of mobile phone users, while 37.8% reported that it helped them to cut out middlemen in their business.

4.4 Sell of fish before and after possession of mobile phone

With respect to the way fishermen sold their catches before the advent of mobile phones, 70.8% said that they sold to customers at the landing sites, while 21.2% gave their catches to their wives to sell, and 7.9% contracted local agents to sell their catches (Table below).

Table 8: Ways of selling catch before and after possession of mobile phone

Channel	**Before (%)**	**After (%)**
Auction to customers	78.3	23.3
Give to wives	17.5	43.8
Contract agents to sell	4.2	-
Arrange by mobile phone to sell to customers	-	32.9
Total	**100**	**100**

Source: Field data, 2013

Direct auction to customers at the landing site fell sharply to 23.3% after introduction of mobile phones, while 32.9% said they arranged by mobile phone to sell their catches to their customers either before or after they have arrived at landing sites (Table above). Interestingly, the proportion of fishermen allowing their wives sell their catches rose to 43.8%.

Statistical comparison of the distributions before and after mobile phone (chi-square test) indicates that the change in modality was significant ($X^2_{(df = 2, N = 70)} = 225.10$, $p < 0.05$). The discussion below (Box 1) confirms that fishermen perceive positive changes in how they sell their catches to customers due to improvement in mobile phone technology.

Box 1: Changes in How Fishermen Communicate with Buyers

One canoe owner interviewed noted changes in the way he contacts his colleague fishermen and customers before his canoe arrives from sea:

At sea my other colleagues just communicate with me when they make a catch. I will therefore call all my customers through the mobile phone to inform them that the fishermen have made some catch, the type of fish, and the time they will arrive and the price per crate/bucket so they should get ready to meet me. Some will buy the quantities they want on the phone but most of them will come to the landing sites to wait for the fishermen.

Another fisherman responded as follows when he was asked: "in what ways has the mobile phone been beneficial to you in the fishing business?"

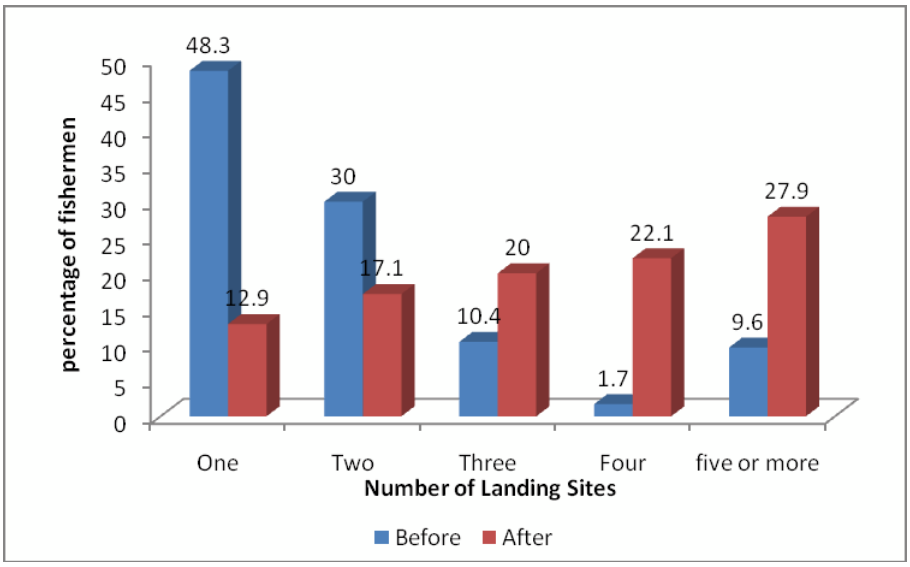
Our fishing activities are not limited to only Kisumu (Dunga), we can travel as far as Sori Beach, Miuru Beach, Port Victoria (Sio Port), Luanda Kotieno, Obenge Beach, Usenge Beach and even some regions of Uganda and Tanzania searching for the fish. If we get a good catch, we can't travel back to Dunga (market area) because of the distance involved…. with our mobile phones we are able to communicate with our customers (fish mongers) along these shores to meet us at our destination point for the catch, making our journey back home easier. I will say that mobile phones help us communicate effectively with fish mongers for easy marketing.

