THE ROLE OF INTERNET IN THE PROMOTION OF AQUACULTURE. A CASE STUDY OF THE MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES FISH FARMING PROJECT.

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DECLARATION

I hereby declare that this Research Project is my original work and has not been presented to any other examination body.
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To God be the glory for His sustenance and strength throughout my studies. I am grateful to my family the unconditional support was of great help to make this work accomplished.

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ABSTRACT

The general objective of this research was to critically analyze the contribution of internet in the improvement of Aquaculture in Kenya and to establish the effectiveness of Phone internet in reaching the fish farmers. This research was descriptive study aimed at analyzing the role of Internet in the promotion of Aquaculture with particular reference to the Ministry Agriculture, Livestock and Fisheries fish Farming project.

The target population was the Aquaculture farmers and officers from the Ministry of Agriculture, Livestock and Fisheries. The study used inferences gotten from the population characteristics exhibited in the samples. So as to ensure that inferences made about the population characteristics on basis of the sample characteristics are accurate.

One of the findings was that the computer, Internet and mobile phones ranked the highest in the most preferred ICT tools used in the promotion of aquaculture. According to the survey 99 percent of the government officials had access to the Internet though the quality of internet service varied depending on the region.

Some factors are also necessary to be considered in order to improve aquaculture information dissemination. Age, income and educational background of fish farmers should be considered while disseminating aquaculture information to them.
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CHAPTER ONE
INTRODUCTION

1.0 Background of the Study
Information is vital in all societies. Information Communication Technology (ICT) is revolutionizing the world and this has a huge socio-economic implication for mankind. At the end of the Twentieth Century, people in rural and remote areas of developing countries are facing many unprecedented challenges brought on by the changing global economy, dynamic political contexts, environmental degradation and demographic pressures. The number of food insecure around the world continues to increase. To deal with these challenges, and to make critical decisions, people at all levels of society, and especially the food insecure and the organizations that serve and represent them, must be able to access critical information and communicate. Improved communication and information access are directly related to social and economic development (World Bank, 1995). Participatory development is fully dependent upon communication and information sharing processes.

One cannot expect poor farmers and food insecure residents of rural communities to list computers and digital telecommunication services as high priority items for improving their lives. However, there exist various intermediaries that serve these populations which, together with small and medium enterprises (SMEs) in rural areas, can take advantage of these technologies to improve their work, improve communication capacity, gain efficiencies and reduce telecommunication costs. An integrated approach that fosters horizontal and vertical channels of communication is key to insuring that such benefits are realized.

Intermediary organizations such as extension field offices, rural NGOs, health clinics, government offices, and church organizations together with SMEs, can offer benefit to their rural client groups in numerous ways. Strategies for improving Internet access and use for rural and agricultural development will necessarily involve full participation of
intermediary organizations and other rural stakeholders. As Internet services become more widely used among these organizations it becomes more important to facilitate the exchange of lessons learned and best practices that emerge from on-the-ground experience (Salleh et al., 2010).

There has been a rapid increase in the use of the Internet in developing countries (Richardson, 1996a). With regard to rural and agricultural development and the Internet, organizations that support the betterment of rural populations and improvements in agriculture have important roles to play. For example, the Food and Agriculture Organization of the United Nations (FAO), is playing an important role in assisting the establishment and growth of Internet services for rural communities and for agricultural development. In partnership with local stakeholders and other development agencies, organizations like FAO can help rural communities and agricultural organizations realize the benefits of improved communication and access to information.

1.1 Concept of Aquaculture.
As defined by the United Nations Food and Agriculture Organization (FAO), aquaculture is the “farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some sort 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…”

Over the past three decades, aquaculture has developed to become the fastest growing food production sector in the world; it has expanded, diversified, intensified and technologically advanced. Its potential contribution to local food security and livelihoods can be very significant, especially in remote and resource-poor areas. To attain its full potential to contribute to human development and social empowerment, the aquaculture sector may require new approaches. These could vary with countries, and the challenge is to develop approaches that are realistic and achievable in the context of current social,
economic, environmental and political circumstances. Such approaches should not only focus on increasing production; they should focus on producing a product that is affordable, acceptable and accessible to all sectors of society (Jiansan, 2000). The concerns and needs that were addressed included increasing the emphasis on aquaculture and aqua farmers in national development plans to enhance institutional and financial support to the sector; providing an enabling environment with appropriate policy, legal and institutional framework to facilitate access to key development resources such as money and knowledge; stimulating investments in aquaculture development; producing products in the acceptable manner for specific consumer preferences and complementing the efforts of other food production sectors; involving the participation of all stakeholders in decision making and policy planning; and broad and closer cooperation among stakeholders, countries and regions. In some, the prospects for aquaculture development are bright and envisaged expectations are achievable. Their achievement can be ensured by creating the appropriate environments for improved support to producers, enhanced participation, strengthened networking, better information and regional and global cooperation.

The vast majority of aquaculture takes place in Asia. In 2002, over 70% of world wide aquaculture production was in China alone. Most farmed fish and shellfish are grown in traditional small-scale systems that benefit local communities and minimize the environmental impact. Utilizing simple culture technologies and minimal inputs, these systems have been used for centuries. The net contribution of these traditional aquaculture systems can be great as they offer many benefits, including food security in developing nations.

1.1.1 Aquaculture establishment in Kenya
Aquaculture in Kenya follows a pattern similar to many countries in this region of Africa. It is characterized by low levels of pond production that have stagnated over the past decade. Fish farming was introduced by the colonialists for the purpose of sport fishing at
the beginning of the 1900s and it evolved to static water pond culture of tilapine fish in the 1920s, later supplemented by common carp and catfish. Trout was subsequently introduced as a riverine sport fish. In order to be able to produce seed for the warm water and cold water species for stocking of rivers, dams and ponds. The colonialists set up two fish farms in 1948, the Sagana Fish Farm (for warm water species) and the Kiganjo Trout Farm (for cold water species). Mariculture was introduced in the late 1970s with the establishment of the Ngomeini Prawn Farm as a pilot project. Although fish farming in rural Kenya has a relatively long history dating back to the 1920s, it was only made popular in the 1960s through the 'Eat More Fish' campaign. However, no spectacular progress has been achieved in this sub-sector since its introduction.

Until six years ago, aquaculture in Kenya had stagnated at an annual production of around 1 000 tonnes. This situation was further exacerbated by poor extension services and inadequate reporting and documentation. Since 1999, however, through consistent efforts in on-farm research and training, Kenya's aquaculture production has risen and is currently likely to be almost 1 500 tonnes (Brummett et al., 2004.) The focus is now on encouraging the development of private, commercial large-scale aquaculture, which is likely to increase Kenya's production to about 12 000 tonnes in the next three years. This development follows the efforts of the Department of Fisheries to promote aquaculture as one of the means to eradicate poverty and hunger. During the preparation of the Poverty Reduction Strategy Paper in 2000, the Government identified aquaculture development as a core activity for funding through the current Medium Term Expenditure Framework budgeting system. The last six years have been marked by aggressive research, training and private sector involvement in aquaculture. Production in real terms has doubled and is set to grow by over 1 000 percent (ten times) in the next three years. The prevailing conditions combine good prices and high demand, which are likely to boost fish production from aquaculture.
1.2 Statement of the Problem
Mass media power in disseminating Aquaculture information to the farmers is essential, but the main question now, does the Department of Fisheries in Kenya wisely utilize all the mass media sources especially the internet to disseminate the valuable agriculture information to the farmers and their officers? However, it appears that the full potential of the aquaculture sector to contribute to human development and social empowerment is yet to be realized, and the sector may require new approaches to realize its goals beyond 2000.

The Department of Fisheries has its' own website for the public, though the delay in information reaching the farmer, how to access it and some of the printed publications that do not reach the grassroot level are among the problems faced by the Department of Fisheries in Kenya.

For the Department of Fisheries to disseminate all of their Aquaculture information and provided up to date information to the farmers and their officers, one of the best answers is the Internet. This research focuses on the internet as a promotion tool, with an intention to bring to light the different channels and opportunities that the internet offers in the promotion and improvement of Aquaculture in Kenya.

1.3 Research objective
The general objective of this research is to critically analyze the contribution of internet in the improvement of Aquaculture in Kenya

1.3.1 Specific Objectives
i. To find out the contribution of the internet in the improvement of Aquaculture in the Ministry of Agriculture, Livestock and Fisheries.
ii. To find how successful aquaculture has been in the Ministry of Agriculture, Livestock and Fisheries.
iii. To establish the effectiveness of Phone internet in reaching the fish farmers.
1.4 Justification of the Study
The Internet power in disseminating aquaculture information to the fish farmers is essential, but the main question now, does the Department of Fisheries in Kenya wisely utilize all the mass media sources to disseminate the valuable aquaculture information to the farmers and their officers?

