SOKOINE UNIVERSITY OF AGRICULTURE

MASTER'S DISSERTATION

SMALLHOLDER FARMERS' DIGITAL LITERACY AND ACCESS TO AGRICULTURAL INFORMATION IN LUSHOTO AND KOROGWE DISTRICTS, TANZANIA

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Dissertation is submitted to Sokoine University of Agriculture in fulfilment of the requirements for the Master Degree of Arts in Project Management and Evaluation

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EXTENDED ABSTRACT

Information communication technology (ICT) offers developing countries' hope for speeding up agricultural development where livelihoods of the majority of rural households rely on agricultural production. However, for smallholder farmers to benefit,they need to be digitally literate. Therefore, the study assessed smallholder farmers' digital literacy and access to agricultural information in Lushoto and Korogwe Districts , Tanga Region. Specifically, it identified types of information accessed from social media and the internet, farmers' sources of agricultural information, farmers' digital literacy and reliability of the agricultural information accessed by smallholder farmers through social media and the internet. A cross-sectional research design was used whereby data were collected from 200 randomly selected smallholder farmers using a structured questionnaire, interviews and focus group discussions. Quantitative data were analysed using Statistical Package for the Social Science (SPSS) version 26 software whereby descriptive statistics (frequencies and percentage) were determined. Content analysis was used for qualitative data.The findings on farmers' sources of agricultural information show that more than a half of the respondents both male and female used relatives/neighbours (63.6%) and radio (72%) as their sources of agricultural information. Furthermore, on average less than a quarter (1 – 23.5%) of all the respondents accessed their agricultural information needs on improved seeds varieties, market, best farming methods, pest management, agricultural incentives, fertilizers and agricultural tools from social media and the internet. Chi-square test results showed that farmers were less likely to use social media and internet when searching for the above-mentioned agricultural information ($p \leq 0.05$). Binary logistic regression results showed that there was a high likelihood of smallholder farmers using social media and the internet to access information on improved seeds, agricultural incentives as well as fertilizers, and this was significant ($p \leq 0.05$). Furthermore, the study findings showed that the majority (72.5%) of the respondents were fairly digital literate based on the study's criteria of using the digital literacy Index (DLI) as presented in the methodology section. Findings further show that the rest fell under good (12%), very good (14.5%) and excellent digital literacy (1%). In addition, the majority (76.4%) of those with good and above digital literacy levels had secondary school level education and above. Furthermore,the findings showed that farmers' age was negatively and significantly ($p \leq 0.05$) associated with access to reliable agricultural information. Farmers' likelihood of accessing reliable agricultural information decreased with increase in age. This, suggests that older farmers' capability to search, understand, evaluate and effectively use of accessed information was lower than that of younger farmers. Additionally, binary logistic regression results showed that farmers' in Lushoto had higher digital literacy levels suggesting that they were more likely to use social media and the internet for their agricultural information needs compared to those in Korogwe District. In addition, they were able to evaluate and effectively use the searched information.The study findings further showed that about a tenth (11.5%) of the respondent's found unreliable agricultural information (i.e., fake manure and pesticide information). Besides, a few (8%) of the respondents believed that the social media and internet sources accessed were not reliable. It is, therefore, concluded that despite the challenges which smallholder farmers face in accessing agricultural extension services their use of ICT to curb the shortfall is still limited. In addition, the surveyed smallholder farmers' digital literacy was fair (satisfactory) suggesting a possibility of them being able to effectively use digital

resources in accessing reliable agricultural information in their daily agricultural practices. Thus, it is recommended that Korogwe and Lushoto District' governments should; through their ICT and agricultural departments, other interested agricultural sector stakeholders and development partners; promote farmers' digital literacy to instil the requisite skills for the search, understanding, evaluation and effective use of reliable agricultural information accessed through the social media and internet to enable farmers to properly use ICT in meeting their agricultural information needs from multiple sources, hence transformation of subsistence farming for farming households' well-being and food security at large.