4.5 Number of landing sites visited before and after mobile phone

The number of landing sites/markets visited by a fisherman per month before the availability of mobile phones in the County of Kisumu was sought. Of the 70 fishermen, 48.3% indicated that they visited only one landing site per month before the introduction of mobile phones (that is fishermen' own local landing sites); 30.0% visited two landing sites; and only 21.7% visited three or more landing sites (Figure below). However, after the introduction of mobile phones,

only 12.9% visited just one landing site a month to sell their catches, while 70% visited three or more landing sites (more than triple the previous share). Wilconxon Sign Rank test indicated that the differences in the number of landing sites visited before and after the availability of mobile phone was statistically significant at $Z=10.074$, $p < 0.05$.

Figure 12: Number of landing sites visited in a month before and after possession of mobile phone



Source: Field data, 2013

The main reasons why fishermen visited multiple landing sites are shown in the Table below. Obtaining the best price was the primary motivation for 66.2% of the fishermen, and 15.0% similarly said they were looking for more buyers. Less than 5% gave reasons other than prices, buyers and financing, e.g., problems with their outboard motors.

These results indicate that, indeed, the mobile phones were facilitating fishermen to seek better prices and more buyers by visiting more landing sites.

Table 9: Reasons for visiting landing/marketing sites

	Frequency	Percent
Best prices at the landing sites	46	65.7
More customers are at the landing	11	15.7
Financiers are at the landing sites	10	14.3
Emergencies	3	4.3
Total	**70**	**100.0**

Source: Field data, 2013

4.6 Influence of mobile phone on price difference among landing sites

The fishermen were asked to state whether or not mobile phone use has influenced price variation by leveling prices among the various landing/marketing sites in the municipality. While 45% did not perceive any impact on price differentials, 48% said that mobile phones have had some influence (large or small) on price differentials among the landing sites (Table 7; statistically significant at $X^2_{(df=3,\ N=240)} = 76.03$, $p < 0.05$).

Table 10: Influence of mobile phone on price leveling among landing/marketing sites

Source: Field data, 2013

	Frequency	Percent
No influence	32	45.7
Small influence	18	25.7
Large influence	16	22.9
Not applicable	4	5.7
Total	**70**	**100**

The conclusion that mobile phones have tended to reduce price differentials is borne out by the following comments of one fisherman:

> "*We also find out prices at the other marketing/landing sites and compare them to prices at our landing site and try to sell at the same price. The phones*

have helped in the fair distribution of fish among the marketing/landing sites. This is because during bumper harvests, we use the phones to find out the markets with less or no fish in order that we land there".

4.7 Perception of quality of services

Fishermen's satisfaction with the quality of services rendered by the network operators was sought. Overall, three-quarters of fishermen were satisfied, one-quarter not satisfied. The highest degree of satisfaction was with Safaricom (93.6%) and Airtel (81.1%); Orange was the least satisfactory (60% not satisfied). A chi-square test for relatedness between network provider and level of satisfaction indicated that differences between providers were significant (X^2 (df = 3, N = 70) = 23.38, $p < 0.05$), though data were not available to compare to the national values. The fishermen were asked to indicate their level of satisfaction or dissatisfaction on specific aspects of services of mobile networks. The overall satisfaction rate by this measure was only 58%, and more than 70% of fishermen expressed dissatisfaction with costs, customer support, network coverage and dropped calls (Table below).

Table 11: Determinants of quality of service

Service Aspects	Satisfaction			
	Yes	**No**	**% satisfied**	**%not satisfied**
Overall mobile phone service	41	29	58.6	41.7
Overall costs of calls from mobile phone	15	55	21.4	78.8
Quality of customer service and support	15	55	21.4	78.3
Network coverage both on land and sea	19	51	27.1	72.9
Dropped calls (i.e. cut off in middle of call)	20	50	28.6	1.4
Congestion (i.e. inability to access network)	25	45	35.7	4.3
Cost of calling others network	40	30	57.1	42.9

Note: Responses on a 4-point scale have been grouped.