Over the past three decades, aquaculture has developed to become the fastest growing food production sector in the world; it has expanded, diversified, intensified and technologically advanced. Its potential contribution to local food security and livelihoods can be very significant, especially in remote and resource-poor areas. To attain its full potential to contribute to human development and social empowerment, the aquaculture sector may require new approaches.

The findings of this study would, thus, help stakeholders in the internet industry and the department of Fisheries to understand the crux of strategic ways to improve and promote fish yield through aquaculture.

1.5 Scope of the Study
This research project explored the improvement of Aquaculture through the use of internet and the focus was on fish farming a key project of the Ministry of Fisheries. This research project went on to attempt and come up with the contribution that the internet has made in the improvement and promotion of aquaculture providing explanatory factors such as changed socio-cultural attitudes, improved economic activity and the geographical locations covered in Kenya.
CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction to Internet
This chapter reviews literature on the role of Internet in the promotion of Aquaculture. The Internet has woven its way into nearly every aspect of our lives: people use it for communication, entertainment, education, and commerce opportunities (Horrigan and Rainie, 2006). Rural households, which have historically lagged behind in terms of Internet access, have seen dramatic increases in recent years. The farming industry, in particular, has found several applications for this distance-negating technology, including checking weather forecasts, buying inputs and selling products online, or even setting up and running individual farm websites. The percentage of farms online has increased from thirteen percent in 1997 to over 60 percent in 2005. In fact, nearly $30 billion of business was conducted online in the agricultural, forestry, and fishing sectors in 2005 (Dorfman and Watson, 2005).

Internet has changed the way we interact with each other, but also how we perform our tasks in a course of day. Although a bit later and a bit shy, internet is now thoroughly changing the face of aquaculture. There has been a major shift in behavior among farming population of the world, which quietly embraces the power of internet to finally take their farming operations to the next level.

Numerous studies have looked at how farmers have incorporated the Internet into their lives and farm businesses. Mishra and Williams (2006) suggest that the propensity for a farm household to adopt the Internet is positively related to a number of variables, including age and educational level of the operator, the presence of a spouse, farm size and regional location. They are further able to examine whether the household uses the Internet specifically for farm business purchases, for household purchases, or both. They find that the results (positive impacts of age, education, farm size, and regional location) are very similar among all groups.
2.1 Internet and Aquaculture in Africa

The benefits that could be derived from the Internet by African countries in general have been mentioned in many publications. Sadowsky has, for example, outlined the potential profits for governments, education, health, statistics, agriculture and natural resources, development and planning, telecommunications, and foreign affairs. The Internet with its different services has recorded a great expansion through the whole of the industrialized world. The developing world, on the other hand, has benefited only marginally from this explosion. This is due to the weak level of technology in these developing countries, but also to the mixed feeling shown by the authorities, who say that data processing networks rely on heavy technology and are generators of high expenses in telecommunications.

There have been significant improvements to Africa’s Internet connectivity in the last five years. Enormous investment in telecoms infrastructure has characterized these improvements, especially in terms of intercontinental connectivity and terrestrial fiber networks: Submarine cable investment has amounted to around USD3.8 billion and terrestrial networks have seen over USD8 billion of investment. Internet exchange points (IXPs), used for local exchange of traffic, have become increasingly important in many countries.

However, these investments have not always translated into a corresponding improvement in the Internet access services experienced by users, through lowered prices or increased quality of service. In many countries the development of Internet access services is still held back by constraints on key inputs, notably in relation to the terrestrial connectivity between the submarine cables, the IXPs, the ‘last-mile’ access infrastructure – whether fixed or wireless – and the Internet service providers (ISPs) that deliver access to the end-users in Africa. As discussed in this report, policy remedies are required that remove roadblocks to new market entry and expansion, promote of investment by providing clear rules, and provide strong political leadership to achieve ICT goals.
The necessity of a permanent Internet connection no longer needs to be emphasized. Such a connection will enable users to be constantly in touch with the whole Internet world using the least effort imaginable. Considering that there is already a large population of potential users of Internet services, the availability of all its services would be a welcome relief. It would go a long way to stimulate, facilitate, and enhance research undertakings in many domains such as business, health, education, and science and technology as a whole.

According to Jensen (2007) Internet facilitates dialogue among communities and with government planners, development agencies, researchers, and technical experts: encourage community participation in decision-making; coordinating local, regional and national development efforts for increased effectiveness; and help aquaculture researchers, technicians, farmers and others in sharing information. Internet can also give a vast global information resource. The Internet has proven valuable for the development of Fisheries in developing countries.

It is not enough to generate information alone but it is also necessary to ensure that the required information is delivered to the end users at the earliest and with the least dissemination loss. The establishment of aquaculture technology information centers (ATIC) can forge a better interaction between researchers and technology users. This acts as a single window system with an objective to help farmers and other stakeholders to provide solutions to their aquaculture related problems. This also helps in providing technological information along with technology inputs and products. Such information is useful for farmers, entrepreneurs, extension workers, NGOs and private sector organizations.

Aquaculture — the farming of aquatic plants and animals — makes a vital contribution to nutrition. Fish is a rich source of protein and fatty acids, vitamins, minerals and other micronutrients.
Fish is a critical addition to starchy staples in the diets of millions of poor people in the developing world and demand for it is increasing. Meeting this demand from wild fisheries, which are largely dependent on fully or over-exploited stocks, is not an option. By contrast, aquaculture has been the world's fastest growing food sector for the past two decades. Worldwide, almost half of all fish eaten is farmed rather than caught. Throughout the half-century following the end of the Second World War, fish farming in Sub-Saharan Africa was promoted by donors and development organizations as a means of diversifying livelihoods among smallholder farmers.

Aquaculture is growing at a much faster rate in developing countries than in developed countries. The FAO states that from 1990-1996, developing countries grew in aquaculture production at an average of 16.7%; whereas advanced economies grew at an average of only 2.9%. Aquaculture is a relatively new and underdeveloped farming practice compared to agriculture and animal husbandry, even in many parts of Asia. Its positive social and environmental attributes make it an attractive entry point to improve the livelihoods of the poor in rural development programmes, Edwards (2000). For aquaculture to make greater contributions to rural development, policy implications like targeting the poor and associating them at least initially with public sector support are very important although aquaculture has to function on a self-financing basis with in the private sector.

The contribution of Sub-Saharan Africa (SSA) to global aquaculture production remains insignificant but is increasing significantly. Between 1998 and 2007 there was a four-fold increase in production from 43,000 to slightly over 183,000 tonnes. The average yearly growth (APR) was 14.45 percent. This was due to the emergence and intensification of private sector led small and medium size enterprises and the expansion of large commercial ventures, stimulated in some cases by growing public support and the inflow of foreign capital and expertise.
International awareness and interest in aquaculture spawned by the NEPAD Fish for All Summit in 2005 and implementation of the FAO Special Programme for Aquaculture Development in Africa (SPADA) also contributed to this development. Farming fish provides food for smallholder families, and fishponds, by providing a constant source of water, can reduce vulnerability of an entire farm to unpredictable rains. We also know from Malawi and elsewhere that it makes excellent use of on-farm wastes and increases nutrient recycling. But family-owned ponds in Africa are generally small and, because they depend on scant on-farm resources, unproductive, generating little surplus for sale. Moreover, my experience is that many years of technical advice are needed for smallholders to sustainably adopt fish farming.

Yet aquaculture production in Sub-Saharan Africa is growing fast, albeit from a low baseline. Aquaculture has increased three-fold in the past seven years, though it remains less than 0.2 per cent of global production. According to recent Food and Agriculture Organization figures, fish farming in Malawi, Mozambique, Nigeria, Togo and Uganda is among the fastest growing in the world. This growth has largely been achieved through a relatively new phenomenon on the continent: the development of small and medium enterprises (SMEs) in aquaculture. SME producers are primarily motivated by profit. They have larger ponds, use off-farm resources and produce tonnes rather than kilos of fish. SME aquaculture producers create market chains, providing jobs not just for producers, but also those who supply credit, fry and fingerlings to stock ponds, fertilizers and feed, as well as those who distribute, process and trade the farmed fish.