IKISIRI KUU

Teknolojia ya habari na mawasiliano (TEHAMA) inatoa matumaini ya nchi zinazoendelea kuharakisha maendeleo ya kilimo katika nchi zinazoendelea ambapo maisha ya kaya nyingi za vijijini hutegemea uzalishaji wa kilimo. Hata hivyo, ili wakulima wadogo wanufaike wanahitaji kuwa na ujuzi wa kidijitali ili waweze kutumia TEHAMA ipasavyo katika shughuli zao za kila siku. Kwa hiyo, utafiti unatathmini ujuzi wa kidigitali wa wakulima wadogo na upatikanaji wa taarifa za kilimo katika wilaya za Lushoto na Korogwe, Mkoa wa Tanga. Hasa, inabainisha aina za taarifa zinazopatikana kutoka kwa mitandao ya kijamii na mtandao, vyanzo vya wakulima vya taarifa za kilimo, ujuzi wa kidijitali wa wakulima na kutegemewa kwa taarifa za kilimo zinazofikiwa na wakulima wadogo kupitia mitandao ya kijamii na mtandao. Muundo wa utafiti wa sehemu mbalimbali ulitumika ambapo data zilikusanywa kutoka kwa wakulima wadogo 200 waliochaguliwa bila mpangilio kwa kutumia dodoso, mahojiano na mijadala ya vikundi. Data ya kiasi ilichanganuliwa kwa kutumia Kifurushi cha Takwimu cha Programu ya Sayansi ya Jamii (SPSS) toleo la 26 ambapo takwimu za maelezo (masafa na, asilimia) zilibainishwa: uchanganuzi wa maudhui ulitumika kwa data ya ubora. Kwa ujumla, matokeo ya vyanzo vya taarifa za kilimo vya wakulima yanaonyesha kuwa zaidi ya nusu ya wahojiwa wanaume na wanawake walitumia ndugu/majirani (63.6%) na redio (72%) kama vyanzo vyao vya habari za kilimo. Zaidi ya hayo, kwa wastani chini ya robo (1 – 23.5%) ya wahojiwa wote walipata taarifa za kilimo kuhusu aina za mbegu bora, soko, mbinu bora za kilimo, udhibiti wa wadudu, motisha za kilimo, mbolea na zana za kilimo kutoka mitandao ya kijamii na mtandao. Kwa ujumla, matokeo mengine yanaonyesha kuwa wakulima wana uwezekano mdogo wa kutumia mitandao ya kijamii na intaneti wanapotafuta taarifa za kilimo zilizotajwa hapo juu ($p \leq 0.05$). Pia matokeo zaidi yanaonesha kuwa kulikuwa na uwezekano mkubwa wa wakulima wadogo kutumia mitandao ya kijamii na mtandao kupata taarifa kuhusu mbegu bora,motisha za kilimo pamoja na mbolea($p \leq 0.05$). Zaidi ya hayo, matokeo ya utafiti yanaonyesha kuwa (72.5%) ya wahojiwa walikuwa na ujuzi wa kidijitali wa kawaida(mdogo) kulingana na vigezo vya utafiti vya kutumia Kielezo cha ujuzi wa kidijitali (DLI) kama ilivyowasilishwa katika sehemu ya mbinu. Matokeo zaidi yanaonyesha kuwa waliosalia hawakuwa na matokeo mazuri (12%), wazuri sana (14.5%) na ujuzi bora wa kidijitali (1%). Zaidi ya hayo, wengi (76.4%) ya wale walio na viwango vya juu vya ujuzi wa kidijitali walikuwa na elimu kuanzia ya ngazi ya Sekondari na zaidi. Zaidi ya hayo, matokeo yanaonyesha kwamba umri wa wakulima kwa kiasi kikubwa ($p \leq 0.05$) ulihusishwa na upatikanaji wa taarifa za uhakika za kilimo. Kwa ujumla, uwezekano wa wakulima kupata taarifa za uhakika za kilimo ulipungua kutokana na ongezeko la umri. Zaidi ya hayo, matokeo zaidi yanaonesha wakulima wa Lushoto walikuwa na viwango vya juu vya ujuzi wa kidijitali vinavyopendekeza kuwa wana uwezekano mkubwa wa kutumia mitandao ya kijamii na mitandao mingine kwa mahitaji yao ya taarifa za kilimo ikilinganishwa na wale wa wilaya ya Korogwe. Kwa kuongeza, wana uwezo wa kutathmini na kutumia kwa ufanisi habari iliyotafutwa. Matokeo ya utafiti yanaonyesha zaidi kwamba karibu (11.5%) ya mhojiwa alipata taarifa za kilimo zisizotegemewa (yaani, samadi bandia na taarifa za dawa). Kando na hayo, wachache (8%) ya waliohojiwa waliamini mitandao ya kijamii na vyanzo vya mtandao vilivyofikiwa si vya kutegemewa. Hivyo basi inahitimishwa kuwa pamoja na changamoto zinazowakabili wakulima wadogo katika kupata huduma za ugani wa kilimo matumizi yao ya TEHAMA ili kukabiliana na upungufu huo bado ni mdogo. Aidha, ujuzi wa kidijitali wa wakulima wadogo uliofanyiwa utafiti