Source: Field data, 2013

4.8 Specific challenges faced in the use of mobile phone

When asked about the biggest challenges of using mobile phones at sea, the overwhelming concerns were with limited network coverage and the risk of dropping phones into the sea (95-100% of fishermen; Table below). The cost (73%) and the tendency of the phones to rust (68.6%) were also seen as important drawbacks. During the interviews, one fisherman stated the challenges as follows:

> *The first and foremost is the limited network coverage ("out of coverage area") causing us not to communicate effectively with our colleagues even when there is a problem//breakdown. Secondly, contact of the phone with the waves and salty water renders it ineffective. Also, phones may/do fall into the water on several occasions.*

Table 12: Specific challenges faced in the use of mobile phone

	Responses	
	N	**Percent**
Not much network coverage	70	100.0%
Mobile phone sometimes fall into the	67	95.7%
Mobile phones are expensive	51	72.8%
Mobile phone easily rust	48	68.6%
Mobile phones are attractive to thieves	33	47.1%
Total	**70**	**100%**

Source: Field data, 2013 (Multiple responses were permitted)

4.9 Summary

Mobile telephony over the past decade has grown rapidly in developing countries. Almost 70 per cent of the world's mobile phone subscribers are in the developing world. Reasonable pricing and easy access have helped make this technology a potential tool for generating economic opportunities and social networking, even in rural areas (e-agriculture.org, 2009).

According to Donner (cited in Rashid and Elder, 2009) the reasons for this explosive growth include sense of security to users, good leapfrogging technology, the requirement of only basic literacy, extra features (besides voice communication) such as text messaging and data transfer, which can be used for education, commerce, advertising, even banking; increasing competition (especially where open to private investment) and innovative payment methods (e.g., pre-paid, unit transfer) that make them increasingly affordable to the lower quintile of the population. The analysis shows how mobile phone use among artisanal fishermen in Kisumu County has enhanced the efficiency of input and output markets and improved their businesses relations and livelihoods. The analysis shows that access to telecommunications has a fairly strong impact on growth and economic development, as well as poverty reduction.

Recently, some studies have focused on the relationship between access to telecoms and economic well-being of the poorer segments of society in several countries at the micro-level, as does this study (Abraham, 2006; Aker, 2008; Galperin and Mariscal, 2007; Jensen, 2007). In theory, lowered transaction costs, inter alia through faster access to more accurate information, should help the poor to increase their incomes directly or indirectly through the more productive use of the time saved by placing a call. While empirical evidence of such impacts at a generalized level is sparse, other studies do show concrete empirical evidence of the benefits at this micro-level in specific markets or for certain groups of people. Mobile phone ownership has boomed throughout Sub-Saharan Africa, accounting for about 9% of subscriptions worldwide, with "Africa and Asia-Pacific the main drivers of growth, accounting for 80% of global net additions in the first half of 2010" (engineeringnewsonline 2010).

The use of mobile phones can correct market inefficiencies through affordable access to information. The Palliathya help line in Bangladesh is a successful example in this direction. Palliathya (cited in Bhavnani et al. 2008) uses mobile phones to increase access to information on the part of men and women living in Bangladesh's rural areas, as well as to stimulate economic opportunities for underprivileged women. The Palliathya initiative concluded that *"the helpline services: (a) prevent exploitation by middlemen; (b) provide employment opportunities (particularly for rural women); (c) reduce information gaps; (d) save cost and*

time; and (e) strengthen access of service providers to rural people."

The introduction of mobile telephony in fishing has been seen as a boon to artisanal fishermen, by giving them access to information on alternative prices from different buyers at different markets, as well as on locations of shoals at different points in the sea. Jensen's (2007) study of fishermen in Kerala state in India argues that mobile phone use by fishermen was associated with a great reduction in price dispersion, elimination of waste, and almost near-perfect adherence to the Law of One Price:

> *Both consumer and producer welfare increased: waste (6% of the fish were unsold before cell phones) has been eliminated; fishermen's profits are up 8% and consumer prices are down 4%, directly driving a 20 rupee/person/month consumer surplus, the equivalent of a 2% increase in per-capita GDP from this one market alone..*

Similarly, Abraham (2007) reported the results of a series of focus groups discussions conducted at 12 locations in Kerala, India, and interviews with nearly 200 local people associated with the fishing industry. He concluded that "*with the widespread use of mobile phones, fishermen are able to respond quickly to market demand and prevent wastage*". He asserts that mobile phones enable fishermen to respond quickly to market demand and reduce or prevent wastage of catch, which was a common phenomenon before the adoption of phones. At the marketing end, mobile phones help coordinate supply and demand, and merchants and transporters are able to take advantage of the free flow of price information by catering to demand in undersupplied markets. There is also far less wastage of time and resources in all segments of the fishing community. Fishermen spend less time idling on shore and at sea, whereas owners and agents go to the landing centres only when they receive information (via mobile phones) that their boats are about to dock. He finds that with the widespread use of mobile phones, markets become more efficient as risk and uncertainty were reduced. There is greater market integration and price dispersion, and price fluctuations are reduced.

