The sub Saharan Journal of Social Sciences and Humanities (SJSSH)
ISSN: 2619-8894 (Online), 2619- 8851 (Print)

Determinants of Information and Communication Technology Use in sharing Information by Fish Farmers in the Southern Highlands of Tanzania

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Received: February 13, 2019; **Accepted:** December 12, 2019; **Published:** June 15, 2021

Abstract: *Understanding the determinants of information and communication technologies (ICT) usage in fish farming is very important; as it enables development of strategies that promote ICT usage in sharing information on different fish farming technologies. Very little empirical evidence exists on having studies conducted in Tanzania which have assessed how the combination of socio-economic factors and other factors particularly farmers' attitudes, and perceptions on perceived usefulness and easiness in the usage of ICTs among farmers. A cross sectional study was conducted in twelve purposively selected divisions in Ruvuma, Mbeya and Iringa . Both quantitative and qualitative data were collected from 240 randomly selected fish farmers. Questionnaires, Focus Group Discussions (FGDs), observation and key informants interviews were used to collect data. Descriptive and inferential statistics were used to analyse quantitative data; while content analysis was employed to analyse qualitative data. Findings show that fish farmers had positive attitudes toward the use of mobile phones, radio and television in sharing agricultural information. Likewise results show that fish farmers had high and medium perceptions on usefulness of mobile phones, radios and television. Perceived usefulness was reported high for mobile phones by 175 (72.9%) of farmers and radio and TV were reported medium by 124 (51.7%) and 120 (50.0%) respectively. Furthermore, the findings indicated that income, perceived ease of use, quantity of fish produced, attitudes, household size, radio ownership and perceived usefulness were significant at $p<0.05$ and positively related to the use of mobile phones, radios and television. It can plausibly be concluded that fish farmers in the study area have a positive attitude and perceptions in the use of ICTs for sharing information related to fish farming. Based on the findings from this study, it is recommended that stakeholders like research institutions, policy makers and information providers should make sure that they incorporate ICTs use in sharing fish farming information among farmers and should motivate individual farmers in the use of such ICTs.*

Keywords: ICTs, agricultural information, aquaculture, fish farming.

1.0 Introduction

In aquaculture field, information plays an important role in determining extent of fish farming productivity. This is due to the fact that 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. In addition, access to information on fish farming opens windows for sharing best farming practices, ideas, experiences, market prices and new markets (Soyemi and Haliso, 2015). Obviously, fish farmers need to be updated with different information in order to improve their fish farming management practices for improved productivity. Scholars Ofuoku, *et al.*, 2008; Adefalu *et al.*, *2013;* Ijatuyi *et al.*, 2016) 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 at the right time. Olaniyi (2013) asserts that one of the ways to improve production in fish farming is through provision of right information via 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 sharing 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). Rajoria *et al.*, (2017) claims that traditional methods of extension approaches have been regarded as less accountable, and ineffective in terms of time management, larger audience coverage and greater impression on people. Nevertheless, these approaches have been inhibited by inadequate extension capacity. It is reported (URT, 2015) that there are only 436 fisheries extension officers in Tanzania; far below the requirement of the country which stands at 16,000. Among others, such a challenge has been affecting dissemination of information

and knowledge to fish farmers (Yaseen *et al.*, 2015). 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. It also falls short in 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 fish extension officers. In this regard, Information and Communication Technologies (ICTs) have 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 share up-to-date information on fish prices, access to credit and training, and interact with other farmers. Aker (2010) claims that one promising area for agricultural extension to reach a significant proportion of farmers is to use a combination of various ICT tools such as mobile telephones, innovative community radios and television programmes.

Through ICTs, fish farmers can access information and reduce the cost of communicating and disseminating information. Unlike the traditional agricultural information dissemination methods, ICT tools have been offering a cheaper way of communicating and sharing knowledge and information to fish farmers within a shortest period of time. In addition, Matuha (2015) claims that ICTs can be used in aquaculture to assist in creating possibilities to solve challenges faced by fish farmers. This can be done 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 improvement of fish farming production can be realised through improving capacity in terms of enhancing access to information which can be achieved through enhanced information seeking behaviour by the use of ICTs. Obviously, this potential of ICTs use in sharing information to fish farmers can only be realised, if farmers are able and willing to use it.