ulikuwa wa haki (wa kuridhisha) ukipendekeza uwezekano wa wao kuweza kutumia ipasavyo rasilimali za kidijitali katika kupata taarifa za uhakika za kilimo katika shughuli zao za kila siku za kilimo. Hivyo, inashauriwa kuwa uongozi wa Halmashauri za wilaya ya Lushoto na Korogwe kupitia idara zao za TEHAMA na kilimo, wadau wengine wa sekta ya kilimo na wadau wa maendeleo kukuza ujuzi wa kidigitali wa wakulima ili kuwajengea ujuzi unaohitajika katika utafutaji, uelewa, tathmini na matumizi bora ya kilimo cha uhakika. habari inayopatikana kupitia mitandao ya kijamii na mtandao.Hivyo, kuwawezesha wakulima kutumia ipasavyo TEHAMA katika kukidhi mahitaji yao ya taarifa za kilimo kutoka vyanzo vingi hivyo,kubadili kilimo cha kujikimu kuwa cha biashara kwa ustawi wa kaya za wakulima na kuwepo kwa chakula cha kutosha kwa ujumla.

DECLARATION

I, Joyce James, do hereby declare to the senate of Sokoine University of Agriculture that this dissertation is my own original work, and it has not been submitted for a degree award in any other institution.

…….. ……

Joyce James **Date**
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Dr. Justin Job Ringo **Date**
(Supervisor)

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Prof. Justin Kalisti Urassa **Date**
(Supervisor)

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DEDICATION

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AUTHOR CONTRIBUTION STATEMENT

The study's conception and design, data collection and analysis, findings and discussions, manuscript preparation, writing and publication verify that the author is merely held responsible.

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LIST OF ABBREVIATIONS

ASDP II	-	Agricultural Sector Development Programme Phase II
FDGs	-	Focus group discussions
KIIs	-	Key informant interviews
ICT	-	Information Communication Technology
SPSS	-	Statistical Package for the Social Science
SSA	-	Sub Saharan Africa
SDGs	-	Sustainable Development Goals
SLT	-	Social Learning Theory
LT	-	Loftus Theory
TDV	-	Tanzania Development Vision
TEHAMA	-	*Teknolojia ya Habari na Mawasiliano*
SUA	-	Sokoine University of Agriculture
PO-RALG	-	President Office, Regional Admiration and Local Government
RAS	-	Regional Administrative Secretary

CHAPTER ONE

1.0 General introduction

1.1 Background Information

It is well known that information and knowledge are the driving forces behind many different manufacturing sectors in today's global community (Mwantimwa, 2020). In efforts to transform the agricultural industry, agricultural knowledge and information are seen as essential resources and vital necessities (Evans, 2019). Generally, access to agricultural knowledge and information, among other reasons, can affect change and advance the agricultural industry by enabling smallholder farmers to make wise decisions about food production (Awazi and Tchamba, 2018). Therefore, digitalization offers remarkable opportunities for beneficial food production and trade, especially for smallholder farmers (FAO, 2020).

Globally,over 500 million smallholder farms made a considerable contribution to food supp ly and genetic diversity (Gray *et al*., 2018). However, due to poor digital literacy and inadequate telecommunications infrastructure, getting information to or from smallholder farmers in some regions has been difficult up until now, complicating access to inputs, markets, funding, and training (Klemer *et al*., 2021). Yet, the spread of mobile technology has given smallholder farmers around the world new options, which could speed up an agrarian revolution (Xie *et al*., 2021).

In Sub-Saharan Africa (SSA), smallholder farming is becoming more prominent in discussions of the digital economy (Abdulai, 2022). Generally, modern digital technologies have brought new opportunities among smallholder farmers for agricultural extension services (Mubofu and Elia, 2017). However, inadequate digital knowledge of smallholder farmers, insufficient investment in human capital development and infrastructure in rural areas became the main restrictions for access and the effective use of data (Mtega and Ngoepe, 2017). For example, radio is mostly used compared to other tools such as phones, computer, television due to more availability and affordability (Awadalla, 2019).

Tanzania's government over the years has made several efforts to promote the dissemination of agricultural information and knowledge to smallholder farmers in order to enhance their production. Among these, the establishment of the 2013 National ICT Policy and its review in 2016 that intended to change the agricultural sector from a subsistence to a commercialized one through increased use of ICT, sustainable ICT infrastructure that supports universal connection hence, easier access to agricultural information, expertise and e-trade operation (URT, 2016a).