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS & RECOMMENDATIONS

5.0 Introduction

The empirical material for this report was collected during a one week field study in Dunga Beach of Kisumu County during 1st September to 7th September 2013. During the study 7 translator aided interviews were conducted with local fishermen. The results from the outcome of the research are discussed below.

5.1 Findings

The findings indicate that fishermen use their mobile phones as "umbilical cords" which connect them to their suppliers, buyers and families, including while at sea. Fishermen now are much more likely to purchase inputs via mobile phones through an arrangement with their suppliers instead of having to walk to the suppliers' shops to purchase the inputs, as before. This reduces transaction costs and the risk of supplies not being available, and enables just-in-time purchases. As many as two-thirds of the fishermen are in touch with their customers and their suppliers continuously, seven days a week. Over 20% have used the phone to get access to new customers. This frequent interaction helps to builds trust and confidence in their businesses.

The findings in this study suggest that the availability of mobile phone has facilitated information flow among fishermen in many ways. With respect to the selling of fish, the study observed a shift in the way fishermen sell their catches, with about a third now selling their catches through mobile phone arrangements to customers instead of the traditional form of selling through face-to-face auctioning at their home landing sites. This arrangement was found to have helped about 12% of the fishermen to bypass middlemen and sell straight to their customers. These findings support the conclusions of Boadi and Shaik (2008) and Morowczynski and Miscione (2008) that mobile phones have helped small businesses to bypass middlemen and obtain better prices.

In particular, the study found that 22% of the fishermen used the phone specifically to access price information from the various markets/landing sites, and the evidence showed a significant

increase in the number of landing sites visited monthly after the advent of mobile phones. Buyers likewise call sellers to find out about catches and how much of each species, even while the canoes are at sea. This includes new buyers who come to the landing sites to obtain the mobile phone numbers of fishermen, thus empowering the fishermen to choose from alternative buyers and obtain the best prices. About 48% of fishermen agreed that the result has been reduced price differentials between sites/markets, consistent with the finding by Abraham (2006) that mobile phones have reduced price dispersion and fluctuation among fishing markets in India.

5.2 Conclusions

The survey found four major categories of reasons fishermen gave for using mobile phones: cost reducing factors, safety factors, coordination factors, and market expansion factors. Ways in which the mobile phone has helped them to reduce costs include reduction in the quantity of fish spoilage (by selling catches even while at sea); reduced time consumed in search of a good price; and lower quantity of fuel consumed and time used in search of fish (through communication among fishermen as to where shoals are located). Reduction in price differentials among the landing sites provides evidence of more efficient markets due to better information, which previously was very difficult to come by as fish could be sold at one landing or marketing site without any knowledge of prices at other landing sites.

Safety factors refer in particular to the usefulness of the phone in times of emergencies such as engine breakdowns, as well as access to bad weather information from other fishermen. Better access to information on their families during fishing hours was also a benefit, permitting information to be relayed to their families in case of mishap and improving their peace of mind and confidence as they conduct their business.

Coordination factors include the ability to be in constant touch with colleague fishermen before, during and after fishing. For instance, the crew leader uses the phone to call all crew members (some of whom may stay a distance away from the sea) to arrange fishing expeditions, and to make alternative arrangements in cases where crewmembers are indisposed. Fishermen also inform colleagues on the location of shoals, or ask for help in finding lost nets.

Finally, the fishermen stated that the mobile phone has helped them to expand their markets by finding new customers and the best prices, both within and outside their local landing sites. In effect, the mobile phone has helped the fishermen to make informed decisions on who, where and how much to sell their catches.

5.3 Recommendations

While fishermen were generally satisfied with mobile phone services, there were very different perceptions of the various networks, and some dissatisfaction with network coverage at sea, customer support, and dropped calls, as well as cost. One challenge is that the phones easily fall into the sea water (which some fishermen address through the insertion of corks on their phones) and are susceptible to rusting due to the salinity of the sea. The principal recommendation by fishermen to improve the usefulness of mobile phones would be to expand the reach of network coverage beyond 20-25km at sea. They would also like phones to be cheaper and more resistant to salt water.