Scholars (Mwombe *et al*., 2014; Jiriko *et al*., 2015; Soyemi *et al.*, 2015; Mittal and Mehar, 2016); argue that the ability and willingness of fish farmers to use ICTs tend to vary from an individual to another and demographic variables like age, gender, education, income, family size, farming experience, and marital status. Timothy *et al.* (2016) report poor access to electricity, high cost of inappropriate programme or content and illiteracy together with socio-demographic variables to 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 socio-economic or demographic factors influencing ICTs usage (Mwakaje, 2010; Nyamba and Mlozi, 2012; Mtega, 2016; Timothy *et al.*, 2016). Therefore, this study specifically determined the attitude of fish farmers toward ICTs usage, assessed fish farmers' perceived easiness and perceived usefulness of usage of ICTs, and, examined 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 ICTs 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.

2.0 Theoretical and Conceptual Framework

This study was guided by the Theory of Technology Acceptance Model (TAM) 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 two 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. Also, Davis (1989) further defines attitude as an individual's positive or negative feeling about performing the target behaviour.

TAM has been known to be the most influential and frequently tested model and is widely applied to explain general ICT acceptance and usage in the ICTs (Saga and Zmud, 1994; Ma and Liu, 2004; Jong-Ae, 2005). TAM describes how technology may be adopted and used to facilitate performance of a particular activity. Eventually, the TAM has been 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. The theory guided the study by showing the inter-relationship that exists between different variables. In short, beside the previously mentioned advantages of TAM, the model was selected because it provided the basis for selecting the variables that were used to answer the research objectives and questions of this study.

However, one of the weakness 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 toward the actual use of the system and with him this

is only possible with mediation of behaviour intention (Davis, 1989). Following this trend, the research model considered this weakness by omitting some of the factors and adding or incorporating some factors that might directly influence ICTs usage in information sharing. Thus, the research conceptual framework was built upon TAM. The literature was reviewed and modification of TAM was proposed to serve the study objectives and make it more relevant to the study of the determinants of ICTs use in sharing agricultural information by fish farmers 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 (Figure 1).

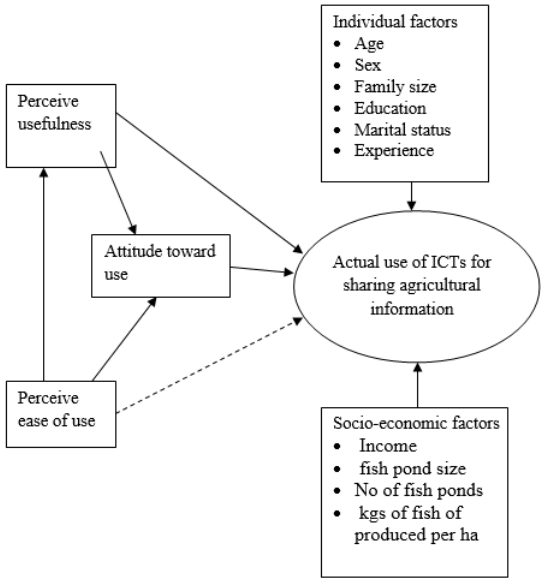

Figure 1: TAM adapted from Davis (1989)

3.0 Methodology

The study was carried out in the Southern Highlands of Tanzania, in regions namely Iringa, Mbeya and Ruvuma. The regions were chosen due to having relatively a big number of fish ponds and well developed ICTs infrastructures like electricity, radio, television cables and mobile networks coverage (Churi *et all*, 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 4,942 fish ponds in Ruvuma Region, 3,137 in Iringa Region and 1,176 Mbeya Region (URT, 2014).

3.1 Sampling procedure and sample size

In this study, the sampling frame included all individual fish farmers from twelve divisions in six districts, namely Mbeya City, 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. From each district, 20 fish farmers were randomly selected from two purposively selected divisions based on ownership of one or more kinds of ICTs. Twenty (20) fish farmers were selected from each division using simple random 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. Thus, a sample size of 20 from each division was thought to satisfy this requirement.

3.2 Methods of data collection

The study used both quantitative and qualitative approaches. A cross-sectional research design was employed to collect primary data 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 (Chen and Popovich 2002; Taherdoost, 2018). After pre-test, the questionnaire with both closed and open ended questions was modified and administered to 240 respondents using face- to -face interviews. 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. Davies *et al.,* (2008) posit that the FGD group size is usually between 6-12 people, but it can be as small as 4 people. Thus, the study adopted six participants as recommended. The farmers with five or more years of fish farming were thought to have experience in fish farming, had started to harvest fish and would more likely be able to own ICTs that have been beneficial in sharing fish farming information from extension officers and other stakeholders. 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 was also used as a tool for data collection to complement data collected through other techniques. It contained some issues like presence and use of ICT tools, ICT infrastructures, network cables, source of electricity used and status of fish ponds.