Another initiative is the creation of community telecentres in places such as Lugoba, Mpwapwa, Ngara, Dakawa, Kilosa, Mtwara, and Kasulu to ensure smallholder farmers, particularly those with limited access to telecommunication services, had access to agricultural information and knowledge. In addition, the government trained extension officers and deployed them across the country to ensure smallholder farmers have access to accurate and timely agricultural information and knowledge for agricultural development. Nevertheless, despite the above mentioned initiatives there is limited access to agricultural expertise and other resources particularly in rural areas, mainly due to low digital knowledge among smallholder farmers hence, low productivity (Mwantimwa, 2020).

Furthermore, increased use of ICT in access to agricultural information is required through promoting digital literacy and equipping people with the ability to make proper agricultural production decisions. Doing so can lead to success in the agricultural sector(Mwantimwa, 2019).According to Mubofu and Elia (2016) appropriate access of agricultural information and knowledge is linked to success in any farming activity opportunities among smallholder farmers for agricultural extension services.Therefore, use of ICT to access agricultural information services has the potential to revolutionize agriculture and dramatically enhance the livelihoods of smallholder farmers in Tanzania as long as they are digital literate (Townsend and Mtaki, 2018)**.** Thus the current study aimed at examining smallholder farmers' digital literacy and how this enables them to access agricultural information.

1.2 Problem Statement

Access to agricultural information using digital network by smallholder farmers in Tanzania is still low (Misaki *et al*., 2015). Information and communication technologies (email, internet, phone, radio, television, and print) are currently underutilized in provision of agricultural extension services (Mgelwa, 2017).Moreover, access to reliable information has been identified as an issue that hinders decision-making and productivity among smallholder agriculturalists (Barakabitze *et al*, 2015; Krone *et al.*, 2016).

Furthermore, lack of reliable channels, few extension staff and knowledge for farming information are challenges smallholder farmers face in Tanzania, hence limited access of timely news from social media and the internet on agricultural operations in relation to tools, pesticides, markets, seeds, prices, credit, manure, subsidies among others, thus low productivity. Moreover, availability of misinformation online/social media which might not be accurate worsens the situation (Brett and Canziani, 2021). In addition, the Government and many agricultural extension professionals acknowledge that an information technology revolution has happened, with enormous and mostly untapped potential for rural development, especially among impoverished farmers (Kaske *et al*, 2017; Nat, 2018; Alant and Bakare, 2021).

Moreover, along with the government's initiatives to improve the agricultural sector, large mobile companies such as Vodacom, Tigo, Halotel, Airtel and Zantel have developed mobile services that allow smallholder farmers to seek and obtain agricultural information and knowledge relevant to their production activities.However, despite these extensive interventions and attempts aimed at improving the transmission of agricultural information and expertise to smallholder farmers, Tanzania's distribution of these resources remains mostly inadequate hence, low access and misinformation, mostly in rural areas (Waruingi and Muriithi, 2016).

Furthermore, despite the fact that digital literacy and access to agricultural information among smallholder farmers is crucial in raising agriculture productivity and income both at the household and national levels, not much is known in Tanzania in terms of the smallholder farmers use of social media and the internet to access agricultural related information. Therefore, the need for a study to examine smallholder farmers' digital literacy and access to agriculture information using Lushoto and Korogwe districts, Tanga region, Tanzania as case studies.

1.3 Justification for the Study

Tanzania's agricultural sector is a source of livelihood to about 70% of the country's population. In addition, Tanzanian smallholder farmers provide almost 80% of the country's food (Ndimbwa *et al*., 2019). In addition, their yields might increase if they were given digital literacy to access agricultural extension services. Moreover, Tanzania faces a shortage of agricultural extension staff, thus constraining smallholder farmers access to information (Balchin, 2017). Nonetheless, the rapid spread of ICTs across Africa holds a lot of promise for improved smallholder farmers' agriculture. Building climate resilience for smallholder farmers to increased productivity,improved access to finance for all stakeholder groups to increase profitability along the value chains, and addressed social inclusion gaps for youth, women, and other marginalized groups are just a few of the areas where digitalization can be used effectively to build more efficient food systems (Addom and Baumuller, 2020).