5.4 Implications and further research

The study confirms that a modern technological innovation (mobile telephony) can be made accessible to a largely illiterate, low-income population with positive effects on their ability to manage their business profitably and to cope with risks. One area of further work to enhance these effects would be development of applications suitable for artisanal fisherman, such as readily accessible reports on local weather conditions and prices, or reporting illegal trawling operations. Given that cell phone towers cannot be located at sea, improving coverage will depend on the providers developing technologies to extend the signal farther, or locating more towers close to the sea.

Since it was not feasible in this study to obtain direct data on prices before and after introduction of mobile phones, further research to investigate the impact of mobile telephony on artisanal fishing (or other occupations with variable prices) in other countries could usefully be done on a randomized experimental basis with tracking of prices before and after provision of mobile phones to those selected.

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Appendix

MOBILE PHONE USE AND THE ARTISANAL FISHING INDUSTRY

The questions below are being used to find out mobile phone use and the artisanal fishing industry.Your responses will be used purely for academic purpose; hence confidentiality and anonymity are assured.

INSTRUCTIONS:

Please read the following questions carefully in preparation for the focus group discussions.

Thank you

GENERAL SURVEY DATA

1 Date of interview.....

2 Name of interviewer.....

3 Name of supervisor.....

4 Name of landing site.....

5 Name of crew leader.....

6 Name of canoe.....

7Name of district.....

8 Name of mobile phone service provider of crew leader.....

9 Mobile phone number of crew leader.....

RESPONDENT DATA

1 Approximate age of respondent

2 Gender: ***(tick appropriate box)*** Male [ ] Female [ ]

3 What is the highest level of Education that you have achieved?

(***Tick one box indicating the highest level of education mentioned***)

No formal schooling [ ]

Primary school [ ]

Junior secondary [ ]

Senior secondary [ ]

Post secondary e.g. diploma, degree [ ]

Only if they have had no formal schooling ask question 4

4 Do you know how to read and write?

Yes [ ]

No [ ]

OBJECTIVE: Assess the role of mobile phone use in the input supply, harvesting and trading of fish by fishermen.

1. For how long have you used a mobile phone at sea?

   Less than 1 year

   1 year but less than 2

   2 years but less than 3

   3 years or more

   Used to take phone but no longer do

   Have never taken mobile phone to sea

2. Which of groups of people do you use your mobile phone to call?
3. Has mobile phone use helped to coordinate input supply in your fishing business?

   Yes [ ]

   No [ ]

4. Which input(s) do you use your mobile phone to coordinate their supply?
5. Before mobile phone use, how did you coordinate the supply of all the activities ticked above in question (3)

   Premix fuel ……

   Food ……..

   Ice block ……..

   Kerosene/Diesel ……..

   Mending twine ……

   Nets …….

   Hooks ……

   Baits ……

   Lead …….

6. Has mobile phone use reduced the time you take to prepare for
   Yes [ ]
   No [ ]

7. If yes, by what percentage proportion has the time reduced?
   Below 10% [ ]
   11-30% [ ]
   31-50% [ ]
   Above 50% [ ]

Harvesting of Fish

8. Do you use the mobile phone at sea during fishing?
   Yes [ ]
   No [ ]

9. During the last [three] months, how many times did you use the mobile phone at sea during fishing?

10. Indicate the extent to which you
   To contact engineer to repair outboard motor engine [ ]
   To contact premix fuel seller [ ]
   To contact meteorologist for weather and tide information [ ]
   To contact other fishermen when shoals are located [ ]
   To contact landing/marketing sites for best selling price [ ]
   To report poachers on local fishing grounds [ ]
   To contact other fishermen to help find lost net [ ]
   To contact fishermen for information e.g. health condition [ ]

11. How frequently do you use the mobile phone at sea?
   Sometimes at sea [ ]
   Not at all [ ]

12. Do you face problems at sea during fishing?
   Yes [ ]
   No [ ]

13. If yes, what are some of the problems you face at sea?

Fuel shortage [ ]

All ice melting before returning period [ ]

Taken ill [ ]

Canoe leakage [ ]

Other(s)(specify) .....

