USING INFORMATION AND COMMUNICATION TECHNOLOGIES TO ENHANCE INFORMATION SHARING FOR IMPROVED FISH FARMING PRODUCTIVITY IN TANZANIA

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EXTENDED ABSTRACT

The use of Information and Communication Technologies (ICTs) in sharing information is very important in enhancing fish farming productivity among fish farmers. However, little is known on the linkage that exists between the use of ICTs and fish farming productivity in the Southern Highlands of Tanzania. The main objective of this study was to assess the use of ICTs to enhance information sharing for improved fish farming productivity in the Southern Highlands of Tanzania. Specifically, the study focused on establishment of the information needs of fish farmers in the study area; analyzing the influence of ICTs use in sharing agricultural information on fish farming productivity in the Southern Highlands of Tanzania; examining the determinants of the ICTs usage in sharing agricultural information among fish farmers in Tanzania, and determining the challenges facing fish farmers on the use of ICTs in sharing agricultural information.

This cross sectional study was conducted in three regions, namely, Ruvuma, Mbeya and Iringa and involved twelve divisions purposively selected from six districts. The study used both quantitative and qualitative approaches in collecting data. Questionnaires, Focus Group Discussions (FGDs), observation and key informants interview were used as a data collection methods. The study involved 240 fish farmers who were randomly selected. Moreover, six key informants (one fisheries extension officer in each of the six districts) and six Focus Group Discussions (eight participants in each of the districts) were conducted in each district. Quantitative data were analysed with the aid of the Statistical Product Service SolutionP (SPSS) Version 20 while content analysis was used to analyse qualitative data. Descriptive statistics were computed to establish the profile of research participants: information needs, information accessibility, challenges of ICTs use in information sharing, and fish farming productivity level. The multiple linear regression was used to establish the influence of ICTs use and fish farming

productivity. Additionally, the ordinal logistic regression model was used to examine the determinants of ICTs usage by fish farmers. The fish farmers highly needed information related to water treatment (management), spawning operations and fish preservation and processing. However, it was found that access to these categories of information was very low. Mulitple linear regression analysis revealed that the use of ICTs (mobile phones, radio, and television) for sharing agricultural information was found to influence fish productivity level ($p<0.05$). Moreover, it was found through ordinal logistic regression analysis that the predictors of ICTs use in information sharing were income, perceived ease of use, quantity of fish produced, attitude, household size, radio ownership and perceived usefulness. Likewise, the study findings revealed that major challenges facing fish farmers in sharing information included unfavorable radio or televisions broadcasting time, high cost of acquiring and maintenance of ICT facilities, lack of training on ICTs, and poor network connectivity. The study concluded that the more the frequency the farmers use the ICTs in sharing agricultural information on fish farming technologies, the more they could be informed about fish farming, and thus the more they could increase their fish farming productivity. It is recommended to the Government, Non-Governmental Organisations (NGOs), researchers and policy makers to consider establishing community FM radio stations in the Southern Highland regions to encourage sharing of agricultural information on fish production and knowledge to the farmers. It was also recommended that responsible organs like research institutions, policy makers and information providers should make sure that behavioural factors (perceived ease of use, perceived usefulness and attitude) that motivate individual farmers in different communities to accept the use of any ICTs are considered prior to the introduction of the respective technologies. This could assist responsible organs to design the ICT models that are relevant to fish farmers' needs.

DECLARATION

I, Ronald Benard, do hereby declare to the Senate of Sokoine University of Agriculture that this thesis is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted in any other institution.

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This work is dedicated to my late beloved Father Benard Tarimo who passed away before the dreams of this work were realised; to my loving wife Gillness Tarimo, my children Flora, Reina and Ronnie for their tireless support and understanding of my long absence from home.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
FAO	Food and Agriculture Organization
FGD	Focus Group Discusion.
FFS	Farmer Field School
GDP	Gross Domestic Product
ICTs	Information and Communication Technologies
IT	Information Technology
KMO	Kaiser-Meyer-Olkin
NGOs	Non-Governmental Organisations
NSGRP	National Strategy for Growth and Reduction of Poverty
PEU	Perceived Ease of Use
PU	Perceived Usefulness
SPSS	Statistical Product Service Solution
TAM	Technology Acceptance Model
TNBS	Tanzania National Bureau of Standards
TRA	Theory of Reasoned Action
URT	United Republic of Tanzania
VIF	Variance Inflation Factor

CHAPTER ONE

1.0 Introduction

1.1 Background of the Study

Fish farming is defined as the raising of fish for personal use or profit. It is sometimes called fish culture (FAO, 2016). It serves as a means of livelihoods to millions of people worldwide (FAO, 2016, Little *et al*., 2016; Thilsted *et al*., 2016). This agricultural sub-sector helps to empower the poor and directly promotes their standard of living (Obikezie, 1999). Additionally, fish farming in Africa is increasingly growing with millions of poor people relying heavily on fishing and farming to earn their livelihood and feed their families (Brummett *et al*., 2008; Beveridge *et al*., 2010; World Bank, 2014; Kassam and Dorward, 2017). Margaret and Gakuu (2018) add that fish farming in developed countries is highly commercialised while in developing countries it is mainly carried out for subsistence purposes. To illustrate, specifically, fish farming in Tanzania has the potential to significantly contribute to poverty alleviation through income generation, creation of jobs, and enhanced food security (FAO, 2010). For this reason, more than 4 milion people are engaged in fisheries and fisheries related activities whereas more than 400 000 fisheries operators are directly employed in the sector which has a total of operational 21 300 grow-out earthen ponds and nine raceway systems (URT, 2015).

Despite the existing potentials of fish farming in agricultural sector, fish farming; particularly in the Southern Highland regions of Tanzania is still lagging behind due to the inadequate aquacultural extension, unavailability of quality fish seeds and feeds, poor fish pond management practices caused by inadequate aquacultural information and knowledge, poor transport infrastructure, unreliable markets, limited accessibility of capital and low incentives to aqua-farmer investors (URT, 2010; Shoko *et al*., 2011;

Ogello *et al.,* 2013; Chenyambuga *et al.,* 2014). Other constraints include low appreciation of the opportunities in aquacultural development, accessibility to capital and markets, and incentives to aqua-farmer investors (URT, 2010; Shoko *et al*., 2011, Ogello *et al.,* 2013). This is in line with a specific study by Margaret and Gakuu (2018) in Kenya who noted a similar scenario that, low pond productivity is caused by poor extension services that contribute to poor information accessibility among fish farmers leading to poor pond management practices, marketing problems, and influence of cultural background.

With this regard, rapid growth of agriculture, of which fish farming is a major sub-sector, depends highly on efficient flow of agricultural information and knowledge to fish farmers. Opara (2008) defines agricultural information as all unpublished and published knowledge related to all aspects of agriculture. Thus, in the context of this study, agricultural information (fisheries information, fish farming information or aquacultural information) has been defined as all published or unpublished knowledge in all aspects of culture or fish farming production. The sector depends on continuous flow of information from local, regional and world markets (Rutger, 2000; Akinpelu *et al*., 2013). Like other agricultural sub-sectors, information in fish farming is very important for increasing productivity (Opara, 2008; Das *et al*., 2016). Rational decisions on fish farming depend much on the availability of timely and reliable information. Such information helps fish farmers decide on how to allocate inputs, find appropriate markets for their products and decide on the best post-harvest storage of the products (Demiryurek *et al*., 2008). According to Riesenberg (1989) as well as Aphunu and Atoma (2011), optimal fish farming production depends on accurate market-related information, efficient allocation of available resources, and the use of new or innovative farming practices. Additionally, information on fish farming needed by farmers covers

ponds construction and management, breeds and spawning, processing; storage, marketing and financing, disease control and treatment, fingerlings, and credit facilities (Ofuoku *et al*., 2008; Okwu and Iorkaa, 2011). When acquired and effectively utilised by the fish farmers, such information can increase fish production and hence increased income and improved farmers' standard of living. Nevertheless, the defficiency of any of such information leads to poor pond management practices, which, in turn, leads to poor fish farmig productivity. This is specifically supported by a study done by Adomi *et al*. (2003) in Nigeria where they found that fish farmers needed access to agricultural information in order to improve their fish pond management practices and hence increased their fish farming production.

Additionally, Ferris (2005) reports that lack of accurate and relevant agricultural information is among the obstacles in improving the fisheries sector in most African countries. Poor accessibility of fish farming information leads to low adoption of improved fish farming technologies, which invariably affects farmers' productivity and could lead to poverty (Ozowa, 2005). It is therefore important to stress that the adoption of improved fish farming practices requires adequate access to information. Such information should be effectively disseminated to the famers and other stakeholders to receive, understand and regard it as a valid basis for action.

To realise this, several traditional approaches have been used by fishery officers in delivering and disseminating information and knowledge to fish farmers in Tanzania. These approaches include public awareness creation, training such as Farmer Field School (FFS), demonstration and farmer visit (Kimaro *et al.*, 2010; NAP, 2012). However, these approaches have been constrained by inadequate extension capacity. As a reminder, fishing is one of the agricultural subsectors with the lowest numbers of

extension staffs in Tanzania. Presently, there exist 750 fisheries extension officers countrywide whereas the recommended number is 16 000. In the field of agriculture there are 8 323 extension staff out of the required 20 100, and in the livestock field there are 8 600 extension staff out of the required 21 768, (URT, 2018). It is therefore obvious that the currently available number of the 750 fisheries extension officers is not enough in the country to meet information and knowledge needs of fish farmers (URT, 2015). Such a constraint decreases the dissemination of information and knowledge to fish farmers and consequently poor pond management practices which leads to poor productivity (Yaseen *et al.,* 2015). In addition, some of those fisheries officers do not have adequate and relevant knowledge on fish farming as some of them have been trained on livestock or crop production. This impedes farmers' acquisition of the right information, and consequently leads to poor fish farming productivity. In supporting this view, Matuha (2015) reported that much of the agricultural information provided by extension workers is sometimes outdated, irrelevant and inapplicable to small scale fish farmers' needs, leaving them with very little information or knowledge resources to improve their productivity.

Due to low capacity and/ or limited understanding of fish farming environment by the fisheries extension officers, extension services have therefore not led to significant increase in production (CUTS International, 2011). Thus, the use of ICTs such as mobile phones, radio and television can play a critical role in this regard. The benefits of ICTs to enhance information communication for improvement of fish farming productivity was previously proposed (Armstrong *et al.,* 2010, Armstrong *et al.,* 2011, Armstrong *et al.,* 2012).

ICTs are sets of technologies that facilitate the capturing, storage, processing, and dissemination of information by electronic means (Akinbile and Alabi, 2010). The range of technologies is growing all the time and there is convergence between new and old media. The new media are computers, mobile phones and the internet, while the old media include radio, television, telephone and fax, among others. The revolution of ICTs has globally opened larger opportunities for efficient information sharing in many sectors including the fish farming sub-sector. In fact, ICTs can play a key role in providing extensionists and fish farmers with vital information needed for their fish farming activities (Munyua *et al*., 2008). According to Donovan (2011), fish farmers can apply ICTs to increase fish farm productivity by providing farmers with access to information which enables them to match fish farming practices to climatic trends, use inputs and resources optimally, and ensure good fish farming practices through improved fish breeds, disease control, markerts access, and pond management.

Besides, the use of ICTs is an essential resource in the development process. Many studies have been carried out globally to ascertain the use of ICTs in sharing and dissemination of agricultural information to smallholder farmers. An empirical study in India revealed that the use of ICTs has been vital and beneficial to fish farmers in sharing information related to fishing location and market demands from their colleagues, agency officers and dealers in the fishing communities (Mahalakshmi *et al.*, 2014). Likewise, findings from a study conducted in Turkey shows that radio and television technologies in rural areas have been significantly used even by farmers in the low-income group (Cukur, 2013). The evidence from the same research also reveals that the use of radio and television helps to overcome barriers of time; location; access to market players; customers and improves productivity for smallholder fish farmers in the rural area.

Comparing this method (ICTs use) in delivering information to fish farmers, studies in Benin found that the information delivered through hands-on workshops by local NGOs was less effective compared to the effect of using farmer to farmer video training. The information communicated by this means proved to reach three times more female rice farmers (Zossou *et al.,* 2009). Another study by Ndati and Okumu (2014) in Kenya on ICT use for information sharing had reported that 60% of the fish farmers who were interviewed proclaimed that, after they received information through ICTs, their productivity had increased tremendously while 40% of the farmers reported that after using ICTs they got a higher selling price for their produce due to improved yield.

Nevertheless, efficient use of ICTs may be affected by several factors. For instance according to Taleghani *et al*. (2011), the usage of ICTs depends on the adoption level, self-efficacy, perceived cost, perceived risk, perceived usefulness, and perceived ease of use. When more have adopted and have adequate skills to use the tools, the level of usage of ICTs becomes higher. Likewise, farm size, availability and ownership of ICTs have positive significant relationship with farmers'usage of ICTs (Rashid and Akanda, 2015). Moreover, the study by Olumuyiwa *et al*. (2016) in Nigeria found that the major determinants of ICTs usage by farmers were years of farming experience, marital status, education level and age. A similar study by Okello *et al.* (2014) on determinants of ICT use found that location variables, membership to a farmer organisation, transport cost to the nearest output market, literacy level had a positive influence on the decision to use ICT in accessing agricultural information. Furthermore, Derso *et al*. (2014) mentioned frequency of listening agricultural programme, ICTs use, training, farm size, access to credit, and access to ICT tools as factors that influence ICTs usage.

In Tanzania, various studies have been done to explore on how rural farmers (crops and livestock farmers) use ICTs in accessing agricultural information and other services (Lwoga, 2010; Churi *et al.*, 2012; Mtega and Msungu, 2013; Mtega and Benard, 2013). However, it is evident that no specific studies that have been done on the use of ICTs in information sharing for improving fish farming productivity to fish farmers in Tanzania. This study, therefore, attempt to assess the extent to which fish farmers use ICTs in enhancing information sharing and consequently improving the fish farming productivity in Tanzania.

1.2 Problem Statement

Fish farmers in the Southern Highlands of Tanzania lack vital agricultural information, leading to inefficiencies, inequity, poor productivity and post-harvest losses (Mwaijande and Lugendo, 2015). Inadequate access to knowledge on inputs and pond management among fish farmers has dwarfed the growth of the sub-sector in the said highlands (Wetengere, 2011; Chenyambuga *et al.*, 2014). Inadequate access to information leads to poor pond management practices which, in turn, leads to poor fish farming productivity. When fish farmers put into use the information related to pond management practices productivity goes to about 10 000 kg/ha/year (Eknath and Acosta, 1998; Hussain *et al*., 2000). Under poor access to information on how to manage ponds, fish productivity ranges from 2089 kg/ha/year to 4704kg/ha/year (Kaliba *et al.*, 2006; Shoko et *al.*, 2011). Due to limited usage of fisheries production information, fish production among small holders in Mbeya is estimated to be 5312 kg/ha/year (Chenyambuga *et al*., 2014). This situation could be improved by making use of ICTs to timely share the required information, hence solve some of the information related to challenges that Southern Highlands farmers face in fish farming.

Moreover, the extent to which ICTs have been used in sharing of fisheries information for improved fish farming productivity in Tanzania particularly in the Southern Highlands is not known. Most studies done so far in the country have either analysed the usage of the ICTs in accessing agricultural information and other information services (Lwoga, 2010; Mwakaje, 2010; Mtega and Benard, 2013), or use of mobiles phones in communicating agricultural information (Nyamba, 2011; Churi *et al.,* 2012), or the socio-economic impact of ICTs (Chilimo, 2008; Mwakaje, 2010). All these studies have explained ICTs usage without linking it with farmer's productivity especially fish farmers and none of them has been specific to fish farming. In addition, many studies in Tanzania addressing poor yield on fish farming have concentrated on production-based innovations while none has investigated on the impact of ICTs on fish farming productivity. According to Das *et al*. (2016), aquaculture development as one of the agricultural sub sectors cannot be understood without the use of modern ICTs in information sharing. Thus, this study attempt to assess how these ICTs are used in sharing fisheries information, and consequently improving fish farming productivity in the Southern Highlands of Tanzania

1.3 Justification of the Study

The findings of this study provide a basis for influencing policy makers to develop and design fish farmers training guides focused on need-based and user-oriented information infrastructure in fish farming. The findings also contribute to a better understanding of the determinants of ICT usage in aquaculture that assist in the development of strategies that promote ICT usage in information sharing, assist in designing relevant farmer's information systems, increase the effectiveness and efficiency of information use in aquaculture sector, and consequently improve fish farming productivity. Examining the extent of ICTs use also helps to know the areas where we need more improvements. In

addition, establishing the information needs that are most important to fish farmers helps fisheries extension officers to pay more special attention to these information needs in order to meet farmers' specific needs of agricultural information.

Furthermore, the study contributes to previously unavailable data in the field of aquaculture and ICTs, and the research may assist as useful input for development of workers, researchers, and all those concerned with designing and sharing agricultural information for greater impact on fish farming communities. The study also contributes to the designing of training for fish farmers and extension agents regarding utilisation of ICTs in agricultural information dissemination.

The findings further contribute to a better understanding of the extent to which ICTs have been used in enhancing information sharing and consequently improving the fish farming productivity in Tanzania. The research findings finally create awareness of the problems facing fish farmers about the use of ICTs in sharing agricultural information particulary that on fish farming and the recommended solutions to the problems.

1.4 Objectives

1.4.1 General objective

The general objective was to assess the use of ICTs in enhancing information sharing for improving fish farming productivity in the Southern Highlands of Tanzania.

1.4.2. Specific objectives

The specific objectives were:

i. To establish the information needs of fish farmers in the study area;

ii. To analyse the influence of ICTs use in sharing agricultural information on fish farming productivity in Southern Highlands of Tanzania;

iii. To examine the determinants of the ICTs usage in sharing agricultural information among fish farmers in Tanzania, and

iv. To determine the challenges facing fish farmers on the use of ICTs in sharing agricultural information.

1.5 Research Questions

The study provide solutions to the problem through following research questions:

i. What are the types of information needed by fish farmers in the study area?

ii. What is the influence of ICTs use in sharing agricultural information on fish farming productivity in the Southern Highlands of Tanzania ?

iii. What are the determinants that influence the use of ICTs in accessing agricultural information among fish farmers in Tanzania?

iv. What are the challenges facing fish farmers on the use of ICTs in sharing agricultural information?

1.6 Theoretical and Conceptual Framework of the Study

Theory can be defined as a set of interrelated constructs (concepts), definitions, and prepositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting such phenomena (Bailey, 1994). A range of theories and models has been established over a period of time under various conditions and situations to describe user acceptance and adoption of ICTs. The following theories below have been used in various studies to explain the use of ICTs in different sectors.

1.6.1 Diffusion of Innovation (DOI) theory

Rogers (1995) defines DOI as the process by which an innovation is communicated through certain channels over time among the members of a social system. It was developed by E.M. Rogers in 1962, and it is one of the oldest social science theories. It originated in communication to explain how, over time, an idea or product gains momentum and diffuses (or spreads) through a specific population. The end outcome of this diffusion is that people, as part of the social system, adopt a new behaviour, idea, or product. Adoption means that a person does something contrarily to what they had done previously (i.e. purchase or use a new product, acquire and perform a new behaviour, etc.). The key to adoption is that the person must perceive the idea, behaviour, or product as new or innovative. It is through this that diffusion is possible.

Diffusion occurs progressively within one market (a system of users) when information and opinions about a new technology are shared among potential users through communication channels. In this case, information users gain personally knowledge about a new technology. Knowledge is the first step of Rogers' five-stages of adoption. The other four steps are persuasion, decision (to adopt or to reject new technology), implementation and confirmation. Rogers argues that a great number of conditions (e.g. personal limitations of the potential user) and/or external obstacles (e.g. ineffective communication channels) may prevent the success of the adoption process. However, one of the weaknesses of this theory is that, it is often simplified to focus solely on a product or innovation, disregarding the complex societal, cultural, economic and other factors that determine how the product is adopted into a society.

1.6.2 Theory of Planned Behaviour (TPB)

Another theory that has been used to understand acceptance behaviours with respect to ICT is the Theory of Planned Behaviour (TPB). This theory was proposed by Ajzen (1989) as a refinement to the earlier theory of reasoned action proposed in the 1970s by Ajzen and Fishbein. According to Bamberg, Ajzen and Schmidt (2003), TPB is guided by three considerations: beliefs about likely consequences of the behaviour (behavioural beliefs), beliefs about the normative expectations of others (normative beliefs), and beliefs about the presence of factors that may further or hinder performance of the behaviour (control beliefs). They further theorize that behavioural beliefs create a favorable or unfavorable attitude towards the behaviour. Indeed, Armitage and Conner (2001) have observed that the more favorable the attitude towards the behaviour, the stronger should be the individual's intention to perform it." Normative beliefs result in perceived social pressure or subjective norm. However, one of the weaknesses of this theory is that, it does not take into account environmental or economic factors that may influence a person's intention to perform a behaviour. Likewise, another weakness is that it does not account for other variables that factor into behavioural intention and motivation, such as fear, threat, mood, or past experience .

1.6.3 The theory of Technology Acceptance Model (TAM)

This theory was developed by Davis (1989). The model was established from the Theory of Reasoned Action (TRA). This model used TRA as a theoretical basis for specifying the causal linkages between key beliefs: perceived usefulness and perceived ease of use and users' attitudes, intentions and actual computer usage behaviour. According to this theory, behavioural intention is jointly determined by attitude and perceived usefulness. Attitude is determined by perceived usefulness (PU) and perceived ease of use (PEU). According to Davis (1989) PEU is the degree to which a person believes that a particular

technology would be free of effort while PU is the degree to which a person believes that using a particular system would enhance their job performance. Additionally, Davis further defines attitude as an individual's positive or negative feeling about performing the target behaviour. As a matter of fact, TAM has been known to be the most influential and frequently tested models and is widely applied to explain general ICTs acceptance and usage (Saga and Zmud, 1994; Ma and Liu, 2004; Jong-Ae, 2005). Furthermore, TAM describes how a technology may be adopted and used to facilitate performance of a particular activity. Eventually, TAM was tested for reliability and validity; the obtained results demonstrated that it is a quite reliable and robust model in predicting users' acceptance and usage of any Information Technology (IT) in many studies (Chismar and Patton, 2003).

According to Chisita (2012), TAM helps to assess determinants involved in ICT acceptance and usage, explore ICT usage behaviours and provide cross-cutting theoretical explanations for the adaptation of an innovation. Thus, TAM was selected to guide the study, since it fits well with the objectives of the present study compared to other mentioned theories. Also the theory guided well the study by showing the inter-relationship between the different variables under the study.

However, one of the weaknesses of this theory is that, it does not explain the individual and socioeconomic factors influencing ICTs usage. Likewise, another weakness is that, TAM overlooks the direct link between PU, PEU and attitude towards the actual use of the system and it is only possible with the mediation of behaviour intention (Davis, 1989). Following this trend, the research model considered this weakness by omitting some of the factors and adding some factors that might directly influence ICTs usage in information sharing. Thus, the research conceptual framework was built upon TAM.

Literature was reviewed and modification of TAM was proposed to serve the study objectives and make it more relevant to the study of the usage of ICTs in sharing agricultural information for enhancing fish farming productivity in the Southern Highlands of Tanzania. The factors that were incorporated on the model included socio-economic and individual variables like income, fish pond size, number of fish ponds, age, sex, family size, education, experience, kilograms of fish harvested per year, PU, PEU and attitude as determinants that might have direct relationship with the use of ICTs in information sharing for improving fish farming productivity (Figure 1.1).

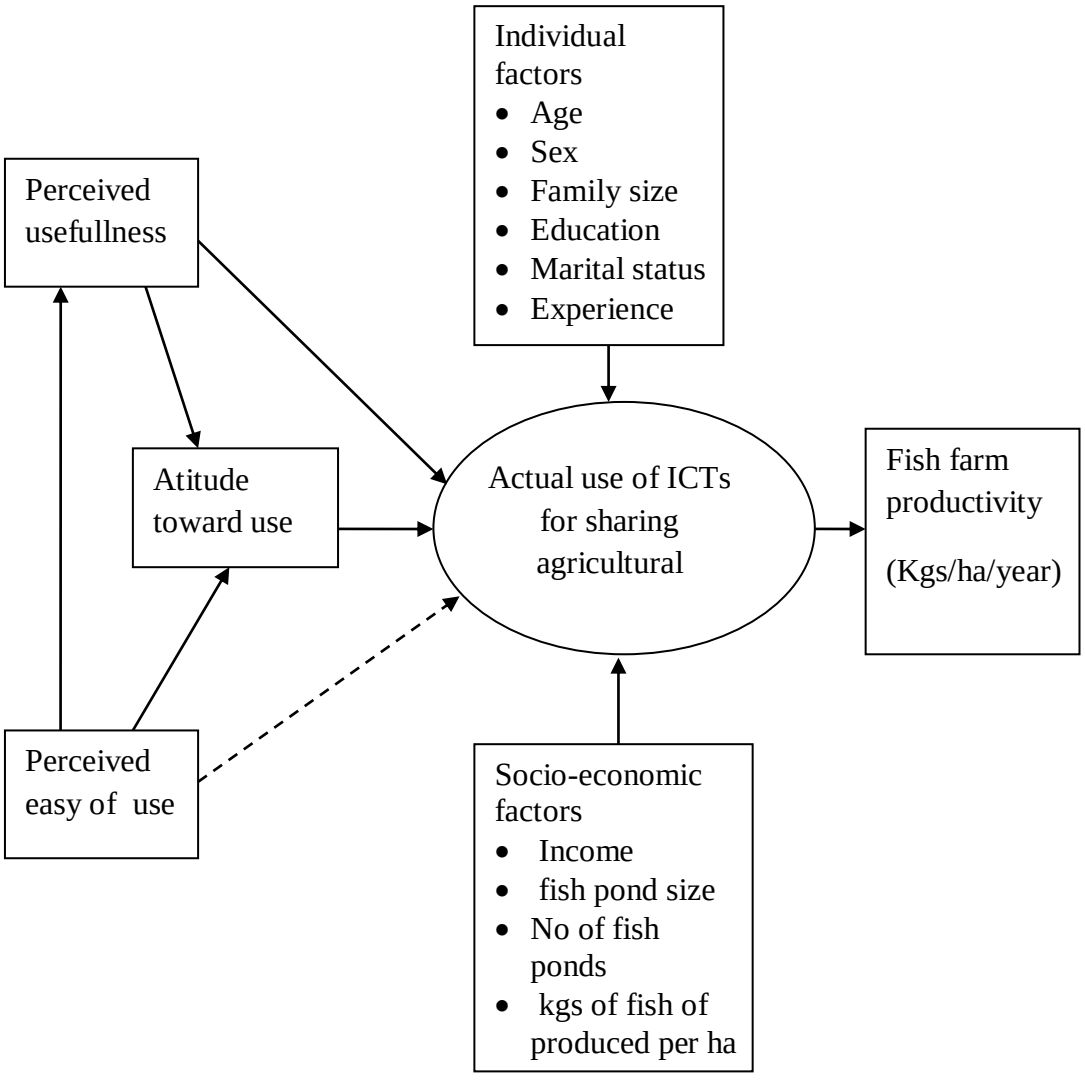

Figure 1.1: A modified TAM adapted from Davis (1989: 16)

1.7 General Methodology

This study was conducted in 2016 in three regions found in the Southern Highlands of Tanzania, namely, Iringa, Mbeya and Ruvuma. These regions were selected due to the fact that they have a relatively bigger number of fish farms, a longer history of fish farming as compared to other regions in the country and relatively well developed ICTs infrastructures (FAO, 2012). According to URT (2012), Ruvuma, Iringa and Mbeya regions have more fish ponds than other regions in the country. There are 4942 fish ponds in Ruvuma Region, 3137 in Iringa Region and 1176 in Mbeya Region (FAO, 2017).

The sampling frame comprised all fish farmers in twelve divisions, in six districts namely, Mbeya, Mbarali, Iringa, Mufindi, Mbinga and Songea. The districts were chosen based on the number of fish farms and presence of ICTs infrastructures like electricity, radio, television cables and mobile networks. Based on these criteria, two districts from each region, namely Mbinga and Songea districts in Ruvuma Region, Mbeya and Mbarali districts in Mbeya Region, and Iringa and Mufindi districts in Iringa Region were selected for this study. From each District, two divisions with 20 fish farmers and good ICTs infrastructures were purposively selected. Simple random sampling technique was used to select the 20 fish farmers from each division; making a total sample size of 240 respondents out of 408. This sample size is in line with Israel (2012), who asserts that a sample size greater or equal to 20 can yield meaningful results in a survey study.

The study used both quantitative and qualitative approaches. It used a cross-sectional research design in collecting primary data where data were collected once from individual fish farmers who were the sampling units of the study. Quantitative data were mainly collected using a structured questionnaire while qualitative data were collected from key informant interviews and focus group discussions. A prepared interview guide

was used for the interview with six key informants (one fisheries extension officer in each of the six districts was selected purposively); and a focus group discussion guide was used to gather information from 48 fish farmers who had an experience of at least five years in fish farming. One group discussion (eight participants in each of the districts) was conducted in each selected district. Barbour (2011) recommends that eight participants per session is an adequate number for the FGD. In addition, direct observation through observation guide was used as a method of data collection.

With the aid of the SPSS Version 20, quantitative data collected through structured questionnaires were statistically analysed both descriptively and inferentially whereas content analysis was used for qualitative data. Detailed descriptions on the methodology employed in this study has been clearly depicted in consequent chapters.

1.8 Organisation of the Thesis

This thesis is organised in six chapters. With exception of Chapters One and Six, each of the other chapters is organised in a publishable manuscript. Chapter Two presents manuscript number one that examines the information needs and information accessibility among fish farmers. Chapter Three explain the second specific objective (manuscript number two) which analyse the the influence of ICTs usage in sharing agricultural information on fish farming productivity. The third manuscript in Chapter Four examine the determinants of ICTs usage in sharing agricultural information among fish farmers. Chapter Five, which presents the fourth specific objective and manuscript number four, determine the challenges facing fish farmers in the use of ICTs in sharing agricultural information. Finally, the last chapters presents a summary of the thesis together with conclusion and overall recommendations of the study findings.

References

Adomi, E.E., Ogbomo, M.O., and Inoni, O.E (2003). Gender factor in crop farmers access to agricultural information in rural areas of Delta state. *Journal of Library review, 52*(8): 388-391.

Akinbile, L.A., and Alabi, O.E. (2010). Use of ICTs among fish farmers in Oyo state. *Journal of Agricultural Extension 14* (1): 22-30

Akinpelu, O.M., Akinbile, L.A., Ayeloja, A.A., Akinosho, G.A., George, F.O.A., Jimoh,W.A., and Adebisi, G.L. (2013). Gender differentials in knowledge and utilization of ICT among fish farmers in Ido local Government of Oyo state, Southwestern. *Nigeria, Journal of Agricultural Economics and Development, 2*(5): 255-263.

Aphunu, A., and Atoma, C.N.(2011). Extent of use of ICTs by fish farmers in Isoko agricultural zone of Delta state, Nigeria. *Journal of Agricultural Extension, 15*(1) :10-20.

Armstrong, L., Diepeveen, D., and Gandhi, N., (2011). *Effective ICTs in agricultural value chains to improve food security: An international perspective.* World Congress on Information and Communication Technologies Conference (WICT), Mumbai India, 11 to 14th December.

Armstrong, L.J., Adinarayana, J., and Dunstan, N. (2012). The use of ICT and geospatial techniques to improve Australian and Indian ground water and land resource management under climate change scenarios: A position paper. Proceedings of the Geomatrix 12, IIT Mumbai India, 26 to 29th February.

Armstrong, L.J., Diepeveen, D.A., and Tantisantisom, K. (2010). An Agriculture-based decision support framework for information dissemination, IGI Global Publications, Madrid Spain. *International Journal of Human Capital and Information Technology Professionals, 1*: 1–13.

Bailey, D.K. (1994). Methods of Social Science Research, 4th edition, The Free Press, New York. 588pp.

Brummett, R E., Lazrd,J., and Moehl, J. (2008). African aquaculture: Realizing the potential, *Journal of Food Policy 33*(5):371-385.

Chenyambuga, S .W. Mwandya, A., Lamtane, H. A., and Madalla, N. A. (2014). Productivity and marketing of Nile tilapia (*Oreochromis niloticus*) cultured in ponds of small-scale farmers in Mvomero and Mbarali districts, Tanzania. *Journal of Livestock Research for Rural Development, 26*(43). [http://www.lrrd.org/lrrd26/3/chen26043.htm]. Visited on 21st March 2016.