Many of these job opportunities are for women and the socially marginalized. In Cameroon, a number of the larger commercial catfish hatcheries are run by women, while the majority of those engaged in seaweed farming in Tanzania are also women. Increasing the support to the SME sector is vital to help aquaculture improve the diets of
Africa's rapidly urbanizing populations. First and foremost, this means working in partnership to develop productive, profitable technologies.
As well as ponds, cages — net enclosures, installed in lakes, reservoirs and river margins — are the most widely used production systems. While fish production can be readily increased by stocking more and larger fish and by using more fertilizers and feed, it is critical to understand how these actions contribute to profits.

2.2 Internet and Aquaculture in Kenya
For geographically remote locations, connectivity through computer networks may be an appropriate way to provide information to farmers. For example, each village centre could communicate with the outside world, nearby villages, other countries or other continents, via several types of communication tools, such as dial-up telephone connections, wireless networks or a satellite communication system called very small aperture terminal (VSAT).

The Internet’s popularity, its efficiency in communication and the reducing price of hardware have resulted in the implementation of Internet connectivity in several projects such as the iKisan.com project (Tiwari, 2008), the Tarahaat project (Tiwari, 2008) and the e-Choupal project (Rao, 2007) in India. These projects have applied a variety of connectivity based technologies to the needs of each project. Telephone dial-up connections may be a simple answer for limited budget projects with low amounts of data transferred within telephone line-covered areas. Examples are the i-Village and the Gydanroot projects (Tiwari, 2008).

Other studies have reported how the Internet has assisted farmers. The i-Community by Hewlett-Packard project chose VSAT to solve the last mile” connection problem (Tiwari, 2008). This solution accords with the e-Choupal and the i-Village project (Tiwari, 2008). Additionally, the VSAT was also an alternative mode of connection used by the Zee Interactive Learning System for its communication satellites (Sood, 2001). Wireless
networks are another alternative for limited and unstable telephone lines in rural areas. For instance, a wireless system has been used occasionally to transfer off-line contents in a project in Pondicherry (Sood, 2001). Furthermore, Wireless-in-Local-Loop (WLL), which is able to transfer both data and voice simultaneously across long distances, was an option implemented by the Indian Institute of Technology Madras (IIT-Madras) (Sood, 2001). These channels have been applied to disseminate aquaculture information in local languages which were more attractive to Internet users (Sheriff, 2009). Furthermore, alternatives of preferred languages have been made available for users (Rao, 2004). Web 14 portals, agricultural databases and Internet kiosks presented in local languages have been developed and then introduced to needy farmers in order to encourage them to develop more knowledge (Rao, 2004; Tiwari, 2008).

Both private and public networks have been established for use by the agricultural industry. For example, private networks have been set up in African countries. The Regional Informatics Network for Africa (RINAF), for instance, has been shared among Kenya, Malawi, Tanzania, Uganda, Zimbabwe and Zambia (Kiplang, 1999). The Africa Regional Standards Organization Network (ARSONET) project which connects Ethiopia, Egypt, Kenya and Senegal is another good example (Kiplang, 1999). Additionally, private networks for communicating between business and farmers or among villages are another option.

Africa has a low level of internet access. This is partly due to poor telecommunication infrastructure with low bandwidths in most of the countries. In addition only a few countries operates internet exchange point and hence this impact negatively on high international traffic. (Ngini et al., 2002), referring to (ITU, 2001) report indicates that the continent has a teledensity of 2.48 which is far below that of developed countries. The cost of accessing internet remains high in Africa. The scenario in Kenya is different from the developed world. Kenya has a high capacity international bandwidth but national backbone which is not fully developed. Since 2009,
three fiber-optic submarine cable systems have landed in Mombasa; SEACO, TEAMS and EASSY. The 2010 report from the communications Commission of Kenya (CCK) indicates that at Sept 2010, the total international bandwidth available in the country was 202,240 Mbps – which includes submarine (99%) and satellite (1%) bandwidth.

The (CCK, 2010) report further indicates that access to traditional lines is very limited in both urban and rural areas. They have singled out Nairobi (14.1%) and the coast province (6.9%), all remaining provinces have a rate of access less than 5% the main point of access in Nairobi is people’s home. The report brings out that, in all other provinces the main access points are the office or a payphone. It concludes that the traditional fixed lines play a minimal role as a means of access to ICT services in Kenya. The access cost to internet services still remain high to most of the citizens, with majority earning below a dollar per day. The (CCK, 2010) report observes that the lack of access takes place in low-income and rural areas, making poor people pay more for the services than high income individuals living in urban areas.

Aquaculture entails growing (farming) of fish and other aquatic organisms in controlled environment. The farmed fish or organisms are deemed to be of commercial value. Aquaculture is the only viable alternative source of fish especially at this time when the natural stocks of fish are dwindling. Kenya has great potential for aquaculture growth because it is endowed with climatic diversity, natural features and other resources that favor the culture of a wide variety of aquaculture species. However though not yet quantified, only a small portion of these resources are utilized.

Aquaculture in Kenya can be categorized into three broad divisions. These are:

- Warm fresh water aquaculture dominated by the production of various species of tilapia and the African catfish (clarias gariepinus) mainly under semi intensive systems using earthen ponds
- Cold fresh water aquaculture involving the production of rainbow trout (Oncorynchus mykiss) under intensive systems using raceways and tanks.
- Marine water aquaculture (mariculture) which is underdeveloped.
The Tilapine species constitute about 90% of aquaculture production in Kenya. Polyculture of the Tilapine with the African catfish is under mixed sex culture systems. The production of the Tilapine and the African catfish is characterized by low pond productivity mainly due to poor seeds and employment and low pond management practices. The result has been stagnation of National aquaculture production over the past decade.

Aquaculture contributes about 1% of the total national fish production. Approximately 1000 million tons are harvested from 7,477 small ponds owned by about 4,742 fish farmers. The current mean yield from fish farming is approximately 5.84Mt/ha/year. It is important to note here that this figure could be much higher if fish produced and consumed by farmers, bait and ornamental fish produced are accounted for.

Over the years the government has constructed several aquaculture facilities in various parts of the country. These centers serve as research centers, training facilities for fisheries personnel and fish farmers, aquaculture demonstration centers and sources for fingerlings to farmers. Some of the important ones are:

1) Sagana Fish Farm – Kirinyaga
2) Kiganjo Trout Hatchery – Nyeri
3) Ndaragua Trout Farm – Nyandarua
4) Chwele Fish Farm – Bungoma
5) Walchungu fish farm – Busia
6) Sangoro Research Station (Kenya Marine and Fisheries Research Institute) – Rachuonyo
7) Kibos fish Hatchery (Lake Basin Development Authority) – Kisumu

Aquaculture as a potential contributor to national development is presented with a lot of opportunities in Kenya. Some of these are:
1. Recognition by the government in its various strategic development papers as a priority area especially for the rural development and the government has created conducive climate in which aquaculture can flourish.

2. Aquaculture can easily be integrated into conventional farming including small scale crop and animal production in the rural areas and maximize resources use.

3. Aquaculture management involves issues conventional farmers deal with e.g. stocking, harvesting feeding etc.

4. Aquaculture is legitimate user of land and water, consequently, industry has equitable access to the aquatic resource base.

5. Aquaculture is considered in the development of fisheries management policies.

6. Aquaculture development is focused and implemented, in a manner consistent with national objectives, and standards.

7. The government is harmonizing policies and regulations essential to aquaculture development.

8. The government has put in a lot of effort in research and development and technology transfer which are prerequisites for industry development.

9. An appropriately trained workforce essential to aquaculture development in place

2.3 Telephones and mobile phones used as a connection to Internet

The telephone system is not only a fundamental communication infrastructure but also a basic facility which supports the use of other technologies. For example, in some African areas, the telephone was the only ICT tool used by most farmers (Bertolini, 2004 cited in Munyua, Adera & Jensen, 2008). Its advantages included adaptability and the capability of transferring both voice and data at gradually decreasing cost (Mangstl, 2008). Additionally, mobile communication technologies have become gradually more important in many parts of the world, especially in improving the delivery of information about agriculture (Munyua, Adera & Jensen, 2008). These communication devices present several advantages such as portability, wide range of coverage and instantaneous
two-way communications. For instance, mobile phones were used to communicate among Ghanaian.

Fishermen with the purpose of providing each other with information about where to fish, weather conditions and market prices. Real-time aquacultural information and fish prices were also provided through mobile phones in Senegal (Munyua, Adera & Jensen, 2008). The advice communicated about best place to sell their catch was also utilized by Kerala fishermen in India (Abraham, 2007 cited in Mittal & Tripathi, 2009; Jensen, 2007 cited in Mittal & Tripathi, 2009).