3.3 Data analysis

IBM-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 statements. Overall scores for perceived usefulness, easy to use and attitude were calculated by summing up responses for each farmer. The higher values indicated that a farmer perceived ICTs to be useful, user-friendly and have positive attitude toward using ICT devices for sharing agricultural information. Since the dependent variable was ordinally arranged, the ordinal logistic regression model was used to examine the determinants of ICT usage by fish farmers. 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 employed 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 1 to 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 – 1000 000, 2=1 000 001 – 1500 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.

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 was 0.760 for perceived usefulness, 0.794 for ease of use and 0.648 for attitude. Furthermore, a Cranach's α obtained for radio was 0.871 for perceived Usefulness, 0.955 for user-friendly and 0.655 for attitude. However, a Cranach's α obtained for television was 0.926 for perceived usefulness, 0.971 for user-friendliness and 0.644 for attitude.

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 and0.948 for mobile phone, radio and television respectively. 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 maximizing the variance of a column in the pattern matrix. Also, the data was suppressed at 0.4 factor loading.

4.0 Findings and Discussion

4.1 Socio- Demographics and economic characteristics of the respondents

The demographic and socio-economic characteristics of the fish farmers are summarised in Table 1. The study revealed that the majority of the fish farmers involved in the study 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) that the majority of fish farmers are males than females. Similarly, Table 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 primary school level of education. It was reported that the majority (87.9%) of the fish farmers were married (Table 5). Likewise, research findings indicate that the majority (72.9%) of the respondents had fish farming experience of up to five years (Table 5). 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 Tsh. 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 capita income of Tanzanian which is Tsh. 2,100,000/= per year (NBS, 2016).

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

Factors	Frequency	%
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
1000 001 – 1500,000	33	13.8
More than 1500,000	109	45.4
Farming experience(years)		
Up to 5	175	72.9
6 – 10	51	21.2
More than 10	14	5.8

Attitudes of Fish Farmers towards ICTs Use

Attitudes can be defined as an individual's positive or negative feeling about performing the target behaviour (in this case ICTs in sharing information). According to Manjula (2017), Results in Table 2 indicate that the majority of the respondents (88%) had a positive attitude towards mobile

phone use in sharing agricultural information. This implies that fish farmers had positive attitude towards mobile phone usage. The positive attitude towards mobile phone usage was also observed by the study of Manjula (2017) in India who recorded higher percentage of farmers who had positive attitude towards mobile phone use. This positive attitude could be explained by 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 from extension officers.

Furthermore, the study found that half of the respondents had positive attitude toward using radio in information sharing (Table 6). This means that fish farmers had a positive attitude toward ICTs usage in sharing information in different farming technologies. Lokeswari (2016) argues that a positive attitude on use of ICTs is very important component and requirement for any ICT usage. The positive attitude could be explained by its affordability, flexibility, easy language comprehension and its credibility in communicating timely, and relevant agricultural information to farmers. Results in Table 2 indicate that the majority (89%) of the respondents had a positive attitude toward television usage in sharing information on various fish farming technologies. The high attitude toward television is due to its credibility, relevance and timely information sharing to farmers.

Perceptions of Fish Farmers towards Usefulness of ICTs

Results in Table 6 show that the majority (73%) of the respondents had positive perceptions on usefulness of mobile phone. This implies that fish farmers perceived mobile as beneficial technology for sharing information on various fish farming technologies, and consequently enhancing their farming practices. This is in line with the results from a study by Kacharo (2016) which found that nearly all respondents (97%) agreeing on the usefulness of mobile phones for accessing agricultural information. Further results reveal that 52% of the respondents had relatively positive perceptions on usefulness of radio in sharing information. implying that, the fish farmers' perceptions on the usefulness of radio had association with its usage, that is, those who perceive it to be useful are eager to use it more that those who perceive it to be useless. Also, the study found that half (50%) of the respondents had relatively positive perceptions on the usefulness of television in sharing information. This implies that farmers perceived television as a beneficial ICT tool in sharing information related to different fish farming practices. Manjulla (2017) claimsthat perceived usefulness is a very important construct in determining farmer's attitudes toward using ICT tools.