Chilimo, W. (2008). *Information and communication technologies and sustainable livelihood: A case of selected rural areas of Tanzania* (PhD Dissertation, University of KwaZulu-Natal, Pietermaritzburg)

Chisita, C.T. (2012). Knotting and networking agricultural information services through Web 2.0 to create an informed farming community: a case of Zimbabwe, World Library and Information Congress 78th, IFLA general conference and assembly, Harare, Zimbabwe, 24th May .21pp.

Chismar, W.G., and Patton, S.W. (2003). Does the extended technology acceptance model apply to physicians, Proceedings of the 36th Hawaii international conference on system sciences.
[http://www.hicss.hawaii.edu/HICSS36/HICSSpapers/HCDMG04.pdf]

Churi, A.J., Mlozi, M.R.S., Tumbo, S.D., and Casmir, R. (2012). Understanding farmers information communication strategies for managing climate risks in rural semi-arid areas, Tanzania. *International Journal of Information and Communication Technology (JICT) 2*(11): 838 – 845.

Cukur, T. (2013). Determination of communication behavior of earthen pond fish farmers. *Bulgarian Journal of Agricultural Science, 19* (6): 1358-136.

CUTS International (2011). Extension services in Tanzania: Better reaching remote areas. CUTS International Geneva. [http://www.cuts-geneva.org/pdf/Action-Alert] visited on 24th October 2015.

Das, S. M. Munshi. N., and Kabir, W. (2016). The impact of ICTs on agricultural production in Bangladesh: a study with food crops. *SAARC Journal of Agriculture, 14*(2): 78-89.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and use acceptance of information technology. *MIS Quarterly, 13*(3): 319-339.

Demiryurek, K., Erdem, H., Ceyhan, V., Atasever, S., and Uysal, O. (2008). Agricultural information systems and communication networks: The case of dairy farmers in Samsun Province of Turkey. *Journal of Information Research, 13*(2): 12-13.

Derso, D., Mamo, Y., and Jema, H. (2014). Analyzing socio-economic factors affecting the use of Information and Communication Technologies among farmers in central highlands of Ethiopia. *African Journal of Agricultural Science and Technology (AJAST), 2*(8): 163- 171.

Donovan, K. (2011). Anytime, anywhere: Mobile devices and services and their impact on agriculture and development. Module 3 in ICT in Agriculture: Connecting Smallholders to Knowledge, Networks, and Institution: The World Bank Report No. 64605: 49-7

Eknath, A.E., and Acosta, B.O. (1998). Genetic improvement of farmed tilapias (GIFT) project: Final report, March 1988 to December 1997. International Center for Living Aquatic Resources Management, Makati City, Philippines. [*http://www.ictinagriculture.org/sites/ictinagriculture.org/files/final_Module 3.pdf] visited on 13 August 2015.*

FAO, (2010). Regional Review on Status and Trends in Aquaculture Development in Sub-Saharan Africa. Fisheries and Aquaculture Circular No. 1061/4 , Rome, Italy

FAO, (2016). The State of World Fisheries and Aquaculture .Contributing to Food Security and Nutrition for all, Rome, Italy. 47pp.

Ferris, S. (2005). Developing market information services in Eastern Africa: the food net experience, local, national and regional market information services. International Institute of Tropical (IITA), Ibadan Nigeria. [https://cgspace.cgiar.org/bitstream/handle/10568/96333/U04BkFerrisD] visited on November 2015.

Hussain, M.G, Kohinoor, A.H.M, Islam, M.S, Mahata, S.C, Ali, M.Z, Tanu, M.B, Hossain, M.A., and Mazid, M.A. (2000). Genetic evaluation of GIFT and existing strains of Nile Tilapia, Oreochromis niloticus L., under on-station and on-farm conditions in Bangladesh. *Journal of Asian Fisheries Science*, *13*: 117-126.

Jong-Ae, K. (2005). User acceptance of web-based subscription databases: extending the technology acceptance model. Dissertation for award of PhD at Florida State University, Tallahassee.

Kaliba, A.R, Osewe, K.O., Senkondo, E. M., Mnembuka, B.V., and Quagrainie, K.K. (2006). economic Analysis of Nile Tilapia *(Oreochromis niloticus*) production in Tanzania. *Journal of the World Aquaculture Society, 37*(4): 464 – 473.

Kassam,L . Dorward,A. (2017). Comparative assessment of the poverty impacts of pond and cage aquaculture in Ghana. *Aquaculture, 470* (2017): 110-122.

Kimaro, H., Mukandiwa, L., and Mario, E.Z.J. (2010). Towards improving agricultural extension service delivery in the SADC Region. Workshop on Information Sharing among Extension Players in the SADC Region", Dar es Salaam, Tanzania.

Little *et al*. (2016). Contribution of Fisheries and Aquaculture to food security and poverty reduction: Assessing the current evidence. *Journal of World Development, 79*: 177–196.

Lwoga, E.T. (2010). Bridging the agricultural knowledge and information divide: the case of selected telecenters and rural radio in Tanzania. *Electronic Journal of Information Systems in Developing Countries, 43*(6): 1-14.

Ma, Q., and Liu, L. (2004). Technology acceptance model: A meta-analysis of empirical findings. *Journal of organizational end user computing* 16: 59-72.

Mahalakshmi *et al., (*2014). Needs assessment of tribal and aqua farmers for disseminating aqua cultural information through ICT in Gujarat. *Journal of Science and Technology, 4*(6). [http://www.ejournalofscience.org] visited on 12th May 2015.

Margaret, G., and Gakuu, C. (2018). Influencing sustainability of small scale fish farming projects in Kenya: The case of South Imenti sub-County, Meru county. *International Journal of Latest Research in Engineering and Technology, 4*(6): 7 – 32.

Matuha, M. (2015). *Mobile phone use in Ugandan aquaculture: Farmer experiences and aspirations.* Master's thesis, Auburn University, Uganda) Mtega, W., and Benard, R. (2013). The state of rural information and communication services in Tanzania: a metaanalysis. *International Journal of Information and Communication Technology Research, 3*(2), 64 – 73.

Mtega, W.P., and Msungu, A. (2013). Using ICTs for enhancing the accessibility of agricultural information for improved agricultural production in Tanzania. *Electronic Journal of Information Systems in Developing Countries*, *56*(1): 1-14.

Mtega, W. and Benard, R. (2013). The state of rural information and communication services in Tanzania: a meta-analysis. *International Journal of Information and Communication Technology Research, 3(2), 64 – 73.*

Munyua, H., Adera, E., and Jensen, M. (2008). *Emerging ICTs and their potential in revitalizing small scale agriculture in Africa*. Proceedings of the World Conference on Agricultural Information and IT ,JAtsugi, Japan, November 2008.

Mwaijande, F.A., and Lugendo, P. (2015). Fish-farming value chain analysis: Policy implications for transformations and robust growth in Tanzania. *The Journal of Rural and Community Development, 10*(2), 47-62.

Mwakaje, A.G. (2010). Information and communication technology for rural farmer's market access in Tanzania. *Journal of Information Technology Impact 10*(20): 111 -128.

NAP (2012). The National Agricultural Policy (Final draft), United Republic of Tanzania; Dar es Salaam

Ndati, N., and Okumu, P. (2014). Internet and the promotion of Aquaculture in Kenya. *European Scientific Journal, 10*(35).

Nyamba, S.Y.(2011). The use of mobile phones in communicating agricultural information in Tanzania: the roles of different stakeholders. Dissertation for award of PhD at Sokoine University of Agriculture, Morogoro.

Obiekezie, A.I. (1999). *Poverty Alleviation through Fishery Production:The Way Forward.* Paper presented at th eAnnual Zonal Workshop of the Research-Farmer-Input-Linkage System, Umudike, Nigeria. 21st June 1999.

Ofuoku, A.U. Emah, G.N., and Itedjere, B.E. (2008). Information utilization among rural fish farmers in central agricultural zone of delta state. *Nigeria World Journal of Agricultural Sciences, 4*(5): 558-564.

Ogello, E.O., Mlingi FT, Nyonje B.M, Charo-Karisa, H., and Munguti J.M. (2013). Can integrated livestock-fish culture be a solution to East Africa's food insecurity? A review. *African Journal of Food Agriculture and Nutrition Development, 13*: 8058-8076.

Okello, J., Kirui, O.K., Njirani, G.W. and Gitonga, Z.M. (2014). Determinants of awareness and use ICT-based market information services in developing-country agriculture: The case of smallholder farmers in Kenya. *Quarterly Journal of International Agriculture, 53*(3): 263-282. [http://ageconsearch.umn.edu/bitstream/195738/2/4_Okello.pdf] site visited on 12 March 2018

Okwu, O.J., and Iorkaa, T.I, (2011). An assessment of farmers' use of new Information and Communication Technologies as sources of agricultural information in Ushongo Local Govern-ment Area, Benue State, Nigeria. *Journal of Sustainable Devel-opment in Africa, 13*(2): 41-52.

Olumuyiwa, O., Akin O.A., and Ismaila, K.O. (2016). Information and Communication Technologies (ICTs) usage and household food security status of maize crop farmers in Ondo state, Nigeria:implication for sustainable development. Journal of Library Philosopy and practice.

Opara, U.N. (2008). Agricultural Information Sources Used by Farmers in Imo State, Nigeria. *Journal of Information Development*, 24(4) :289-295.

Ozowa, V.N. (2005). Information needs small scale farmers in Africa: in Nigeria example. Quarterly Bulletin of the International Association of Agricultural Information Specialist, IAALD/CABI, 40(1).

Riesenberg, L.E., and Gor, C.O. (1989). Farmers'preferences for methods of receiving information on new or innovative farming practices. *Journal of Agricultural Education, 30*(3):*713.*

Rutger, J.E.(2000). *Technical Policy and Institutional Trends in Information and Communication.* Proceedings of a CTA Seminar, Wagengen, Netherlands.

Saga, V., and Zmud, R. (1994). The nature and determinants of IT acceptance, routinization and infusion,IFIP Transactions. *Journal of Computer Science and Technology,45*: 67–86.

Shoko, A.P, Getabu, A., Mwanyuli, G., and Mgaya, Y.D. (2011). Growth performance, yields and economic benefits of Nile tilapia (*Oreochromis niloticus)* and Kales (*Brassicoleracea*) cultured under vegetable-fish culture integration. *Tanzania Journal of Science 37:* 37 - 48.

Taleghani, M., Gilaninia, S., Rouhi, A., and Mousavian, S.J. (2011). Factors influencing on customers decision to use of cell phone banking based on SMS services. *Interdisciplinary Journal of Contemporary Research in Business, 3*(5): 86-97.

Taleghani, M., Gilaninia, S., Rouhi, A., and Mousavian, S.J. (2011). Factors influencing on customers decision to use of cell phone banking based on SMS services. *Interdisciplinary Journal of Contemporary Research in Business, 3*(5): 86-97,

United Republic of Tanzania (URT) (2015). An overview of fisheries subsector in Tanzania: Achievements and challenges. Ministry of Livestock and Fisheries Development, Dar es Salaam.

URT (2010). Ministry of Livestock and Fisheries Development, Fisheries Sector Development Programme.

URT (2018). Empowering extension officers' drive on cards, workshop. workshop held by Ministry of Livestock and Fisheries Development, aimed at empowering extension officers July 2018, Dodoma.

Watengere, K. (2011). Socio-economic factors critical for intensification of fish farming technology. A case of selected villages in Morogoro and Dar es Salaam regions, Tanzania. *Journal of Aquaculture International, 19*(1): 33-49.

Yaseen, M., Shiwei, X., Wen, Y., and Hassan, S. (2015). Policy challenges to agricultural extension system in Pakistan: A review. *International Journal of Agricultural Applied Science, 7* (2).

Zossou, E.R., Van Mele, P., Vodouhe, S.D., and Wanvoeke, J. (2009). The power of video to trigger innovation: Rice processing in Central Benin. *International Journal of Agricultural Sustainability*, *7*(2):119–129.

CHAPTER TWO

PAPER ONE

Information needs and accessibility by fish farmers in the southern highlands of Tanzania

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ABSTRACT

The purpose of this study is to assess the information needs and accessibility for fish farmers in the Southern high lands of Tanzania

Design/methodology/approach – Both quantitative and qualitative methods were employed. Semi-structured interviews were used to collect qualitative and quantitative data from 240 fish farmers in six selected districts from three regions in Southern high lands of Tanzania. Focus groups and key informant interviews were also used to collect qualitative data from 54 fish farmers in the selected districts

Findings – Findings indicated that fish farmers highly needed information related to water treatment (management), spawning operations and fish preservation and processing. However, it was found that access to these categories of information was

very low. In addition, findings indicated that age, education and income had a statistically significant and positive relationship with farmers' information accessibility at $p < 0.05$. On the other hand, age, amount of fish harvested, education and farming experience had statistical significant and negative relationship with farmer's information at $p < 0.05$

Originality/value -The study provides a deep understanding of information needs and accessibility for fish farmers in the Southern high lands of Tanzania, which will be assisting in in designing focused, need-based, and user-oriented information infrastructure in fish farming.

Key words; agricultural information, information needs, information accessibility, fisheries, fish farming.

2.0 INTRODUCTION

The aquaculture sub sector has increasingly become an important source of income, food security and livelihoods for many people around the world. In Tanzania, aquaculture is among the priority sectors in the National Strategy for Growth and Reduction of Poverty (NSGRP) (URT, 2015). More than four million people are directly or indirectly involved in fisheries and aquaculture related activities in the country (URT, 2015). In 2014 the fishery and aquaculture sector contributed 2.4 percent to GDP, and has been growing at the rate of 5.5 percent (Economic Survey Report, 2014). This percentage contribution to GDP is low considering the significant fisheries resources and large water bodies present in the country.

The low contribution of aquaculture in Tanzania, particularly in the Southern highlands regions has been attributed to lack of reliable and adequate agricultural information on

aquaculture, lack of access to finance and credit facilities, and lack of access to aquaculture inputs (URT, 2015). It is also attributed to limited ability to manage and control aquaculture resources including fish diseases surveillance, diagnosis, control and treatment, inadequate aquaculture extension services, inadequate investment in aquaculture infrastructure and facilities for processing and marketing of fish and fishery products and ineffective management and sustainability of fisheries resources (URT,2012). These challenges can be addressed through improved information accessibility to fish farmers.

For fast growth of fish farming, efficient flow of information to fish farmers is important, whether it is for economic, technical, socio-cultural or legal aspects, is of significance to fish farming activities**.** This importance is also stressed by Opara (2008) and Eucharia *et al*. (2016) who pointed out that information in fish farming is very potential for increasing productivity. It is a resource that must be acquired and used for the improvement of agricultural production and without suitable agricultural information bad decisions are made (Ducombe and Heeks, 2001). Thus, appropriate farmers' decisions on fish farming practices can very much be influenced by the availability and accessibility of relevant information.

Meitei and Devi (2009) placed the information needs of farmers in six categories, namely:

- Field acquisition: Farmers want to know about the different types of schemes and subsidies available and the purchasing of agricultural land.
- Agricultural inputs: Farmers need information about improved varieties of seeds, as well as pesticides, agricultural implements, weather conditions, harvest and post- harvest technology, etc.

- Agricultural technology: Farmers should be fed with information about innovative technology suitable for their farming activities.
- Access to credit: Farmers need information about credit facilitates, terms of loans. Etc.
- Agricultural marketing: Farmers need information about marketing trends, the price of different varieties of crops and fertilizer.
- Food technology: Farmers need information about post- harvest food technologies to get optimum benefit from their crops.

Moreover, Ofuoku *et al*. (2008) and Ugboma (2010) reported that agricultural Information on fish farming may include ponds construction and management, breeds and spawning, processing, storage and financing, disease control and treatment, fingerlings, and credit facilities A study conducted in Nigeria reported that the information needs of fish farmers includes stocking operation, improvement of fingerling breed, feed formulation technique, feeding operation, marketing information, spawning operation, preservation method (Ijatuyi *et al*., 2016). When acquired and effectively utilized by the fish farmers, such information helps to increase fish production and hence increased income and improved farmers' standard of living.

Studies conducted by Rashid and Akanda (2015) in Bangladesh found that the information needs of fish farmers ranged from fish fry collection and transportation, type and amount of fish feed need to apply, fish pest and disease control, selecting appropriate fish variety fish collection method and harvesting time, to fish preservation and marketing. Also, Samson (2006), Okwu *et al.* (2011) revealed that fish farmers need information in 11 areas of fisheries production which are modern fish capture methods, sales improvement, cooperative society management, preservation and smoking

methods, marketing, marketing channels, access to and control of credit, coastal aquaculture and wild collection of fish seeds. In addition Mustapha *et al.* (2016) revealed that, the highest information needs of fish farmers in Nigeria was record keeping, pond stocking, group formation, fish pond management practices, fish harvesting techniques, fish breeding, fish preservation techniques.

Morever, many previous studies agree that the challenges of fish farmers are poor accessibility of needed information. For instance, Bargumua, and Ndaghu (2014) revealed that majority of the respondents interviewed had low access to information on temperature, feed type, production management, disease control, pond management, improved fingerling, community development project, current market prices, fish harvesting, and environmental protection. In addition, Ugboma (2010) described that high cost of agricultural information materials, lack of irrelevant materials in agricultural offices and libraries, agricultural information providers, format presentation and language barriers are the one of the constraints in information accessibility by fish farmers in Nigeria.

According to Davidson and Lingam (1996), information needs represent gaps in the current knowledge of the user. In day to day work, lack of self-sufficiency constitutes an information need. Information needs are thus a factor that may drive fish farmers to seek information to fill the gaps in their information and knowledge. However, the level of information needs may differ between people, or a group of people, depending on certain factors such as level of education, age, socio-economic status, level of awareness, acquaintance with, and ease of use of information (Kaniki, 2003). The study focused on both comparative and felt information needs of the farmers.

2.1 Statement of the Problem

Scholars, Shoko *et al.* (2011), (URT, 2015), and Chenyambuga *et al.(* 2014) indicate that lack of accurate and relevant information is a major obstacle in efforts to improve the aquaculture sector in Tanzania and that very few fish farmers have access to such information. Lack of information leads to poor fish management practices, which in turn results to low fish production. This is emphasized by Ozowa (2005) who reports that poor accessibility to fish farming information leads to low adoption of improved aquaculture technologies, which invariably affects farmers' productivity. On the other hand, Ijatuyui (2016) had stated that information needs of fish farmers change from time to time due to changing fish farming technologies, environmental changes, fishery policies, and the emergence of aquaculture innovations. Thus, adequate knowledge about the information needs is very important to support policy makers, researchers and information intermediaries in meeting the information needs of the fish farmers. Naveed and Anwar, (2013) adds that understanding farmers' information needs and accessibility is an important first step in designing focused, need-based, and user-oriented information infrastructure in fish farming.

In Tanzania, particularly in Southern High Lands there dearth of studies that have been conducted to specifically assess fish farmers' information needs and determine their accessibility to fisheries related information. Available studies conducted in the country had focused only on crops and livestock farmers (Benard *et al*., 2014; Msoffe and Ngalube, 2015; Angello *et al*., 2010; Lwoga *et al*., 2010; 2013; Tumsifu and Silayo, 2013). This study was therefore conducted to assess the information needs and accessibility of fish farmers in Southern highlands regions of Tanzania. Thus, this will be of a great importance in satisfying the information needs of the farmers and consequently, improved fish farming. It will also help program designers, policy makers

and other agricultural stakeholders to develop interventions that target users with specific information needs.

2.2 Objectives of the Study

The general objective was to assess the information needs and their accessibility of fish farmers in Southern highlands regions of Tanzania while the specific objectives were:

i. To establish information needs and accessibility of fish farmers in the study area;
ii. To determine the influence of social economic characteristics on fish farmers' information needs.
iii. To examine the influence of social economic characteristics on fish farmers' information accessibility

2.3 Methodology

This study was conducted in 2016 in three regions in the Southern Highlands of Tanzania namely Iringa, Mbeya and Ruvuma. These regions were selected because they have relatively large number of fish farms, long history of fish farming compared to other regions in the country and relatively well developed Information and Communication Technologies (ICTs) infrastructure (FAO 2012). According to URT (2012), Ruvuma, Iringa and Mbeya regions have more numbers of fish ponds than other regions in the country such as Arusha, Mwanza, Kigoma and other regions which practicing fish farming. For instance, the number of fish ponds in Ruvuma is 4942, in Iringa is 3137 and in Mbeya it is 1176 (FAO, 2017).

2.4 Study Population

The study involved fish farmers from the three regions. It also involved fisheries extension officers from three regions as the key informants.

2.5 Sampling Techniques

Purposive sampling was used to select key informants, districts, and divisions to be included in the study area. John and Christensen (2004) argued that purposive sampling relies on the decision of the researcher, based on some well-known criteria. Districts were chosen basing on the number of fish farms and presence of Information and Communication Technologies (ICTs) infrastructure. Basing on these criteria two district from each region namely: Mbinga and Songea Districts (Ruvuma region), Mbeya and Mbarali Districts (Mbeya region) and Iringa and Mufindi Districts (Iringa region) were chosen for the study. From each District two divisions with at least twenty (20) fish farmers and good ICTs infrastructures were selected and involved in the study. Twenty fish farmers were randomly selected from each division basing on ownership of at least one type of Information and Communication Technology (ICT). Simple random sampling was used because it gives each case in the population an equal chance of being included in the sample (Singleton, 1993).

2.6 Sample Size

Basing on financial and time constraints, size of the population (fish farmers that possessed the ICTs), and the geographical distribution of the rural villages and fish farmers, the sample size was limited to 240 fish farmers. Bailey (1994) argued that a sample or sub sample of 30 respondents is the bare minimum for studies in which statistical data analysis can be done. In addition, Saunders *et al.* (2007) argued that a sample size of 30 or more will usually result in a sampling distribution that is very close to the normal distribution and the larger the absolute size of a sample, the closer its distribution will be the normal distribution.

2.7 Methods of data Collection

Pre-testing of the questionnaire was done in the village similar to the study villages based on ICTs infrastructures and fish farmer's availability. After pre-test, the questionnaire with both closed and open ended questions was modified and administered to 240 respondents using face- to -face interviews. Focus Group Discussions (FGDs) involving six participants were conducted in each district (six Focus Group Discussion) were conducted) and used to complement information gathered through questionnaires, also personal observation was used as the method of data collection. In addition, key informants (fishery officers) were also interviewed. The rationale for using a mixed method approach is based on its major advantage of neutralizing or cancelling the biases of a single method (Creswell, 2003; Glazier and Powel, 1992).

2.8 Data Analysis

Data collected were statistically analysed using Statistical Package for Social Sciences (SPSS) Version 20. Data analysis was done as shown below.

2.9 To establish the information needs and accessibility of fish farmers in the study area.

To ascertain the degree of information needed among the respondents, a list of agricultural information needs was compiled and rated on 4 point Likert type scale, with response options of High = 3, Moderate =2, Low = 1, Not at all= 0. One-way analysis of variance (ANOVA) was used to evaluate any significant differences in degree of information needed and accessibility among different information needs. Duncan multiple range test were used to detect significant differences between the means. Significant differences were judged at a probability level of $P<0.05$. Furthermore, the mean cut off of 2.00 was used to establish information needs and accessibility. The mean

score that is equal to or higher than 2.00 is the most needed information and highly accessible by respondents while those that are less than 2.00 are categorized as not needed and accessible.

2.10 To Determine the Influence of Social Economic Characteristics on Fish Farmer's Information Needs

The multiple linear regression equation used for analysis was as follows:

$Y = \beta_0+\beta_1X_1+ \beta_2X_2+\ldots+\beta_9X9$ ……..…….(i)

Where;

Y=Degree of needed information (summation of degrees of information needed scores)

β= Regression Coefficients.

β_0= Intercept.

X_1 …X_9 are explanatory variables (Sex (0=Female, 1=Male), Age(0=Up to 35, 1=more than 35), Marital status(0=Single, 1=Married), Education level (0=No formal education, 1=Primary, 2=Secondary, 3=Tertiary), Household income(0 up to 500,000, 1=500 001 – 1 000 000, 2=1 000 001 – 1500 000, 3= More than 1 500 000).Fishing experience (0=Up to 5, 1=more than 5), Fish production (Amount of fish in kilograms per hectare), Membership (1=, member, 0=, None member)

2.11 To Determine the Influence of Social Economic Characteristics on Fish Farmer's Information Accessibility

The multiple linear regression equation used for analysis was as follows:

$Y = \beta_0+\beta_1X_1+ \beta_2X_2+\ldots+\beta_nX_n + \varepsilon,$ ……..(ii)

Where;

Y=Information accessibility (summation of information accessibility scores)

β= Regression Coefficients.

β_0= Intercept.

X_1 …X_n are explanatory variables (Sex (0=Female, 1=Male), Age(0=Up to 35, 1=more than 35), Marital status(0=Single, 1=Married), Education level (0=No formal education, 1=Primary, 2=Secondary, 3=Tertiary), Household income(0 up to 500,000, 1=500 001 – 1 000 000, 2=1 000 001 – 1 500 000, 3= More than 1 500 000).Fishing experience (0=Up to 5, 1=more than 5), Fish production (Amount of fish in kilograms per hectare), Membership (1=, member, 0=, None member). However, Variance Inflation Factor (VIF) was used to determine multicollinearity among independent variables while, the Durbin-Watson's d test was used to test for auto-correlations.

2.12 RESULTS AND DISCUSSION

2.12.1 Social Economic Characteristic of the Respondents

The socio-economic characteristics of the interviewed fish farmers are given in Table 2.1. 48 (20%) of the respondents were females and 192 (80%) were males. This suggests that more males are involved in fish farming than females. These findings are in line with Uzezi (2015) in Nigeria who reported that males participate more in fish farming than females. Also these findings are similar to a study by, Chenyambuga et al. (2011), Chenyambuga (2014), Mwaijande and Lugendo (2015) in Tanzania who indicated that, very few women owned fish ponds and most of them were widowed, divorced or unmarried. This may be due to the fact that in Tanzania women are sometimes not intitled to own land, this make it difficult for some women to invest in fish farming. Chenyambuga *et al.* (2011) Mwaijande and Lugendo (2015) noted further that local customs and cultural practices in many farming systems in Tanzania make it impossible

for a woman to own assets and land as these are attained mainly through inheritance which favors men to own assets.

Likewise, findings showed that 47.1% of the respondents were in the 47 to 56 age group (Table 2.1), whose main economic activities were crop, livestock and fish farming as a third career. This indicates that most of the respondents in the study area were within the economically active age group. According to Olaoye *et al.* (2014) ages between forty and fifty are considered highly productive and active to undergo energetic task associated with fish farming activities.

People above the age of 56 were few in fish farming since they may not be interested and active enough in carrying out fish farming activities. Also from Table 01 it shows that large percentage of the fish farmers at the study area, had at most, primary school education. It has been reported that level of education may affects information accessibility, comprehension and adoption of modern agricultural practices (Ortindi and Katikpo, 2015).

Furthermore, it was found that majorities of the respondents were married couples (Table 2.1). This married percentages are in line with Tanzanian married statistics whereby about 51% of Tanzanian are married couples. (NBS, 2014). Likewise, research findings indicate that (72.9%) of the respondents had fish farming experience of up to five years (Table 2.1). This experience in fish farming is similar to that reported by Barguma and Ndaghu (2014) in Nigeria. This implies that majority of the respondents had experience in fish farming activities, despite of working in fish farming also fish farmers had experienced working on other farming before like crops and livestock, this could have an impact on information accessibility. Moreover, findings show that 45.4% of respondents

(had income level of more than Tsh. 1,500,000/= per year. This connotes that income level of the fish farmers in the study area was below the per capital income of Tanzanian citizen which is Tsh. 2,100,000/= per year (TNBS, 2016). The low income of the fish farmers in the study area could be the reason for low information accessibility. According to Fadoyin *et al*. (2015) income may influence farmer's information source preferences.

Table 2. 1: Social economic characteristic of the respondents (n= 240)

Factors	n	%
Sex		
Male	192	80.0
Female	48	20.0
Education level		
No formal education	15	6.3
Primary education	163	67.9
Secondary education	39	16.3
Tertiary education	23	9.6
Age (years)		
18 – 35	40	16.7
36 – 46	71	29.6
47 – 56	113	47.1
57 – 66	16	6.7
Marital status		
Single	18	7.5
Married	211	87.9
Divorced	3	1.2
Separated	1	0.4
Household income (Tsh.)		
Less than 500,0000	38	15.8
500 001- 1000 000	60	25.0
1 000 001 – 1 500,000	33	13.8
More than 1 500 000	109	45.4
Farming experience(years)		
Up to 5	175	72.9
6 – 10	51	21.2
More than 10	14	5.8

2.12.2 Information Needs for the Fish Farmers

Before asking the farmers to identify their information needs, they were asked if they need information in supporting their fish farming activities. Findings indicated that all the respondents (100%) needed information for their fish farming activities. This could be explained by the fact that information is a key factor in quality decision making. These findings are supported by Kamba's (2009) study in Nigeria who argues that no community can progress without information as it can only become knowledgeable if it recognizes and uses information as the tool for development.

The respondents were asked to indicate the type of agricultural information they needed from the checklist of answers and were asked to provide more than one answer. Table 2. 2 summarizes the agricultural information needs of respondents. Findings indicate that the highest information needs were on how to produce fingerlings through artificial propagation, how to manage/monitor water quality and how to deal with fish preservation and processing at ($P<0.05$). This means that fish farmers still need a lot of information in these areas in order to improve their fish farming productivity. According to Ijatuyi (2016), for fish production to be increased, current, relevant and timely information must be shared to fish farmers especially in the technological and agricultural trends. These findings are in accordance with those of Ofueku *et al* . (2008) and Okoedo-Okojie (2012). This was also confirmed during FGDs where farmers claimed that they would like to produce their own catfish fingerings, using artificial propagation rather than purchasing it. However, they reported that, they don't have such information on artificial propagation and hatchery management. In fish breeding or production, spawning (can be naturally or artificially (induced spawning/artificial propagation). According to Carballo *et al*. (2008) induced spawning/artificial propagation is a technique whereby hormones are provided to the fish via the feed or in-

jected into its muscles in order to stimulate eggs/sperms production. Therefore, this information on spawning operation (artificial propagation) especially for catfish is very important as it helps farmers to be equipped with enough knowledge of fingerlings production and thus to fil the current gap of fish fingerlings in Tanzania.

Likewise, farmers complained about the lack of information on how to carry out and manage fish pond water quality parameter (as part of pond management). It was also observed during field visits that most of the fish ponds water had brown colour. According to Carballo *et al*. (2008) in fish pond water management brown colour indicates water turbidity (degree to which the water loses its transparency) while greenish colour indicates water clarity, fertilized and productive. Thus, the observed brown colour from fish ponds might be caused by presence of suspended particles or dead organic materials from the water sources or from the fish ponds itself. This condition may affect other water quality parameters like oxygen level, PH level, and water temperature, and that could have a negative impact on fish production. information on how to monitor water quality parameters in pond fish culture systems is very important as these variables affect fish physiological processes (Musiba *et al.*, 2014). Unfortunately, during interview with fisheries officers it was informed that there was absence of water quality parameters measurement kit in surveyed areas. It was found that out of six districts only one district had a water quality parameter measurements kit. However, it was noted during FGDs that no farmer was aware of such a kit. This means that farmers had no enough information on what is, when, where and how to use water quality parameter measurements kit. This problem was also reported by Nsonga and Mwiya (2014) who found that pond water management was a challenge among small scale fish farmers.

Fish processing and preservation techniques were another area where farmers needed information in in a large extent. Bonnet (1994) recommended that to reduce bacterial and other processes immediately on dead fish, it should be beheaded, gutted, washed and chilled to inhibit unfavorable enzymatic and microbial processes. However, in the study area very few farmers were practicing this. For instance, it was informed that, some farmers harvested and left fish for one day without processing (beheaded and gutted), they only washing fish until the next day for full processing, and this might cause fish spoilage or affect fish nutritional value. This implies that farmers had little information on how to carry full fish processing immediately after being harvested. In addition, in the study area it was observed that fish farmers had little information on how to use different methods/techniques of fish preservation, also some were not aware of some other techniques like sun drying, smoking, freezing, chilling, brining, freezing, fermentation, and canning as identified by Ghaly *et al.* (2010), Akinola *et al.(* 2006). Unfortunately, during FGDs and interviews with extension officers and also through personal observation it was found that most of the farmers had relied more on one fish preservation techniques (sun drying) to preserve their harvested fish. This method (sun drying) has got some weakness especially when you want to preserve a large number of harvested fish. Sun drying may not be effective and efficient in fish preservation. For example, according to Akinola *et al. (*2006) lack of control of over drying rate may sometimes result to over-drying or under-drying, exposure of fish to dust, dirt, insects infestation and contaminant are some of the drawbacks of sun drying as methods of fish processing and preservation. For instance, during FGDs one farmer complained on condemnation of their harvested fish by buyers due to processing and preservation by sun drying. This suggests that farmers relied on local methods of fish preservation and processing; this could be attributed by low accessibility of information on other techniques, or awareness of existence of other recommended methods

It was also found that farmers needed information on feed formulation techniques and fish feeding. Majority of the farmers mentioned lack of information on such areas. For example, during FGDs it was noted that most of the farmers did not feed fish with formulated feed but just fed them with locally available feeds like kitchen wastes, maize brans and other wastes because they did not know how to formulate fish feeds and also due to low per capital income of the farmers. This was confirmed through observation and interview with fishery officers and it was found that most of the farmers used the locally available feeds to feed fish. According to fishery officers very few farmers used the poultry formulated feeds instead of fish feeds and it was very expensive to afford among farmers. Poor management of fish farming practices including feeding is also confirmed by a study conducted in Tanzania by Chenyambuga *et al*. (2014) who found that fish management practices were generally poor, characterized by improper feeding, lack of concentrate feeds and pond fertilization.