Furthermore, the availability of state-of-art technologies, which are now integrated into mobile phones, has further improved communication. Built-in global positioning systems (GPS), high-resolution digital cameras and short-length video recorders are exemplary embedded technologies. These advances facilitate the use of mobile phones for sending and receiving voice, text, image and video information (Munyua, Adera & Jensen, 2008). In addition, most respondents in Hassan et al. (2008) study claimed that telephone and mobile phones have become ubiquitous. Other studies have found that mobile telephony is regarded as the most successful ICT tool used in attempts to develop the global agricultural sector (Mangstl, 2008).

Mobile telephones have been used by farmers for a variety of purposes. For example, Jensen and Thysen (2003) reported that short message service (SMS) was used to acquire required information, such as weather information and suitable time to spray pesticides. Besides information delivery, the mobile phones can be applied to specific other purposes such as transferring money from one bank account to another for labour payments and input purchases in Kenya (Hafkin & Odame, 2002 cited in Munyua, Adera & Jensen, 2008).
Moreover, market information in voice mail formats, and also the access of information in the internet through mobile phones is delivered to Kenyan farmers (Munyua, Adera & Jensen, 2008). Other research studies have reported that farmers and agricultural experts are sending information as images via mobile phones with a built-in digital camera and internet access (Parikh, 2009). This approach saved time and money in addition to providing more support by a limited number of aquaculture experts to a greater number of farmers over a larger area.

2.4 Use of Internet in aquaculture in developing countries
Most developing countries’ economies are based on an agricultural or food industry. For example, growing rice for consumption is the main agricultural activity among impoverished families in Thailand (Office of Agricultural Economics [OAE], 2009). However, small farm activities cannot cover all expenditure; an OAE’s (2009) study found that about 80% of Thai farmers were still in debt. Poor farmers thus need income from other sources, such as out-of-farm jobs.

As Internet has spread throughout the world, Internet tools and techniques have been employed in aquaculture sector with the hope that they will eventually improve agricultural productivity, quality and values. Karnka’s (2006) study, which provided computer sets connected to the Internet for a specific farmer group, revealed that most participants had positive attitudes toward the use of internet for supporting their learning activities. These respondents also regarded the Internet as not only a useful information source but also as a more credible information provider (OAE, 2009). Furthermore, the success of innovations in learning also depends on the communication channels used (Elsey & Sirichoti, 2003).

Karnka’s (2006) study found that after becoming familiar with using the Internet, the respondents positively changed their mind toward the complications of using internet. However, at first, attitudes toward the use Internet among farmers were expressed as
novel, extravagant and too modern for them (Karnka, 2006). These attitudes can be seen as a challenge to overcome in order to encourage needy farmers to adopt innovations. Moreover, foreign languages, and too generalized information in conjunction with low-speed and unstable Internet connection were seen as barriers to access to required information by impoverished farmers in a developing country (Karnka, 2006).

2.5 Use of Internet in Aquaculture in developed countries
Although a number of studies in developing countries showed that TV was a main source of aquaculture information among poor and illiterate farmers, TV did not show this kind of significant role in some developed countries such as New Zealand and the USA (Field et.al, 2007; Locke, 2005). The use of the Internet for agricultural purposes, such as record keeping, online selling or purchasing and searching for information, was about 31.8% of the farmers in Locke’s (2005) study. This finding was in accordance with Pickernell et.al (2004) study that 71% of respondents used information technology for business purposes. In details, 33% of the respondents had their own web sites and customers were able to perform their purchases online on 18% of the respondents’ web sites (Pickernell et. al, 2004). The ICT networks also facilitated the knowledge transfer, in forms of either technical information or advice, between farmers and experts in a training programme held in the Northwest of England (Lowe, 2011).

In contrast, American farmers were more likely to use traditional media, such as print media and interpersonal sources, compared to electronic information sources (Diekmann & Batte, 2009). In detail, it was also found that print media were more preferable to Ohio farmers than interpersonal sources and broadcast media (Diekmann & Batte, 2009). Additionally, it was supported in an American study that even a number of aquaculture information available in various forms, other farmers were considered as one of the most important information sources (Velandia et al, 2011).
Despite reports that the number of computer and Internet users in developed countries was much greater than those in developing countries (Warren, 2004), some barriers to technology adoption among farmers in developed countries still occur. Reason behind those obstacles is the lack of appropriate hardware: for example, a number of farmers in the USA and the United Kingdom did not have a computer; or had a low-performance computer (Warren, 2004). In addition, only a half of the English farmers who owned a computer used their computer for business purposes (Department for Environment, Food and Rural Affairs [DEFRA], 2002 cited in Warren, 2004). In England, farmers surfed the Internet for both business and non-business purposes including checking the weather reports, checking input and productivity prices, searching for farming information, sending emails to friends and family and general browsing (Warren, 2004).

Moreover, lack of awareness of internet capabilities is another issue in aquaculture development in developed countries (Warren, 2004). Even in developing countries such as New Zealand, a difficulty on ICT infrastructure could be found in rural areas which partly caused a delay in adapting internet for aquaculture purposes (Shiblaq & Fielden, 2008). It was also reported that the level of education as well as household income related to the tendency of adopting new technology (Archer, 2004 cited in Shiblaq & Fielden, 2008; Warren, 2004).

Nevertheless, it is found that family members play a significant role in internet adoption by passing relevant information to other members who were not confident about internet tool usage (Warren, 2004). Additionally, family members tended to realize internet potentials and had positive attitudes toward using internet for their business, especially if a child or a spouse had skills in using a computer and the Internet (Warren, 2004).

Furthermore, it was found that the importance of information sources in farmers’ point of view may be affected by their age, land tenure and income (Velandia et al, 2011). Additionally, extension officers were more influential to decision making than other farmers in high income or old farmers’ point of view (Velandia et al, 2011). Computer
wireless connections and the third generation (3G) mobile telephone networks were expected to be crucial means in improving agricultural sectors in developed countries by combining a mobile phone with a handheld computer to transfer a variety of information types at a higher rate (Warren, 2004). Additionally, e-Commerce was anticipated to be a key distribution channel for aquaculture businesses (Pickernell et al., 2004).

2.6 Drivers for the use of ICT in agriculture
To encourage a group of people to try something new requires effective drivers and benefits to convince them. Turkish farmers in Sindir’s (2005) study were a good example of a group resisting the adoption of new technologies until the consequent advantages were realized. Relative advantages from the changing behaviors were considered as the most important factor among trained farmers in Elsey and Sirichoti’s (2003) study. These advantages maybe better yields and incomes from adopting new technologies or practices including breeding new fish species (Kalusopa, 2005; Sheriff, 2009).

Reliability of information sources is also an important issue for adopting new knowledge. Poor credibility or unfamiliar information channels are likely to cause illiterate farmers to be reluctant to take any risks or to experiment with new methods and practices. moreover, it is confirmed in Elsey and Sirichoti’s (2003) study that the source of information was ranked second for adopting new knowledge into practices. Furthermore, appropriate aquaculture information may directly reduce costs of aquaculture inputs, improve quality of the fish produced and increase chances to get higher selling prices (Kalusopa, 2005). Internet also plays a role as an assistant for information flows from senders, who usually are researchers, academia, government officers. In some situations, as shown in an IICD’s (2006) project, knowledge senders and receivers can be farmers transferring experiences from one group to other groups.

2.7 Barriers to the use of Internet in Aquaculture
Studies and projects around the world related to aquaculture information dissemination have encountered different obstacles depending on several issues (Kari, 2007; Margono
These problems include poverty, illiteracy, insufficient support, lack of timely information, user-friendly interface, two-way communication, insufficient network infrastructure and a lack of awareness of internet benefits and cultures (Kari, 2007; Margono & Sugimoto, 2011; Ratnam, Krishna Reddy & Reddy, 2005).

Most farmers in developing countries are not able to earn adequate incomes to cover all expenses for living and carrying out agricultural processes. Therefore, all revenue is saved for necessary expenditure such as food and aquaculture supplies. In many studies, even fundamental communication tools such as radios, televisions and telephones were viewed as extravagant assets and had to be shared among community members (Irivwieri, 2007; Opara, 2008). Moreover, in some areas, other more expensive ICT tools like computers and mobile phones could not be taken into account unless provided by the project supporters (Sheriff, 2009; Sindir, 2005). This issue exacerbates the lack of useful information dissemination through ICT tools.