14. How do you call the attention of others about your problem?

Use mobile phones to contact others [ ]

Sail to other fishermen to inform them at sea [ ]

Wave a white shirt or flag [ ]

Shout for help from nearby canoe [ ]

Does not communicate the problem to anyone [ ]

Other(s) (specify).....

Fish Trading

1. Has mobile phone changed the procedure of selling fish at landing/marketing sites?

Yes [ ]

No [ ]

2. If yes, how has that changed?.....

If no, why?.....

3. Do customers (market women) contact you on the mobile phone to found out catch?

Yes [ ] No

[ ]

4. Do you arrange to sell fish to customers through the mobile phone while at sea?

Yes [ ]

No [ ]

If no, why?.....

5. Do you contact customers on mobile phone to sell your catch?

Yes [ ]

No [ ]

OBJECTIVE. Determine the extent to which mobile phone use facilitates the flow of

information among fishermen and traders.

1. During the last [month? Week?] how many times did you communicate with customer(s)?

   Face-to-face [ ]

   By Mobile phone [ ]

2. Do you have a record of the customers' mobile phone number(s)?

   Yes [ ]

   No [ ]

3. How well do you know the customer(s)?

   Not well [ ]

   Somewhat [ ]

   Very well [ ]

4. Is the relationship strictly business?

   Yes [ ]

   No [ ]

5. Where does your most important customer /buyer

   In neighborhood [ ]
   Some part of city [ ]
   Elsewhere [ ]

6. How would you say mobile phone use has facilitated the flow of information in your fishing business? (Tick as many as apply)

   It makes me stay in touch with my customers [ ]

   It makes me stay in touch with my suppliers [ ]

   It gives me access to new customers [ ]

7. How often do you communicate on your phone with the following groups?

   Buyers (retailers, wholesalers, consumers) [

8. Mobile phone use has improved the level of information flow in your fishing business?

OBJECTIVE: ***To assess the level of satisfaction of mobile phone services to fishermen***

1 Which mobile service do you use in your fishing business?

Safaricom	[ ]
Airtel	[ ]
Orange	[ ]
Yu	[ ]

2 How satisfied are you with the mobile phone suppliers?

Not at all satisfied	[ ]
Not very Satisfied	[ ]
Fairly Satisfied	[ ]
Satisfied	[ ]

3 The level of call service changes for using your mobile phone?

Very satisfied	[ ]
Fairly satisfied	[ ]
Not very satisfied	[ ]
Not at all satisfied	[ ]

4 How often if at all, do you use mobile phone for;

	Business purposes?	Social/person Purposes
Frequently	[ ]	[ ]
Sometimes	[ ]	[ ]
Rarely	[ ]	[ ]
Never	[ ]	[ ]

5 Do you encourage other fishermen to use mobile phone during fishing?

Yes	[ ]
No	[ ]

6 If yes, what is the level of encouragement?

Strongly encourage	[ ]
Slightly encourage	[ ]

7 Which of the following do you use to pay for your mobile phone service?

Pre-paid (i.e. after paying one off fee for the phone, top up is bought as and when required) [ ]

Monthly subscription contact (line rental and call charges are paid each month) [ ]

OBJECTIVE: ***To determine the extent to which mobile phone use reduces price***

variation of fish along the landing sites in Dunga and beyond.

1. Before you started to use mobile phone in your canoe, how many landing/marketing sites did you visit in a month to sell your catch?

   One [ ]

   Two [ ]

   Three [ ]

   Four [ ]

   Five or more [ ]

2 If the answer in question (1) is two or more, name the landing or marketing sites and their locations.

3 Since the year you started to use mobile phone in your canoe, on the average a month, how many landing sites do you visit?

4 If the answer in question (3) is two or more, name the landing sites and their location.

5 What informs you to go to the other landing or marketing sites apart from your local landing or marketing sites?

6. The landing/marketing sites you visited, were there different prices among them?

   Yes [ ]

   No [ ]

7. If no, why.....

OBJECTIVE: Assess the extent to which mobile phone use improves income and well being and reduces vulnerability of fishermen in Dunga and beyond.

1. Indicate the extent to which mobile phone use has influenced each of the following benefits for you over the last two (2) years
2. What impact has using the mobile phone had on?

   Impact on income (earnings)

   Impact on time saved

   Impact on savings (reduced costs)

OBJECTIVE: To find out some of the challenges facing fishermen in mobile phone use

Which of these challenges do you face as fisherman in the use of mobile phone?