Other areas in which farmers needed information were information on source of fingerlings and types. This implies that there was knowledge gap by farmers on how to identify and where to obtain improved fish seeds for fish farming. For example, during interview with extension officers it was noted that out of the six-district surveyed in three regions there was only one district with one government centre for fingerings production and very few farmers were aware of the existence of such centre. Also, very few farmers were making use of the centre to obtain fish seeds due to its location and low capacity to attend large numbers of farmers. During FGD and personal observation the inability of the farmer to identify and recognize good quality fish seeds was noted, this was evidenced by presence of large numbers of very small fish sampled from the farmer's fish ponds during the study, a situation that made some farmers to abandoned their ponds.

Fish ponds fertilization was another area where information was needed by the farmer. Farmers complained on the lack of information on how, why and when to carry out pond fertilization. This was evidenced by the researcher in the field as most of the fish water ponds were in brown colour but very few had green colour. This indicates that fish farmer's ponds were little or not fertilized. This can have negative effect of farmer's productivity. Shoko *et al*. (2011) pointed out that for fish to attain maximum growth and production, fishponds must be well fertilized to produce natural foods and fish must receive enough supplementary feeds.

Further, the study revealed that, significant numbers of fish farmers needed information on stocking operation/stocking density. Hasan *et al*. (2010) argued that to attain maximum economic returns, it would be essential to stock the ponds at optimum stocking densities for optimum growth in relation to inputs and productivity of the water body. Moreover, through field study it was observed that most of the farmers were under stocked or overstocked the required numbers of stocking capacity per unit fish pond area, thus resulting to poor fish growth. This implies that there is knowledge gap that needs to be addressed and hence improve fish farming productivity.

Other areas in which information were needed by the farmers were fish disease prevention and treatment, fish harvesting, and pond construction. Nevertheless, if the above-mentioned information needs were to be translated into farmers' training and information programmes through governmental and NGOs assistance, most of the fish farmers' skills in fish farming would be enhanced, which would probably improve fish farming productivity.

2.12.3 Information accessibility

Findings indicated that most of the respondents had little access to agricultural information (Table 2.2). This is perhaps due to either lack of funds to subscribe to information sources, expressivity of the information sources, inadequate extension services or , relatively low educational status among fish farmers in the study area. This was proven during interviews with fishery officers who pointed out that they rarely visit farmers due to lack of transport and that they are very few when compared to the total numbers of fish farmers. In addition, through observation it was found that there were no information centres or libraries purposely available for farmer's. Similar findings were reported by Barguma (2014) who found that most of the fish farmers in Nigeria had low access to information on water quality management, feed type and source, production management, disease control and sources for improved fingerlings. In addition, Ogboma (2010) also pointed out that, lack of fishery extension officers, language barrier, lack of relevant materials in agricultural offices and libraries, and cost for accessing information through seminars or workshops are the main obstacles hindering fish farmers to access information.

Table 2. 2: Information needs and accessibility

Type of Information	Need	Accessibility
Information on Market situation	1.50^{ef}	1.80^{a}
Information on Weather conditions	1.56^{e}	1.55^{b}
Information on credit/ loans	1.39^{f}	1.75^{a}
Information on Stocking operation	2.16^{d}	0.94^{d}
Pond Construction	2.06^{d}	1.13^{c}
Fish Fingerling types/ sources	2.41^{c}	0.73^{e}
Feed types and sources	2.40^{c}	0.74^{e}
Fish disease prevention and treatment	2.35^{c}	0.63^{e}
Fish pond fertilization	2.09^{d}	1.10^{c}
Fish harvesting	2.12^{d}	1.07^{cd}
Fish preservation and processing	2.71^{ab}	0.36^{f}
Water quality management	2.87^{a}	0.13^{g}
Feed formulation techn.and Fish feeding	2.66^{b}	0.28^{fg}
spawning operation (artificial propagation)	2.84^{a}	0.24^{g}

Mean on the same column with different superscript are significantly different at 0.05 probability level

2.12.4 Determinants of fish farmer's information needs

Before running the regression model, the collinearity/multicollinearity diagnostics test was done in order to detect whether there is a correlation among the independent (X_i) variables. Results showed that no variables had a tolerance value of VIF <10. Pallant (2011) suggests that a VIF above 10 indicate multicollinearity. This means that there was no violation of the multicollinearity assumption in this study. Furthermore,the results showed that the Durbin-Watson's were 1.51 and 1.63 respectively which falls within the values of $1.5 < d < 2.5$ (implying that there is no auto-correlation) (Kutner *et al.,* 2005). Hence, there is no auto-correlation in the multiple linear regression data.

From the regression analysis, the value of coefficient of multiple determinations (R^2) was 0.329 (Table 3) which implies that 32.9% of the variations in the fish farmers' information needs is explained by the independent variables in the model and it was

significant at 0.05 level of probability. Findings indicated that education, age, and farming experience were negative and statistically significant (P< 0.05). (Table 3). The negative correlation between level of education and information needs suggests that less educated farmers have a higher need for agricultural information than educated ones. This is supported by Maogi and Oladele (2012) and Okojiei (2012) who reported that as the level of education of the farmer decreases their information needs becomes higher. This is probably because educated farmers can have ability and chance to search and consult different information sources compared to less educated and hence their information needs may differ in such aspects. In addition, less educated people face difficulties in expressing and evaluating their information needs compared to educated ones and results into struggling for more information. Umunakwe *et al*. (2014) supported this statement by arguing that education furnishes facts and may equip the farmers with the right cognitive domain to analyze and understand their information needs.

Moreover, the negative correlation between age and farmer's information needs indicates that, the younger farmers have a higher need for agricultural information than the older farmers. This is in line with Okojiei (2012) who reported that age has negative correlation with farmer's information needs. This is perhaps due to the fact that the younger farmers can be less experienced in farming when compared to experienced adult farmers. Thus, experienced farmers have limited information needs when compared to younger farmers. Farming experience also had a negative correlation with farmer's information needs. This is supported by Maogi and Oladele (2012) who found that as farmers gain experience, their information needs become less.

Furthermore, the results in Table 2.3 revealed that there is a negative significant relationship between the number of kilograms harvested per hectare and the degree of the

information needed by the farmer. The negative relationship reveals that as farmers gain more harvest from fish farming, their level of information needs becomes less. This could be attributed by the fact that the farmer who have more harvest from his/her fish farming can have ability to pay and consult different information sources and hence more accessible to information, consequently low demand for information. This is in support of the study by Nkonya (1997) Mwakaje (2010) who noted that farmers with large farms outputs are likely to have more access to various information and are able to take risk associated to experiment with new practices.

Table 2. 3: Influence of social economic characteristics on fish farmer's information needs

Variable	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**p-value**
	B	Std. Error	Beta		
(Constant)	45.151	3.558		12.692	0.001
Sex of respondent	0.956	1.101	0.063	0.869	0.387
Age_categories	-1.060	0.528	-0.150	-2.010	0.046
Household_size	0.200	0.963	0.015	0.208	0.836
Marital_status	-0.406	1.278	-0.024	-0.318	0.751
Education level of respondent	-1.220	0.566	-0.166	-2.155	0.033
Income_categories	-0.371	0.459	-0.067	-0.807	0.421
Farming experience	-3.479	0.818	-0.320	-4.256	0.001
Member_of_farm_group	-0.955	0.854	-0.079	-1.118	0.266
Fish_harvest_per hectre_	-1.675	0.399	-0.301	-4.201	0.001

R^2=0.329, p=0.001,

2.12.5 Influence of social economic characteristics on fish farmer's information accessibility

Farmers' access to information can be influenced positively or negatively by farmers' socio-economic characteristics such as education, age, income, farming experience, marital status and farm size. From the regression analysis, the value of coefficient of multiple determinations (R^2) was 0.266, (Table 4) which implies that 26.6% of the variations in the fish farmers' accessibility to agricultural information is explained by the independent variables in the model, and it was significant at 0.05 level of probability. Out of the nine socio-economic characteristics that were regressed on fish farmers' accessibility to agricultural information, only formal education, income, age and farming experience were positively and statistically significant at 0.05 level of probability (Table 4). These findings are in line with the work of Idrisa *et al.* (2006) who discovered that a unit increment in education increase farmer's accessibility to agricultural information. This implies that the higher the level of education of the fish farmers the more they can have access to information. Educated person is likely to consult various information sources like newspapers, brochures, internet and other mass media so as to access information thus, increasing the chance of accessing agricultural information. According to Ani (1998), education enhances the ability of a person to decode, derive, use, and evaluate useful information for production purposes.

Likewise, income was found to be positively and statistically significant at 0.05 level of probability (Table 4). This means that income increases chances of fish farmers to access agricultural information. This is supported by Koskei et al. (2013) who reported that increase to income among farmers increases the probability of accessing information by about 48%. This may be due to the fact that as farmer's income increases ability to pay for consultation fees for accessing information increases too.

Furthermore, findings indicate that the probability of accessing agricultural information increased with the age of the farmer by 5% (Table 4). This implies that the older the farmer the higher is the possibility of accessing agricultural information from multiple sources. This is supported by Mtega *et al*. (2015) who found that the level of accessibility of agricultural information increased with an increase in age because due to experience older farmers may be at know multiple sources of agricultural information. Fadoyin *et al*. (2015) also support this by reporting that as farmers' age increase the probability of accessing information would also increases too.

Moreover, Table 4 describes that there is a positive significant relationship between the farming experience of the farmers and their access to agricultural information. The positive relationship reveals that as farmers gain experience, their level of information accessibility becomes higher. This implies that an experienced farmer is more aware and exposed in various information resources, hence more accessible to information. In the same vein Rahman *et al*. (2002) posited that farming experience enhanced better accessibility of information for improved farming.

Table 2. 4: Regression results of socio economic characteristics influencing fish farmers' access to agricultural information

Variable	Unstandardized Coefficients		Standardized Coefficients	t	pvalue
	B	Std. Error	Beta		
(Constant)	1.630	3.638		.448	0.655
Sex of respondent	-1.282	1.126	-0.086	-1.139	0.257
Age categories	0.658	0.540	0.095	1.219	0.025
Househol_size	0.683	0.985	0.051	.693	0.489
Marital_status	-0.569	1.307	-0.034	-.435	0.664
Education level of respondent	1.742	0.579	0.242	3.008	0.003
Annual income	0.628	0.470	0.115	1.336	0.184
Farming_exprience	2.610	0.836	0.245	3.122	0.002
Member_of_farm_group	0.551	0.874	0.047	.630	0.530
Fish_harvest_perhectre_	1.104	0.408	0.203	2.707	0.008

R^2=0.266, p=0.001

2.13 Conclusion and Recommendations

Access to current and relevant information is important for improved and increased fish farming productivity. Enhancing information accessibility is necessary for fish farmers to use it for improved and increased fish farming productivity. To enhance access to relevant information among fish farmers, information needs assessment must be conducted from time to time. Through these findings, fishery extension officers and the Ministry of Agriculture, Livestock and Fisheries in Tanzania can now enhance access to relevant information to fish farmers in the country. Moreover, is now possible to develop a well-focused and relevant fish farming training guide and design a fish farming information system that can meet fish farmers' information needs. Therefore, public and private providers of fish farming information services can use the information needs assessment results to meet the needs of farmers.

For enhancing provision of adequate, accessible, relevant and current information to fish farmers' information, services providers are recommended to conduct regular assessments of fish farmer's information needs and enhance timely accessibility of needed information. The Tanzanian Government, on the other hand, should increase the number of fishery extension officers in all villages, this will enhance access to expert advice, fish farming technology and current information among fish farmers. To enhance mobility and ability to attend more fish farmers, fishery extension officers should be provided with means of transport. Likewise, actors in the fish farming sub-sector should empower fish farmers and fishery extension officers through timely seminars and workshops on issues related to fish farming from time to time for updating their knowledge and skills.

References

Angello, C 1; Msuya, Jangawe 2; and Matovelo, Doris (2016). Assessing the Information Needs and information sources of urban and peri-urban livestock keepers in Kinondoni and Morogoro urban districts, Tanzania." *Library Philosophy and Practice (e-journal). Paper 1363: 2-33.*

Ani, A.O. (1998). Assessment of farmers' extension education needs in Yobe state, Nigeria. *Nigerian Journal of Agricultural Education, 1*(1): 152–158.

Bailey, D.K. (1994). Methods of social science research. 4th edition. The free press, New York USA. 588pp.

Bargumua, K and Ndaghu (2014). Information accessibility among fish farmers in Girei, Yola North and Yola South Local Government areas, Adamawa State, Nigeria. *Journal of Science and Technology, 4*(8): 503-507.

Benard, R, Dulle, F, Nagalapa, H. (2014). Assessment of information needs of rice farmers in Tanzania; A Case study of Kilombero district, Morogoro, Library Philosophy and Practice (e-journal). Paper 1071: 1-34.

Chenyambuga, S .W. Mwandya, A., Lamtane, H. A., and Madalla, N. A. (2014). Productivity and marketing of Nile tilapia (*Oreochromis niloticus*) cultured in ponds of small-scale farmers in Mvomero and Mbarali districts, Tanzania. *Livestock Research for Rural Development, 26*(43).[http:// www. lrrd. org/lrrd26/3/chen26043.htm].

Creswell, J. W. (2003). Research design: Qualitative, quantitative and mixed methods approaches, second edition. Thousand Oaks: SAGE Publications. 588pp

Devadson, F.J and Lingam, P.P (1996). 62 IFLA general conference proceedings: A methodology for identification of information needs of users. Pp.25-31. http//www.ifla.org/iv/ifla62/62-devf.html. retrieved on 22 February 2016).

Duncombe, R. and Heeks, R. (2001). Enterprise development and Information and Communication Technologies in developing countries: supporting "ICT-Flyers"Manchester: Working Paper Series. Paper No. 19. University of Manchester, Institute for Development Policy and Management.

Eucharia. N., Okereke. E., Jonadab. C. Ogueri., U., Ifeanyi.E., Ngozi.C., (2016). Roles of Information and Communications Technologiesn improving fish farming and production in rivers State, Nigeria. *Library Philosophy and Practice (e-journal*). 1445

Fadoyin, A.S. Ayanrinde, F.A., Baba, G.O. Majolagbe, M.O. Erhabor, T.A. Sulaiman, Y.D Musa kabiru., (2015). Evaluation of socio-economic factors influencing information accessibility among farmers in Oyo State, Nigeria. *Developing country studies, 5*(9): 43-46.

FAO (2012). Food and Agriculture Organization of the United Nations. United republic of Tanzania -national aquaculture sector overview. Retrieved June 8, 2016 from http://www.fao.org/fishery/countrysector/naso_tanzania/en

FAO, (2017). National aquaculture sector overview United Republic of Tanzania, Rome, Italy. 123pp.

Ferris, S. (2005). Developing market information services in Eastern Africa: the food net experience, local, national and regional market information services. International Institute of Tropical (IITA), Ibadan Nigeria.

Glazier, J. D. and Powel, R. R. (1992), qualitative research in information management, Englewood: Libraries Unlimited. 201pp.

Idrisa, U.L; Gwary M.M and Ibrahim A (2006). Determinants of adoption of Cassava farming technologies in Mubi North Local Government area of Adamawa State. *Nigeria Journal of Agricultural Research, 2* (2): 2-6.

Ijatuyi, E,J., Abiou ,O, A., and Olaniyi, O,A.,(2016). Information needs of fish farmers in Osun-State. *Nigeria Journal of Human Ecology, 56*(3): 309-317.

Johnson and christensen, L. (2004). Educational research; quantitative, qualitative and mixed approaches, Ally and Bacon, Alabama. 169pp.

Kamba, A.K (2009). Access to information: The dilemma for rural community development in Africa, http://globelics2009dakar.merit.unu.edu/papers/1238296264_MA.pdf retrieved on 21 february, 2017

Kaniki, A.M (2003). Information needs for basic research: African perspective, symposium on open acess and the public domain in digital data and information for science, UNESCO Head quarters, Paris, France, 10-11-2003.

Koskei, R.C., (2012). Access and use of information by small holder tea farmers in Bureti district, Kenya, Thesis Presented at the Sokoine University of Agriculture

as the requirement of master of science degree in Agricultural Information and Communication Management (AICM) of Egerton University

Kughur, P.G., Ortindi, P.I. & Katikpo, G., (2015). Factors affecting farmers accessibility to agricultural information in Gwer-East Local Government area of Benue State, Nigeria. *International Journal of Information and Communication Technology Research*, 5(10):

Lwoga, ET., Ngulube, P., Stilwell., (2010). Information needs and information seeking behaviour of small-scale farmers in Tanzania Vol 40: 82: 103

Moagi, T. M., and Oladele, O. I. (2012). Analysis of information needs among land redistribution for agricultural development beneficiaries in Waterberg district, Limpopo Province,South Africa. *Journal of Human Ecology* 39(2): 95-101

Msofe, G and Ngulube, P., (2015). Information needs of poultry farmers in selected rural areas of Tanzania, *Journal of information Development 32(4)*

Nkonya, E., Schroeder, T. and Norman, D. (1997). Factors affecting adoption of improved production technologies and interface of out-reach efforts with farmers. *Journal of agricultural resources, 46*(1): 1-12.

Nsonga A, Mwiya S (2014). Challenges and emerging opportunities associated with aquaculture development in Zambia. *International Journal of fish aquaculture studies, 2*(2):232-237.

Ofuoku, A.U. Emah, G.N. and Itedjere, B.E (2008), Information utilization among rural fish farmers in central agricultural zone of delta state, Nigeria *World Journal of Agricultural Sciences, 4*(5): 558-564. http://www.idosi.org/wjas/wjas4%285%29/7.pdf retrieved on 14 January, 2017.

Ogboma, M. U., (2010). Access to agricultural information by fish farmers in Niger Delta region of Nigeria. LibraryPhilosophy and Practice (e-journal). Paper 424: 1-7.

Okoedo-Okojie, D. U. and Ovharhe2, J. O. (2012). Assessment of information needs of fish farmers in delta state, Nigeria. *Nigerian Journal of Agriculture, Food and Environment.* 8(3):72-77.

Opara, U. N. (2008). Agricultural information sources used by farmers in Imo State, Nigeria. *Journal of Information Development* 24 (4) 289-295.

Ozowa, V.N (1997), "Information needs of small scale farmers in Africa: The Nigerian example". http://www.worldbank.org/html/cgiar/ newsletter /j une97/ 9nigeria.html retrieved on 3 June, 2017.

Saunders, M., Lewis, P. and Thornhill, D (2007). "Research methods for business students". 4th ed.Prentice Hall, London. Pearson Education Limited. Pp. 226

Singleton, R.A (1993). Approaches to social research, New York, Oxford University Pres.

Swanson, B. E, (1997). The changing role of extension in technology transfer. *Journal of International agriculture. and extension education, 4*(2). 87 – 94.

Tanzania National Bureau of Statistics (2016). Economic survey publications, retrieved from [http://www.nbs.go.tz/nbstz/index.php/english/]

Tanzania National Bureau of Statistics (NBS) (2016). Basic demographic and socio-economic profile retrieved from [http://www.nbs.go.tz/nbstz/index.php/english/]

Tumsifu, E , Silayo, E.E. (2013).Agricultural information needs and sources of the rural farmers in Tanzania: A case of Iringa rural district. *Library Review*,62 I8/9: .547 – 566.

Ugboma, U, M. (2010). Access to agricultural information by fish farmers in Niger Delta region of Nigeria. *Library Philosophy and Practice Journal* Paper 424: 1-7 http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1443&context=libphilprac retrieved on 21 march 2017

URT (2012). National census of agriculture 2007/2008 small holder agriculture, Vol 3 livestock sector national report, ministry of agriculture, food security and cooperatives, Dar es salaam. 168pp.

Uzezi, O.P. (2015). Agricultural and information needs and utilization among migrant fishermen by gender: A study of Isoko reverie community, Delta State, Nigeria. *Journal of Emerging Trends in Computing and Information Sciences, 6*(5): 265.

Wulystan, P. Mtega, Mpho Ngoepe, Luyanda Dube (2015). Factors influencing access to agricultural knowledge: The case of smallholder rice farmers in the Kilombero district of Tanzania. *South Africa Journal of Information Management* vol 18(1)

Rashid, M and Akanda A.G, (2015). Fish farmer's access to information communication media: A gender based comparative study in a selected village of Bangladesh, *International Journal of fisheries and aquaculture studies, 2(4): 168-173*

Meitei, L.S. and Devi, T.P (2009), "Farmers information needs in rural Manipur: an assessment". *Annals of library and information studies*. Vol.56, 35- 40.

Okwu O.J. Yahaya, M.A and Obinne, C.P.O. (2011). Analysis of artisanal fisher folk information needs and accessibility in Benue State, Nigeria. *Asian Journal of Agricultural Sciences* 3(5): 408-413.

Mustapha S. B., Mustaphab, A. A., Reubena, A. B., Obettac, N. C. and Alkalia, M. A. (2016). assessment of extension service delivery on fish farming in Maiduguri Metropolis, Borno State, Nigeria. *International academic Journal of innovative research* 3(9): 9-14.

CHAPTER THREE

PAPER TWO

The influence of ICT usage in sharing information on fish farming productivity in the Southern Highlands of Tanzania

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Abstract

The use of ICTs in sharing information is very important in enhancing fish farming productivity among fish farmers. However, little is known on the linkage that exists between the use of ICTs and fish farming productivity in the Southern Highlands of Tanzania. This study was conducted in three regions, namely, Ruvuma, Mbeya and Iringa, and involved twelve divisions purposively selected from six districts. This cross sectional study involved 240 fish farmers who were randomly selected. The study used both quantitative and qualitative approaches in collecting data. Questionnaires, Focus Group Discussion (FGD), observation and key informants' interview were used as methods of data collection. Both descriptive and inferential statistics were used to analyse quantitative data while content analysis was used to analyse qualitative data. Findings indicate that mobile phones were the most used ICT tools followed by radios and television among fish farmers for sharing agricultural information. In addition, the study revealed a higher fish farming productivity in Mbinga and Mufindi districts as compared to Iringa District. Moreover, the use of the ICTs for sharing agricultural

information was found to have statistically significant and positive relationship with farmers' productivity at $p < 0.05$. Thus, it is recommended that the media owners and other information providers should disseminate more agricultural programmes related to fish farming practices and make sure that such information is aired during appropriate and convenient time period for farmers.

Keywords:ICT, fish farming, information, aquaculture, agricultural information, Tanzania

3.0 Introduction

Agriculture is the backbone of most African countries. In Tanzania, the sector employs about 80% of the total population (World Bank, 2014), contributes about 25.7% to the Gross Domestic Product (GDP) and 30.6% the foreign exchange (URT, 2010). Fish farming serves as a means of livelihoods to millions of people worldwide (Robert, 2011). In Tanzania, fish farming plays a significant role in building and strengthening a strong national economy by increasing household income, food security and employment opportunities. In 2014 the Tanzania fish farming sub-sector employed 183 800 full time fishermen and about 4.0 million people earned their livelihoods from fish farming related activities (URT, 2015). In addition, the sub sector contributed 2.4% to the GDP (Economic Survey Report, 2014).

Tanzania has the greatest fish farming potential in Africa with suitable land and water body resources. It has a total of 21 300 grow-out earthen ponds and nine raceway systems which are in operation (URT, 2015). These ponds can contribute to poverty reduction and enhance food security in the country. Despite the existing potentials of fisheries sector, fish farming in Tanzania is constrained by inadequate aquaculture extension, unavailability of quality fish seeds and feeds, inadequate aquaculture

information and knowledge, poor transport infrastructure, unreliable markets, limited accessibility of capital and low incentives to aqua-farmer investors (URT 2010; Shoko *et al*., 2011; Ogello *et al.*, 2013; Chenyambuga *et al.*, 2014).

For rapid growth of fish farming, efficient flow of information and knowledge to the fish farmer on pond management practices is important. The sub sector depends on continuous flow of information and knowledge from local, regional and world markets (Rutger, 2000; Akinpelu *et al*., 2013). Like other agricultural sub-sectors, information in fish farming practices is very important for increasing productivity (Opara, 2008). Rational decisions on fish farming depend much on the availability of timely and reliable information. Such information helps fish farmers decide on how to allocate inputs, find appropriate markets for their products, and decide on the best post-harvest storage of products (Demiryurek, *et al*., 2008). According to researchers such as Riesenberg,(1989); Aphunu and Atoma(2011), optimal fish farming production depends on having accurate information related to the market, efficient allocation of available resources, and use of new or innovative farming practices. Mudukuti and Miller (2002) emphasised that in the information age, dissemination of agricultural information and applying this information in the process of fish farming production play a substantial role in the development and improvement of fish farming. When acquired and effectively utilised by the fish farmers, such information helps to increase fish production, and hence increase income and improve farmers' standard of living. The idea of access to agricultural information for fish farmers to improve their aquaculture production is backed by a study by Adomi *et al*. (2003) in Nigeria. Thus, adoption of improved fish farming practices requires adequate access to information. Such information should be effectively disseminated to the famers and other stakeholders.

Several traditional approaches have been used by fisheries officers in delivering and disseminating information and knowledge to fish farmers in Tanzania. These approaches include public awareness creation, training such as Farmer Field School (FFS), demonstration and farmer visit (Kimaro *et al.,* 2010; NAP, 2012). However, these approaches have been constrained by inadequate extension capacity. Presently, there are 750 fisheries extension officers out of 16 000 who are required in the country to meet information and knowledge needs of fish farmers (URT, 2018). Such a constraint decreases the dissemination of information and knowledge to fish farmers (Yaseen *et al.,* 2015). This empenches, farmers' acquisition of the right information, and consequently leads to poor fish farming productivity. Due to low capacity and/or limited understanding of fish farming environment by the fisheries extension officers, extension services have therefore not led to significant increase in production (CUTS International, 2011). ICTs (mobile phones, radios and television) use can play a critical role in this regard. In supporting this Okoedo-Okojie (2015) revealed that, the old and modern ICTs ie. radio,television and wireless technology as well as the internet are important tools for meeting the information needs of small scale farmers.

Information and communication technologies (ICTs) are basically technologies that enhance the communication, dissemination, sharing, creation, storage, processing, and implementation of data as well as information using microelectronics, tele communication and Computers. (Akinbile and Alabi, 2010; Okoedo-Okojie 2015). The range of technologies is growing all the time and there is convergence between the new and old media. The former includes computers, mobile phones and the internet, whereas the latter includes radio, television, telephone and fax, among others.

The revolution of ICTs globally has opened larger opportunities for efficient information sharing in many sectors including the fish farming sub-sector. Likewise, ICTs can play a key role in providing extensionists and fish farmers with vital information needed for fish farming activities (Munyua *et al*., 2008). ICTs enable interactive communication among farmers unconstrained by location or distance, volume, medium, or time as compared to traditional technology dissemination methods, such as field demonstrations, printed material, group meetings, or face-to-face (Joel and Adigun, 2013; Samansiri and Wanigasundera, 2014). Thus, a farmer can make use of various ICT tools such as mobile phones, radios and television to access and share relevant and timely agricultural information for improved fish farming. Fish farmers can apply ICTs to increase fish farm productivity by providing farmers with access to information which enables them in matching fish farming practices to climatic trends, use inputs and resources optimally, and ensure good fish farming practices through improved fish breeds, disease control, market access, and pond management (Donovan 2011). Success in any fish farming enterprise is largely determined by the amount of information related to fish pond management practices provided and used by farmers (Soyemi, 2014; Chenyambuga, *et al.*, 2014; Mwaijande and Lugendo, 2015).

Fish farmers in the Southern Highlands of Tanzania lack vital agricultural information, leading to inefficiencies, inequity, poor productivity and post-harvest losses (Mwaijande and Lugendo, 2015). Inadequate access to knowledge on inputs and pond management among fish farmers has dwarfed the growth of the sub-sector in the Southern Highlands of Tanzania (Wetengere, 2011; Chenyambuga *et al.*, 2014). Inadequate access to information leads to poor pond management practices which, in turn, lead to poor fish farming productivity. When fish farmers put into use the information related to pond management practices, the productivity goes to about 10000 kg/ha/year (Eknath and

Acosta 1998; Hussain, *et al*., 2000). Under poor access to information on how to manage ponds, fish productivity ranges from 2089 kg/ha/year to 4704kg/ha/year (Kaliba *et al.*, 2006; Shoko et *al.*, 2011). Due to limited usage of fishery production information, fish production among small holders in Mbeya is estimated to be 5312 kg/ha/year (Chenyambuga *et al.* 2014). This situation could be improved by making use of ICTs to timely share the required information; hence solve some of the information related challenges that Southern Highlands farmers face in fish farming. Moreover, the extent to which ICTs have been used in sharing of fishery information for improved fish farming productivity in Tanzania particularly in the Southern Highlands is not known.

Most studies done so far in the country have either analysed the usage of the ICTs in accessing agricultural information and other information services (Lwoga, 2010; Mwakaje 2010; Mtega, 2011; Mtega and Benard, 2013), or use of mobile phones in communicating agricultural information (Nyamba, 2011; Churi *et al.*, 2012), or the socio-economic impact of ICTs (Chilimo, 2008; Nyakisinda, 2009). All these studies have explained ICTs usage without linking it with farmers' productivity especially fish farmers and none of them has been specific on fish farming. In addition, many studies in Tanzania addressing poor yield or low yield on fish farming have concentrated on production based innovations while none has investigated the impact of ICTs on fish farming productivity.

Thus, this study intended to analyse how these ICTs are used in sharing agricultural information and consequently improving the fish farming productivity in the Southern Highlands of Tanzania. Specifically, the study intended to evaluate the extent to which ICTs are used in accessing agricultural information by fish farmers in the study area; to examine the productivity level and fish management practices of fish farmers in the

study area, and to determine the influence of ICTs use on fish farming productivity. The ICTs considered in this study comprised mobile phones, radios and television.

3.1 Methodology

This study was conducted in 2016 in three regions found in the Southern Highlands of Tanzania, namely, Iringa, Mbeya and Ruvuma. They were selected because they have a relatively big number of fish farms, long history of fish farming compared to other regions in the country and relatively well developed ICTs infrastructure (FAO, 2012). According to URT (2012), Ruvuma, Iringa and Mbeya regions have more numbers of fish ponds than other regions in the country. There are 4,942 fish ponds in Ruvuma Region, 3137 in Iringa Region and 1176 Mbeya Region (FAO, 2017).

3.2 Sampling Procedure and Sample Size

The sampling frame comprised all fish farmers in twelve divisions, in six districts namely, Mbeya, Mbarali, Iringa, Mufindi, Mbinga and Songea. The districts were chosen based on the number of fish farms and presence of ICTs infrastructures like electricity, radio, television cables and mobile networks. Based on these criteria, two districts from each region, namely Mbinga and Songea districts in Ruvuma Region, Mbeya and Mbarali districts in Mbeya Region, and Iringa and Mufindi districts in Iringa Region were selected for this study. From each District, two divisions with 20 fish farmers and good ICTs infrastructures were purposively selected. The 20 individual fish farmers were randomly selected through simple randomly sampling from each division based on ownership of at least one type of ICT, and making a total sample size of 240 respondents. According to Israel (2012) a sample size greater or equal to 20 can yield meaningful results in a survey study.

3.3 Data Collection Approaches and Methods

The study used both quantitative and qualitative approaches. It used a cross-sectional research design in collecting primary data where data were collected once from individual fish farmers who were the sampling units of the study. Quantitative data were mainly collected using a structured questionnaire while qualitative data were collected from key informant interviews and focus group discussions. A prepared interview guide was used with six key informants (one fisheries extension officer in each of the six districts were selected purposively); and a focus group discussion guide was used to gather information from 48 fish farmers who had an experience of at least five years in fish farming. One group discussion (eight participants in each of the districts) was conducted in each of selected district. Barbour (2011) recommends that eight participants per session is an adequate number for the FGD. In addition, direct observation through observation guide was used as an additional method of data collection.