Illiterate unskilled workers are also a vital problem for information delivery via ICT tools in many developing countries (Curtain, 2003). It is also claimed that poor people in developing countries did not necessarily have fluency in their own language (Mangstl, 2008). In some areas, all members of the community disclosed that they have not used computers before (Sheriff, 2009). Additionally, use of many state-of-art devices may require some level of capability or experience (Sindir, 2005). This may hinder knowledge transfer processes, particularly scientific concepts. In the worst case, farmers may be forced to move into other types of agriculture in which they have not been involved previously (Irivwieri, 2007).

This problem is aggravated when it comes to valuable information resources at the global level in which English is typically used (Rao, 2004; Mangstl, 2008). Unavailability of aquaculture information in local languages may hinder the improvement of aquaculture
information dissemination (Curtain, 2003). Even in some countries where different local languages have been used, communicating and transferring information is not always easily done. In Nigeria, different twenty five local languages had been used in different thirty seven states (Oladele, 2006). This causes inconvenience when it is necessary to produce materials in many different languages in order to provide the same contents. While there is a large amount of information freely available on the Internet, financial and hardware supports only; cannot help people in many countries to understand those contents what are provided in a foreign language.

Fundamental infrastructures and ICT devices may be insufficient or poorly-functioning in rural areas in many developing countries, for several reasons such as inadequate support from government and private sectors, unstable or restricted power supply, unavailability of landline phones, delayed restoration of communication networks after failure and insufficient network connectivity (Sood, 2001; Tiwari, 2008). In an on-going project, unreliable connectivity and hardware malfunctions also amplified the levels of displeasure among users (IICD, 2006). These issues limit the optimal use of internet for disseminating information to needy people. Additionally, inconsistent national policies were also claimed to be an obstacle for progress of aquaculture development (Kizilaslan, 2007; Sindir, 2005).

Besides infrastructure, information and other supports from government or government officers, have not fulfilled the requirements of needy farmers. Insufficient information support and weak links between information users such as farmers, researchers and extension workers were reported to be major factors for low agriculture yields (Ministry of Agriculture, Republic of Kenya, 1997 cited in Kiplang’tat & Ocholla, 2005). The relationships between extension workers and farmers in some areas needed to be strengthened because some farmers had the perception that the extension workers do not provide the necessary information; or use technical and scientific terms which could not be easily understood (Kalusopa, 2005; Irvwieri, 2007).
Ill-timed recommendations from experts or aquaculture support systems are one of the difficulties reported in several studies. Useful information which arrives belatedly may be considered as useless. This situation may cause unfavorable yields from aquaculture activities or result in sub-optimal incomes (Krishna Reddy & Ankaiah, 2005). Moreover, complaints in regard to behind-schedule market prices were raised among project participants (Rao, 2007). Farmers unaware of the advantages and benefits from utilizing internet presented another difficulty to be overcome (Rao, 2004). This issue may cause a large amount of investment and effort to become worthless.

2.8 Impacts
Attempts to apply technological tools and techniques along with aquaculture knowledge result in a number of benefits. At first, the ICT tools improve the accessibility of valuable information in a broad range which may lead to improved productivity and quality (Rao, 2004). The tools along with appropriate training, also emphasize the approachability of government resources and services which will eventually lead to continuing growth of the e-government concept (Rao, 2004). Furthermore, the technological training not only affects the improvement of aquaculture practices among farmers but also enhances their skills in using internet for other purposes such as long distance education, life-long learning and online services (Rao, 2004). Eventually, when the farmers are familiar with the use of ICT technologies, the opportunities for livelihood development will be gradually increased with minor supports from outside. Further, with the confidence, it will be easier to adopt recent and advanced internet use.

2.9 Theoretical Framework
In this study Reception Theory and Two step flow theories will be used. Reception theory is a version of reader response literary theory that emphasizes the reader's reception of a literary text. It is more generally called audience reception in the analysis of
communications models. In literary studies, reception theory originated from the work of Hans-Robert Jauss in the late 1960s.

Reception theory is an approach to textual analysis which puts more emphasis on the audience, the meaning is made at the moment of consumption. At that moment, the individual audience member considers the representations presented to them in the context of their own values, opinions and experiences. Therefore, people with similar socio-cultural backgrounds are likely to make similar readings of the same texts. The theory also follows, that if the audiences values, opinions and experiences are similar to the producers, then they are likely to read the meaning of the text in the way it was intended, or at least which is very close to it.

Stuart Hall a leading sociological thinker of the late twentieth and early 21st century's, whose writings often encompass media perspectives. Explored how texts make meaning, as was the predominant practice of his analytical forerunners, for Hall, the meaning of the text is not inherently in the text itself. From this Hall claimed that no amount of analysis can find the texts actual one meaning because different people who encounter the text will make different interpretations.

This can be applied to other media formats such as films, TV, internet etc, as an audience not all like the same characters portrayed in those media texts but we are all able to see the same representations. The technical and symbolic codes which construct the representations we perceive are the same as the denotation is often the same.

The two-step flow of communication hypothesis was first introduced by Paul Lazarsfeld, Bernard Berelson, and Hazel Gaudet in *The People's Choice*, a 1944 study focused on the process of decision-making during a Presidential election campaign. These researchers expected to find empirical support for the direct influence of media messages on voting intentions. They were surprised to discover, however, that informal, personal contacts were mentioned far more frequently than exposure to radio or newspaper as sources of
influence on voting behavior. Armed with this data, Katz and Lazarsfeld developed the two-step flow theory of mass communication.

This theory asserts that information from the media moves in two distinct stages. First, individuals (opinion leaders) who pay close attention to the mass media and its messages receive the information. Opinion leaders pass on their own interpretations in addition to the actual media content. The term ‘personal influence’ was coined to refer to the process intervening between the media’s direct message and the audience’s ultimate reaction to that message. Opinion leaders are quite influential in getting people to change their attitudes and behaviors and are quite similar to those they influence. The two-step flow theory has improved our understanding of how the mass media influence decision making. The theory refined the ability to predict the influence of media messages on audience behavior, and it helped explain why certain media campaigns may have failed to alter audience attitudes and behavior.

An integrated approach to the expansion of Internet services will promote the necessary (but often neglected) horizontal communication between agencies linked to rural and agricultural development. Therefore when Internet is used as a tool to promote and relay information about Aquaculture to the farmer it does not only create a relationship between the farmer and the text but the farmer is able to interpret and give meaning to the text and this will go a long way in promotion and development of Aquaculture.
CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction
This section deals with the methodology which was adopted by the study so as to ensure that the objectives were achieved. It outlines how the study is to be carried out, the research design, the population, sampling design and the sample size, data collection method and instruments and data analysis.

3.1 Descriptive Research
Descriptive research is used to obtain information concerning the current status of the phenomena to describe "what exists" with respect to variables or conditions in a situation. The methods involved range from the survey which describes the status quo, the correlation study which investigates the relationship between variables, to developmental studies which seek to determine changes over time (James, 1997).

Descriptive studies are helpful in revealing patterns and connections that might otherwise go unnoticed. Descriptive research is also used to obtain information concerning the current status of the phenomena to describe what exists with respect to variables or conditions in a situation.

This research was a descriptive study aimed at analyzing the role of Internet in the promotion of Aquaculture with particular reference to the Ministry Agriculture, Livestock and Fisheries fish Farming project.

3.2 Population of the Study
Schloss P, and Smith M, (1996) state that target population is a large population from which a sample is to be selected for the purpose of research. This project’s targeted population was the Aquaculture farmers and officers from the Ministry of Agriculture, Livestock and Fisheries. The study used inferences gotten from the population
characteristics exhibited in the samples. So as to ensure that inferences made about the population characteristics on basis of the sample characteristics are accurate, the elements in the sample must be representative of the population.

3.3 Sample size
Wiersma and Jurs (1991) state that a sample is a subject of a target population to which the researcher intends to generate the findings. According to Best and Kahn (1998), an ideal sample should be large enough to serve as an adequate representation of the population about which the researcher wishes to generalize and small enough to be selected economically in terms of availability and experience in both time and finances.

3.4 Sampling Techniques
Simple random sampling is to be used to select 15 respondents form the Ministry of Agriculture, Livestock and Fisheries to form part of the study. From the data acquired from the Ministry of Agriculture, Livestock and Fisheries thirty large scale farmers middle and low level farmers were selected using simple random sampling from the counties constituting the respondents for the study.

To ensure an unbiased sample, every member of the population had equal opportunity to be selected in the sample, Pattern, (2004) thus random sampling.