Perceptions of Fish Farmers on the Easiness of ICTs Use

The results show that more than half of the respondents (64%) had high level of perception on easiness of mobile phone usage.. The results are similar to what has been reported by Kacharo (2016) which indicated that nearly two-thirds (63%) of the respondents agreed that mobile phone technology being user-friendly in information sharing. Likewise, the study indicated that nearly half (48%) of the respondents had relatively positive perceptions on easiness of radio usage while almost similar proportion (47%) had relatively positive 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 negative perceptions on easiness of television usage while 46% had positive perceptions. This suggests that farmers perceived television as difficult technology to operate and use in sharing information (Table 2). During FGD in Hagati division in Mbeya districts, some farmers were complaining about some difficulties in television operations. 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'.

Table 2: Attitude and perceptions of fish farmers toward ICTs use (n=240)

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

Determinants of mobile phone usage in sharing agricultural information among fish farmers

In order to understand the determinants of ICTs usage, it was imperative to run the ordinal regression analysis. Understanding 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 analysis was used. The analysis was used to determine variables to be fitted into the ordinal regression equation, which were then subjected to the ordinal regression analysis. 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, perceived easiness of the mobile phone use and attitude towards 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 3). Thus, from the study results it is indicated that income, perceived easiness of use, perceived usefulness and use of electricity were significantly positive with use of mobile phone in the model ($p<0.05$).

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 annual income, increases usage of mobile phone by a factor of 1.12. 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 to communicate with my extension officer through WhatsApp."

Furthermore, the results revealed that perceived easiness 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 3). This signifies 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 a farmer finds mobile phone user-friendly, he/she is able to do what he/she wants to do and when he/she finds a mobile phone is cheap and beneficial in sharing information he/she will use it frequently. These results are in line with TAM (Davis *et al*.,1989) which postulates that, in a workplace environment, a system will be adopted if it is regarded as useful, irrespective of attitude provided that the use of the system is perceived to offer direct benefits to the user. Similarly, Manjula (2017) points out that when mobile applications are made userfriendly, simple and compatible with existing technologies, it would pave way to improving its usage. Also, Venkatesh *et al*., (2003) reports that perceived usefulness and easiness 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. This view is supported by Timothy *et al.* (2016) who claim that poor access to electricity can reduce the prospect of use of any ICT technologies.

Determinants of the radio usage in sharing agricultural information among fish farmers

In order to determine the determinants of radio usage in sharing agricultural information among fish farmers, it was imperative to carry out the extraction method of Principal Component Analysis. This was done in order to determine variables to be fitted into the ordinal regression equation, which were then subjected to the ordinal regression analysis. Out of 12 variables, only three variables were constructed and fitted into the ordinal regression equation. These three variables were perceived usefulness of the radio use, perceived easiness of the radio use and attitude toward the radio 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 3). 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 fish yield increased the usage of radio by a factor of 1.5. This could be 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 those farmers who use ICTs tools as sources of agricultural information are likely to have high banana 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 could be radio was user-friendly, affordable, and credible sources 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. This could be explained by the fact that farmers will prefer and enjoy using something which belongs to them rather than borrowing it from someone else, and this can influence its usage. Adegbidi *et al*. (2012) and Anselme et *al.(*2012) affirm the findings as they conclude that the more the farmers have their own mobile phones the more they call through it for their farming business.

Determinants of the television usage in sharing agricultural information among fish farmers

In order to determine the determinants of television usage in sharing agricultural information among fish farmers, it was imperative to carry out the extraction method of Principal Component Analysis. This was done in order to determine variables to be fitted into the ordinal regression equation, which were then subjected to the ordinal regression analysis. 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 3). 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.

Furthermore, findings in Table 3 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.

Likewise, 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. This could be attributed by 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 farmer 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 to electricity had 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.

Furthermore, 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 7). This means that a unit increase in this household size increased the frequency of television watching by a factor of 1.08. This could be 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 (2016) reported that a big number of household members leads to increased exposure to information.

Table 3: 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=.726; Nagelkerke=.662; **For radio** Cox and Snell=.501; Nagelkerke=.555; For **television:** Cox and Snell= .648; Nagelkerke=.696

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 toward 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 can 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:
- 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.
- 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.

- 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.
- 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.

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