3.4 Data Analysis

With the aid of the SPSS Version 20, quantitative data collected through structured questionnaire were statistically analysed both descriptively and inferentially, while qualitative data were analysed using content analysis as follows:

3.4.1 The extent to which fish farmers make use of ICT in accessing agricultural information in the study area

To ascertain the extent of ICT use among the respondents, a list of available ICTs was compiled and rated on a 5 point Likert type scale, with response options of “Very frequently = 4, Frequently =3, occasionally = 2, Rarely = 1, Never= 0”. The response values were added up to obtain 10 , which was divided by 5 to get a mean score (mean cut off point) of 2.0. (4+3+2+1+0= 10/5 = 2). Mean scores of 2.0 or above were

classified as most often used, while scores less than 2.0 were regarded otherwise. This method of calculating the mean score (mean cut off point) was also adopted by various scholars, for exaamples Aphunu and Atoma (2011); Osondu and Ibezim 2015; Nenna, 2016).

3.4.2 The extent of productivity level of fish farmers in the study area

Fish farming productivity was measured in terms of total kilograms of fish produced by farmer per hectare per year (kgs/ha/year). One-way analysis of variance (ANOVA) was used to determine significant differences of the mean yield among the districts, and Duncan multiple range test was used to detect significant differences between the means. Differences were judged at a probability level of $p<0.05$.

3.4.3 The influence of ICTs use on fish farming productivity

The multiple linear regression equation was used for analysis. The multiple regression equation used for analysis was as follows:

$$Y = \beta_0+\beta_1X_1+ \beta_2X_2+\ldots+\beta_nX_n + \varepsilon,$$

Where;

Y= Productivity (yield in kg per hectare)

β= Regression Coefficients

β_0= Intercept

$X_1 \ldots X_n$ explanatory variables

ICTs use (radio, television and mobile phone), 4= Very frequently, 3 = Frequently, 2 =, Occasionally, 1 = Rarely, 0 = Never), type of fertiliser used; Pig manure, Poultry manure coded as Use=1, Do not use =0**,** Access to extension services (1 = have access, 0 = do not have access), Source of fingerling (1=official, 0 =fellow farmers)**,** Member of farmer group (1 = Member, 0 not member)**,** Annual income (TZS)**,** Experience in fish farming

(in years), (Sex (0=Female, 1 =Male), Age (0=Up to 35, 1 =more than 35), Education level (0 =No formal education, 1 =Primary, 2 =Secondary. On the other hand, Variance Inflation Factor (VIF) was used to determine multicollinearity among independent variables whereas the Durbin-Watson's d test was used to test for auto-correlations. Likewise, the content analysis was used to analyse qualitative data. This was done by grouping collected information into abstract themes categorized based on research objectives.

3.5 Results and Discussion

3.6 Socio-economic Characteristic of the Respondents

Table 3.1 summarises the findings of the research study on socio-economic characteristics of the respondents. It was found in this study that 80% of the respondents in the study area were males while 20% were females. These findings are similar to those of Chenyambuga *et al*. (2012), Chenyambuga (2014), Mwaijande and Lugendo (2015) who also reported that almost all fish ponds surveyed in Morogoro, Ruvuma, Kilimanjaro, Njombe, Mbeya and Dar es Salaam regions in Tanzania were owned and managed by male farmers. This perhaps is due to tedious nature of fish farming particularly on pond management practices. This was also noted by Ofuoku *et al. (*2008) from Nigeria who reported that the male dominance in fish farming suggests the labourious nature of farming operations which their female counterparts cannot afford.

Similarly, findings reveal that nearly half (47.1%) of the respondents were in the age group of 47 to 56 (Table 3.1). This means that most of the respondents were within the economically active age group and this could have a positive influence on information accessibility and fish farming productivity in the study area. Olaoye *et al.* (2014) opine that ages between 40 and 50 are considered highly productive and active to undergo

energetic task associated with fish farming activities. Respondents above the age of 56 in the study area were few in fish farming.

In addition, results show that the majority (67.9%) of the respondents had attained primary education. Likewise, study findings show that 58.8% of the respondents had a family size of 1-4 members while the remaining 38.3% and 2.9% had members of 5-8 and more than 8 members.

Further analysis of the research findings showed that 45.4% of the respondents had income level of more than TZS 1 500 000 per year. This suggests that income level of the fish farmers in the study area was below the per capital income of Tanzanian which is TZS 2 100 000 per year (TNBS, 2016). Income level can have positive or negative consequences on information accessibility and use and influence the level of fish farm productivity. This is because the success or the failure of agricultural productivity depends on household income (Urgessa**,** 2015).

Table 3. 1. Socio-economic characteristic of the respondents (n= 240)

Factors	**n**	**%**
Sex		
Male	192	80.0
Female	48	20.0
Education level		
No formal education	15	6.3
Primary education	163	67.9
Secondary education	39	16.3
Tertiary education	23	9.6
Age		
18 – 35	40	16.7
36 – 46	71	29.6
47 – 56	113	47.1
57 – 66	16	6.7
Marital status		
Married	211	87.9
Not married	29	12.1
Household income		
Less than 5 00 0000	38	15.8
5 00 001- 1 000 000	60	25.0
1 000 001 – 1 500 000	33	13.8
More than 1 500 000	109	45.4

3.7 Fish Management Practices in the Southern Highlands

Table 3.2 shows fish management practices of fish farming in the study area. It was observed that, most of the ponds were small with an average size of less than 250 m^2. According to FAO (2012), most small-scale fish farmers own small ponds of an average size of 150 m^2. The majority (60%) of the respondents claimed that they got their fish seeds from their colleagues/neighbours while 20.8% claimed that they got fish seeds from Government farms. This means that farmers rely on local produced seeds from their colleagues that might lead to poor productivity and this is partly caused by low information accessibility. During the FGD with the farmers it was reported that some of the farmers were not aware on the existence of some of the fingering production unit, for instance Luwila production center in Songea, Kingolwira in Morogoro and other units. Most of the respondents were feeding their fish either once (37.5%) or twice per day (34.6%). In fish feeding, especially tilapia farming the recommended optimum feeding interval is between 4 – 5 hours depending on the energy and composition of the diet (Riche *et al* 2004). This means that there is inadequate information/knowledge on feeding practices among fish farmers in the study area. In supporting this, during the FGD, for example one respondents in Isagati narrated that, *I always feed once per day my fish as it advised by my neighbor that frequent feeding makes fish not to reproduce well"*.

Additionally, the study revealed that fish farmers provided maize bran (85%), kitchen wastes (29.6%) and fish meals (18.8%) as supplementary feeds to their fish. This is due to the fact that these materials are readily available and low in price. Moreover, these supplementary feeds could be of poor quality since they may lack protein concentrates which are very important in fish growth. Chenyambuga *et al.* (2014) pointed out that fish reared in ponds need to be supplemented with high protein concentrates. Based on the

field observations, it was noted that protein concentrates such as fish meal, soybean meal and oil cakes were not used for feeding fish; due to the lack of information and knowledge on feed formulation, their irregular supply, and high expense for farmers. For instance, during the FGD one farmer in Pawaga pointed that: "*I always feed my fish with only bran as it contains high nutrients compared to other feed staffs."* Likewise, most fish farmers used cattle manure (87.5%) to fertilise their fish ponds while (12.1%) fertilised their fish ponds using poultry manure. Chenyambuga *et al*. (2014) reported similar findings on type of fertilisers used by fish farmers in pond fertilisation in Mbarali District, Tanzania. This is due to lack of information on the use of other manure for pond fertilisation and easy availability of cattle manure in the study area. Poultry manure was not used by the majority of the respondents, since during the FGD, for example, one farmer in Kalenga commented: "*It was my first time to hear from you that poultry manure can be used to fertilise fish ponds too*". On the other hand, some fish farmers complained about unavailability of such manure in the study area.

However, 42.9% of the respondents claimed that they were seldom visited by extension officers. Further, 38.8% reported that they have never been visited by an extension officer. This suggests that fish farmers may lack the necessary technical agricultural information. This is explained by low numbers of fisheries officers in the surveyed districts, also during the interview it was informed that lack of funds to facilitate their movements in their districts as the other reasons for low frequency of visiting farmers. To confirm this problem, this study established that there was only one extension officer in each district for serving the whole district. These findings are in line with Mwaijande and Lugendo (2015), Chenyambuga *et al.* (2014) from Tanzania, and Njagi *et al*. (2013) from Kenya who also found poor extension services and inadequate numbers of extension officers to be among the factors limiting fish farming development.

Table 3. 2: Fish management practices in the Southern High lands

Fish management practices	n	%
Pond size(m2)		
Less than 251	104	43.3
251 – 500	63	26.2
501 – 750	28	11.7
751 – 1000	18	7.5
More than 1000	27	11.2
Feeding frequency		
Once a day	90	37.5
Twice a day	83	34.6
Thrice a day	29	12.1
Twice per week	38	15.8
Feed type		
Grains	21	8.8
Fish	39	16.3
Kitchen waste	71	29.6
Brans	204	85.0
Natural food in pond	29	12.1
Fertiliser used		
Pig manure	15	6.3
Poultry manure	29	12.1
Goat/sheep manure	2	0.8
Composite manure	1	0.4
Cattle manure	210	87.5
Sources of labour		
Hired	39	16.3
Self	120	50.0
Family members	75	31.3
Frequency of extension visit		
Frequently	44	18.3
Seldom	103	42.9
Never	93	38.8

3.8 The Extent of ICTs Use in Accessing Agricultural Information by Fish Farmers

This study evaluated the most common ICT tools used for accessing agricultural information. These were mobile phones, radios and television**.** Aboh (2008), Sousa *et al*. (2016) opined that radio, television, mobile phone are ICT tools that have great potential for use by farmers in sharing agricultural information. The most frequently consulted ICT tools by fish farmers in sharing agricultural information were mobile phones, radio and television (Table 3.3).

Mobile phones were mostly used because they are easily accessible, available and cheap, and facilitate a two-way communication, that is a farmer can seek more clarification and get instantly answers. This was confirmed during Focus Group Discussions and key informant interviews where it was pointed out that most fish farmers prefer to use of mobile phones because they are convenient to use. For example, during the FGD one farmer from Sadani pointed out that,

> *"With a mobile phone I can communicate with fisheries* extension *officers asking for some information related to weather, market, credits, fish pond construction, fish feeding, source of fingerings and other information without necessarily traveling a long distance to meet them".*

Likewise, some fisheries extension officers pointed out that they uses mobile phones more frequently as these gadgets were user-friendly and helped them to overcome problems of transport. With mobile phones, they did not need to travel to visit farmers located far away. They could just call them when there was new information. The findings of this study are similar with those of Chavula (2014) and Eucharia (2016) which also found that mobile phones are the most used ICT tools among fish farmers because of their availability, wide coverage, and being accessed at a modest cost. In addition, findings from a study conducted by Masuki *et al.* (2010) in Nigeria revealed that the use of mobile phones was appreciated by rural farmers because they are user-friendly, fast and convenient to share and get prompt answers of respective problems.

Further, radio was another ICT tool that is utilised by fish farmers in accessing and sharing agricultural information. The high level of usage of radio is explained by its affordability, flexibility, ease language comprehension and its credibility in communicating timely, and relevant agricultural information to farmers. In addition, during the FGD it was informed that radio programmes aired to farmers were useful and

enriched them with credible information on how to improve their fish farming activities. For example, during the FGDs in Kigonsera in Mbinga District one farmer pointed out that '*listening to radio programmes related to fish farming has helped me to construct a fish pond with acceptable dimensions*'. The use of radio is also supported by Njoku (2016) who confirmes that radio is a very effective and credible medium in agricultural technology transfer to rural farmers. Moreover, Nyareza and Dick (2012) opine that while other communication media like television remain in the hands of a small percentage of people, low-cost transistor radios run on batteries are now affordable for the poorer sections of the population.

Finally, the study findings show that, even though television programmes are credible and key sources of information to farmers, they were least consulted by fish farmers in the study area as compared to mobile phones and radios (Table 3.3). However, this observation contradicts the results by Aphunu and Atoma (2011) and Eucharia *et al*. (2016) who report that the majority of the fish farmers use television more frequently in accessing fisheries information elsewhere. Based on the findings through the FGDs, this disparity is explained by the high cost of purchasing television sets, lack of electricity in most rural areas and in appropriate time for broadcasting the agricultural programmes related to fish farming.

Table 3. 3: The extent of ICTs use in accessing agricultural information by fish farmers

ICTs	Mobile phone		Radio		TV	
	n	**%**	**n**	**%**	**n**	**%**
Never	19	7.9	32	13.3	95	39.6
Rarely	70	29.2	135	56.2	71	29.6
Occasionally	56	23.3	45	18.8	25	10.4
Frequently	86	35.8	27	11.2	46	19.2
Very frequently	9	3.8	1	.4	3	1.2
Total	240	100.0	240	100.0	240	100.0

3.9 Productivity Level of Fish Farmers in the Study Area

Table 3.4 summarises the productivity level of fish farmers in the study area. The study revealed that among the six districts surveyed Mbinga, Mufindi, Mbeya, Mbarali, and Songea had higher productivity levels while Iringa District had lowest fish productivity level (Table 3.4). The differences in productivity attributed mainly by the differences in fish pond management practices, information accessibility, socio-economic characteristics as well as to lack of extension officer's visits to farmers in Iringa District. The differences in productivity was observed during the FGDs and key informant interviews whereby farmers from Iringa District complained that they were never visited by fisheries extension officer that makes them to have inadequate knowledge on fish farming, also they complained about poor stunted fish growth due to poor fish seeds acquired from other farmers or from the wild (rivers), lack of supplementary feeds like protein concentrates and about lack of knowledge on the construction of modern fish ponds. For instance, it was observed that there was an abnormal fish pond dimensions and stocking density from some of the fish farms in Iringa District. One farmer from Kalenga Division in Iringa had a pond with 10 m x 15 m which was three metres deep and was stocked with 1100 fingerings; this can have a negative impact on the productivity. According to Carballo *et al.* (2008), the recommended pond depth should be 0.5m to 1m in at a shallow end and slopping of 1.5m to 2.0m at the drain end whereas the recommended stocking density should be 2 to 3 fingerings per square meter.

The other reason attributing to variations in productivity was the presence of a number of ongoing projects on fish farming in some districts. Mufindi District, for example, had a project on different aspects of fish farming practices implemented by Sokoine University of Agriculture. These projects offered some training that imparted farmers with some information, knowledge and skills that helped farmers to improve their fish

farming practices, and consequently improving their productivity. FAO (2012) and Chenyambuga *et al.* (2014) confirm that poor productivity among fish farmers in Tanzania is due to the unavailability of fingerlings, long interval from stocking to harvesting lack of concentrate feeds, inadequate information/knowledge on fish farming, and small pond size. Findings indicate that the overall mean productivity observed in this study (1810.78 kg/ha/year) is lower than the productivity of 5312 kg/ha/year and 4704 kg/ha/year reported by Shoko *et al.* (2011) and Chenyambuga *et al.* (2014). The mean productivity is also low compared to the productivity of 10 000 kg/ha/year, which can be attained when improved breeds and pond management are used in Tanzania (Eknath and Acosta, 1998; Hussain *et al*., 2000).

Table 3. 4.Productivity (kg per hectare) level of fish farmers in the study area

District	Mean + sem	P - value
Mufindi	1991.70 $\pm$ 287.97a	0.015
Iringa	1153.20 $\pm$194.69b	
Mbeya	1878.90$\pm$ 299.25ab	
Mbarali	1835.20$\pm$278.10ab	
Songea	1757.60$\pm$250.75ab	
Mbinga	2208.10$\pm$ 110.42a	
Overall	1810.78 +110.42	

Mean in the same column with different superscript are significant different at $p \leq 0.05$

3.10 The Influence of ICT Use on Fish Farming Productivity

Before running the regression model, the collinearity/multicollinearity diagnostic tests were done in order to detect whether there was correlation among the independent (X_i) variables. Results showed that no variables had a tolerance value of < 1 or VIF >10. Pallant (2011) suggests that a VIF above 10 or tolerance < 1 indicate multicollinearity. This means that there was no violation of the multicollinearity assumption in this study. Further analysis, showed that the Durbin-Watson's was 1.99 which falls within the values of $1.5 < d < 2.5$, implying that there was no auto-correlation (Kutner *et al.,* 2005). However, before further regression analysis, the extraction method of the Principal

Component was used to determine variables to be fitted into regression equation, which was then subjected to the multiple linear regression analysis. Out of 34 variables, only 18 variables were constructed and fitted into multiple linear regression equation. (Table 3.5).

An analysis of the relationship between ICTs use and the fish farming productivity is displayed in Table 3.5. From the regression analysis, the value of coefficient of multiple determinations (R^2) was 0.35 (Table 3.5). This implies that 35% of the variations in the fish farmers' productivity was explained by the independent variables in the model and it was significant at $p<0.05$ level of probability. Results in Table 3.5 revealed that the use of the ICTs, family size, income, pond size, and application of pond manure were positive and statistically significant ($p<0.05$) with fish farming productivity.

The positive correlation between the use of radio and fish farming productivity implies that the more the frequency farmers listen to agricultural information on fish farming technologies on the radio, the more they can increase their fish farming productivity. This is because radio is a powerful medium in sharing relevant, credible and timely agricultural information to farmers. Thus, being informed with timely and relevant information leads to improved fish farming practices; hence an increase in fish farming productivity. This observation was also confirmed during FGD. For, example one farmer from Hagati in Mbeya narrated:

> "*I usually listen to radio agricultural programmes related to fish farming practices like how to measure fish pond water turbidity, how to carry out fish pond fertilisation, and other practices which helped me a lot to improve productivity".*

The significant relationships between the radio and farmer's productivity sustains the findings by Fabusoro (2003) who confirms that there is a positive significant relationship between respondents' level of production and the frequency of listening to radio agricultural programmmes.

On the other hand, the positive correlation between the use of mobile phones and fish farming productivity implies that the more frequently farmers communicate and share information regarding fish farming technologies, the more they increase their fish farming productivity. This was evidenced during the interviewwith one of the fisheries officer in Songea who pointed out that, "*farmers who frequently call or text me seeking for advice on different fish farming practices are those who do well in their fish farming"*. Supporting this, Jehan *et al*. (2014) reported that farmers who use mobile phone more than five hours per week to communicate with agriculture expert earn higher yield than those who use less than four hours. Likewise, Mwakaje (2010) in Tanzania found that the use of mobile phones by farmers in sharing and communicating information was significantly related to the quantity of agricultural produce. Moreover, a study by Theuvsen (2014) confirmed that the use of a mobile phone to communicate with trading partners in Chile had a great positive impact on the productivity of the smallholder raspberry farms. This is explained by the fact that with mobile phones, farmers can timely exchange relevant and credible information which can help them to make right decisions on fish production and increase their production. It is from this point of view that Masuki *et al.* (2010) assert that access to appropriate information and knowledge from the right source is known to be one of the biggest determinants of agricultural production. Therefore, farmers who adopt ICT technologies for sharing or exchanging agricultural information gain competitive advantages.

Findings also indicate that the use of television sets for sharing agricultural information had a positive significant relationship with fish farming productivity (Table 3.5). This suggests that the more the frequency the farmers watch television programmes related to agricultural information on fish farming technologies, the more they can be informed on those technologies, and thus increase their fish farming productivity. This was confirmed during Focus group discussion, for example one farmer from Kigonsera in Mbinga Dstrict stated:

> "*By watching Citizen Television I learnt and improved a lot on different pond management practices especially on fish feeding, fingerling selection and pond fertilisation".*

This revelation is supported by Ali *et al*. (2016) in Zambia, Mwakaje (2010) in Tanzania and Chavula in (2014) who found that there was a higher significant relationship between watching agricultural programmes on TV and increased farm productivity.

Other factors a part from ICTs usage found to have a positive significant relationship with fish farming productivity at $p<0.05$ level of probability were income, feeding frequency , pond size and application of poultry manure during pond fertilisation (Table 3.5). The positive correlation between income and fish farming productivity infers that the more the income of the farmer the higher the productivity of the farmer. This was explained by the fact that a higher income leads to higher capital investment in various improved fish farm inputs which invariably leads to higher productivity. Waithaka *et al*. (2007) validate this assertion when they note that higher incomes mean that a farmer will be able to satisfy their basic requirements and have a surplus for productive activities such as buying farm inputs.

Likewise, the positive correction between the feeding frequency and farmer's productivity indicates that, the higher the feeding frequency as recommended the higher the production of fish frming. Pond size was found to be positively correlated with fish farming productivity. The positive sign infers that increase in size of ponds increases fish stocking rate and this would influence the increased use of other inputs which would result to increased profit and productivity. The result is in line with (Osondu and Ijioma (2014) who reported that an increase fish pond size leads to an increase fish farming output with sufficient and right inputs.

Furthermore, the application of poultry manure in pond fertilisation had a positive correlation with fish farming productivity. This suggests that farmers who utilize more poultry manure to fertilize their fish pond produce better results than farmers who utilize other animal manure. This is supported by Lemu (2003), Kang'ombe *et al.* (2006), Ghaly and MacDonald (2014) who reported that total fish production increase with an increasing optimal loading of fishpond with poultry manure. This can be explained by the fact that poultry manure enriched with more nutrients stimulates production of fish natural food (phytoplankton and zooplankton) which, in turn, increase yield. Researchers (such as Kang'ombe *et al.*, 2006;, Endebu *et al.*, 2016) asserted that poultry manure triggers more production of phytoplankton (natural food) in ponds than any organic fertilisers including cattle manure due to high percentages of potassium, nitrogen and phosphorous.

Table 3. 5: The significant relationship between utilisation of ICTs and productivity of fish farming among fish farmers

Variable	Unstandardised Coefficients		Standardised Coefficients	t	p-value
	B	Std. Error	Beta		
(Constant)	-1631.125	2840.645		-.444	.450
Education level of respondent	160.316	150.120	.084	1.086	.279
Average income for the last 12 months (TZS)	.200	.022	.178	2.122	.042*
Experience in fish farming (years)	11.134	30.324	.028	.390	.314
Member	-12.815	212.109	-.003	-.052	.841
Pond size (square metres)	10.107	.038	-.221	-3.112	.722
Feeding frequency	50.105	122.032	.018	.312	.039*
Frequency of pond fertilisation	-80.567	135.399	-.037	-.534	.501
Frequency of liming	-41.222	138.111	-.014	-.290	.723
Frequency of cleaning	51.181	130.699	.027	.322	.690
Frequency of water flushing	.577	218.136	.00	.001	.910
Radio	301.230	139.555	.132	2.88	.029*
Mobile phone	222.386	109.623	.132	1.900	.031*
TV	13.821	115.121	-.016	-.123	.006*
Pigmanure	567.323	512.134	.113	1.111	.152
Poultry manure	705.304	399.345	.168	1.060	.031*
Source of fingerling	311.714	299.011	.075	1.111	.100
If extension services are adequate	303.327	318.319	.052	.915	.287
Water status	67.123	378.234	.013	.210	.513

R=0.231, p=0.007, Significant at 0.05

3.11 Conclusion and Recommendations

ICT tools (mobile phones, radios and television) have been found to be very important tools in sharing information to fish farmers and consequently increase farming productivity in Tanzania particularly in the Southern Highlands. Therefore, to enhance fish farming productivity through ICTs use, the following recommendations are made:

i. The Government should facilitate more rural electrification so that more fish farmers can use ICT tools such as television sets as a few farmers use these tools due to problems of electricity in some areas.

ii. Media owners and other information providers should broadcast more agricultural programmes related to fish farming practices on both radio and television and should make sure that the programmes are broadcast on appropriate and convenient times especially during evening hours as proposed by most farmers.

iii. Moreover, the Government should consider granting incentives and support to the fish farming sub-sector and to fish farmers in form of credits or loans that they may

use sustainable fish farming management practices like feeding and pond fertilisation.

iv. Lastly, there is a need for the Government, NGOs, researchers and policy makers to consider establishing community FM radio station in the Southern Highland regions to encourage sharing of agricultural information on fish production and knowledge that is more relevant to the farmers.

References

Aboh, C.L. (2008). Assessment of the frequency of ICT tools usage by agricultural extension agents in Imo State, Nigeria. *Journal of Agriculture and Social Research (JASR), 8*(2).*33-38.*

Adejoh, S.O.1., Adah, O.C., and Shaibu, M.U. (2017). Use of Mobile Phones for information dissemination among fish marketers: Evidence from Kogi State, Nigeria. *New Media and Mass Communication, 57*(2): 29-34.

Adomi, E.E., Ogbomo, M.O., and Inoni, O.E. (2003). Gender factor in crop farmers" access to agricultural information in rural areas of delta state. *Library review, 52*(8): 388-391.

Agbamu, J.U, Fujita Y, Idowu, I., and Lawal, A (1996). Effects of socio-economic factors on adoption of new varieties of maize and cassava: A case study of Ogun State in Nigeria. *Journal of Agricultural development studies, 6* (3) 8 – 16.

Akinbile, L.A., Alabi, O.E. (2010). Use of ICTs among fish farmers in Oyo state. *Journal of Agricultural Extension, 14* (1): 22-30.

Akinpelu, O.M., Akinbile, L.A., Ayeloja, A.A., Akinosho, G.A., George, F.O.A., Jimoh,W.A. and Adebisi, G. L. (2013). Gender differentials in knowledge and

utilization of ICT among fish farmers in Ido local government of Oyo state, south-western Nigeria. *Journal of Agricultural Economics and Development* 2(5): 255-263

Aphunu, A., and Atoma, C.N.(2011). Extent of use of ICTs by fish farmers in Isoko agricultural zone of Delta state. N*igeria Journal of Agricultural Extension*, *15*(1) 10-20.

Bailey, D.K. (1994). Methods of Social Science Research. 4th edition. The Free Press, New York USA. 588pp.

Barbour, R. (Ed.) (2011). Doing Focus Groups. Sage Publications Ltd, Los Angelos, London, New Delhi, Singapore, and Washington DC. 174 pp

Barguma K.A., and Ndaghu, A.A. (2014). Information accessibility among fish farmers in Girei, Yola-North and Yola-South local government areas, Adamawa State,Nigeria ARPN. *Journal of Science and Technology*, *4*(8): 503-507

Chenyambuga, S.W., Mwandya, A., Lamtane, H.A and Madalla, N.A. (2014). Productivity and marketing of Nile tilapia (*Oreochromis niloticus*) cultured in ponds of small-scale farmers in Mvomero and Mbarali districts, Tanzania. *Livestock Research for Rural Development, 26(*43):

Chenyambuga S.W.,Madella, N. A., and Mnembuka, B.V. (2012). Management and value chain of Nile Tilapia cultured in ponds of small-scale farmers in Morogoro Region, Tanzania. International Institute of Fisheries Economics and Trade.

Chilimo, W. (2008). Information and Communication Technologies and Sustainable Livelihood: A Case of Selected Rural Areas of Tanzania. PhD Thesis. University of KwaZulu-Natal, Pietermaritzburg. 284 pp.

Churi, A. J., Mlozi, M. R. S., Tumbo, S. D. and Casmir, R. (2012). Understanding farmers information communication strategies for managing climate risks in

rural semi-arid areas, Tanzania. *International Journal of Information and Communication Technology (JICT), 2*(11): 838 – 845.

CUTS International. (2011). 'Extension Services in Tanzania: Better Reaching Remote Areas'.CUTS International Geneva. [http://www.cuts-geneva.org/pdf/Action-Alert-]

Demiryurek, K., Erdem, H., Ceyhan, V., Atasever, S., and Uysal, O. (2008). Agricultural information systems and communication networks: The case of dairy farmers in Samsun province of Turkey". *Journal of Research Information, 13*(2): 12-13.

Donovan, K. (2011). Anytime, anywhere: Mobile devices and services and their impact on agriculture and rural development. ICT in Agriculture: Connecting smallholders to knowledge, networks and institutions. World Bank. 23 pp.

Eknath, A.E., and Acosta, B.O., (1998). Genetic improvement of farmed tilapias (GIFT) project: Final report, March 1988 to December 1997. International Center for Living Aquatic Resources Management, Makati City, Philippines

Fabusoro, E., and Oyegbami, A. (2003). The use of radio and television as sources of agricultural information among poultry farmers in Egbeda local government area of Oyo State, Nigeria, Moor. *Journal of agricultural research, 14*(1): 164-169.

FAO, (2012). Food and Agriculture Organization of the United Nations. United Republic of Tanzania - National Aquaculture sector overview.[http://www.fao.org/fishery/countrysector/naso_tanzania/en.] Accessed on 8th June 2017.

Ghaly, and MacDonald, (2014). Drying of poultry manure for use as animal feed. *American Journal of Agricultural and Biological Sciences, 7* (3): 239-254

Hansen, H. G. P., Pender, J., Damon, A., and Schipper, R. (2006). Rural development policies and sustainable land use in the hill-side areas of Honduras. A quanti tativelivelihoodsapproach. Research Report147.Inter-national Food Policy Research Institute. Washington. D.

Hussain, M.G, Kohinoor, A.H.M., Islam, M.S., Mahata, S.C, Ali, M.Z, Tanu, M.B., Hossain, M.A., and Mazid, M.A. (2000). Genetic evaluation of GIFT and existing strains of Nile Tilapia, *Oreochromis niloticus* L., under on-station and on-farm conditions in Bangladesh. *Asian Fisheries Science, 13*: 117-126.

Joel, A.S., and Adigun, G.O. (2013). Use of Information and Communication Technologies(ICTs) by Yam Farmers in Boluwaduro Local Government A rea of Osun State, Nigeria. *Library Philosophy and Practice (e-journal). 1018*

Kaliba, A.R, Osewe, K.O., Senkondo, E.M., Mnembuka, B.V., and Quagrainie, K.K. (2006). Economic analysis of Nile Tilapia *(Oreochromis niloticus*) production in Tanzania. *Journal of the World Aquaculture Society, 37* (4): 464 – 473.

Kimaro, H., Mukandiwa, L., and Mario, E. Z. J. (2010). Towards improving Agricultural Extension Service Delivery in the SADC Region. In"Workshop on Information Sharing among Extension Players in the SADC Region", Dar es Salaam Tanzania. 56-62.

Lwoga, E.T. (2010). Bridging the agricultural knowledge and information divide: the case of selected telecenters and rural radio in Tanzania. *The Electronic Journal on Information Systems in Developing Countrie,s 43*(6): 1-14.

Masuki, K.F., Mowo, J.G., Kamugisha, R., Tanui, J., Tukahirwa, J., and Adera, E.O., (2010). Integrated information and communication technologies for farm-level access to natural resource managementinformation: A case of South Western Uganda. Kampala: Africa Highland initiative. 48-71.

Mtega, W. and Benard, R. (2013). The state of rural information and communication services in Tanzania: a meta-analysis. *International Journal of Information and Communication Technology Research*, *3*(2), 64 – 73.

Mudukuti, A. E. and Miller, C. (2002). Factors related to Zimbabwe women's educational needs in agriculture. *Journal of International Agricultural Extension and Education, 9*(2):8-10.

Munguti, J. Kim, J., and Ogello, E.O. (2014). An Overview of Kenyan Aquaculture: Current Status, Challenges, and Opportunities for Future Development. *Fish Aquatic Science, 17*(1): 40.

Munyua, H. (2000), Information and Communication Technologies for rural development and food security: Lessons Learned from field experiences in developing countries. CAB International, Africa region centre. 96-110.

Mwaijande, F.A., and Lugendo, P. (2015). Fish-farming value chain analysis: Policy implications for transformations and robust growth in Tanzania. *The Journal of Rural and Community Development, 10*(2), 47-62.

Mwakaje, A.G. (2010). Information and communication technology for rural farmer's market access in Tanzania. *Journal of Information Technology Impact, 10*(20): 111 -128.

NAP (2012). The National Agricultural Policy (Final draft), United Republic of Tanzania; Dar es Salaam. 20pp.

Naveed J.,, Khalid, M .A., Muhammad, S., Abid, H, Muhammad, Z., Majid, K., and Ahmed B., (2014). Use of mobile phones by farming community and its impact on vegetable productivity. *Pakistan Journal of Agricultural Reshearch, 27* (1): 58-63.

Njagi, K.A., Njati, I.C., and S.G.H. (2013). Factors affecting profitability of fish farming under economic stimulus programme in Tigania East District, Meru County, Kenya. *Journal of Business and Management, 15*(3): 25–36.

Njoku, J.I.K. (2016). Effectiveness of radio agricultural farmer programme in technology transfer among rural farmers in Imo State, Nigeria. *Net Journal of Agricultural Science, 4*(2): 22-28.

Nyamba, S.Y. and Mlozi , M.R.S. (2012). Factors Influencing the Use of Mobile Phones in Communicating Agricultural Information: A Case of Kilolo District, Iringa, Tanzania. *International Journal of Information and Communication Technology,* 29 *(7)*: 838 – 845.