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large scale farmers</td>
<td>14</td>
</tr>
<tr>
<td>Middle level farmers</td>
<td>10</td>
</tr>
<tr>
<td>Low level farmers</td>
<td>6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

3.5 Data Collection methods
Questionnaires were used for this study because they are much more efficient in that they permit collection of data from a much larger sample. Schloss P and Smith M, (1996). Plus, all the respondents who participated in the study are literate and therefore capable of answering the items adequately. Questionnaires also allowed respondents to
give frank answer to sensitive questions especially if they are not required to disclose their identity. The research administered the data collection instruments. All respondents were assured of confidentiality and security. Questionnaires were reinforced by conducting in-depth interviews to collect detailed information on the area of study.

The questionnaires were administered through face to face method to the respondents and the questionnaires consisted of two sections. The first part included the demographic and operational characteristics designed to determine fundamental issues including the demographic characteristics of the respondents. The second part was devoted to the identification of the role of internet in the promotion of Aquaculture where the variables of the study were into focus.

These questionnaires consisted of both open (unstructured) and closed (structured) ended questions. The structured questions were used to facilitate an easier analysis as they were in immediate usable form; while the unstructured questions were used so as to encourage the respondent to give an in-depth and felt response without feeling held back in revealing of any information.

3.6 Data Analysis and Presentation
Quantitative technique is a scientific method of investigation that employs numerical data. The researcher used his knowledge and judgment to get the important information from the pile of data and summarized the data. Qualitative technique is a scientific method of investigation based on the use of non-numerical data. It uses textual data during investigations and method used will be the response from the open questions. Weber R.P (1985). The researcher employed qualitative technique to analyze the non-numerical data. This helped in establishing meanings, contentions, intentions, trends, patterns and relationships from the area of study. The findings were presented using tables and charts. Descriptive statistics like frequencies, percentages, means, standard deviations and other central tendencies were used.
CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.0 Introduction

This chapter presents analysis and findings of the study as set out in the research methodology. The results are presented on the role of internet in the promotion of aquaculture. A case study of the ministry of agriculture, livestock and fisheries fish farming project. The data was gathered exclusively from questionnaire as the research instrument. The questionnaire was designed in line with the objectives of the study.

4.1 Response Rate

The study sampled 15 respondents who are government officials and 15 respondents who are fish farmers in collecting data with regard to the role of internet in the promotion of aquaculture. A case study of the ministry of agriculture, livestock and fisheries fish farming project. From the study, 13 out of 15 government officials filled in and returned the questionnaire contributing to 86.7%, while 12 out of 15 fish farmers filled in and returned the questionnaires contributing to 80%. This commendable response rate was made a reality after the researcher made personal calls and visits to remind the respondents to fill-in and return the questionnaires.

Table 4:1: Response Rate

<table>
<thead>
<tr>
<th>Response from government officials</th>
<th>Frequency</th>
<th>Percentage</th>
<th>Response from fish farmers</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responded</td>
<td>13</td>
<td>86.7</td>
<td>Responded</td>
<td>12</td>
<td>80</td>
</tr>
<tr>
<td>Not responded</td>
<td>2</td>
<td>13.3</td>
<td>Not responded</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>100</td>
<td>Total</td>
<td>15</td>
<td>100</td>
</tr>
</tbody>
</table>
4.2 ICT tools used by the ministry for the promotion of aquaculture

Computer, Internet and mobile phones ranked the highest in the most preferred ICT tools used in the promotion of aquaculture. According to the survey 99 percent of the government officials had access to the Internet though the quality of internet service varied depending on the region. Other forms ICT tools such as TV, radio, CD/DVD players were also used in the promotion of aquaculture in Kenya. In some instances community loud speakers were also used in the promotion of aquaculture.

Figure 1. ICT tools used by the ministry for the promotion of aquaculture

With the help of the ICT tools the government officials drawn from the Ministry of Agriculture, Livestock and Fisheries and in particular the department of Fisheries provide technical information on site selection, pond design, construction, feeding and the best management of aquaculture at all the levels of value chain, advice on proper and appropriate harvesting is also provided.
4.3 Kind of tools used to access internet by government officials.
In terms of the kind of tools currently used by the participants to access internet, The survey showed that computers (40.6%) was the most popular internet tool used, followed by mobile phones (32%) as aquaculture information source. This conforms with Iriwieri”s (2007) conclusion that computers and internet enabled phones are a major source of getting aquaculture information among literate government officials and literate farmers. Its popularity may be due to the high incidence of literacy among government officials in the department of fisheries. (21.4) of the participants also reported that they used internet cafes to access internet while (6.4%) of the government officials also use the I-pad to access internet for aquaculture information.

Figure 2. The kind of tools used to access internet by government officials

4.4 How often and how much time officials would like to spend acquiring new information.
Participants were asked for feedback about the frequency of information about aquaculture transmission and the time devoted to that transmission. Their opinions about various frequencies and times were sought. Nearly a half of the participants (45.3%)
preferred a one hour information session for daily transmission, whereas another 32.1% preferred the length of 45-minute long information sessions. When asked about a potential weekly transmission, the majority of the participants (43.6%) also had a preference for 15-minute information sessions while another 29.3% favored 30-minute long information sessions. In addition, 36.3% of the participants preferred a 30-minute long information session for a monthly transmission. However, a smaller percentage of the participants (31.9%) also preferred to keep the information session at a length of 15 minutes. Overall, it can be seen that the longer the length of information, the less often it was preferred by the participants as shown in Figure 3 below.

**Figure 3. How often and how much time officials would like to spend acquiring new information.**

The survey showed that all the government officials and the extension officers had access to the internet. The government officials also noted that extension workers encountered transport problems in trying to reach the farmers, and they also lacked a standardized manual for their extension services.
4.5. Positive outcomes realized after offering services to fish farmers
With the aquaculture information that the government officials get through the internet, they offer services to farmers who reported the following positive outcomes. 60% of the officers interviewed reported that farmers had increased productivity, while 40% reported higher selling price for the farmers produce due to improved yield.

Figure 4. Positive outcomes realized after offering services to fish farmers.

To further improve how aquaculture information is disseminated to government officials, suggestions such as automatic updates to be provided that is in collaboration with mobile services providers. Information provided should also be in a simplified form for easier understanding. There is also need for increased publicity through advertisements, promotions, publication of aquaculture magazines and aquaculture pamphlets. More information/resource centers in villages should also be established.
4.5.1 Summary Statistics for Respondents from Ministry of Agriculture, livestock and fisheries (Government officials)

**Respondent’s Gender**

Out of the 13 government officials who responded ten were male which marks 76 percent of survey respondents, while the remaining 3 were female this represents 24 percent of the respondents.

**Figure 5. Respondent gender**

- **Respondent’s Age**

Figure 5 shows the number of respondents in four different age groups. The highest number of respondents (5) were in the 41-45 age group, and it was about 38% percent, while those falling between the age group of 31-35 constituted 30% of the total respondents, those in the age groups of 36-40 and 26-30 both represented 15% each of the respondents, while 21-25 represented the remaining 10%.
Figure 6: Respondent’s Age

![Age Distribution Chart]

- **Respondent’s Education**

  The highest respondent education level was bachelor degree (53 percent) followed by masters degree (38 percent). Results indicated that all respondents had more than ‘high school’ education, and about (10 percent) had education levels less than ‘4 year college (B.S./B.A.) degree’. The survey data indicate that government officials are relatively well-educated. Government officials who are computer literate would be expected to be better educated.
4.6 Results of Questionnaire of Representative Farming Groups

A preliminary survey concerning farmers’ information needs, their farming data and ICT usage behaviors was conducted to frame a study implementation. The questionnaire contained three types of questions, namely closed questions, open-ended questions and opinion questions using Likert scales. General demographic data including education, age, gender, marital status, were collected through a questionnaire.

The percentages of male and female computer users and Internet users were somewhat similar. As a result, participants’ gender should be considered, to see ether if it is related to the use of internet among farmers. Additionally, the use of Internet among farmers showed remarkable differences among each educational category.

It was noted that a number of rural residents had to share even basic communication tools. They had a chance to use high technology tools, such as computers and mobile phones only when they were offered free by research projects. It may be assumed that affordability is another reason affecting the use of internet among rural community
members. Therefore, the relationship between income and the use of internet for obtaining new aquaculture knowledge should be determined. Moreover, other characteristics of farmers, such as family size, farm size and marital status, were included to examine whether these factors affect the use of internet for obtaining aquaculture information. In addition, the types of information required, internet availability in the target areas, farmers’ ability to use internet, expectations and attitudes toward information delivery using internet and preferred methods for information delivery were included. Participants’ awareness of currently available aquaculture information in several channels was examined, as were their recollections of positive and negative outcomes after applying aquaculture advice they had previously obtained.