Ofuoku, A.U. Emah, G.N. and Itedjere, B.E. (2008), Information utilization among rural fish farmers in central agricultural zone of delta state, Nigeria. *World Journal of Agricultural Sciences, 4*(5): 558-564.

Okwu, O.J, Kaku, A.A, Aba, J. I. (2007). An assessment of the use of radio in aAgricultural information dissemination: A case study of radio Benue in Nigeria. *African Journal of Agricultural Research, 2*(1):14-19.

Okoedo-Okojie, D. U. (2015). Determinants of constraints to information sources utilization among maize farmers in Edo state, Nigeria. *British Journal of Applied Science & Technology, 9*(2): 182-190.

Olaoye, O. J, Ashley-Dejo, S. S, Fakoya, E. O, Ikeweinwe, N. B, Alegbeleye, W.O., Ashaolu, F. O., and Adelaja, O. A. (2013). Assessment of Socio-Economic Analysis of Fish Farming in Oyo State, Nigeria. *Global Journal of Science Frontier Research Agriculture and Veterinary,13*(9): 1-12.

Opara, U.N. (2008). Agricultural Information Sources Used by Farmers in Imo State, Nigeria. *Journal of Information Development, 24* (4): 289-295.

Osondu, C.K. and Ijioma, J.C**.** (2014). Analysis of profitability and production determinants of fish farming in Umuahia Capital Territory of Abia State, Nigeria. *World Journal of Agricultural Sciences, 2*(7): 168-176.

Otter, V., Theuvsen, L. (2014). ICT and farm productivity: Evidence from the Chilean agricultural export sector. In GIL Jahrestagung (pp. 113–116) retrieved from [https://pdfs.semanticscholar.org] on 23 June 2017

Riche, M, Oetker, M, Haley, D I, Smith, T and Garling, D. L. (2004). Effect of feeding frequency on consumption, growth, and efficiency in juvenile tilapia (*Oreochromis niloticus). The Israeli Journal of Aquaculture* 56(4): 247-255.

Riesenberg, L.E., and Gor, C.O (1999). "Farmers' Preferences for Methods of receiving information on new or innovative farming practices", Graduate Student University of Idaho. 16pp.

Rutger, J.E., (2000). Technical, Policy and Institutional Trends in Information and Communication. Proceedings of a CTA Seminar. *Journal of Agricultural Extension, 14* (1): 44- 59.

Samansiri, B.A.D., and Wanigasundera, W.A.D.P. (2014). Use of Information and Communication Technology (ICT) by extension officers of the tea small Holdings development Authority of Sri Lanka. *Tropical Agricultural Research, 25*(4): 360 – 375.

Shoko, A P, Getabu, A., Mwanyuli, G., and Mgaya, Y. D. (2011). Growth performance, yields and economic benefits of Nile tilapia (*Oreochromis niloticus)* and Kales (*Brassica oleracea*) cultured under vegetable-fish culture integration. *Tanzania Journal of Science, 37*: 37 - 48.

Ukagwu, I, Onuoha G.U. C2, Iheke, R. O, Asonye, N. C4 and Nnodim, P. O**.** (2014). Profitability of aquacultural practice; a case study of fish farmers in ikeduru

local government area of imo state. *International Journal of Research in Applied, 2*(7): 151-160.

URT (2010). Ministry of Livestock and Fisheries Development, Fisheries Sector Development Programme. 52pp.

URT (2018). Empowering extension officers' drive on cards, workshop. workshop held by Ministry of Livestock and Fisheries Development, aimed at empowering extension officers July 2018, Dodoma. 13pp.

Waithaka, M.M., Thornton, P.K., Shepherd, K.D., and Ndiwa, N.N. (2007). Factors affecting the use of fertilizers and manure by smallholders: the case of Vihiga, western Kenya. *Nutr Cycl Agroecosyst*, *78*:211–224.

Watengere, K. (2011). Economic factors influencing the continuation of fish farming technology in Morogoro and Dar es Salaam Regions, Tanzania**.** *Journal of Agriculture and Food Technology, 1*(3) 31- 42.

World Bank (2014). World development indicators. [http://data.worldbank.org/sites/default/files/wdi-final.pdf]Accessed 10 April 2017.

Yaseen, M., Shiwei, X., Wen, Y., Hassan, S., (2015). Policy challenges to agricultural extension system in Pakistan: a review. *International Journal of Agricultural Applied Science 7* (2): 111-115.

CHAPTER FOUR

PAPER THREE

Determinants of ICT use in sharing information by fish farmers in the Southern Highlands of Tanzania

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Abstract

Understanding the determinants of ICT usage in fish farming is very important as it enables the development of strategies that promote ICT usage in sharing information related to different fish farming technologies. However, none of the studies conducted in Tanzania has assessed how the combination of socio-economic factors and other factors particularly farmers' attitudes, perceptions on perceived usefulness and perceived easiness influence the usage of ICTs among farmers. This study was conducted in three regions, namely Ruvuma, Mbeya and Iringa from twelve divisions purposively selected from six districts. This cross sectional study involved 240 fish farmers who were randomly selected. The study used both quantitative and qualitative approaches in collecting data. Questionnaires, Focus Group Discussions (FGDs), observation and key informants interviews were used to collect data. Both descriptive and inferential statistics were used to analyse quantitative data while content analysis was used to analyse

qualitative data. It was found that fish farmers had positive attitude towards the use of mobile phones, radio and television in sharing agricultural information. Likewise results showed that fish farmers had high and medium perceptions on usefulness of mobile phones, radios and television. Also, results revealed that fish farmers had high, medium and low perceptions on easiness of mobile phones, radios and television. Furthermore, the findings indicated that income, perceived ease of use, quantity of fish produced, attitude, household size, radio ownership and perceived usefulness were significant at $p<0.05$ and were positively related to the use of mobile phones, radios and television. Thus, it is recommended that responsible organs like research institutions, policy makers and information providers should make sure that factors that motivate individual farmers in different communities to accept the use of any ICTs are considered prior to the introduction of such technologies.

Keywords: ICTs, agricultural information, aquaculture, fish farming, mobile phones, radios; television.

4.0 Introduction

In aquaculture, information plays an important role in determining extent of fish farming productivity. This is because farmers need to employ up-to-date fish farming practices for higher yield. Access to and use of information in fish farming enhance informed decisions on various improved farm technologies, access to credit, improved farm yield, provision of revenue and increased productivity (Soyemi and Haliso, 2015). In addition, access to information on fish farming opens windows for sharing best farming practices, ideas, experiences, market prices and new markets. Thus, fish farmers need to be updated with different information in order to improve their fish farming management practices for improved productivity. This is backed by researchers (such as Ofuoku, *et al.*, 2008; Adefalu *et al., 2013;* Ijatuyi *et al*., 2016) who suggest that fish farmers need to be

informed and updated with information on fish spawning or breeding operation, construction of fish ponds, feeding and feed formulation techniques, fish processing, storing and preservation, stocking operations, record keeping, and identification of disease symptoms. All these categories of information need to reach farmers through right communication channels and in the right time. Supporting this argument, Olaniyi (2013) and Ndaghu (2014) assert that one of the ways to bring about enhancement in fish farming production is the provision of the right information through the appropriate channel that is accessible to fish farmers for whom such information is meant.

In Tanzania, various traditional approaches of information dissemination have been used by fisheries extension officers in communicating and disseminating information and knowledge to fish farmers. These approaches include Farmer to Farmer Extension, contract farming, participatory extension, Farmer Field School (FFS), demonstration and public awareness creation (Kimaro *et al.*, 2010; NAP, 2012). Nevertheless, these approaches have been inhibited by inadequate extension capacity. The existing data showed that there are 750 fisheries extension officers out of 1 6000 who are needed in the country to meet information and knowledge needs of fish farmers (URT, 2018), such a challenge decrease the dissemination of information and knowledge to fish farmers (Yaseen *et al.,* 2015). This is emphasised by Rajoria *et al.*(2017) who highlight that the traditional methods of extension approaches have less accountability and effectiveness in terms of time management, larger audience coverage and greater impression on people. Likewise, while insufficient staff levels hinder efficient delivery of fisheries extension services, even the services supplied by existing fisheries staff fall short in diagnosing smallholder fish farmers' problems and transferring practical knowledge due to limited understanding of the smallholder fish farming environment by the fisheries extension officers. Consequently, fisheries extension services have not led to significant increase in

fish productivity (URT, 2015). Arising from these challenges is an urgent need for ways which can help fish famers increase their efficiency, productivity and sustainability of the fishery activities using the available personals. In this regard, Information and Communication Technologies (ICTs) has the potential to enable extension officers to gather, store, retrieve, share and disseminate a broad range of information needed by farmers.

Moreover, with the use of ICTs fish farmers can be able to share up-to-dated information on fish prices, access to credit and training, and the ability to interact with other farmers. This view is supported by Aker (2010) who claimed that one promising area for agricultural extension to reach a big number of farmers is through using combination of various ICT tools such as mobile telephones, innovative community radios and television programmes, and mobile phones in combination with radios.

ICTs used in fish farming ranges from advanced, modern technologies such as GPS navigation, satellite communication and wireless connectivity, to older technologies such as radio and television (Shambani, 2013). ICTs facilitate the availability and accessibility of information to fish farmers and reduce the cost of communicating and disseminating the information. Unlike the traditional agricultural information dissemination methods, ICT tools have the benefit of offering a cheaper way of: i) communicating and sharing knowledge and information to fish farmers, ii) delivering training and education modules to farmers, iii) improving farmers' access to markets and aquaculture credit, iv) empowering fish farmers to negotiate better prices, and v) facilitating and strengthening networking among fish farmers (Okello *et al.*, 2014). In addition, Matuha (2015) says that ICT in aquaculture can assist in creating possibilities to solve challenges faced by fish farmers by enabling extension workers to gather, store, retrieve and disseminate a broad range of timely information needed by farmers, thereby promoting fish farming

production. Likewise, Akinbile and Alabi (2010) point out that enhancement of fish farming production can be achieved by improving capacity in terms of enhancing access to information which can be achieved through enhanced information seeking behaviour by the use of ICTs. This potential of ICT use in sharing information to fish farmers can only be realised, if farmers are able and willing to use it.

Scholars including Jiriko *et al*. (2015); Soyemi *et al*. (2015); Mittal and Mehar (2016) showed that the ability and willingness of fish farmers to use ICTs tend to vary from an individual to another and demographic variables like age, education, income, family size, farming experience, and marital status. Also, other studies (such as Aleke, Ojiako and Wainwright, 2011; Adegbidi *et al.,* 2012) found that farmers' attitude, perceived usefulness, perceived easiness, ICTs infrastructure and availability of ICT tools are also associated with the increased use of ICTs in information sharing. In addition, Mwombe *et al*. (2014) in their study in Kenya found that age, gender, income and acreage of bananas planted had an influence on the intensity of the use of ICT tools as a source of agricultural information for small scale banana farmers. Likewise, Timothy *et al.* (2016) reported that age, income, poor access to electricity, high cost of inappropriate programme or content and illiteracy have influence on the use of ICTs in accessing information by farmers in Tanzania. All these factors can have a positive or negative impact on ICTs usage by fish farmers on sharing fish farming information.

A review of scholarly works related to ICT usage in Tanzania reveals an existence of knowledge gap on how the combination of socio-economic factors and behavioural factors such as attitudes, perceived usefulness, and perceived easiness influencing the usage of ICTs among fish farmers. Most studies conducted in the country so far have only assessed the soco-economic or demographic factors influencing ICTs usage

(Mwakaje, 2010; Nyamba and Mlozi, 2012; Mtega, 2016; Timothy *et al.*, 2016). Therefore, this study specifically intended to: determine the attitude of fish farmers toward ICTs usage, assess fish farmer's perceived easiness and perceived usefulness of usage of ICTs and, to examine the main determinants of ICTs usage by fish farmers in Southern Highlands of Tanzania. Kurtenbach and Thompson (2000) and Timothy *et al.* (2016) maintain that understanding the determinants of ICT usage in agriculture enables promotion of ICT usage in information sharing, assists in designing relevant farmer's information systems, increase the effectiveness and efficiency of information use in aquaculture sector, and consequently improve fish farming productivity.

4.1 Methodology

This study was carried out in three regions in the Southern Highlands of Tanzania, namely Iringa, Mbeya and Ruvuma. The regions were chosen because they have relatively a big number of fish ponds and well developed ICTs infrastructures like electricity, radio, television cables and mobile networks coverage (FAO, 2012). According to URT (2014), Ruvuma, Iringa and Mbeya regions have more fish ponds than other regions in the country. The available data revealed that there were 4942 fish ponds in Ruvuma Region, 3137 in Iringa Region and 1176 Mbeya Region (URT, 2014).

4.2. Sampling Procedure and Sample Size

In this study the sampling frame included all individual fish farmers from twelve divisions of six districts, namely Mbeya, Mbarali, Iringa, Mufindi, Mbinga and Songea. The districts were purposively chosen based on the number of fish ponds and presence of basic ICT infrastructures such as electricity, radio, television cables and mobile networks. Two divisions with 20 fish farmers and well established ICTs infrastructures were purposively selected from each district. The 20 fish farmers were selected from each division using simple randomly sampling making a sample size of 240

respondents. According to Israel (2012) a sample size greater or equal to 20 can yield meaningful results in a survey study.

4.3 Methods of Data Collection

The study used both quantitative and qualitative approaches. It used a cross-sectional research design in collecting primary data whereby data were collected once from individual fish farmers. To ensure validity and reliability the research tools were pretested in a village with similar conditions to the study villages. The value of 0.78 for reliability of scale (Cronbach's Alpha) for overall variables in this study was obtained, showing good internal consistency reliability for the instruments. After pre-test, the questionnaire with both closed and open ended questions was modified and administered to 240 respondents using face- to -face interviews. One major advantage of the face – to -face interviews is that it allows the researcher to probe and clarify issues on the spot (Walliman, 2006). Six Focus Group Discussions (FGDs) involving six participants (fish farmers) who had an experience of five years in fish farming were purposively selected in each district and used to compliment information gathered through questionnaires. According to Lengua *et al*. (1992) a good Focus Group discussion is the one which normally consisting of 6-12 participants. The study also collected data from six key informants (six fisheries extension officers, one from each district) who were purposively selected and interviewed.

Moreover, personal observation through observation guide contained some issues like presence and use of ICT tools, ICT infrastructures, network cables, source of electricity used, status of fish ponds etc. was also used as a tool for data collection to complement data collected through other techniques. The rationale for using a mixed method

approach is built on its main advantage of neutralising or cancelling biases of a single method (Glazier and Powel, 1992; Creswell, 2003).

4.4 Data Analysis

The SPSS Version 20 was used for data analysis. A five point Likert scale with values 5-Strong agree, 4-Agree, 3-Neutral, 2-Disagree and 1-strong disagree was used to determine the attitudes and perceptions of the fish farmers on perceived easiness and usefulness toward ICTs usage. Numerical values for the response options were reversed when calculating the overall score for a negative statement. Overall scores for perceived usefulness, easy to use and attitude were calculated by summing up responses for each farmer. The higher values indicated that farmer perceived an ICT to be useful, user-friendly and have positive attitude toward using ICT devices for sharing agricultural information. The ordinal logistic regression model was used to determine the determinants of ICT usage by fish farmers. Thus, the model estimated how socio economic variables, attitudes and perceptions of fish farmers on easiness of use and usefulness toward ICTs are associated with fish farmer usage of ICTs. Sirak and Rice (1994) revealed that the logistic regression model is more powerful, convenient and flexible and is often chosen if the dependent variable is ordinally arranged. Thus, since the dependent variable in this study is ordered therefore this study uses the ordinal logit regression model to identify the determinants of ICT usage by farmers.

The ordinal regression equation used for analysis was as follows:

$$Logit(Y) = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \varepsilon_i$$

Where: π = probability of the event,

α = Y intercept,

β_i = regression coefficients,

X_S = a set of predictors.

Y= Dependable variable (ICTs use) ranges from 1to 5 corresponding to four point scale levels of: (4) Very frequently**,** (3) Frequently, (2), Occasionally, (1) Rarely, (0) Never).

X_1 …X_n are explanatory variables or independent variables (Sex (0 = Female, 1 = Male), Age(0 = Up to 35, 1 = more than 35), Marital status(0 = Single, 1=Married), Education level (0 = No formal education, 1 = Primary, 2 = Secondary, 3 = Tertiary), Household income (0 up to 500 000, 1 = 500 001 – 1 000 000, 2 = 1 000 001 – 1 500 000, 3 = More than 1500 000), Fishing experience (0 = Up to 5, 1 = more than 5), Fish production (Amount of fish in kilograms per hectare), Membership (1 =, member, 0 =, None member). Attitude, perceived usefulness, perceived easiness (index scores from PCA). However, From the list of 36 items, the extraction method of the Principal Component Analysis was used to determine variables to be fitted into the regression equation, which were then subjected to the multiple regression analysis. Also,the model assumptions was tested using proportional odds assumption (testing of parallel lines) in order to check the validity of the model.

4.5 Reliability and Validity Analysis of ICTs

A reliability analysis is based on a calculation of correlation among the statements using Cronbach's α (Chen and Popovich 2002). A Cronbach's α of 0.7 or greater indicates a reliable scale. In this study a Cronbach's α for mobile phone obtained (Table 4.1) was 0.760 for perceived usefulness, 0.794 for ease of use and 0.648 for attitude. Since the greater the Cronbach's α the better the internal consistency, and value 0.648 is not acceptable and it indicates that the scale is not reliable. Then two statements that had the largest Cronbach's α if item deleted for attitude were removed from the scale and remained with 6 statements and the Cronbach's α obtained after deleting the two

statements with high Cronbach's α was 0.886 indicating highly reliable scale. Furthermore, a Cronbach's α obtained for radio (Table 4.1) was 0.871 for perceived Usefulness, 0.955 for user-friendlyrfriendiness and 0.655 for attitude.

Likewise, for better internal consistency one statement for perceived usefulness was deleted and one statement for perceived user-friendiness was deleted and the Cronbach's α obtained was 0.891 and 0.971 for perceived usefulness and perceived user-friendly.

Furthermore, Cronbach's α 0.655 for attitude is not acceptable if indicating scale is not reliable. Then two statements that had largest Cronbach's α if item deleted for attitude was removed from the scale and remained with 5 statements and the Cronbach's α obtained after deleting the two statements with high Cronbach's α was 0.957. However, a Cronbach's α obtained for television (4.1) was 0.926 for perceived usefulness, 0.971 for user-friendiness and 0.644 for attitude. For better internal consistency, one statement for perceived usefulness was deleted and two statement for perceived user-friendiness was deleted and the Cronbach's α obtained was 0.945 and 978 for perceived usefulness and perceived user-friendliness.

Also, Cronbach's α 0.644 for attitude is not acceptable indicating scale is not reliable. Then two statements that had largest Cronbach's α if item deleted for attitude were removed from the scale and remain with 5 statements and the Cronbach's α obtained after deleting the two statements with high Cronbach's α was 0.847.

Table 4. 1: Reliability analysis results

Mobile phone	Number of items	Cronbach's Alpha	Cronbach's Alpha if Item Deleted
Perceived Usefulness	4	0.760	0.648 -0.746
Perceived Easy of Use	4	0.794	.688 -0.848
Attitude	8	0.648	0.478-0.881
Radio			
Perceived Usefulness	4	0.871	0.800-0.891
Perceived Easy of Use	5	0.955	0.940-0.971
Attitude	7	0.655	0.423-0.954
Television			
Perceived Usefulness	4	0.926	0.867-0.945
Perceived Easy of Use	7	0.971	0.961-0.978
Attitude	5	0.644	0.478-0.840

4.6 Validity Test for ICTs

Before proceeding with factor analysis, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test were conducted to determine whether or not it was appropriate to conduct factor analysis. Kaiser (1974) recommended K.M.O. value 0.5 as minimum (Fairly acceptable), values between 0.7- 0.8 acceptable, and values above 0.9 excellent. Thus, in this study the Kaiser-Meyer-Olkin measure was 0.92, 0.963 and 0.948 for mobile phone, radio and television respectively as it is indicated in Table 4.2, 4.3 and 4.4). Therefore, the data set was suitable for further analysis.

The validity of the research instruments was assessed using Principal Components Analysis. After principal component analysis, the data were rotated using an orthogonal rotation (varimax rotation), which simplifies the factor structure by maximising the variance of a column in the pattern matrix. Also, the data were suppressed at 0.4 factor loading.

Table 4. 2: Principal Components Analysis Matrix showing response of the farmers toward the statements describing factors influencing the usage of mobile phones in sharing agricultural information

Statements	PC1	PC2	PC3
Using mobile phones enhances my effectiveness in farming practices			.832
Using the mobile phones enhances the quality of my farming practices			.828
Using mobile phones enables me to share information related to my fish farming activities more quickly			.790
I find the mobile phones useful in sharing information in my farming activities		.411	.766
Learning to use the mobile phones is easy for me		.817	
I find it easy for me to become skilled in using the mobile phones in sharing information		.862	
I find the mobile phones user-friendly in sharing information in my farming activities	.571	.565	
Use mobile phones in sharing agricultural information would make my farming activities more interesting	.812		
Use of mobile phones in sharing agricultural information is a good idea	.675		
I have a generally favourable attitude toward using the mobile phones in sharing agricultural information	.546	.465	
You can not receive and share timely agricultural information through mobile phones§	.831		
Mobile phone is not user friendly technology for receiving and sharing agricultural§ information	.781		

§The data for negatively worded statements were reversed prior to analysis
Kaiser-Meyer-Olkin=0.92; Bartlett's Test=2249.000; df=66;p=0.000
PC 1=Perceived user-friendiness; PC2=Perceived usefulness; PC3 =Attitude

Table 4. 3: Principal Components Analysis Matrix showing response of the farmers toward the statements describing factors influencing the use of radios in sharing agricultural information

Statements	PC1	PC2	PC3
Listening to radio enables me to share information related to my fish farming activities more quickly	.723	.517	
By listening fish farming related programmes from radio improves my fish farming productivity	923		.
I find the radio useful in sharing information in my farming activities	.683	.560	
Learning to use the radio is easy for me		.713	
I find it easy for me to become skilful in using the radio in sharing information		.701	
I find the radio user-friendly in sharing information in my fish farming activities		.674	
Use of radio in sharing agricultural information would make my farming activities more interested			.735
Use of radio in sharing agricultural information is good idea			.703
I have a generally favourable attitude toward using the radio in sharing agricultural information			.834
Use of radio for sharing agricultural information is easy for me		.497	.699
You can not access timely and relevant agricultural information through radio			.871
I have a generally negative attitude toward using the radio in sharing agricultural information§			.828

§The data for negatively worded statements were reversed prior to analysis

Kaiser-Meyer-Olkin=0.963; Bartlett's Test=4593.0; df=66;p=0.000

PC1=Perceived usefulness; PC2=Perceived user-friendiness; PC3=Attitude

Table 4. 4: Principal Components Analysis Matrix showing response of the farmers toward the statements describing factors influencing the use of television in sharing agricultural information

Statements	PC1	PC2	PC3
Watching the television enables me to share information related to my fish farming activities more quickly	.964		
Watching television fish farming programmes enhances the quality of my farming practices	.857		
I find the television useful in sharing information in my farming activities	.925		
Learning to use the television is easy for me	.421	.975	
I find it easy for me to become skilful in using the television in sharing information		.942	
I find the television user-friendly in sharing information about my farming activities		.935	
Use of television for sharing agricultural information is easy for me		.943	
Use of television in sharing agricultural information would make my farming activities more interesting			.957
Use of television in sharing agricultural information is good idea		.432	.922
I have a generally negative attitude toward using the television in sharing agricultural information			.926
Television is not user friendly in sharing agricultural information			.914

§The data for negatively worded statements were reversed prior to analysis

Kaiser-Meyer-Olkin=0.948; Bartlett's Test=4745.0; df=55;p=0.000

PC1=Perceived usefulness; PC2=Perceived user-friendiness, PC3=Attitude

4.7 Results and Discussion

4.8 Demographic and Socio-economic Characteristics of the Respondents

The demographic and socio-economic characteristics of the fish farmers are summarised in Table 4.5. The study revealed that the majority of the fish farmers involved in fish farming in the study area were male 92 (80%) and the remaining 48 (20%) were females. Similar findings have been revealed by previous studies in Tanzania (Chenyambuga *et al*., 2011; Chenyambuga, 2014; Mwaijande and Lugendo, 2015). This probably is due to the fact that in Tanzania women unlike men are sometimes not entitled to own land, this makes it difficult for them to practice and invest in fish farming.

Similarly, Table 4. 5 indicates further that most (47.1%) of the fish farmers belonged to economically active age group (47 to 56 years). According to Olaoye *et al*. (2014), ages

between 40 and 50 are considered highly productive and active to undergo energetic tasks associated with fish farming activities. Likewise, findings reveal that (67.9%) of the respondents had completed the primary level of education. Ortindi and Katikpo (2015) describe that the level of education may affect information accessibility, comprehension and adoption of modern agricultural practices.

Similarly, it was reported that the majority (87.9%) of the fish farmers were married (Table 4.5). Likewise, research findings indicate that the majority (72.9%) of the respondents had fish farming experience of up to five years (Table 4.5). These results tallies with that reported by Barguma and Ndaghu (2014) in Nigeria who found the same fish farming experience.. This experience can have an impact on ICTs usage. According to Okello *et al*. (2012), farming experience positively influences the decision to the use of ICTs.

Moreover, findings indicated that 45.4% of respondents earned income level of more than TZS 1 500 000 per year. This suggests that over half (44.6%) of fish farmers in the study area earned an income which is below the per capital income of Tanzanian which is TZS 2 100 000 per year (NBS, 2016). The income level of fish farmers in the study area can have an influence on ICTs usage. Arfan, *et al.* (2015) report income demonstrates a most significant positive linkage with the ICTs usage in enhancing knowledge level of the farming community.

Table 4. 5: Socio-economic characteristic of the respondents (n= 240)

Factors	n	%
Sex		
Male	192	80.0
Female	48	20.0
Education level		
No formal education	15	6.3
Primary education	163	67.9
Secondary education	39	16.3
Tertiary education	23	9.6
Age (years)		
18 – 35	40	16.7
36 – 46	71	29.6
47 – 56	113	47.1
57 – 66	16	6.7
Marital status		
Single	18	7.5
Married	211	87.9
Divorced	3	1.2
Separated	1	0.4
Household income (TZS)		
Less than 5 000 000	38	15.8
500 001- 1 000 000	60	25.0
1 000 001 – 1 500 000	33	13.8
More than 1 500 000	109	45.4
Farming experience(years)		
Up to 5	175	72.9
6 – 10	51	21.2
More than 10	14	5.8

4.9 Attitudes of Fish Farmers Toward ICTs Use.

According to Manjula (2017), attitude can be defined as an individual's positive or negative feeling about performing the target behaviour (in this case ICTs using in sharing information). It can be noted from Table 4. 6 that the majority of the respondents (88%) had high level of attitude towards mobile phone use in sharing agricultural information. This implies that fish farmers had positive attitude toward mobile phone usage. The higher attitude toward mobile phone usage was also observed in a the study by Manjula (2017) in India who recorded higher percentage of farmers who had high positive attitude toward mobile phone use. This high attitude is due to the fact that mobile phones are easily available, accessible, cheap and facilitate a two-way communication for fish farmers to seek for some more clarification and get instant feedback as it was explained during FGD.

Furthermore, the study found that half of the respondents had high level of attitude toward using radio in information sharing (Table 4. 6). This means that fish farmers had a favourable attitude toward ICTs usage in sharing information in different farming technologies. Lokeswari (2016) highlight that a positive attitude is very important component and requirement for any ICT usage. According to FGD and key informat interview findings, the high level of attitude is explained by its affordability, flexibility, easy language comprehension and its credibility in communicating timely, and relevant agricultural information to farmers. Also from Table 4.6 it is observed that majority (89%) of the respondents had high level of attitude toward television usage in sharing information on various fish farming technologies. Based on the findings from FGD and key informats interview, the high attitude towards television use is probably due to its credibility, relevance and timely information sharing to farmers.

4.10 Perceptions of Fish Farmers Toward the Usefulness of ICTs

Moreover, the study also reported the perceptions of fish farmers on ease of use of ICT tools. The definitions of these constructs (perceived ease of use and perceived usefulness) of this study were based on the TAM (Davis, 1989). Thus, PPEU is the degree to which a person believes that a particular technology would be free of effort while PU is the degree to which a person believes that using a particular system would enhance his/her job performance.Therefore, from this study it was noted that (Table 4.6) the majority (73%) of the respondents had high perceptions on usefulness of mobile phone implying that fish farmers perceived mobile as beneficial technology for sharing information on various fish farming technologies, and consequently enhancing their farming practices. This confirms the results of Charo (2016) who reveals that nearly all respondents (97%) agreed on the usefulness of mobile phones for accessing agricultural information.

Further results reveal that nearly above half (52%) of the respondents had medium perceptions on usefulness of radio in sharing information implying that, the fish farmers' perceptions on the usefulness of radio had association with its usage. Also, the study found that half (50%) of the respondents had medium perceptions on the usefulness of television in sharing information implying that farmers perceived television as a beneficial ICT tool in sharing information related to different fish farming practices. Manjulla (2017) had stated that perceived usefulness is a very important construct in determining farmer's attitudes toward using any ICT tools.

4.11 Perceptions of Fish Farmers on the Easy Use of ICTs

Further, results reported that more than half of the respondents (64%) had high level of perception on easiness of mobile phone usage implying that farmers perceived operations of mobile phone as easy technology in which they can be able to do what they want in sharing information. The results are similar to what have been reported by Charo (2016) which revealed that nearly two-thirds (63%) of the respondents agreed that mobile phone technology was user-friendly in information sharing. Likewise, the study indicated that nearly half (48%) of the respondents had medium perceptions on easiness of radio usage while almost similar proportion (47%) had high perceptions. This means that farmers find radio technology as user-friendly in sharing information about various fish farming technologies. In respect to television 49% of the respondents had low level of perceptions on easiness of television usage while 46% had high level perceptions. This suggest that farmers perceived television as difficult technology to operate and use in sharing information. This is probably because different televisions have different modes in its operations, some use difficult menu together with a remote control and some use satellite dish with some sophisticated cables. To confirm this, during the FGD in Hagati division in Mbeya districts, some farmers were complaining about some difficulties in

television operations. For instance, one farmer narrated: *'I cannot operate television properly once I want to watch some news, I always ask my son to do it for me and if he is not around, I just wait for him*'. In supporting this, Bugembe (2010) highlights that the perceived user-friendiness of any ICT tools consists of the following determinants: easy to operate, easy to read, using understandable terms, able to link to search for related information and easy to return to previous page.

Table 4. 6: Attitude and perceptions of fish farmers toward ICTs use

Category	Mobile phone						Radio						Television					
	Low		Medium		High		Low		Medium		High		Low		Medium		High	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Perceived usefulness	20	8.3	45	18.8	175	72.9	4	1.7	124	51.7	112	46.7	17	7.1	120	50.0	103	42.9
Perceived user-friendiness	81	33.8	5	2.1	154	64.2	11	4.6	116	48.3	113	47.1	117	48.8	12	5	111	46.3
Attitude	17	7.1	10	4.2	213	88.8	2	0.8	118	49.2	120	50.0	3	1.3	27	11.3	210	87.5

4.12 Determinants of the Mobile Phone Usage in Sharing Agricultural Information among Fish Farmers

Understanding of the determinants of ICTs usage could serve a multitude of stakeholder's particular systems, designers and policy makers by helping them recognize how to promote usage of ICTs for sharing information. However, before running the ordinal regression analysis, the extraction method of the Principal Component used to determine variables to be fitted into the ordinal regression equation, which were then subjected to the ordinal regression analysis. Table 4.7 presents the results of the Principal Component Analysis using the extraction method. Out of 12 variables, only three variables were constructed and fitted into the ordinal regression equation. These three variables were perceived usefulness of the mobile phone use, easiness of the mobile phone use and attitude toward the mobile phone use in sharing agricultural information.

The model assumption was tested using the proportional odds assumptions (parallel lines regression assumptions) in order to check the validity of the model. The results showed that the model was valid since the proportional odds assumption appears to have held since the significance of Chi-Square statistic for each ICTs (radio, mobile phone and television were > .05 (Agresti,1996). Thus, results from the ordinal logistic regression indicate that the variables influencing the mobile phone use contributed by 72.6% and 66.2% as explained by Cox and Snell R square and Nagelkerke R square values (Table 4.7). Thus, from the study results it is indicated that income, perceived ease of use, perceived usefulness and use of electricity were significantly positive with use of mobile phone in the model ($p<0.05$). The annual income was significant ($p<0.05$) and positively related to the use of mobile phones with odds ratio of 1.12. This means that a unit increase in this variable, increases usage of mobile phone by a factor of 1.12. This is probably due to the fact that farmers with high income can afford to buy mobile phones

and maintaining them through air time recharging and hence facilitating their usage in sharing information. This is supported by results obtained through the FGDs from Kigonsera in Mbinga District, whereby one farmer narrated: *"Due to my business which gives me some money I have succeeded to buy a smart phone which I will use it to communicating with my extension officer through WhatsApp."* Nyamba and Mlozi (2012) affirm the findings as they conclude that the use of mobile phones to communicate agricultural information is highly influenced by income level of farmers.

Furthermore, the results revealed that perceived ease of use and perceived usefulness were significant ($p<0.05$) and positively related to the use of mobile phones with odds ratio of 1.22 and 1.29 respectively (Table 4.7). This suggests that a unit increase in these variables, increases usage of mobile phones by a factor of 1.22 and 1.29 respectively. This can be due to the fact that once the farmer finds the mobile technology user-friendly, able to do what they want to do and when they find technology less cost and beneficial in sharing information definitely they will use it frequently. These results are in line with Davis *et al*. (1989) who in their TAM found that, in a workplace environment, a system will be adopted if it is regarded as useful, irrespective of attitude provided that use of the system is perceived to offer direct benefits to the user. Similarly, Manjula (2017) pointed out that when the mobile applications are made userfriendly, simple and compatible with existing technologies, it would pave way to improving its usage. Also, Venkatesh *et al*. (2003) reported that perceived usefulness and ease of use are taken as important factors that can affect the use of mobile phones in agriculture.

Further results revealed the use of electricity as a source of power was significant ($p<0.05$) and positively related to the use of mobile phones with odds ratio of 2.01. This implies that a unit increase in this variable increases the usage of mobile phone by a factor of 2.01. This can be explained by the fact that with electricity farmers can be

encouraged to purchase mobile phones and are more likely to use them for sharing information due to the presence of power sources for recharging their mobile batteries. Supporting this view, Timothy *et al.* (2016) revealed that poor access to electricity can reduce the prospect of use of any ICT technologies.

4.13 Determinants of the Radio Usage in Sharing Agricultural Information among Fish Farmers

Before analysing the determinants of the radio usage in sharing agricultural information among fish farmers, the extraction method of the Principal Component Analysis was used to determine variables to be fitted into the ordinal regression equation, which were then subjected to the ordinal regression analysis. Table 4. 7 presents the results of the Principal Component Analysis using the extraction method. Out of 12 variables, only three variables were constructed and fitted into the ordinal regression equation. These three variables were perceived usefulness of the television use, perceived easiness of the television use and attitude toward the television use in sharing agricultural information.

Results from the ordinal logistic equation indicate that the variables influencing the radio use contributed by 50.1% and 55.5% as explained by Cox and Snell R square and Nagelkerke R square values (Table 4.7). Thus, results from this study indicated that the quantity of fish produced, perceived ease of use, attitude and radio ownership had significantly positive with the radio use ($P<0.005$). The quantity of fish produced is significant ($p<0.05$) and positively related to the use of radio with odds ratio of 1.5. This means that a unit increase in this variable increased the usage of radio by a factor of 1.5. This is attributed by the fact that the more the quantity of fish produced, the more the propensity to access information using different ICTs including radio for more production. This was evidenced during the interview with one of the fisheries officer in

Mbeya who pointed out:, *"farmers who frequently listen to the radio programmes related to fish farming practices are the ones who do better in their production"*. Jiriko *et al.* (2015) confirm by adding that the quantity of fish produce is contributed significantly by the ability to use ICTs in fish production. Mwombe *et al*. (2014) also reported that high bananas production had an influence on the use of ICT tools as sources of agricultural information among smallholder banana farmers in Gatanga District in Kenya.

However, farmers' attitude and perceived ease of use are significant ($p<0.05$) and positively related to the use of radio with odds ratio of 1.51 and 1.46 respectively. This implies that a unit increased in these variables increases the usage of radio by a factor of 1.51 and 1.46 respectively. A possible reason as per FGD findings is that, radio was user-friendly, affordable, and a credible source of information and could disseminate information to farmer on time, and thus farmers created positive attitude out of these toward the usage. Lokeswari (2016) also agrees that positive attitude is one of the factors influencing the use of ICTs in sharing information.

Radio ownership also had positive statistical significance with the radio usage ($P<0.005$) with odds ratio of 26.71. This means that a unit increment of this variable increases the use of radio by factor 26.71. Based on the FGD findings, it is explained by the fact that farmers prefer and enjoy better using something which belongs to them than borrowing it from someone else. In other words, radio ownership can influence its usage. Adegbidi *et al*. (2012) affirm the findings as they conclude that the more the farmers have their own mobile phones, the more they call to get information on their farming business.

4.14 Determinants of the Television Usage in Sharing Agricultural Information among Fish Farmers

Before analysing the determinants of the Television usage in sharing agricultural information among fish farmers, the extraction method of the Principal Component Analysis was used to determine variables to be fitted into the ordinal regression equation, which were then subjected to the ordinal regression analysis. Table 4.7 presents the results of the Principal Component Analysis using the extraction method. Out of 12 variables, only three variables were constructed and fitted into ordinal regression equation. These three variables were perceived usefulness of the television use, perceived easiness of the television use and attitude toward the television use in sharing agricultural information.

Results from the ordinal logistic regression indicate that the variables influencing the television use contributed by 64.8% and 69.6% as explained by Cox and Snell R square and Nagelkerke R square values (Table 4.7). It was found further that the quantity of fish produced, household size, perceived usefulness, attitude and source of electricity had positive statistical significance with the television usage ($p<0.05$). The quantity of fish produced or fish production was significant ($p<0.05$) and positively related to the use of television with odds ratio of 1.16. This indicates that a unit increase in this factor increases the frequency of television watching by a factor of 1.16. This means that the more the amount of fish harvested by the farmers the more the tendency to seek for information needed for fish farming practices using ICT tools including television. This argument was also supported during the interview with one of the fisheries officer in Songea District who proclaimed: *"farmers who are better in their fish production are the ones who seek for various fish farming technologies from different information channels including watching television programmes related to fish farming".* Jiriko *et al.* (2015)

justify these results by describing that the quantity of fish produce contributes significantly to individual's ability to use ICT for accessing information needed in fish production.

Likewise, findings in Table 4.7 indicate that perceived usefulness and attitude were significant at $p<0.05$ and positively related to the use of television with odds ratio of 1.47 and 1.62 respectively. This suggests that a unit increase in these variables increases the frequency of television watching by a factor of 1.47 and 1.62 respectively. This can be due to the fact that once the farmer finds the television technology less costly, useful, credible, relevant and current in sharing information and having positive attitude on it definitely they will use it frequently. This is not surprising because similar findings are reported by Davis (1989) through the first two applications of the TAM which show that perceived usefulness and attitude was significantly stronger than perceived ease of use of system. Also, Venkatesh *et al*. (2003) and Sarban *et al.* (2015) reported that perceived usefulness and attitudes are taken as important determinants in the use of television in sharing information in agriculture.

Furthermore, the use of sources of power was significant ($p<0.05$) and positively related to the use of television with odds ratio of 1.72. This indicates that a unit increase in this factor increased the frequency of television watching by a factor of 1.72. findings through key infomant interview indicated that, this is due to the fact that the operation of television holding other factors constant mostly depended on electricity as a source of power. Hence when there was a reliable and constant supply of power farmers were encouraged to purchase television and more likely used it frequently in sharing information. This was supported and observed by the researcher during the field study whereby farmers who were connected with electricity owned more than one ICT tools

and were using them for information sharing. This is supported by Okello *et al*. (2012) who revealed that the presence of power is one of the drivers influencing farmers in using ICT tools.

Finally, results revealed that household size was significant at $p<0.05$ and positively related to the usage of television at odds ratio of 1.08 (Table 4.7). This means that a unit increase in this household size increased the frequency of television watching by a factor of 1.08. This is explained by the fact that as a household size increased the demand for food, other domestic needs increased; hence pressure to produce more for household's consumption which could lead to agricultural information searching using different ICT tools. With similar notion, Kacharo (2007) reported that a big number of household members leads to increased exposure to information.

Table 4. 7: Ordinal logistic regression on determinants of the ICTs usage in sharing agricultural information among fish farmers in Tanzania

Variable	Mobile phone			Radio			Television		
	Estimate	**Sig.**	**OR**	**Estimate**	**Sig.**	**OR**	**Estimate**	**Sig.**	**OR**
Age	-.007	.583	0.99	-.017	.238	0.98	.008	.550	1.01
Household size	.004	.952	1.00	-.008	.908	0.99	.074	.028	1.08
Income	.116	.042	1.12	.308	.059	1.36	.084	.612	1.09
Farming experience	.057	.862	1.06	.227	.515	1.25	.418	.021	1.52
Fish production	.255	.054	1.29	.407	.004	1.50	.152	.023	1.16
Perceived usefulness	.258	.000	1.29	.066	.557	1.07	.387	.003	1.47
Perceived user-friendly	.201	.004	1.22	.376	.003	1.46	.135	.073	1.14
Attitude	.194	.007	1.21	.409	.000	1.51	.485	.001	1.62
Sex	.028	.938	1.03	.598	.123	1.82	.559	.137	1.75
Marital status	-.087	.841	0.92	.845	.079	2.33	.217	.648	1.24
Education level	-.414	.458	0.66	.383	.539	1.47	-.020	.974	0.98
source of power	.696	.027	2.01	.608	.077	1.84	.541	.0127	1.72
Membership	-.284	.318	0.75	-.156	.614	0.86	.213	.479	1.24
ICTs ownership (Reference own)	.189	.212	0.66	3.285	.000	26.71	-.404	.547	0.67

For mobile phones: **Cox and Snell=.662; Nagelkerke=.726** ; **For radio** Cox and Snell=.501; Nagelkerke=.555; For **television:** Cox and Snell= .648; Nagelkerke=.696

4.15 Conclusion and Recommendations

The findings established that attitude toward the use of ICTs, perception toward easiness and usefulness, income, sources of power, fish production and farming experience constitute the major drivers on ICTs usage in information sharing among fish farmers. Due to their positive attitude and perception towards ICTs, farmers will be willing in using ICTs to access and share fish farming information, which will lead to the use of aquaculture technologies, and consequently leading to improved productivity. From the findings, researchers, policy makers, information providers and ICT experts in Tanzania may come up with a relevant farmers' information system that will assist fish farmers to access to and share various categories of information through ICTs. Therefore, to enhance more ICTs usage in information sharing, the study recommends the following:

i. Responsible organs like research institutions, policy makers and information providers should make sure that behavioural factors that motivate individual farmers in different communities to accept the use of any ICTs are considered prior to introduction of the technology. This could assist responsible organs to design the ICT models that are relevant to fish farmers' needs.

ii. Since the source of electricity had significant relation with the use of ICTs especially television and mobile phones, the Tanzanian Government through its Ministry of Energy and Minerals should facilitate more rural electrification so that more fish farmers can use ICT gadgets such as television sets. In addition, private companies and businessmen should be encouraged to import more ICT tools such as mobile phones and television at reasonable costs that can be solar-powered to reduce the dependency on electricity which is generally less available in rural areas.

iii. Information services providers are recommended to empower fish farmers with knowledge and skills on how to use ICT facilities such as television since some of

the farmers have low perceptions on easiness of television usage. In addition, designers should enhance perceived ease of ICT tools use especially television either by adding new functional capabilities to the system or by making it easier to invoke the functions which already exist.

iv. Researcher, scholars, ICTs project planners studying factors influencing ICTs usage by farmers should treat each ICTs separately because different factors influence the usage of a specific ICTs tool.

References

Adefalu 1, L. L., Aderinoye-Abdulwahab2, S. A., Bello3, O. G., Olorunfemi1, O. D., and Oba1, *S. A.* (2013). Information needs of fish farmers in Ilorin Metropolis, Kwara state, Nigeria, Nigerian. *Journal of Agriculture, Food and Environment, 9*(2):1-5.

Adegbidi, A.B., Mensah, R., Vidogbena, F., and Agossou, D. (2012). Determinants of ICTS use by rice farmers in Benin: from the perception of ICTS characteristics to the adoption of the technology. *Journal of Research in International Business and Management, 2* (11): 273-284.

Agresti, A. (1996). *An Introduction to categorical data analysis*, New York: Wiley.134pp.

Anselme, B.A., Mensah,R. Vidogbena, F. and Agossou, D. (2012). Determinants of ICT use by rice farmers in Benin: From the perception of ICT characteristics to the adoption of the technology. *Journal of Research in International Business and Management, 2*(11): 273-284.

Arfan, M., Ali S., Safdar, U., and Khan M.A.J. (2015). Study of Association between Demographic Characteristics and increase in knowledge of farmers through Punjab Agricultural Helpline. *Journal of Agricultural Research, 53*(6):

287-294.

[[https://pdfs.semanticscholar.org/1736/a0b72ca91b52414b9ccd21dee81b451] site visited on 16 February 2018

Bailey, D.K. (1994). Methods of Social Science Research. 4th edition. The Free Press, New York USA. 588pp.

Bugembe, J. (2010). Perceived usefulness, perceived ease of use, attitude and actual usage of a new financial management system: a case study of Uganda national examinations board (Master's dissertation, Makerere university). 154pp.

Chenyambuga, S.W., Madalla, N.A., and Mnembuka, B.V. (2011). Management and value chain of Nile Tilapia cultured in ponds of small-scale farmers in Morogoro Region, Tanzania. International Institute of Fisheries Economics and Trade. 28- 38pp.

Chenyambuga, S.W., Mwandya, A., Lamtane, H.A. and Madalla, N.A. (2014). Productivity and marketing of Nile tilapia (*Oreochromis niloticus*) cultured in ponds of small-scale farmers in Mvomero and Mbarali districts, Tanzania. *Livestock Research for Rural Development, 26(3).*

Creswell, J.W. (2003). Research design: Qualitative, quantitative and mixed methods approaches, second edition. Thousand Oaks: SAGE Publications. 588pp

Davis, F., Bagozzi, R.P., and Warshaw, P.R. (1989). User Acceptance of Computer technology: A comparison of two theoretical models. *Management Science, 358(8)*: 982-1003.

Davis. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3): 319-340.

Ijatuyi, E.J., Abiou, O.A., and Olaniyi, O.A.(2016). Information needs of fish farmers in Osun-State. *Nigeria Journal of Human Ecology, 56*(3): 309-317.

Jiriko, R.K., Obianuko J.C., and Jiriko, K.G. (2015), Socioeconomic factors affecting ICTs utilization by youths in fish farming in Kaduna state, Nigeria. *Global Journal of Agricultural Research, 3*(4): 12-22.

Jiriko. R. K., Obianuko, J. C., and Jiriko. K. G. (2015). Socio-economic factors affecting ICTs utilization by youths in fish farming in Kaduna state, Nigeria. *Global Journal of Agricultural Research, 3*(4): 12-22 [www.eajournals.org] site visited on 12 March 2018

Kacharo, D.K. (2016). The use of mobile phones in agricultural extension in Southern Ethiopia. A thesis submitted in fulfilment of the requirements for the degree of doctor of philosophy of Sokoine University of Agriculture. Morogoro, Tanzania**.** 162pp.

Kaiser, H.F. (1974). An index of factorial simplicity. *Journal of Psychometrika, 39*(1): 31–36.

Kimaro, H., Mukandiwa, L., and Mario, E. Z. J. (2010). Towards improving agricultural extension service delivery in the SADC Region. Workshop on Information Sharing among Extension Players in the SADC Region", Dar es Salaam Tanzania. 88-102pp.

Kurtenbach, T., and Thompson S (2000). Information Technology adoption: Implications for agriculture.[https://www.ifama.org/conferences/9/1999/1999%20Congress/Forum%20PapersProceedings/Kurtenbach_Tammy.PDF] site visited on 10 April 2018

Lengua, L. J., Roosa, M. W., Schupak-Neuberg, E., Michaels, M. L., Berg, C. N., and Weschler, L. F. (1992). Using focus groups to guide the development of a parenting program for difficult-to-reach, high-risk families. *Family Relations, 41*: 163-168.

Lokeswari, K. (2016). Study of the use of ICTs among rural farmers. *International Journal of Communication Research*, 6(3): 232-238. [https://search.proquest.com/openview/997eb47273fdfc1c52cf0189166] site visited on 20 February 2018

Manjula. P.S. (2017). Behavioural intention to use mobile applications among farmers of Tanjavur district in Tamilnadu, Kaav. *International Journal of Economics, Commerce and Business Management 1*(4): 133-144. [www.kaavpublications.org] site visited on 10 January 2018

Matuha, M. (2015). Mobile phone use in Ugandan aquaculture: Farmer experiences and aspiration (Master's thesis, Auburn University , U.S.A.). 67pp.

Mittal, S., and Mehar, M. (2016). Socio-economic factors affecting adoption of modern Information and Communication Technology by farmers in India: Analysis using multivariate probit model. *Journal of Agricultural Education and Extension,* 22(2): 199-212.

Mwaijande, F. A., and Lugendo, P. (2015). Fish-farming value chain analysis: Policy implications for transformations and robust growth in Tanzania. *The Journal of Rural and Community Development*, 10(2): 47-62.

Mwakaje, A. G. (2010). Information and communication technology for rural farmer's market access in Tanzania. *Journal of Information Technology Impact, 10*(20): 111 -128.

Mwombe, S. O. L., Mugivane, F. I., Adolwa, I.S. and Nderitu, J. H. (2014). Evaluation of Information and CommunicationTechnology utilization by small holder banana farmers in Gatanga District, Kenya. *Journal of Agricultural Education and Extension*, *20*(2): 247–261.

NAP (2012). The National Agricultural Policy (Final draft), United Republic of Tanzania; Dar es Salaam. 22pp.

Ndaghu, A. A., and Barguma, K. (2014). Information accessibility among fish farmers in Girei, Yola North and Yola South Local government areas, Adamawa State, Nigeria. *Journal of Science and Technology*, *4*(8): 503- 507.

Nyamba, S.Y., and Mlozi, M.R.S. (2012). Factors influencing the use of mobile phones in communicating agricultural information: A Case of Kilolo district, Iringa, Tanzania. *International Journal of Information and Communication Technology Research, 2(7): 557-563.*

Ofuoku, A.U. Emah, G.N., and Itedjere, B.E. (2008). Information utilization among rural fish farmers in central agricultural zone of delta state, Nigeria. *World Journal of Agricultural Sciences*, *4*(5): 558-564. [http://www.idosi.org/wjas/wjas4%285%29/7.pdf] site visited on 14 January, 2017.

Okello, J., Kirui, O.K., Njirani, G.W., and Gitonga, Z.M. (2014). Determinants of awareness and use ICT-based market information services in developing-country agriculture: The case of smallholder farmers in Kenya *Quarterly Journal of International Agriculture 53*(3): 263-282. [http://ageconsearch.umn.edu/bitstream/195738/2/4_Okello.pdf]site visited on 12 March 2018

Olaniyi, O.A. (2013). Assessment of utilization of Information and Communication Technologies (ICTs) among poultry farmers in nigeria: an emerging challenge**,** Transnational. *Journal of Science and Technology, 3*(6): 29-43.

Olaoye, O.J, Ashley-Dejo, S.S, Fakoya, E.O, Ikeweinwe, N.B, Alegbeleye, W.O., Ashaolu, F.O., and Adelaja, O.A. (2013). Assessment of socio-economic analysis of fish farming in Oyo State, Nigeria.*Global Journal of Science Frontier Research Agriculture and Veterinary*, *13*(9): 1 12-118.

Rajoria et al. (2017). Constraints perceived by livestock farmers in use of ICTs in Jaipur District of Rajasthan India. *International Journal of Current. Microbiol. and Applied.Sciences* 6(12): 1834-1839. [https://www.ijcmas.com/6-12-2017/Sunil%20Rajoria,%20et%20al.pdf] site visited on 10 February 2018.

Sarban, V. H, Qeidari, H. S., and Ebrahimi, K. (2015). Factors affecting Villagers use of Information and Communications Technology, Case Study: County of the Eastern Part of Meshginshahr City. *Indian Journal of Science and Technology, 8(35).*

Saunders, M., Lewis, P., and Thornhill, D. (2007). "Research methods for business students". 4th ed.Prentice Hall, London. Pearson Education Limited. 226pp.

Sirak, M., and Rice, J. C. (1994). Logistic regression: An introduction. In B. Thompson, ed. *Advances in Social Science Methodology, 3*: 191-245.

Soyemi, O.D., and Haliso, S.Y. (2015). Agricultural Information use as determinant of farm income of women in Benue State, Nigeria. *Research on Humanities and Social Sciences 5(18): 1-6* [http://www.iiste.org/ Journals/index.php /RHSS/article/viewFile/26076/26750] site visited on January 2018

Timothy et al., (2016). Factors Underlying the Choice of Information and Communication Technologies among smallholder farmers in Tanzania. *International Journal of Computing and ICT Research, 10*(2); 41-62.

United Republic of Tanzania (URT) (2014). An overview of fisheries subsector in Tanzania: Achievements and challenges. Ministry of Livestock and Fisheries Development. 16pp.

United Republic of Tanzania (URT) (2015). An overview of fisheries subsector in Tanzania: Achievements and challenges. Ministry of Livestock and Fisheries Development.32pp.

URT (2018). Empowering extension officers' drive on cards, workshop. workshop held by Ministry of Livestock and Fisheries Development, aimed at empowering extension officers July 2018, Dodoma. 12pp.

Venkatesh, V., Morris, M. G., B., Davis, G., and Davis, F. D. (2003). User acceptance of Information Technology: *Toward a Unified View,27*(3): 425–478.

Walliman, N. (2006). Social research methods**,** London, Sage Publications.92pp.

Wulystan, P. Mtega, Mpho Ngoepe, Luyanda Dube (2015). Factors influencing access to agricultural knowledge: The case of smallholder rice farmers in the Kilombero district of Tanzania. *South Africa Journal of Information Management, 18*(1): 1-8.

CHAPTER FIVE

PAPER FOUR

Challenges associated with the use of Information and Communication Technologies in information sharing among fish farmers in the Southern Highlands of Tanzania

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Abstract

Realising the challenges facing fish farmers in ICTs usage for sharing information on fish farming is of great significance as it enables to improve timely provision and access to relevant information and consequently improve fish farming productivity. Unfortunately, none of the studies conducted in Tanzania has examined the challenges facing fish farmers in ICTs usage in information sharing on fish farming. This study was conducted in three regions, namely Ruvuma, Mbeya and Iringa, involving twelve divisions which were purposively selected from six districts. This cross section study involved 240 fish farmers who were randomly selected. Questionnaires, Focus Group Discussions (FGDs), observation and key informants interview were used as data collection methods. Both descriptive and inferential statistics were used to analyse quantitative data while content analysis was used for a qualitative data analysis. Findings indicated that the most frequently used ICTs by fish farmers in sharing agricultural

information were mobile phones, followed by radios and televisions. Also, the study findings revealed that major challenges facing fish farmers in sharing information include unfavorable radio or televisions broadcasting time, high cost of acquiring and maintenance of ICT facilities, lack of training on ICTs, poor network connectivity, and low levels of literacy. Moreover, findings showed that there was negative significant relationship ($p<0.05$) between challenges associated with the use and degree of ICT usage by fish farmers. It is recommended that the Government, NGOs and other related private organisations should establish more ICT infrastructures for enhanced TV, mobile and radio network connectivity, and invest more in rural areas to promote their usage. Additionally, the Government should subside the cost of acquiring the ICTs equipment so that more farmers can afford to own and use it.

Keywords: Mobile phones, radios and televisions, ICTs, agricultural information, aquaculture, fish farming

5.0 Introduction

Agriculture plays a very important role in the social and economic development of most African countries and is the main contributor to economic growth and stability (Bhalekar *et al*., 2015). In Tanzania, the sector is known for employing more than 70% of the total population. According to URT (2016a), the sector on average contributes around 24% of the GDP compared to 30% a decade ago and it contributes about 24% of exports, down from about 45% ten years earlier, mostly due to the development of alternative foreign exchange earning opportunities from minerals and tourism services. Aquaculture and fishery as one of the agriculture sub sectors has increasingly become an important source of income and livelihoods for many people in African countries including Tanzania.

Tanzania is one among the greatest fisheries nations in Africa, ranking in the top 10 countries in terms of total capture fisheries production (FAO, 2017). In 2014 the fisheries

and aquaculture sector contributed 2.4% to the Tanzania GDP, and has been growing at the rate of 5.5% (Economic Survey Report, 2014). This percentage contribution to the GDP is low compared to other agriculture sub sectors like livestock keeping. Likewise In Tanzania fish farming is dominated by small-scale farmers practice both extensive and semi-intensive fish farming. Fish farming is generally integrated with other agricultural activities such as gardening, livestock and poultry production on small pieces of land. The dominant fish species cultured in Tanzania includes Nile tilapia (*Oreochromis niloticus)*, followed by African catfish *(Clarias gariepinus)* milkfish (*Chanos chanos*) and the flathead grey mullet (*Mugil cephalus*) which are cultured in the brackish and marine waters,(Kaliba *et al.*, 2006; FAO, 2012). And most of the fish-farmers sell their farm outputs to neighbourhoods at the farm gates and local markets and very few sell their produce at the secondary markets or external markerts. (Chenyambuga et al., 2014; Mwaijande and Lugendo, 2015; Ayubu, 2017).

However, fish farmers in Tanzania especially Southern HighLands are faced with some challenges/difficulties in running their fish farming activities. Those challenges include low knowledge on pond managements practices, species selection, inadequate aquaculture extension services; lack of reliable and adequate agricultural information, distant to information sources and absence of the type of information the farmers need to produce their choice aquaculture products, (URT, 2015). Also, fish farmers are hindered by inadequate investment in aquaculture infrastructure and facilities for processing and marketing fish and fishery products, lack of access to finance and credit facilities, improper feeding and pond fertilization and lack of access to aquaculture inputs (URT, 2012; Chenyambuga *et al.*, 2014).

For a rapid growth of fish farming or aquaculture, efficient flow of information to fish farmers is of a great significance. According to Aina *et al.* (1995), also Benard and Dulle (2014), information has a vital role to play in improving and sustaining aquaculture production of any nation. In addition, Eucharia *et al*. (2016) have put it clearly that information as a factor of production is necessary to increase fish farming productivity. Access to the right information at the right time in the right format and from the right source may mean the difference between farmers' success or failure (Opara, 2008). Thus, farmers who possess appropriate and current information are likely to make a more rational decision than those without information. However, important information on various aspect of fish farming in the Southern Highlands of Tanzania are not accessible or does not reach farmers (Benard *et al*., 2018). In this regard, ICT tools like mobile phones, radios and television can play an important role in disseminating and sharing timely and relevant information to fish farmers, and consequently improving their fish farming productivity. Musa *et al*. (2013) point out that the achievement of high agricultural productivity depends on the availability and accessibility of timely and relevant agricultural information. It also depends on the credibility and effectiveness of dissemination tools in sharing and communicating such information.

Thus, ICTs are more convientient, cheaper, effective and effeicient way in disseminating and sharing information to farmers. This is contrary to traditional technology dissemination methods such as field demonstrations, seminars, printed materials and group meetings which are normally used by fishery officers (Joel and Adigun, 2013; Samansiri and Wanigasundera, 2014). These traditional dissemination methods have been inhibited by inadequate extension capacity. For instance, the existing data shows that there are about 750 fisheries extension officers out of 16 000 needed in Tanzania to meet information and knowledge needs of fish farmers (URT, 2015). This deficit of

fisheries extension officers is associated with inadequate dissemination of information and knowledge to fish farmers (Yaseen *et al.,* 2015). Nevetheless , fish farmers in their efforts to access and sharing these agricultural knowledge and information from those ICTs tools for better fish farming and improved fish farming productivity are confronted with certain challenges.

Moreover, through literature it has been shown that many studies that have been done in Tanzania so far on ICTs use by farmers have concentrated either on the extent of ICTs use in information sharing (Lwoga 2010; Mwakaje 2010; Mtega and Msungu, 2013; Benard and Dulle 2017) or use of ICTs in agricultural extension services delivery (Sanga *et al.,* 2013; Sanga *et al.,* 2016; Tarimo and Sanga, 2017; Lwesyal and Kibambila, 2017) or the role of ICTs in improving farming productivity (Angello, 2017; Benard *et al*., 2018). None of the studies has focused on challenges facing farmers on the use of ICTs in information sharing and relationship with its degree of usage particularly in the context of fish farmers in the Southern Highlands of Tanzania. In supporting this, Temba *et al*. (2016) noted that there is scanty of information on the challenges of using ICT in sharing and disseminating agricultural information to farmers. This deficiency of information in this part can have a negative impact on timely and relevant information sharing to fish farmers and consequently poor fish farming productivity. Therefore, this study specifically intended to: to determine the challenges facing fish farmers in the using of ICTs in sharing information and, to analyse the relationship between challenges encountered by fish farmers in information sharing and their degree of ICTs usage. In view of this, Musa *et al*. (2013) reported that the challenges facing farmers on the use of ICTs in sharing and communicating agricultural information are thought to have contributed to the reduction of farmers' productivity, farmers' economic performance, and food security. This situation arosed due to the fact that if farmers are not getting

timely information from relevant and right information sources or getting problems in access information from those sources they will not be able to be informed on different fish farming technologies and consequently can led to low productivity.

5.1 Methodology

This study was conducted in 2016 in three regions of the Southern Highlands of Tanzania, namely Iringa, Mbeya and Ruvuma. These regions were chosen since they have a relatively big number of fish ponds, long history of fish farming compared to other regions in the country and relatively well developed ICTs infrastructure (FAO, 2012). Ruvuma, Iringa and Mbeya regions have more numbers of fish ponds as compared to other regions like Arusha, Kilimanjaro, Morogoro, Dar es Salaam (URT, 2012). According to (URT, 2014) in Ruvuma Region there are 4942 fish ponds, 3137 in Iringa Region and 1176 in Mbeya Region.

5.2 Sampling Procedure and Sample Size

The sampling frame in this study consisted of all fish farmers in twelve divisions of six selected districts, namely Mbeya, Mbarali, Iringa, Mufindi, Mbinga and Songea. The districts were selected based on the number of fish ponds and presence of ICTs infrastructures like electricity, radio, television cables and mobile networks. From these criteria two districts from each selected region (Mbeya, Ruvuma and Iringa) were purposively chosen for this study. These districts were Mbinga and Songea districts in Ruvuma Region, Mbeya and Mbarali districts in Mbeya Region, and Iringa and Mufindi districts in Iringa Region. From each district, two divisions with 20 fish farmers and good ICTs infrastructures were also purposively chosen. According to Israel (2012), a sample size greater or equal to 20 can yield meaningful results in a survey study. Simple random sampling technique was used to select the 20 fish farmers from each division;

making a total sample size of 240 respondents out of 408. The technique was used since the subjects are chosen objectively such that no opportunity for human bias to manifest.

5.3 Methods of Data Collection and Procedures

In order to ensure validity and reliability of the research tools, the tools were pre-tested in a village with similar conditions to the study villages. A reliability analysis is based on a calculation of correlation among the statements using Cronbach's α (Chen and Popovich 2002). Thus, the reliabilit*y* of the data instrument was tested using cronbach Alpha with 11 items relating to challenges facing fish farmers in using ICTs . The Cronbach's Alpha was calculated. The value of 0.78, for reliability of scale (Cronbach's Alpha) was obtained, showing good internal consistency reliability for the instruments. After pre-testing process the questionnaire with both closed and open ended questions was modified and administered to 240 respondents using face to face interviews. The modified Technology Acceptance model by Davis 1989 together with various literature relating to the objectives of the study was used as frame work to guide the questionnaires development. The major advantage of this method (face to face interviews) is that they allow the researcher to probe and clarify issues on the spot (Walliman, 2011).

Six Focus Group Discussions (FGDs) involving six participants who were purposively selected from each district were done. The study also collected data from six key informants (six fisheries officers, one from each district) who were purposively selected and interviewed. Moreover, personal observation was used also as the method of data collection in this study. The data collected from from FGD guide, interview and observation guide were related with objectives of the study aiming at compliment some information which were not easily captured through questionnaires. The rationale for

using a mixed method approach is built on its main advantage of neutralising or cancelling biases of a single method (Creswell, 2003; Glazier and Powel, 1992).