After all distributed questionnaires were collected; all data were encoded in a statistics analysis application, SPSS. Then, basic statistical approaches such as percentages, means, standard deviations and cross-tabulations using Pearson Chi-square were performed to obtain findings. The data analysis was conducted using data gathered from a sample of farmers who were requested to supply information on their sources of information, their preferences toward receiving information via internet. Also their perceptions of the impacts of applying agricultural information, received before the study commenced, were gathered.

4.6.1 Presently used Internet tools and the preference by fish farmers.

In terms of Internet tools currently used by the participants, Table 3 shows the percentage of internet tools used among the fish farmers. The survey showed that computers (73.6%) was the most popular internet access tool used as an aquaculture information source. This conforms with Irivwieri’s (2007) conclusion that computers and mobile phones were the main internet access tool for fish farmers to get aquaculture information. Computers and internet enabled mobile phones helps farmers better understand aquaculture information and material.
By contrast, this result was different to Tarnoczi and Berkes” (2010) findings which showed that computers and mobile phones as a source of internet access only played an additional role to other sources of information.

<table>
<thead>
<tr>
<th>Internet access tool</th>
<th>Percentage use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers</td>
<td>73.6</td>
</tr>
<tr>
<td>Internet enabled phones</td>
<td>15</td>
</tr>
<tr>
<td>Do not use internet</td>
<td>11.4</td>
</tr>
</tbody>
</table>

Contrary to many international studies many fish farmers rarely received aquaculture information from the internet, due to lack of electricity and infrastructure (Ekoja, 2004). However, the different percentages between computer possession and the use of internet enabled mobile phones as an information source may support IICD’s (2006) findings that a majority of the participants regarded computers and mobile phones as a source of entertainment rather than information.

These results were in an agreement with Cecchini (2002, cited in Malhan & Rao, 2007b) that for developing countries the Internet was less useful for improving fish farming decisions. In contrast, developed countries such as the United Kingdom and USA, show higher percentages of internet access in farms at 60% and 55%, respectively (the Department for Environment, Food and Rural Affairs, 2002 cited in Warren, 2004; the United States of America Department for Agriculture (USDA), 2001 cited in Warren, 2004). When they were asked about their willingness to learn or to use internet in order to improve aquaculture productivities, positive results were posted.
4.7 Types of Aquaculture information required and the delivery preference

All participants really needed relevant aquaculture information in order to improve their fish productivity, although their requirements were slightly different. Table 3 presents aquaculture information needs.

Table 3 Aquaculture Information Requirements among Participants

<table>
<thead>
<tr>
<th>Information Requirements</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate fingerlings</td>
<td>62</td>
</tr>
<tr>
<td>Feeding</td>
<td>19.8</td>
</tr>
<tr>
<td>Marketing</td>
<td>14</td>
</tr>
<tr>
<td>Harvesting</td>
<td>4.2</td>
</tr>
</tbody>
</table>

From Table 3, it can be seen that nearly two third of the participants (62%) needed information related to appropriate fingerlings while the other participants required information of fish feed and their prices (19.8%), information on marketing their produce (14%) and harvesting of fish (4.2%). This survey had similar findings to several other studies (Ekoja, 2004; Elizabeth & Zira, 2009; Ogunlade, Oladele & Falaki, 2006) where information on appropriate fingerlings and feeding information occupied the main priority of fish farmers, furthermore, it is in conformity with Aboyade (cited in Ekoja, 2004) that procurement of appropriate fingerlings was the highest ranked request from farmers.

Participants were asked for feedback about how often they would like to receive aquaculture information. Nearly a half of the participants (45.3%) preferred a weekly transmission, whereas another 32.1% preferred a monthly transmission. However another (22.6%) of participants would have preferred a daily transmission of information from the department of fisheries.
4.7.1 Demographic data
The data set was from a total of 15 survey respondents which consisted of both male and female fish farmers. Both study groups were comprised of male and female participants in similar proportions. The figure below shows the percentages of male and female participants.
Overall, most participants (73.4%) were 46 year of age or older. In particular, the male participants were in the 46 to 50 years old category, or were 61 years old or above. On the other hand, the majority in female participants were between the ages of 46 to 55 years old. Figure 2 shows percentage of each age group for each of the two districts.
Characteristically, most participants (67.6%) had an undergraduate level of education. When taken together with participants who also completed secondary school level of education, that figure rose to 80.7% of all participants. The majority of participants (84.0%) were married and 65.4% had four or more members in their household. In terms of land usage and arable areas, most participants (54.6%) were found to use 4 acres or less.

4.7.2 The general view on fish farming in Kenya

Most of the government officials from the department of fisheries interviewed were of the view that fish farming or as commonly referred to as aquaculture was still a new concept to many Kenyans but with the government incentives it has picked up well with 53 percent of the interviewed stating that it is good while 46 percent stated that the situation was good.
CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 New trends in Kenyan Aquaculture
In recent years, more consumers have shown an increased interest in fresh fish products, given that fish is considered healthier (Linnerman et al., 1999). Consumer demand has increased for more high quality fish products, which are expected to deliver specific benefits in terms of health, safety and environmental quality (Van der Heuvel et al., 2007). Fish farmers are interested in technology and the internet as more effective information source (Mishra et al., 2005).

5.1 Summary of the findings

Demographic characteristics
Results from descriptive statistics for the survey indicated that the typical fish farmer was married, male, and the majority of them had acquired bachelors degree, so they were relatively well-educated. The government officials drawn from the Ministry of Agriculture, Livestock and Fisheries and in particular the department of fisheries had a bachelors degree and above so they were as well very well educated. This means that the fish farmers and government officials did not have a problem in computer literacy as well as accessing information on aquaculture from the internet.

Internet use.
According to the Survey, 99 percent of government officials had access to the Internet and reported that they used the Internet. Their mode of access to the internet varied from internet enabled phones, I-pads which were mainly used by more senior officers and computers in regional officers were all connected to the internet.
5.2 Types of necessary Aquaculture information required by Fish farmers

Providing the information that farmers did not truly demand may cause a failure of the ICT services, the survey looked at the requirement and user satisfaction for farmers. It was found that information related to the quality fingerlings, harvesting and marketing was on the highest demand. This may be because the fish farmers may have encountered problems in accessing quality fingerlings for their farms and also marketing for their final produce. Therefore it can be assumed that the type of information currently sought has a relationship with previous problems encountered by the fish farmers.

5.2.1 Factors needed to be considered for information delivery to Fish farmers

It is interesting to note that within Fish farming families, each member had differently impacting roles in conveying aquaculture information. The participants themselves (62.9%) provided aquaculture information to other family members, followed by their spouse (24.3%) and their children (6.4%). The government officials from the ministry of Agriculture, Livestock and Fisheries and in particular the department of Fisheries (56.5%) were mentioned as a major source of aquaculture information to the farmers other sources were web sites which also played a significant role in providing information.

The survey results and interviews with farmers and government officials, some factors needed to be considered in order to improve the aquaculture information dissemination.

The needs survey revealed that age, income and educational background of participants related to the ICT tools used to receive aquaculture information. Significantly, income level of participants related to technology familiarity and attitudes toward the technology services such as convenience, cost, knowledge enhancement, technology practices and information timeliness. In addition,
educational level was also linked to the knowledge enhancement perceived by the participants.

Furthermore, age of respondents also reflect the use of the Internet to receive aquaculture information. This finding corresponded to the fact that the Internet in Kenya became commercialized in less than two decades. Therefore, it may be concluded that the technology emergence also affected the tendency of technology usage for fish farming purposes.

From the interview results it may be assumed that relationship between farmers and government officials responsible in a particular area affected how the information was delivered to farmers. A loose relationship may urge farmers to make use of other available approaches including Internet tools and services.

5.2.2 Effectiveness of the implementation developed in this study

Then, a user satisfaction survey was conducted to evaluate the effectiveness of mobile phones as a tool to access internet for aquaculture information. It revealed that farmers had strong agreements on every measured aspect of the service; namely convenience, ease of use, knowledge enhancement, technology practice, information timeliness and information format. Additionally, more than half of all participants thought that mobile phones were more convenient internet tools compared to computers. Therefore, it may be concluded that fish farmers strongly agreed that internet enabled mobile phones played a critical role in acquiring aquaculture information from the internet.

In addition, interviews with government officials showed that they agreed on the practical use of internet enabled mobile phones as a tool of accessing internet to acquire and disseminate aquaculture information.
5.2.3 How Internet can be used to enhance aquaculture information dissemination to fish farmers

The analysis of the survey revealed that the majority of fish farmers were satisfied with the Aquaculture information that they received through the internet and would like to continue to receive agriculture information on other topics. An overall evaluation of the framework.