5.4 Data Analysis

Data collected in this study were statistically analysed with the aid of the SPSS Version 20 as highlighted earlier. A 5-Point Likert-scale was used to determine the degree of ICT use by the fish farmers with response options of used, very frequently = 4, Frequently =3, occasional = 2, Rarely = 1, Never=, 0. The response values were added to obtain 10 , which was divided by 5 to get a mean score of 2.0. (4+3+2+1+0= 10/5 = 2). Mean scores (mean cut off point) of 2.0 or above were classified as most often used, while scores less than 2.0 were regarded otherwise. Likewise, to ascertain the challenges militating against the use of ICTs by fish farmers, the farmers were asked questions on a number of challenges and also to state the degree to which such challenges impede the use of ICTs in sharing agricultural information using a 4-point Likert type scale of 4= major challenge, 3= moderate, 2=, low and 1= not at all. The responses values were added to obtain 10 , which was divided by 4 to get a mean score of 2.5. (4+3+2+1= 10/4 = 2.5). Mean scores of 2.5 or above were classified as major challenge while those that are less than 2.50 are categorized as not a challenge. This method of calculating the mean score (mean cut off point) was adopted by various scholars ie Aphunu and Atoma (2011); Osondu and Ibezim 2015; Nenna, 2016). However, ordinal logistic regression model was used to analyse the relationship between challenges encountered by fish farmers in information sharing and their degree of ICTs usage. Sirak and Rice (1994) revealed that the logistic regression model is more powerful, convenient and flexible and is often chosen if the dependent variable is categorical and ordinal arranged. Dependent variable in this study is categorical and is ordinally arranged therefore this study used the ordinal logit regression model.

The ordinal regression equation used for analysis was as follows:

$$Logit(Y) = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \varepsilon_i$$

Where: π = probability of the event,

α = Y intercept,

β_i = regression coefficients,

X_s = a set of predictors.

Y= Outcome variable (ICTs use) ranges from 1to 5 corresponding to four point scale levels of: (4) Very frequently**,** (3) Frequently, (2), Occasionally, (1) Rarely, (0) Never).

X_1 …X_7 are explanatory variables (X_1= Language barrier, X_2 = high cost of acquiring and maintenance of ICTs facilities, X_3 =, Inadequate technical knowhow, X_4= Lack of access to ICTs, X_5 = Unfavourable radio/ television broadcasting time, X_6 = Lack of Awareness on the use of ICTs and X_7 = Lack of regular power supply. However, the content analysis was used to analyse qualitative data obtained from Focus Group Discussion and interview. This was done by grouping or organizing collected information into abstract themes categorized based on research objectives.

5.5 Results and Discussions

5.6 Demographic and Socio-economic Characteristic of the Respondents

The demographic and socio-economic characteristics of the fish farmers are summarised in Table 5.1. The results showed that over half of the fish farmers in the study area were males (92, 80%) while few (48, 20%) were females. This means that more males were involved and practiced in fish farming than females. These findings are similar with those of studies by Chenyambuga *et al*. (2011), Chenyambuga *et al.* (2014), Mwaijande and Lugendo (2015) conducted in Tanzania which reported that very few females owned fish ponds and most of them were widowed, divorced or unmarried. This can be due to the fact that in Tanzania women are sometimes not entitled to own land, this makes it difficult for some women to practise and invest in fish farming. In view of this,

Chenyambuga *et al*. (2011), Mwaijande and Lugendo (2015) report further that local customs and cultural practices in many farming systems in Tanzania make it tedious for a woman to own assets and land as these are attained mainly through inheritance which favors men to own assets.

Further results revealed that 47.1% of the fish farmers were in the 47 to 56 age group (Table 5.1). This implies that most of the fish farmers in the study area were within the economically active age group. According to Olaoye *et al* . (2014), ages between 40 and 50 are considered highly productive and active to undergo energetic tasks associated with fish farming activities. Also, findings show that 67.9% of the respondents had completed the primary level of education. This suggests that the majority of the fish farmers at the study area had acquired the primary level education. Generally, there is a positive and significant relationship between formal education and adoption of technologies (Voh, 2002).

Similarly, it was found that 87.9% of the fish farmers were married (Table 2.1). This implies that married people dominate fish farming activities in the area. Furthermore, it was found that 72.9% of the respondents had fish farming experience of up to five years (Table 5.1). These results conform to those by Barguma and Ndaghu (2014) in NigeriaThis experience can have an impact on fish farming productivity and ICTs usage. However, research findings revealed that 45.4% of the respondents earned an annual income level of more than TZS 1 500 000 This means that fish farmers in the study area had an income which was below the per capital income of Tanzanians, which is TZS 2 100 000 per year (TNBS, 2016). The income level of fish farmers in the study area can have an effect on ICTs usage. Arfan *et al.* (2015) highlight that income demonstrates a most significant positive linkage with the ICTs usage in enhancing knowledge level of the farming community.

Table 5. 1 Socio-economic characteristics of the respondents (n= 240)

Factors	n	%
Sex		
Male	192	80.0
Female	48	20.0
Education level		
No formal education	15	6.3
Primary education	163	67.9
Secondary education	39	16.3
Tertiary education	23	9.6
Age (years)		
18 – 35	40	16.7
36 – 46	71	29.6
47 – 56	113	47.1
57 – 66	16	6.7
Marital status		
Single	18	7.5
Married	211	87.9
Divorced	3	1.2
Separated	1	0.4
Household income (TZS)		
Less than 500 000	38	15.8
500 001- 1 000 000	60	25.0
1 000 001 – 1 500 000	33	13.8
More than 1 500 000	109	45.4
Farming experience (years)		
Up to 5	175	72.9
6 – 10	51	21.2
More than 10	14	5.8

5.7 The Extent of ICTs Usage in Sharing Agricultural Information by Fish Farmers

The findings in Table 5.2 show that the extent of ICTs usage in sharing information by fish farmers in the study area. The findings indicate that mobile phones were most frequently used ICTs by fish farmers in sharing information. The reasons behind on its high usage is explained by the fact that mobile phones are affordable, available, easily accessible, cheap and facilitate a two-way communication for fish farmers to seek for some more clarification and get instantly answers. This was evidenced during the FGD and key informant interviews where it was reported out that most fish farmers preferred to use mobile phones more frequently than other ICT tools because they are more convenient. For example, during the FGD, one farmer from Sadani Village in Iringa District pointed out that *"With a mobile phone I can communicate with fisheries* extension *officers and ask for some information related to weather, market, credits, fish*

pond construction, fish feeding, source of fingerings and other information without necessarily travelling a long distance to meet them". Similarly, some fisheries extension officers claimed that they prefer to use mobile phones more frequently to communicate and share information with farmers because they assist them to overcome transport problems. They explained and one was heard saying: "*With mobile phones, we don't need to travel to visit farmers located far away. We can just call them when there is new knowledge or information".*

The findings of this study concur with studies by Chavula (2014) and Eucharia *et al*. (2016) which also found that mobile phones are the most used ICT tools among fish farmers because of their availability, wide coverage, and being accessed at a modest cost. Thus, mobile phone is a very important ICT tool in informing farmers on timely and relevant fish farming technologies. In view of that, Bolarinwa and Oyeyinka (2011) report that farmers who use mobile phones are more informed than farmers making physical contact with extension officers.

Further analysis indicated that radio was another ICT tool used by fish farmers in sharing agricultural information. The high degree of radio use is explained by its trustworthiness by farmers, widely owned, flexibility, ease language comprehension and its credibility in communicating timely, and relevant agricultural information to farmers. The same observation was noted during the FGD in Kigonsera Village in Mbinga District where one farmer pointed out: '*listening to radio programmes related to fish farming has helped me to apply the right manure to fertilise my fish pond*'. Omenesa (1997) holds that radio programmes are usually timely and capable of extending agricultural messages to farmers no matter where they may be as long as they have a receiver with adequate supply of power.

Despite the credibility of television in communicating and sharing information to fish farmers, however, few fish farmers mentioned to have access to information through this tool as compared to radio and mobile phones (Table 5.2). This observation slightly differ with the results of Aphunu and Atoma (2011) and Eucharia *et al*. (2016) in Nigeria who reported that the majority of the fish farmers used television more frequently as compared to other ICTs in sharing fish farming information. This slight variation of the extent in Television use can be explained by differences in countries' ICTs infrastructure development, farmers level of education, economic development and income level of individual farmers. It may also be explained by country policy on television use in broadcasting agricultural information and reliable electricity. In supporting this scenario, findings from the FGDs, found that, high cost of purchasing television sets, lack of electricity in most rural areas and in appropriate time for broadcasting agricultural programmes related to fish farming was one of obstacles hindering farmers from using Television frequently. For instance, During the FGD conducted in Hagati, Mbeya District some of the farmers complained that "*we prefer much television in accessing and sharing information but we don't have source of electricity in our area, we usually rely on solar power which is expensive for us".*

Table 5. 2: The extent of ICTs usage in accessing agricultural information by fish farmers

ICTs	**Mobile phone**		**Radio**		**TV**	
	n	**%**	**n**	**%**	**n**	**%**
Never	19	7.9	32	13.3	95	39.6
Rarely	70	29.2	135	56.2	71	29.6
Occasionally	56	23.3	45	18.8	25	10.4
Frequently	86	35.8	27	11.2	46	19.2
Very frequently	9	3.8	1	.4	3	1.2
Total	240	100.0	240	100.0	240	100.0

5.8 The Challenges Facing Fish Farmers in the Using of ICTs in Sharing Information

Table 5.3 summarises the challenges encountered by fish farmers in sharing agricultural information through ICTs. The findings revealed that the major challenges facing fish farmers in sharing information include unfavorable radio/ television broadcasting time , high cost of acquiring and maintenance of ICT facilities , Lack of training on ICT, poor network connectivity , low levels of literacy . Other challenges include lack of access to ICTs, lack of regular power supply, lack of awareness on the use of ICTs in accessing agricultural information, irrelevant content and lack of internet access as it is indicated in Table 5.3. It was also evidenced through FGDs, key informant interviews and observation that inappropriate time of television and radio broadcasting of information related to fish farming, lack of knowledge on how to use some ICTs like television operation, irrelevance of television programmes and lack of funds as other challenges.

The major challenges faced by fish farmers in sharing agricultural information as pointed out in research findings were unfavorable radio/television broadcasting time. Some of the programmes related to fish farming were broadcast during the afternoon in which most of the farmers were busy with farm work or other related activities, thus this become difficult for them to listen or watch those programmes. To confirm this, during the FGD in Sadan division in Mafinga districts some farmers were complaining about unfavorable time that used to broadcast fish farming information through television and radio, for instance one farmer narrated:

> *Sometimes television especially Azam airs out very good programmes related to fish farming especially fish feeding, however I fail to watch them because those programmes are aired during the afternoon when I am sometimes busy with my other business activities. please researcher,*

advise them to air their programmes during the night when most of us are free"".

The same challenge of inappropriate timing of television or radio broadcasting time was reported by the study done in Uganda by Akullo and Mulumba (2016).

Moreover, the study revealed high cost of acquiring and maintening ICTs facilities as the major challenges facing fish farmers in sharing information. In supporting this, during the FGD, one respondent in Isagati division narrated:

If I had a television set, I could enjoy and learn various fish farming technologies broadcast on televisionbut due to high cost of acquiring a television set together with satellite dish, it becomes very difficult for me.

In connection to that, this was evidenced during the interview with one of the fisheries officer in Songea who pointed out:

sometimes if the farmers have some questions or clarification on issues related to fish farming, they just miss callg me. However, due to the cost of credits, I sometimes ignore it or I fail to call them back.

This statement shows how the cost of purchase and maintance ICTs affects both farmers and fisheries extension officers in information sharing. Supporting this, Familusi and Owoeye. (2014) reported that high cost of purchase, installation and subscription of satellite television were the challenges militating farmers against use of ICTs in accessing and sharing agricultural information in Nigeria.

Additionally, the study noted that lack of training on ICTs usage was another challenge that faced fish farmers in the use of ICTs for sharing information. This was evidenced by the researcher through the observation method as some of the fish farmers had possessed good smart phones but were complaining about the lack of skills and knowledge on how

to use some important mobile phone features like WhatsApp in sharing different fish farming information with fisheries experts or with their colleagues. Similarly, during the FGD held in Ilongo in Mbarali District, some farmers were complaining about lack of knowledge and skills on how to use satellite dish television, for instance one farmer claimed:

> "*In my home, I have a television connected to satellite dish that was bought by my daughter but I cannot operate it, I always ask my daughter to do it for me, and if she is not there, I cannot operate it".*

This finding is in line with what was reported by Cnthia and Nwabugwu (2016) in Nigeria who found that lack of technical training on how to use ICTs was the major constraint to farmers' ability to use various ICT tools in sharing fish farming related information. This leads to low usage of ICTs; poor information sharing, and consequently, poor productivity

Moreover, Poor network connectivity was another challenge that militating fish farmers from the use of ICTs in information sharing. This was evidenced and observed by the researcher in the field as some of the areas surveyed like Isagati, in Mbeya, Hagati in Mbinga and Kibengu in Iringa had a problems of low connectivity of mobile phones . Some of the area have been connected by only one mobile phone service provider and also poor radio signals; this had limited farmers in communicating and sharing information pertaining to aquaculture production. This scenario was also confirmed during the FGD as most of the farmers especially those from Hagati and Isagati divisions were complaining about the low mobile phone network connectivity. For instance, one farmer from Hagati division claimed that "*in our area we have been connected by only one mobile subscriber which is Airtel and its connectivity is poor; sometimes we fail to communicate our fish farming problem to the fisheries officer".* This indicates that there

is a serious problem of poor network connectivity which can affect ICTs usage and hence poor information sharing. These findings are similar to what have been reported by Eucharia *et al.* (2016) who revealed the presence of poor network connectivity as the main challenges to most of the rural farmers in Nigeria.

Furthermore, study findings showed that language barrier was another challenge that militating fish farmers against using ICTs in sharing agricultural information as reported by most of the fish farmers in the study area. This was also confirmed during interview with extension officer who reported some problems of language that farmers face in use of ICTs especially mobile phone particular who possess and use smart phones. For example, one fisheries officer from Sadan in Mafinga District pointed out:

> "*Some fish farmers possess very good smart phones with some useful applications for easy sharing of information e.g. WhatsApp applications but they sometimes fail to use due to language barrier since those mobile applications instructions are written in english language where the majority of fish farmers are not conversant with it".*

These results are in line with Shanthya and Elakkiya (2017), in their study in Tamilnadu village in India, who found that the majority (90%) of the farmers encountered the problem of foreign language in interpretations of the ICTs use instructions. This can lead to poor usage of ICTs and consequently poor information sharing which can cause low fish farming productivity.

Other challenges as mentioned by some farmers and fisheries extension officers includes, lack of access to ICTs, lack of regular power supply, lack of awareness on the use of ICTs in accessing agricultural information, irrelevant content and lack of internet access

and possession of television. All these challenges can affect negatively on the use of ICTs in information sharing and hence low fish farming productivity**.**

Table 5. 3: The challenges facing fish farmers in the using of ICTs in sharing information

Challenges facing fish farmers	n	%
Language barrier	186	77.5
High cost of acquiring and maintenance of ICTs facilities	228	95
Inadequate technical knowhow	189	78.8
Lack of internet access in rural areas	165	68.8
Irrelevant content	171	71
Lack of training on ICTs	225	93.8
poor network connectivity	213	88
Lack of awareness on the use of ICTs for accessing agricultural information	170	70
Lack of regular power supply	172	71.8
Lack of access to ICTs	173	72
Unfavourable radio/ television broadcasting time	231	96

5.10 The Relationship between Challenges Encountered by Fish Farmers in Sharing Information and their Degree of Radio Usage

In addition, the study sought to ascertain whether the challenges facing fish farmers in sharing information influence the degree of radio usage. The findings are presented in Table 5.4. These results indicate that high cost of acquiring and maintenance of ICTs (radio) facilities, poor network connectivity (poor radio signals), lack of awareness on the use of ICTs for accessing agricultural information and lack of training on ICT were significant at $p<0.05$ and negative related to the degree of radio use in information sharing. This implies that as the cost of acquiring and maintaining radio increases, the degree of radio usage in sharing information by fish farmers decreases. This relationship was confirmed during Focus Group Discussion. For instance, during the FGD in Karenga in Iringa District one farmer pointed out: *"I sometimes when I don't have money to buy batteries for my radio I stop listening to it and once I get some money for buying new*

ones I tend to reduce the frequency of listening to the radio to cope with my economic situations". This suggests that the high cost of maintaining and acquiring radio affects negatively the frequency of radio use by fish farmers in information sharing.

Likewise, connectivity problems (poor radio signals) was significant at $p<0.05$ and negatively related to the degree of radio use in information sharing. This implying that farmers who faced more challenges on radio signals or network on use of radio in information sharing are more likely to reduce their degree of radio use in information sharing than their counterparts. In view of this, Okoedo-Okojie (2015) highlights that the effectiveness and the extent of radio use in communicating information to farmers depends much on how a strong radio signals is in that particular location.

Also, lack of awareness on the use of ICTs for accessing agricultural was significant at $p<0.05$ and negatively related to the degree of radio use in information sharing. This suggesting that farmers who are not more aware on the use of radio on information sharing are more likely to reduce their degree of its usage in information sharing than their counterparts. This is explained by the fact that awareness is very important components in promoting the use of any technology. In supporting this, Dire *et al*. (2016) assert that adequate awareness on any given innovation or technology is a key to the success in adoption and frequently utilisation of the technology.

5.11 The Relationship between Challenges Encountered by Fish Farmers in Sharing Information and their Degree of Mobile Usage

The findings in this study indicate that low levels of literacy, lack of training on ICT, lack of awareness on the use of ICTs for accessing agricultural information were significant at $p<0.05$ and negatively related with the degree of mobile phone use in information sharing (Table 5.4). This means that farmers who are not able to use mobile

phone due to illiteracy in information sharing are more likely to reduce their extent of mobile phone use in information sharing compared to literate farmers. This relationship was confirmed during the FGD. For instance, during the FGD in Pawaga, Iringa District, some fish farmers reported that they cannot use most of the basic functions of the mobile phones, such as SMS, mainly due to the illiteracy and lack of skill in using it.

Similarly, lack of training on mobile phone use was significant at $p<0.05$ and negatively related to the degree of mobile phone use in information sharing. This implying that farmers who are less exposed to various ICTs training including mobile phones are more likely to reduce the extent of mobile usage in information sharing. This is explained by the fact that training exposure to any ICT is very crucial aspects in motivating and increasing the level of technology usage. The result agreed with the study conducted by Syiem and Raj (2015) in India which found that, lack of training and practical exposure to use mobile phone applications as well as internet detained farmers from using it in sharing agricultural information from time to time.

5.12 The Relationship between Challenges Encountered by Fish Farmers in Sharing Information and their Degree of Television Usage

The findings on the relationship between challenges encountered by fish farmers in sharing information and their degree of television usage is presented in Table 5.4. The results found that illiteracy level and lack of regular power supply were significant at $p<0.05$ and negatively related with the degree of television use in information sharing. This suggesting that as the level of illiterate of farmers increases their degree of television usage in sharing information decreases. This result is attributed to the fact that some televisions have menus which sometimes complicated and some operations instructions have been written in English language whereby due to the problem of

illiterate among farmers it becomes very difficult for them to use it to certain level. This is also in line with the findings by Okello *et al.* (2014) who reported that a unit increase in farmer's literacy level increases the degree of television use by a farmer by 0.55, holding another factors constant.

Likewise, further analysis revealed that lack of regular power supply was significant at $p<0.05$ and negatively related with the degree of television use in information sharing. This suggests that farmers who often suffering from the problems of power supply are more likely to reduce the degree of television use in information sharing. This was also evidenced by the researcher in the field as researcher observed a problem of frequently power outage in some of the areas which lead to low usage of television by some of the farmers. These findings are similar to what have been reported by Syiem and Raj (2015) who mentioned that erratic power supply was the major constraint affecting farmers from frequently use of television in information sharing. This similarities is explained by the fact that operation of any ICTs technology depend much on regular power supply.

Table 5. 4.The relationship between challenges encountered by fish farmers and their degree of ICTs usage

Challenges facing fish farmers	Radio			Mobile phone			Television		
	Estimate	Wald	Sig.	Estimate	Wald	Sig.	Estimate	Wald	Sig.
Low levels of literacy	-.316	2.212	.137	-.442	6.112	.013	-.545	9.887	.002
High cost of acquiring and maintenance of ICTs facilities	-.075	.144	0.023	-.099	.334	.563	-.004	.001	.982
Inadequate technical knowhow	.573	5.172	.705	.166	.645	.422	.-275	2.143	.143
Lack of internet access	-.410	5.099	.540	-.167	1.275	.259	-.136	1.041	.307
Irrelevant content	-.169	1.298	.255	-.266	4.389	0.400	-.189	2.671	.102
Lack of training on ICTs	-.438	5.901	.015	-.138	.707	.036	-.179	1.474	.225
Poor network connectivity	-.113	.376	.024	-.213	1.638	.201	-.146	.967	.325
Lack of awareness on the use of ICTs for accessing agricultural information	-.343	6.501	.011	-.607	24.403	.000	-.699	24.820	0.502
Lack of regular power supply	-.087	.291	.589	-.010	.005	.946	-.084	.451	.000
Lack of access to ICTs	-.501	7.352	.007	-.213	2.054	.152	-.106	.655	.418
Unfavourable radio/ television broadcasting time	-.090	.337	.561				-.103	.786	.375

5.13 Conclusion and Recommendations

The findings established that mobile phones, radios and television were frequently used by fish farmers in sharing agricultural information in the Southern Highlands of Tanzania. These devices can play an important role in enhancing the capacity of farmers specially fish farming community. However, the findings revealed that fish farmers faced several challenges in using mobile phones, radios and television in sharing various fish farming information which found to be negatively affecting its degree of usage. This scenario can have negative impact in timely sharing of various information related to fish farming technologies or innovations and consequently can cause poor fish farming productivity among fish farmers in the country. Therefore, to ensure the problems facing fish farmers in the use of ICTs are being solved, the study recommends the following:

i. The findings suggested that relevant ministry through their extension personnel should motivate and provide regular trainings to the fish farming community about the use of ICTs (mobile phones, radios, and television), in order to increase the, competence and skill in using ICTs in accessing and sharing agricultural information.

ii. Government, NGOs and and other related private organisations should establish more ICTs infrastructure for enhanced mobile phones, radios and television network connectivity and invest more in rural areas to promote their usage. Also, the government should subside the cost of acquiring the ICTs equipment so that more farmers can afford to own and use it.

iii. Government should encourage media owners to broadcast more agricultural programmes related to fish farming on both radio and television and should make sure that the programmes are broadcasted at appropriate and convenient times for farmers particularly during the night hours as it was proposed by most of the farmers.

References

Aina, I.O, Kaniki, A.M., and Ojiambo, J.B. (1995). Agricultural information in Africa, Third World Information Services Ltd. Ibadan, pp12-31.

Akinbile, L.A., and Alabi, O.E. (2010). Use of ICTs among fish farmers in Oyo state. *Journal of Agricultural Extension, 14* (1): 22-30.

Akullo, W.N., and Mulumba, O. (2016). Making ICTs relevant to rural farmers in Uganda: A Case of Kamuli District [http://library.ifla.org/1488/1/110-akullo-en.pdf] visited on 12 June 2018.

Angello, C. (2017). Role of ICTS in Accessing and disseminating information for improved urban livestock keeping in Tanzania. A review of related Literature. *Library Philosopy and Practice (e-journal).*

Aphunu, A., and Atoma, C.N. (2011). Extent of use of ICTs by fish farmers in Isoko Agricultural Zone of Delta State, Nigeria. *Journal of Agricultural Extension 15* (1): 28- 39.

Arfan, M., Ali S., Safdar, U., and Khan M.A.J. (2015). Study of association between demographic characteristics and increase in knowledge of farmers through Punjab agricultural helpline. *Journal of Agricultural Research*,53(2): 287-294.

Babatope, F.E., and Olufemi, O.P. (2014). An assessment of the use of radio and other means of information dissemination by the residents of Ado- Ekiti, Ekiti-State, Nigeria, *Library Philosophy and Practice* (ejournal). [1088.http://digitalcommons.unl.edu/libphilprac/ 1088] visited on 6 January 2018.

Bailey, D.K. (1994). Methods of Social Science Research. 4th edition. The Free Press, New York USA. 588pp.

Barguma K. A., and Ndaghu, A. A. (2014). Information accessibility among fish farmers in Girei, Yola-North and Yola-South local government areas, Adamawa State,Nigeria ARPN. *Journal of Science and Technology*, 4(8): 503-507 .

Benard, R., and Dulle, F. (2017), Application of ICT tools in communicating information and Knowledge to artisanal fishermen communities in Zanzibar, *Knowledge Management and E Learning*, 9(2): 239- 253.

Benard.R., Dulle, F., and Lamtane. H., (2018). The influence of ICTs usage in sharing information on fish farming productivity in the southern highlands of Tanzania. *International Journal of Science & Technoledge, 6* (2): 67- 79.

Bhalekar, P., Ingle, S., and Pathak, K. (2015). The study of some ICTs projects in agriculture for rural development of India. *Asian Journal of Computer Science and Information Technology, 5* (1): 5-7.

Bolarinwa, K.K., and Oyeyinka, R.A., (2011). Use of cell phone by farmers and its implication on farmers' production capacity in Oyo State Nigeria. In: World Academy of Science, Engineering and Technology 51pp.

Bolarinwa, K.K.,and Oyeyinka, R.A. (2016). Use of cell phone by farmers and its implication on farmers' production capacity in Oyo State Nigeria. International conference held in Abadan, Nigeria [https://waset.org/publications/11792/use-of-cell-phone-by-farmers-and] visted on June 2018.

Chavula, H.K. (2014). The role of ICTs in agricultural production in Africa. *Journal of Development and Agricultural Economics, 6* (7):279-289.

Chenyambuga, S.W., Madalla, N.A., and Mnembuka, B. V. (2011). Management and value chain of Nile Tilapia cultured in ponds of small-scale farmers in Morogoro Region, Tanzania. International Institute of Fisheries Economics and Trade. 56- 72.

Chenyambuga, S.W. Mwandya, A., Lamtane, H.A., and Madalla, N.A. (2014). Productivity and marketing of Nile tilapia (*Oreochromis niloticus*) cultured in ponds of small-scale farmers in Mvomero and Mbarali districts, Tanzania. *Livestock Research for Rural Development, 26*(43). [http://www.lrrd.org/lrrd26/3/chen26043.htm].

Chen, P.Y. Popovich, P.M. (2002). Correlation: Parametric and nonparametric measures 1st (first) edition , Sage Publications, Calfonia, United States.122pp.

Creswell, P. (2003). Research design qualitative, quantitative. and mixed methods approaches second edition University of Nebraska, Lincolin 108pp.

Cynthia, E.N., and Nwabugwu, T.S. (2016). Challenges to adoption of ICT tools by agricultural extension workers in Anambra State, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, *10*(4): 1-6.

Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and use acceptance of information technology. *MIS Quarterly, 13*(3): 319-339.

Dire, B. J.I., Onu, A.A.U., Jungur, A.A., and Ndaghu, D.Y. Giroh. (2016). Awareness on the use of Information and Communication Technologies (ICTs) among agricultural. extension agents in north -eastern Nigeria, Scientific papers series management, economic engineering in agriculture and rural development [http://managementjournal.usamv.ro/pdf/vol.16_1/Art20.pdf] visited 5 March 2018.

Eucharia, E, Ngozi,U.,, Chikaire, J., Ifeanyi, O.E. and Patience, C.N. (2016). Roles of Information and Communications Technologies in improving fish farming and production in Rivers State, Nigeria. *Library Philosophy and Practice (e-journal)*. 1445. [http://www.ejournalofscience.org] visited on 12th May 2018.

Familusi, E. B., and Owoeye, P. O. (2014). An assessment of the use of radio and other means of information dissemination by the residents of Ado- Ekiti, Ekiti-State, Nigeria. *Journal of Library Philosophy and Practice*, 1088.

FAO (2012). Food and Agriculture Organisation of the United Nations. United Republic of Tanzania - National Aquaculture sector overview. [http://www.fao.org/fishery/countrysector/naso_tanzania/en] visited June 2018.

FAO (2017). National Aquaculture sector overview United Republic of Tanzania, Rome, Italy. 56pp.

Glazier.J. and Powell.R. (1992). Qualitative research in information management. Englewood, CO: Libraries Unlimited Inc.97pp.

Israel, G.D. (2012). Determining sample size. University of Florida IFAS Extension, Florida. 65, 1- 5.

Lwesya1, F. and Kibambila,V. (2017).The role of ICT in facilitating farmers' accessibility to extension services and marketing of agricultural produce: The case of Maize in Mbozi District, Tanzania. *International Journal of Agricultural Marketing*, *4*(2): 142-151.

Lwoga E. T., Ngulube, P., and Stilwell, (2010). Information needs and information seeking behaviour of small-scale farmers in Tanzania. *Jornal of inovation* 40 (82): 103- 118pp.

Mtega, W., and Msungu, A. (2013). Using information and communication technologies for enhancing the accessibility of agricultural information for improved agricultural production in Tanzania. *The Electronic Journal of Information Systems in Developing Countries, 56*(1): 1-14.

Musa, N., Githeko, J., and El-Siddig, K. (2013). Challenges of using information and communication technologies to disseminate agricultural information to farmers in sudan. *International Journal of Sudan Research, 3* (2): 119-131.

[http://www.ruforum.org/sites/default/files/IJSR_V3_N2_2013_MUSA_GITHEKO_EL-SIDDIG.pdf] visited on 12th May 2018.

Mwaijande, F.A., and Lugendo, P. (2015). Fish-farming value chain analysis: Policy implications for transformations and robust growth in Tanzania. *The Journal of Rural and Community Development 10*(2), 47-62.

Mwakaje, A.G. (2010). Information and communication technology for rural farmer's market access in Tanzania. *Journal of Information Technology Impact, 10*(20): 111 -128.

Nenna, M.G. (2016). Assessment of Information and Communication Technologies (ICTS) among Cassava farmers in Anambra State, Nigeria. *British Journal of Research* 3 (2); 041-054.

Okello, J.J., Oliver, K., Zachary, K.M., Jonathan, G., and Nzuma, M. (2014). Determinants of awareness and use ICT-based market information services in developing-country agriculture: The Case of Smallholder Farmers in Kenya. *Quarterly Journal of International Agriculture, 53*(3): 263-282.

Okoedo-Okojie, D.U., and Omoregbee, F. E. (2012). Determinants of Access and Farmers' use of Information and Communication Technologies (1CTs) in Edo State, Nigeria. *Journal Applied Science and Environmental . Management 16* (1): 41 – 44.

Okoedo-Okojie, D. U. (2015). Determinants of constraints to information sources utilization among maize farmers in Edo state, Nigeria. *British Journal of Applied Science & Technology, 9*(2): 182-190.

Olaoye, O.J, Ashley-Dejo, S.S, Fakoya, E.O, Ikeweinwe, N.B, Alegbeleye, W.O., Ashaolu, F.O., and Adelaja, O.A. (2013). Assessment of Socio-Economic Analysis of Fish Farming in Oyo State, Nigeria. Global Journal of Science Frontier. *Research Agriculture and Veterinary13*(9): 1-12.

Omenesa, Z.E. (1997). Rural agricultural radio in Nigeria: An overview of the National Agricultural Extension and Research Liaison Service (NAERLS) Farm broadcaster. *Journal of Agriculture Extension 3*(6): 74-81.

Opara, U.N. (2008). Agricultural information sources used by farmers in Imo State, Nigeria. *Journal of Information Development, 24 (4)* 289-295.

Osondu, C.K. and Ibezim, G.M.C (2015). Awareness and perception of farmers to the use of Information and Communication Technologies (ICTs) in agricultural extension service delivery: A Case study of Imo State, *Nigeria International Journal of Agriculture Innovations and Research* 4,(1); 55-60.

Ramli, S.A., Samah, B.A., Hassan, M.S., Omar, S.Z., Bolong, J., and Shaffri, H.A.M. (2015). Potential benefits of ICT for youth agro-based entrepreneurs in Malaysia. *Journal of Applied Sciences*, *15*(3): 411.

Sanga, C., and Mlozi, M.R.S., and Tumbo, S. (2016). Mobile learning bridging the gap in agricultural extension service delivery: Experiences from Sokoine University of Agriculture,Tanzania. *International Journal of Education and Development using Information and Communication Technology* (IJEDICT), *12*(3): 108-127.

Sanga, C., Mlozi, M.R.S., Tumbo, S., Mussa, M., Sheto, M.C. R., Mwamkinga, G.H., and Haug, R. (2013). On search for strategies to increase the coverage of agricultural extension service: Web-based farmers' advisory information system. *International Journal of Computing & ICT Research, 7* (1): 42-55.

Saunders, M., Lewis, P., and Thornhill, A. (2007) Research Methods for Business Students. 4th Edition, Financial Times Prentice Hall, Edinburgh Gate, Harlow 123pp.

Shanthya, M.S., and Elakkiya, S. (2017). Constraints encountered by famers in ICT utilization–an analysis. *International Journal of Agriculture Innovations and Research*, *6*(2): 2319-1473.

Syiem1, R., and Raj, S. (2015). Access and usage of ICTs for agriculture and rural development by the tribal farmers in Meghalaya State of North-East India. *Journal of Agricultural Informatics*, *6*(3):24-41.

Sirak, M., and Rice. J. C. (1994). Logistic regression: Advances in social science methodology, *13*: 191-245. Greenwich, CT: JAI Press.

Tarimo, B. R, and Sanga, C. (2017). Harnessing Multi-Stakeholders Involvement in Result Based Aquaculture (HASIRA) Extension Service in Tanzania. *International Journal of Information Communication Technologies and Human Development (IJICTHD) 9*(4): 98- 122.

Temba, B.A., Kajun, F.K, Pango, G.S., and Benard, R. (2016). Accessibility and use of information and communication tools among farmers for improving chicken production in Morogoro municipality, Tanzania. *Livestock Research for Rural Development, 28(1): 230- 241*. [http://www.lrrd.org/lrrd28/1/temb28011.html] visited on July 2018.

United Republic of Tanzania (URT) (2015). An overview of fisheries subsector in Tanzania: Achievements and challenges. Ministry of Livestock and Fisheries Development.16pp.

URT (2016a). Bank of Tanzania Annual Report 2015/16, Minister for Finance and Planning United Republic of Tanzania, Dar es salaam. 22pp.

URT (2016b). Challenges and opportunities in fishery sector, Ministry of livestock and fishery development, Dar es salaam.21pp.

URT (2012). National census of agriculture 2007/2008 small holder agriculture, Vol 3 Livestock sector national report, Ministry of Agriculture, Food Security 18pp.

URT (2018). Empowering extension officers' drive on cards, workshop. workshop held by Ministry of Livestock and Fisheries Development, aimed at empowering extension officers July 2018, Dodoma. 31pp.

Voh, J.P. (2002). Information sources and awareness of selected recommended farm practices: A case study of Kaduna State, Nigeria. *African Journal of Agricultural Science, 8* (1): 221- 232.

Walliman, N. (2011). Research methods the basics, New York: Taylor & Francis e-Library. 56pp.

CHAPTER SIX

6.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter gives a summary of the findings conclusions and recommendations based on the specific objectives of the study**.**

6.1 Summary of Major Results and Conclusions

This study analysed the use of ICTs in enhancing information sharing for improved fish farming productivity in the Southern Highlands of Tanzania. The study had four specific objectives which were 1) establishing the information needs and information accessibility among fish farmers in the study area, 2) analysing the influence of ICTs usage in sharing agricultural information on fish farming productivity in the Southern Highlands of Tanzania, 3) examining the determinants of ICTs usage in sharing agricultural information among fish farmers in Tanzania, and 4) determining the challenges facing fish farmers in the use of ICTs in sharing agricultural information and suggesting possible strategies for overcoming the challenges. Thus, four manuscripts have been prepared from the study each of which is based on a specific objective and each manuscript or article is a Chapter in this thesis.

6.1.1 Information needs and accessibility by fish farmers in the study area

The findings of the information needs and information accessibility among fish farmers were discussed in Chapter Two and were based on Objective One. The findings indicated that fish farmers highly needed information related to water quality management, feeding practices and fish processing and preservation. However, it was found that access to these categories of information was very low. Also, results from multiple linear regression indicated that age, education and income had a statistical significance and

positive relationship with farmers' information needs at $p < 0.05$. Additionally, age, amount of fish harvested, education and farming experience had statistical significance and negative relationship with farmer's information accessibility at $p < 0.05$.

Based on these findings, it is concluded that fish farmers' information needs are centered around fish pond management practices. Furthermore, it can be concluded that fish farmer's ability to fulfill and access information depends on their age, level of education, amount of fish harvested, farming experience and income level. For instance, educated farmers can have ability and chance to search, evaluate and consult different information sources compared to less educated farmers, and hence their information needs and accessibility may differ in such aspects.

6.1.2 The Influence of ICTs use in sharing agricultural information on fish farming productivity

Chapter Three, which is based on Objective Two, analysed the influence of ICTs use in sharing agricultural information on fish farming productivity. The findings revealed, among the three ICTs studied, the mobile phones were the most frequently used by farmers in communicating and sharing information. Moreover, the results from multiple regression model showed that the frequency of using the ICTs in sharing information had positive and statistically significant ($p<0.05$) influence on fish farming productivity. Thus, from these results, it can be concluded that the more the frequency the farmers use the ICTs in accessing agricultural information on fish farming technologies the more they can be informed on fish farming, and thus the more they can increase their fish farming productivity.

6.1.3 The Determinants of the of ICTs Usage in Sharing Agricultural Information among Fish Farmers

Chapter Four is based on the third objective. In this chapter factors influencing the use of ICTs in sharing agricultural information among fish farmers in the Southern Highlands of Tanzania were assessed. Specifically, it assessed the attitude of fish farmers towards ICTs usage and examined fish farmers' perceived easiness and perceived usefulness of ICTs usage.

The findings revealed that fish farmers had positive attitude towards the use of mobile phones, radio and television in sharing information. Likewise, the results showed that fish farmers had high and medium perceptions on usefulness of mobile phones, radio and television. It was also found that fish farmers had high, medium and low perceptions on easiness of mobile phones, radios and television. Moreover, findings from ordinal regression model indicated that income, perceived ease of use, quantity of fish produced, attitude, household size, radio ownership and perceived usefulness had significant influence at $p<0.05$ and positively related to the use of mobile phones, radios and television.

Based on the above findings, it is concluded that fish farmers' attitude is very positive toward using radio, television and mobile phones in sharing information thus contributing to improved fish farming practices and inturn increasing fish farming productivity. It can also be concluded that the extent of ICTs usage by fish farmers depends much on the income level of a farmer, easiness of on ICT operation, usefulness of the ICTs to farmer, how the farmer feels (attitude) about a given ICT tool, and productivity level of the farmer.

6. 1.4 Challenges associated with the use of Information and Communication Technologies in Information sharing among fish farmers.

Findings indicated that the major challenges facing fish farmers in sharing information include unfavorable radio and or television broadcasting time, high cost of acquiring and maintenance of ICTs facilities, lack of training on ICTs, poor network connectivity and low levels of literacy. Moreover, findings showed that there was negative significant relationship ($p<0.05$) between challenges associated with ICT usage in sharing agricultural information and degree of actual ICTs usage by fish farmers.

It is therefore concluded that fish farmers face several challenges in using ICTs for sharing various fish farming information. These challenges affect negatively the extent of ICTs usage among fish farmers in sharing agricultural information and may lead to poor pond management practices and low fish farming productivity.

6.2 Recommendations

Based on the conclusions of this study, the following recommendations are forwarded:

i. For enhancing provision of adequate, accessible, relevant and current information to fish farmers' information services providers like Government through fisheries extension officers, private institutions, and NGOs should conduct regular assessments of fish farmers' information needs and enhance timely accessibility of needed information.

ii. Media owners in collaboration with the department of extension services in the Ministry of Livestock and Fisheries Development and other information providers should broadcast more agricultural programmes that focus on farmers' information needs both from radio and television and should make sure that the

programmes are broadcasted on appropriate and convenient times especially during evening hours as proposed by most farmers

iii. The Government through the Ministry of Livestock and Fisheries Development, NGOs and other related private organisations should also consider the aspect of ICTs usage in sharing information among fish farmers as one of the strategies for strengthening fish farming productivity in Tanzania.

iv. Since ICTs usage has influence on fish farming productivity, the government ,through the Ministry of Energy and Minerals, should facilitate more rural electrification so that more fish farmers can use ICT tools because they are power dependant.

v. Likewise, there is a need for the Government via the Ministry of Information, Culture, Arts and Sports, Ministry of Livestock and Fisheries Development, NGOs, researchers and policy makers to consider establishing call centers and community FM radio stations in the Southern Highlands regions of Tanzania to encourage sharing of agricultural information on fish production.

vi. Responsible organs like research institutions, policy makers and information providers should make sure that behavioural factors that motivate individual farmers in different communities to accept the use of any ICTs are considered prior to introduction of the technology. This could assist responsible organs to design the ICT model that are relevant to fish farmers' needs

vii. The Government, NGOs and other related private organisations should establish more ICT infrastructure for enhanced TV, mobile and radio network connectivity and invest more in rural areas to promote their usage. Also, the government should subside the cost of acquiring the ICT equipment so that more farmers can afford to own and use it.

6.3 Contribution of the Study to the Body of Knowledge

This study contributes to the existing literature that fish farmers' information needs are centered on fish pond management practices. Likewise, fish farmer's ability to fulfill and access information related to different fish farming technologies depends on farming experience, level of education, age and income level and amount of fish harvested. This information is important for policy makers to develop and design agricultural policies and fish farmers' training guide that focuses on need-based and user-oriented information infrastructure in fish farming.

In addition, this study contributes to the existing literature that frequent use of ICTs in sharing information related to fish farming technologies contributes to fish farming productivity. Thus, the knowledge gap on linkage between ICT usage and fish farming productivity, that was not aired by previous studies, is addressed by the current study. Knowing this gap will help policy makers, fish farmers and local communities and other aquaculture stakeholders to be aware of the potentials of utilising ICTs for improved fish farming productivity. The study endeavoured also to contribute to the knowledge gap that the use of ICTs in sharing information has empirically been proved to vary by perceived easiness of ICT use, income level of a farmer, perceived usefulness of the ICTs by farmer's attitude and productivity level of the farmer. Thus, understanding these factors will assist in the development of strategies that promote ICTs usage in information sharing, in designing relevant farmer's information systems and consequently in improving fish farming productivity.

Furthermore, this study contributes to the existing literature that fish farmers face several challenges in using mobile phones, radios and television in sharing various fish farming information, and these challenges affect negatively the extent of ICTs usage among fish farmers. Through this it will help to create awareness among the responsible organs on

the challenges facing fish farmers with regard to the use of ICTs in sharing information and be able to provide relevant solutions to the problems.

Theoretically, the study contributes to the TAM theory in that the perceived usefulness, attitude and perceived easiness directly influence the actual use of ICTs while according to the theory, this is only possible with mediation of behavioural intention to use them. Thus, from these findings, it is suggested that any scholar attempting to conduct a similar study should include these factors. Also, the study has further shown that not only the perceived usefulness, attitude and perceived easiness directly measure the actual use of ICTs but also the socio-economic factors measure the actual use of the ICTs something contrary to the TAM. Thus, with these statements, the study findings have offered empirical and theoretical evidences and explanations on different factors or issues influencing the actual use of ICTs and consequently improving or increasing fish farming productivity.

6.4 Suggested Areas for Further Research

There is a need to conduct further research on assessing gender aspects of ICTs use in information sharing among fish farmers in Tanzania. This study may help to create an understanding on issues related to the use of ICTs in accessing agricultural information and consequently improving fish farming productivity. Additionally, further research is needed on assessing the effectiveness and usability of mobile phone applications particularly WhatsApp on information sharing among fish farmers. Likewise, even though the study assessed the level of ICTs use in information sharing among fish farmers, the degree of farmers' satisfaction on aired radio and television programmes on fish farming was not established, hence creating another area for further research in this aspect may be useful in designing appropriate fish farming radio and television programmes

APPENDICES

Appendix 1: A copy of fish farmers questionnaire used in the research

SOKOINE UNIVERSITY OF AGRICULTURE

COLLEGE OF SOCIAL SCIENCES AND HUMANITIES
DEPARTMENT OF DEVELOPMENT STUDIES, P. O. BOX 3024, MOROGORO

A fish farmers questionnaire for a PhD Research on

Using Information and Communication Technologies to enhance information sharing for improved fish farming productivity in Tanzania

by

Ronald Benard, PhD Student

I am Benard Ronald, a PhD student at the Sokoine University of Agriculture doing research on:.**Using Information and Communication Technologies to enhance information sharing for improved fish farming productivity in Tanzania.** I would appreciate it if you could spare a few minutes for an interview with you. The information provided will be treated confidentially and your name will not be mentioned.

SECTION A: GENERAL INFORMATION

1. District Name ……..
2. Division Name…….....
3. Ward Name …….....
4. Village Name……

SECTION B: SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENT

5. Sex of respondent **(Please tick the appropriate response)**

	Sex	**Response**
1	Male	
2	Female	

6. Age in years……..
7. How many members are you in your family?

8. Marital Status. **(Please tick the appropriate response)**

	Marital status	**Response**
1	Single	
2	Married	
3	Divorced	
4	Separated	
5	Widowed	

9. Level of Education (**Please tick the appropriate response)**

	Level of Education	**Response**
1No formal education		
2	Primary education	
3	Secondary education	
4	Tertiary education	
5	Other, Please specify……..	

10. What was your average income (TZS) for the last 12 months?
11. Do you use electrical power in your house ?1= YES, 2= NO
12. If yes, what source power do you use in your house ? **(Please circle the appropriate response)**
    1= Electrical from TANESCO, 2= Solar power, 3= Generator, 4= Biogas, 5= Dry cells, 6= others, specify please……

13. For how long have you been involved on fish farming activities (in years)

14. Are you a member of a fish farming group/cooperative/ associations? **(Please circle the appropriate response)**
    1. Yes 2. No

SECTION C: FISH FARMING PRODUCTIVITY

15. Which source of water do you use in fish farming activities? **(Please tick all responses that apply)** ?

	Source of water	**Response**
1	Spring	
2	Rivers	
3	Underground water	
4	Others (please specify).....	

16. What is the status of water availability from your sources above? **Please circle the appropriate response)**
    1. Permanent
    2. Seasonal

17. How many numbers of fish ponds do you own?.....

18. What are the types of your ponds? **(Please tick all responses that apply)**

	Types of fish pond	**Response**
1	Earthen ponds	
2	Concrete ponds	
3	Tank ponds	

Put your response by filling in the space provided

19. What is the size of your pond? (m^2).....

20. How many Kilograms of fish do you harvest per hectare per year ?

21. How do you measure the amount mentioned above?

22. What do you normally do with the harvested fish?

1= Sold, 2= Consumed, 3= Both sold and consumed

23. How many times do you harvest per year?

24. How many numbers of fingerings have you stocked per unit pond area?.....

25. What are the sources of your fish seeds (fingerings) ?**(Please tick all responses that apply)**

	Sources of fish seeds	**Response**
1	Traders	
2	Own farm pond	
3	Other farmers/neighbours	
4	Government farm	
5	Wild waters (streams/ rivers)	
6	Others (please specify).....	

26. What is your source of labour in fish farming practices? **(Please tick all responses that apply)**

	Sources of labour	**Response**
1	Hired	
2	Self	
3	Family members	
4	Others (please specify).....	

27. How many times do you feed your fish? 1= once a day, 2= twice a day, 3=, thrice a day, twice per week

28. What type of feed do you normally feed your fish? 1= Grains, 2=, vegetables, 3= fish meal, 4= kitchen waste, 5= Brains, 6=, Cakes, 7=,Natural food in ponds, 8=, other byproducts

29. What type of fertiliser do you use? 1=, Pig manure, 2=, Poultry manure, 3=Goat /sheep manure, 4-= compost manure,5= Cattle manure, 6= compost manure, 7= other please specify……

30. DO you practice fish production management practices in your fish farming?

1= Yes, 2= No

31. If yes, please rank the means below according to your frequency ofpracticing of fish production management practice. Identify your frequency **1= everydays/week, 2= 1-3 days/week, 3=, 1-3 days per month, 4= twice a year and 5= Never**

	Types of fish production management practices	**Frequency of use**				
		1	2	3	4	5
1	Pond Fertilisation					
2	Water quality maintenance					
3	Weeding					
4	Liming					
5	Cleaning					
6	Disease control					
8	Water flushing					
9	Others (please specify).....					

32. Have you ever received any extension services?
1= Yes, 2= No

33. If Yes, how often did the extension agent vist your fish pond?
I Frequently II Seldom III Never

34. Are the extension services adequate for you?
1= Yes, 2= No

35. If no give reasons……..

36. A part from fish farming, what other types of agricultural activities do you practice?**(Please tick all responses that apply)**

	Types of agricultural activities	**Response**
1	Keeping animals	
2	Growing crops	
3	Others (please specify).....	

SECTION D: INFORMATION NEEDS OF FISH FARMERS

37. In your effort to improve on your fish farming activities do you need any information? **(Please circle the appropriate response)**
2 Yes 2. No

38. If Yes**,** how do you rate the degree of the information needed? Assign number to identify the degree of needed information **1= high , 2= moderate 3= low 4= Not at all**

	Types of information	Degree of needed information			
		1	2	3	4
1	Information on market situation				
2	Information on weather conditions				
3	Information on credit/ loans				
4	Information on stocking operation				
5	Pond construction				
6	Fish fingerling types/ sources				
7	Feed types and sources				
8	Fish disease prevention and treatment				
9	Fish pond fertilisation				
10	Fish harvesting				
11	Fish preservation and processing				
12	Water treatment (management)				
14	Feed formulation techn.and Fish feeding				
15	spawning operation				
16	Others please specify……..				

39. Have you tried to find this information in order to meet your needs? **(Please circle the appropriate response)**

1. Yes 2. No

40. If your answer to question 34 is "No" please give reasons

……
……

Please rate the accessibility to needed Information on the question (33) above. Assign number to identify the accessibility of needed information **1= highly accessible, 2= accessible 3= moderately accessible 4= Not accessible**

Types of information	Accessibility of needed information			
	1	2	3	4
Information on Market situation				
Information on Weather conditions				
Information on credit/ loans				
Information on Stocking operation				
Pond Construction				
Fish Fingerling types/ sources				
Feed types and sources				
Fish disease prevention and treatment				
Fish pond fertilisation				
Fish harvesting				
Fish preservation and processing				
Water treatment (management)				
Feed formulation techn.and Fish feeding				
spawning operation				
Others please specify……..				

41. There has been various modern fish production technologies/ innovations/ meant for solving fish farming problems and improving fish farming practices for example floating feeds (Pellets), Sex reversal methods (hormones), use of homestead fish tanks, induced breeding, etc. Are you aware of any of the above? **(Please circle the appropriate response)**

1. Yes 2. No

42. If Yes which one are you aware of **(Please tick all that are appropriate)**

	Fish production technologies/ innovations	**Response**
1	Floating feeds (Pellets)	
2	Sex reversal methods (hormones)	
3	Use of homestead fish tanks	
4	Induced breeding	

43. How did you get to know about the mentioned modern fish production technologies above? **(Please tick all that are appropriate)**

	Source of information	**Response**
1	Listen to radio programmes	
2	Watching TV programmes	
3	Through mobile phones communication	
4	Through agriculture extension staff	
5	Through talking to relatives	
6	Others (please specify) ……...	

SECTION E: EXTENT OF THE USE OF ICTs IN SHARING AGRICULTURAL INFORMATION

44. How many of the following ICTs do you or any other colleague in your household

own? (Give *the number of each ICT facilitates*)

	Types of ICTs	**Number**
1	Radio	
2	Mobile phone	
3	Television	
4	Internet/computer	
5	Other (please specify).....	

45. Rate the availability of the following ICT tools in your area

1= Easily available, 2= moderate available 3= Hardly available 4= Unavailable

	Types of ICTs	**Availability**			
		1	2	3	4
1	Radio				
2	Mobile phone				
3	Television				
4	Internet/computer				
5	Others (please specify).....				

46. How do you rate the accessibility of the available ICTs mentioned above in your area that are used in sharing agricultural information? Assign number to identify the rate of accessibility to your applicable ICTs **1= highly accessible, 2= accessible 3= moderately accessible 4= Not accessible**

	Types of ICTs	**Accessibility**			
		1	2	3	4
1	Radio				
2	Mobile phone				
3	Television				
4	Internet/computer				
5	Others (please specify)				

47. Do you use such ICTs for sharing information on fish farming practices? **(Please circle the appropriate response)**

1. Yes 2. No

48. If yes, what are the main three types of ICTs that you use in sharing agricultural information **(*Check three main means)***

	Types of ICTs used for sharing agricultural information	**Response**
1	Radio	
2	Mobile phone	
3	Television	
4	Internet/computer	
5	Other (please specify).....	

49. If No, Please give reasons:

……..... ....

51. Please rank the means below according to your frequency of use of the mentioned ICTs above for sharing agricultural information by assigning numbers to identify your frequency **1= Very frequently, 2= Frequently, 3=, Occasionally, 4= Rarely, 5= Never**

	Types of ICTs used for sharing agricultural information	**Frequency of use**				
		1	2	3	4	5
1	Radio					
2	Mobile phone					
3	Television					
4	Internet/computer					
5	Others (please specify).....					

Key: *Very frequently = Hours and Daily, frequently =, three times a week and once a week, occasionally= Once a month, Rarely = once in three months, Never = Not using ICTs at all*

50. Do the ICTs mentioned above provide useful information on fish farming practices? (Please indicate usefulness of information acquired from each ICT by assigning numbers to identify your usefulness **1= Very usefully, 2= usefully, 3=, satisfactory and 4= not usefully)**

	Types of ICTs	**Usefulness of information**			
		1	2	3	4
1	Radio				
2	Mobile phone				
3	Television				
4	Internet/computer				
5	Others (please specify).....				

51. Are the information shared through the following ICTs relevant to your fish farming practices?

Indicate the relevant of information acquired from each ICT by assigning numbers to identify your relevancy 1**= Very relevant, 2= relevant, 3=, notrelevant)**

	Types of ICTs	**Relevancy of information**			
		1	2	3	4
1	Radio				
2	Mobile phone				
3	Television				
4	Internet/computer				
5	Others (please specify).....				

52. Which ICT do you prefer for sharing agricultural information on fish farming practices?Please rank the means below according to your preferences by assigning numbers to identify your preference **1= Most preferred, 2= Preferred, 3=, slightly preferred and 4= not preferred at all**

	Types of ICTs	**Preferences**			
		1	2	3	4
1	Radio				
2	Mobile phone				
3	Television				
4	Internet/computer				
5	Others (please specify).....				

53. 46. At what time do you prefer to listen/ watching television programmmes related to agricultural information?

1=Early morning 2=Afternoon 3=Evening 4= Night

54. How do you receive or send agricultural information on fish farming through mobile phones?

1= SMS 2= WhatsApp 3= Voice call 4= Others, please specify…….

55. A part from ICTs what other sources of information do younormally use for sharing agricultural information on fish farming ?

……
……
……
……

SECTION E: FACTORS INFLUENCING THE USAGE OF ICTS IN SHARING AGRICULTURAL INFORMATION.

PERCEIVED USEFULNESS about the usage of mobile phones in sharing agricultural information

56. To what extent do you agree or disagree with the following statements regarding your expected usefulness of using mobile phones in sharing agricultural information, Key: **1= strongly agree; 2= Agree ; 3= Disagree; 4= Strongly disagree; 5= Neutral** (Please tick the most appropriate option for each statement below)

	Perceived Usefulness	**Responses**				
		1	2	3	4	5
1	Using the mobile phones enables me to share information related to my fish farming activities more quickly.					
2	Using the mobile phones enhanced my effectiveness in farming pratices.					
3	Using the mobile phones enhances the quality of my farming practices.					
4	I find the mobile phones useful in sharing information in my farming activities.					

PERCEIVED EASE OF USE about using the mobile phones.

57. To what extent do you agree or disagree with the following statements regarding your expected difficulty or ease of using mobile phones in sharing agricultural information, Key: **1= strongly agree; 2= Agree ; 3= Disagree; 4= Strongly disagree; 5= Neutral (Please tick the most appropriate option for each statement below)**

	Perceived Easy of Use	**Responses**				
		1	2	3	4	5
1	Learning to use the mobile phones is easy for me					
2	I find it user-friendly the mobile phones to do what I want to do in my fish farming practices					
3	I find it easy for me to become skilful in using the mobile phones in sharing information					
4	I find the mobile phones user-friendly in sharing informationabout my farming activities					

58. To what extent do you agree or disagree with the following statements regarding your attitude toward mobiles phones in sharing agricultural information, Key: **1= strongly agree; 2= Agree ; 3= Disagree; 4= Strongly disagree; 5=Neutral (Please tick the most appropriate option for each statement below)**

	Attitude toward Mobile Phones	**Responses**				
		1	2	3	4	5
1	Use mobile phones in sharing agricultural information would make my farming activities more interested					
2	Use of mobile phones in sharing agricultural information is good idea					
3	I have a generally favorable attitude toward using the mobile phones in sharing agricultural information					
4	Use of mobiles phones for sharing agricultural information is easy for me					
5	You can notreceived and share timely agricultural information through mobile phone.					
6	I have a generally negative attitude toward using mobile phone in receiving and sharing agricultural information					
7	Mobile phone is not user friend technology for receiving and sharing agricultural information					
8	It is difficult to access and share agricultural information through mobile phone					

PERCEIVED USEFULNESS about the usage of radio in sharing agricultural information

59. To what extent do you agree or disagree with the following statements regarding usefulness of using radio in sharing agricultural information, Key: **1= strongly agree; 2= Agree; 3= Disagree; 4= Strongly disagree; 5= Neutral (Please tick the most appropriate option for each statement below)**

	Usefulness of Radio in Sharing Agricultural Information	**Responses**				
		1	2	3	4	5
1	Listening radio enables me to share information related to my fish farming activities more quickly.					
2	By listening fish farming related programmes from the radio improve my fish farming Productivity (by saving money and making more money)					
3	Radio enhances the quality of my farming practices					
4	I find the radio useful in sharing information in my farming activities					

PERCEIVED EASE OF USE about using the radio.

60. To what extent do you agree or disagree with the following statements regarding your expected difficulty or ease of using radio in sharing agricultural information, Key: **1= strongly agree; 2= Agree ; 3= Disagree; 4= Strongly disagree; 5= Neutral (Please tick the most appropriate option for each statement below)**

	Perceived Easy of Use	**Responses**				
		1	2	3	4	5
1	Learning to use the radio is easy for me					
2	I find it user-friendly the radio to do what I want to do in my fish farming practices					
3	I find it easy for me to become skillful in using the radio in sharing information					
4	I find the radio user-friendly in sharing information about my farming activities					

61. To what extent do you agree or disagree with the following statements regarding your attitude toward radio in sharing agricultural information, Key: **1= strongly agree; 2= Agree ; 3= Disagree; 4= Strongly disagree; 5= Neutral (Please tick the most appropriate option for each statement below)**

	Attitudes toward Radio in sharing Agricultural Information	**Responses**				
		1	2	3	4	5
1	Use radio in sharing agricultural information would make my farming activities more interested					
2	Use of radio in sharing agricultural information is good idea					
3	I have a generally favorable attitude toward using the radio in sharing agricultural information					
4	Use of radio for sharing agricultural information is easy for me					
5	You can not access timely and relevant agricultural information through radio					
6	I have a generally negative attitude toward using the radio in sharing agricultural information					
7	It is difficult to access and share agricultural information through radio					
8	Radio is not user friendly in sharing agricultural information					

PERCEIVED USEFULNESS about the usage of radio in sharing agricultural information

62. To what extent do you agree or disagree with the following statements regarding usefulness of using television in sharing agricultural information, Key: **1= strongly agree; 2= Agree ; 3= Disagree; 4= Strongly disagree; 5= Neutral (Please tick the most appropriate option for each statement below)**

	Usefulness of Television in Sharing Agricultural Information	**Responses**				
		1	2	3	4	5
1	Watching the television programmes enables me to share information related to my fish farming activities more quickly					
2	Watching television programme related to farming activities improve my fish farming Productivity (by saving money and making more money)					
3	Watching television fish farming programmes enhances the quality of my farming practices					
4	I find the television useful in sharing information in my farming activities					

PERCEIVED EASE OF USE about using the television

63. To what extent do you agree or disagree with the following statements regarding your expected difficulty or ease of using television in sharing agricultural information, Key: **1= strongly agree; 2= Agree ; 3= Disagree; 4= Strongly disagree; 5= I don't know (Please tick the most appropriate option for each statement below)**

	Perceived Easy of Use	**Responses**				
		1	2	3	4	5
1	Learning to use the television is easy for me					
2	I find it user-friendly the television to do what I want to do in my fish farming practices					
3	I find it easy for me to become skillful in using the television in sharing information					
4	I find the television user-friendly in sharing information in my farming activities					

64. To what extent do you agree or disagree with the following statements regarding your attitude toward television in sharing agricultural information, Key: **1= strongly agree; 2= Agree ; 3= Disagree; 4= Strongly disagree; 5= Neutral (Please tick the most appropriate option for each statement below)**

	Attitudes toward television in sharing Agricultural Information	**Responses**				
		1	2	3	4	5
1	Usetelevision in sharing agricultural information would make my farming activities more interested					
2	Use of television in sharing agricultural information is good idea					
3	I have a generally favorable attitude toward using the television in sharing agricultural information					
4	Use of television for sharing agricultural information is easy for me					
5	It is difficult to access and share agricultural information through television					
6	You can not access timely and relevant agricultural information through television					
7	I have a generally negative attitude toward using the television in sharing agricultural information					
8	Television is not user friendly in sharing agricultural information					

SECTION G: CHALLENGES FACING FISH FARMERS ON THE USE OF ICTS IN SHARING AGRICULTURAL INFORMATION

65. Do you face any challenges when using radio, television, mobile phones and other ICTs?

in sharing agricultural information?**(Please circle the appropriate response)**

1. Yes
2. No

66. If yes, tick the appropriate problem and indicate the magnitude of the problems from each ICT by assigning numbers to identify problem magnitude**1= major problem , 2= moderate, 3=, low and 4= not at all ((Please tick all that apply)**

	Challenges facing fish farmers	**magnitude of the problems**			
		1	2	3	4
1	Low levels of literacy				
2	High cost of acquiring and maintenance of ICTs facilities				
3	Inadequate technical knowhow				
4	Lack of internet access in rural areas				
5	Irrelevant content				

	Challenges facing fish farmers	**magnitude of the problems**			
		1	2	3	4
6	Lack of training on ICT				
7	poor network connectivity				
8	Lack of awareness on the use of ICTs for accessing agricultural information				
9	Lack of regular power supply				
10	Lack of access to ICTs				
11	Unfavourable radio/ television broadcasting time				
12	Others (please specify).....				

67. What strategies do you use to overcome such challenges? (Please explain……
……
…….....
.....
……

68. In your opinion what should be done in order to meet your information needs through use of Radio,television and mobile phones?.....
.....
.....

THANK YOU FOR YOUR COOPERATION

Appendix 2: Focus Group Discussion Guide

Using Information and Communication Technologies to enhance information sharing for improved fish farming productivity in Tanzania

Focus Group Discussion Guide for fish Farmers

1. Do you use information in your daily fish farming activities? If yes what kinds of information do you normally need to run your fish farming activities?
2. Generaly, what are your fish farming production level per year
3. What types of ICTs available in your area?
4. Which ICTs mentioned above do you use for sharing agricultural information?
5. Which ICTs do you prefer most for sharing agricultural information on fish farming practices? Give reasons
6. Do the ICTs mentioned above provide useful information on fish farming practices?
   1=Yes, 2= No
7. If no, give reasons
8. Is there any significant changes in production by using the mentioned ICT in sharing fish farming information?
9. Is there any new fish farming technologies acquired from using ICTs ?
10. Are the information shared through the following ICTs relevant information to your fish farming practices?
    1=Yes, 2= No
11. If no, give reasons
12. What are your opnion on the use of ICTs in sharing agricultural information?
13. What are the challenges facing you in use of ICTs for sharing agricultural information?
14. In your opinion what strategy (ies) can be used to overcome those challenges?
13. In your opinion what should be done in order to meet your information needs through the use of ICTs

Thank you for your time and input

Appendix 3: A copy of key Informant Interview Guide

Using Information and Communication Technologies to enhance information sharing for improved fish farming productivity in Tanzania.

Key Informants Interview Guide

1. Sex (Please tick the applicable)
   1. Male 2. Female
2. Education qualification
   1=Certificate
   2=Diploma
   3=Graduate
   4 =Postgraduate
   5 = Other, Please specify……
3. How long have you held this job?
   1=Under 2 years
   2=3- 4 years
   3=5- 6 years
   4=6 years and above
4. What kind of information do farmers ask to run their fish farming activities in your District?
5. How frequently do you visit fish farmers?
6. Are you getting any challenges in visiting farmer?
   1= Yes, 2= NO
   If yes what are the challenges ?
7. What existing types of ICTs are available in your District?
8. What ICTs mentioned above do you use to share/communicate agricultural information to fish farmers in your District?
9. Which ICTs do you prefer most for sharing/communicating agricultural information to fish farmers? Give reasons
10. In your opnion, do you think that use of ICTs for enhancing sharing agricultural information by fish farmers can have effect on their fish farming productivity?
    1=Yes, 2= No
    If yes, how?
11. If no, give reasons
12. What challenges/ problems do you face when sharing /communicating information to fish farmers through using of ICTs? Please explain

13. What do you think are the possible strategies for overcoming these challenges?
14. In your own words what should be done to enhance ICTs use in sharing agricultural information for improved fish farming productivity?

Any other comments:

Thank you for your time and input