Additionally, the interviews with fish farmers showed that the use of ICT tool for aquaculture information dissemination is another option for solving the gap between farmers and government officials. Consequently, a number of fish farmers can receive aquaculture information without waiting for the Fisheries officials’ visits. This benefit will be more obviously seen in remote areas, where are very far from Fisheries offices.

Comments from Fisheries Officers supported the advantages of using the internet to provide the farmers instant announcements to a multitude of farmers in broad areas. This will help farmers stay up-to-date with aquaculture news, the farmers can recheck the information details at anytime they would like to because the provided information can be accessed at any time from the specific website. Compared to TV or radio, if the farmers did not watch or listen to the programs at that time, they would miss the information. In case they had a chance to do that, they might miss some information such as date, time and conditions. Even publications or brochures free provided to farmers included specific information details and could be rechecked several times, the farmers might simply lose these materials.

In addition, it was found in the survey that many factors, such as income, education and gender, may affect the preference of using ICT tools for fish farming purposes.
5.3 Further Studies

In this study, Internet enabled mobile phone was used to see how efficient and reliable it would be in acquiring Aquaculture information through the internet. However, in terms of further implementations to improve the efficiency of aquaculture information delivery, other techniques may be utilized. This section will explain further research issues to be considered if the framework will be adapted as well as technology advancements that can be employed to achieve higher outcomes.

5.3.1 Adaptation of the use of Internet enabled mobile phones

In order to adapt this framework some issues should be considered. For instance, in some parts of the country and in particular the Kenyan Coast not only English is used as a common Language but Kiswahili is used as well in daily life. In order to be effective in information delivery the most used language in a particular area should be taken into account. It may affect the script coding in the application and features for supporting language in the mobile phones.

The 3G network in Kenya does not presently cover all over the country; it will be achieved in the near future. In accordance with the continuously reducing phone prices and better features on mobile phones, short video clips presenting new aquaculture practices or technologies can be a possible option for rural fish farmers. It will be able to compensate for illiteracy among farmers.

5.3.2 Possible technology advancements employed

SMS web service can also be an option that can be pursued in information delivery to the fish farmers. The SMS web service provides an Internet-based application which subscribers are able to log into the system from anywhere around the world via the Internet connection and then manage the content delivery to receivers. Utilizing this technique broadens working areas for the sender.
Alternatively, rather than employing the push technology by disseminating information straight to users, the pull technology which provides the information only on request may be another practice to be considered as shown in Jensen and Thysen’s (2003) study. With this technique, fish farmers will receive Aquaculture information only in the topic that they would like to know and at the time they are convenient to consume. However, to properly use this technique, having a certain level of SMS use skills are necessary to the farming users. Consequently, a requirement on application training for fish farmers themselves or responsible government officials is essential. However, according to Islam and Gronlund’s (2010) study, it also encountered the situation that farmers did not send information requests to the system in a significant amount as it was expected due to their lack of confidence concerning the SMS expense issue. Therefore, to apply this technique comprehensible communication is very necessary. Nevertheless, in case the farming users are familiar with using their mobile phones to request information in their interest or report field problems, all incoming messages are able to be mapped in the geographic information system (GIS) for further analysis, implementations and prediction. For example, after a certain number of requested information related to a fish disease or a certain pest management in a particular area, it may be assumed that the farming areas infected from the outspread disease or pests. Then all connected farming areas should be given a warning. Another example, high requests for a specific type of aquaculture information from the same area may hint the government officials to educate those fish farmers with particular information for better understanding.
REFERENCES


APPENDICES
APPENDIX I

THE ROLE OF INTERNET IN THE PROMOTION OF AQUACULTURE. A CASE STUDY OF THE MINISTRY OF AGRICULTURE, LIVESTOCK AND FISHERIES FISH FARMING PROJECT.

Questionnaire for Government officials

Part A. Demographic Data

1. What is your gender □ male □ female?

2. Please select your age range in the categories provided below (excluding months)

□ Below 15 years old □ 16–20 years old □ 21–25 years old
□ 26–30 years old □ 31–35 years old □ 36–40 years old
□ 41–45 years old □ 46–50 years old □ 51–55 years old

3. What is your highest level of education?

□ Primary school □ junior high school □ high school
□ Certificate □ undergraduate diploma □ bachelor degree □ master degree or higher

Part B. General Information about Aquaculture

4. What is fish farming?

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54
5. What is your general view of fish farming in Kenya?

☐ poor ☐ fair ☐ good ☐ excellent ☐

6. What are the general requirements in starting a fish farm?

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7. In the governments’ policy of poverty eradication, why is fish farming emphasized?

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8. What kind of Information Communication Technology (ICT) tools does your Ministry use in the promotion of Aquaculture? (You can make more than 1 choice)

☐ TV ☐ radio ☐ CD/DVD player ☐ home phone ☐ mobile phone ☐ computer ☐

☐ Internet ☐ community loud speakers

9. What extension services do you provide to fish farmers?
10. How often and how much time would like to spend acquiring new information?

Please tick one box

<table>
<thead>
<tr>
<th>Frequency</th>
<th>5 minutes</th>
<th>15 minutes</th>
<th>30 minutes</th>
<th>45 minutes</th>
<th>1 hour</th>
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<td>weekly</td>
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<td>fortnightly</td>
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<td>monthly</td>
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</tbody>
</table>

11. Do your extension officers have access to the Internet?

☐ Yes ☐ No

12. What kind of tools does your Ministry officers use to access the internet? (You can make more than 1 choice)

☐ Mobile phone ☐ computer ☐ I pads ☐ internet cafes

13. What problems do extension workers encounter in extending their services to farmers?

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14. What general problems do farmers encounter in trying to access information on Aquaculture?

☐ Technology unfamiliarity
Information received is not practical or relevant
☐ Illiteracy
☐ Others (please specify)…………………………………………………………....

15. Which positive outcomes have resulted from the information that has been provided to the fish farmers? (Please tick any that apply.)

☐ Increasing amount of productivity
☐ Higher quality of productivity
☐ Lower cost
☐ Higher selling price
☐ Others (please specify)…………………………………………………………....

16. In your opinion, what should be done to further develop how Aquaculture information is disseminated to the farmers?

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APPENDIX II

QUESTIONNAIRE FOR FISH FARMERS.

Please mark ☐ in the ☐ in front of the choice you have made.

**Part A** Demographic Data

1. What is your gender
   ☐ male ☐ female?

2. Please select your age range in the categories provided below (excluding months)
   - ☐ Below 20 years old
   - ☐ 21 – 30 years old
   - ☐ 31 – 40 years old
   - ☐ 41 – 50 years old
   - ☐ 51 – 60 years old
   - ☐ over 61 years old

3. What is your highest level of education?
   - ☐ Primary school
   - ☐ junior high school
   - ☐ high school/certificate
   - ☐ Undergraduate diploma
   - ☐ bachelor degree or higher

4. What is your marital status?
   - ☐ single
   - ☐ married
   - ☐ divorced
   - ☐ separated

5. The number of family members
   - ☐ 1 - 2 people
   - ☐ 3 - 4 people
   - ☐ 5 or more people

6. Farm areas
   - ☐ 4 acres or less
   - ☐ 5 – 10 acres
   - ☐ 11 – 20 acres
   - ☐ 21 – 20 acres
   - ☐ 31 acres or more

7. Do you have Internet access of any kind – at home, through other family members, the library, or some other way?
   - ☐ Yes
   - ☐ No

8. Do you use the internet for your farm operation?
   - ☐ Yes
   - ☐ No

**Part B:** Data related to the satisfaction toward receiving Aquaculture information through the internet.
9. What kind of information have you selected?
   Appropriate fingerlings  □
   Feeding □
   Harvesting □

10. How often have you received Aquaculture information from the Ministries website?
    □ Daily □ weekly □ fortnightly

11. How often would you like to receive the information?
    □ Twice a day □ daily □ twice a week □ weekly
    □ Fortnightly □ monthly □ others (please specify)………

12. If you would not like to continue on receiving the Aquaculture information, please give us the reason. (You can make more than 1 choice)
    □ Technology unfamiliarity
    □ Inconvenience in reading including too small character problem
    □ Cause of annoyance
    □ Information received is not practical or relevant
    □ Others (please specify)…………………………………………………………....

13. What are your expectations towards aquaculture information dissemination via internet?
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    ........................................................................................................
    ........................................................................................................
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    ........................................................................................................

14. What are your opinions for improving the Aquaculture information dissemination using the internet?
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