The current study is in line with Tanzania's policies and strategies. For example, the third five years' development plan of 2021/22-2025/26 and Tanzania's Agricultural Sector Development Program (ASDP) Phase II which aim to transform the country's agricultural sector through improved smallholder farmers' access to agricultural extension services through developing ICT infrastructures and knowledge in order to foster a competitive and participatory economy (URT, 2016b; URT, 2017; URT, 2021).

Furthermore, Tanzania's Agricultural policy of 2013 and Tanzania's Development Vision (TDV) 2025 both aim at high quality rural livelihoods through transforming smallholder farmers' agriculture.The study is also in line with the ICT policy of 2016 which promote innovative ways of doing things through use of ICT (URT, 2016a). Furthermore, the Sustainable Development goals (SDGs) specifically goal number 2 and number 4 address issues of eradication of hunger and equipping communities with ICT skills for improved livelihoods respectively (URT, 2013; URT, 2015; UNDP, 2021).

Further to the above, findings from the study could be used as reference by the Tanzanian policy makers, planners, academicians, researchers, the community and other stakeholders at large to better understand the situation of smallholder farmers' digital literacy and access to use of the same to agricultural information.Therefore, the possibility of better strategies being put in place to ensure farmers get agricultural information through use of ICT for increased agricultural productivity which could then lead to improved rural households well being.

1.4 Research Objectives

1.4.1 Overall objective

The general objective of the study was to examine how smallholder farmers' digital literacy enabled them to access agricultural information in the study areas.

1.4.2 Specific Objectives

The specific objectives of the study was:

i. Identify farmers' sources of agricultural information,
ii. Identify types of agricultural information accessed by smallholder farmers from the internet and social media,

iii. Assess famers' digital literacy, and
iv. Determine the reliability of the agricultural information accessed by smallholder farmers through social media and the internet.

1.5 Research Questions

1. What sources of agricultural information do smallholder farmers in Lushoto and Korogwe Districts use?
2. What kind of agricultural information do smallholder farmers in Lushoto and Korogwe Districts access from the internet and social media?
3. How digital literate are smallholder farmers in Lushoto and Korogwe Districts?
4. How reliable is the information accessed by smallholder farmers from the internet and social media?

1.6 Theoretical Framework

The study was guided by two theories i.e. the Social Learning Theory (SLT) and the Loftus Theory (LT)

1.6.1 Social Learning Theory (SLT)

According to Groenewald (2021) the 'Social Learning Theory' by Albert Bandura emphasizes on the significance of watching, displaying, and copying the behaviours, states of mind, and passionate responses of others action. And that behaviour is learned from the environment through the method of observational learning. The SLT has often been seen as a connection between behaviourist and cognitive learning theories because it encompasses attention, retaining, memory, and inspiration (Bandura, 1969).

However, the SLT is criticised for being artificial and ignoring biological elements related to behaviour, such as hormones and heredity. This reduces a person's behaviour to either nature or nurture, rather than acknowledging that behaviour is the result of a complex interaction between biology and environment. Furthermore, another critique of the SLT is when a person imitates bad behaviours from criminal friends which is motivated negatively by punishment (Griffin, 2006).Nonetheless, the study used SLT to guide it as the theory shows how individuals can learn from others hence, change their behaviours.Therefore, it was the study's assumption that smallholder farmers could learn from their colleagues who were using ICT to access agriculture information. And is so doing transform their agriculture (Bandura, 1986).

1.6.2 Loftus Theory (LT) of memory and effect of misinformation

The LT theory was introduced by Elizabeth Loftus, an American psychologist who claimed that feeding someone false information about an experience they may have experienced can distort, corrupt, or change their memory (Loftus, 2005).Loftus' critics have frequently questioned whether her conclusions can be applied to real-world situations.In the study's context the LT is applicable as farmers have the possibility of coming across misinformation on the internet or through social media hence, affecting their production negatively.

1.7 Conceptual Framework

The study's conceptual framework is as presented in Figure 1.1.Generally, the framework shows that smallholder farmers' digital literacy and access to agricultural information are influenced by several factors, i.e., the independent, intermediate (dependent) variables. In addition, the framework shows the background variables (i.e., farmers' characteristics) which can directly be associated with two independent variables hence, influencing the access to agricultural information through social media and the internet.Moreover, the dependent variable can also be influenced by other intermediate variables such as the agriculture and ICT policies, nonetheless, the effect/influence of the policies on the dependent variable is beyond current study's scope. Generally, it is expected that farmers with high levels of digital literacy are capable of accessing reliable agricultural information which might then enable them to increase their productivity and household living standards.However, misinformation can lead to lower productivity and lost income (Wardle, 2021).

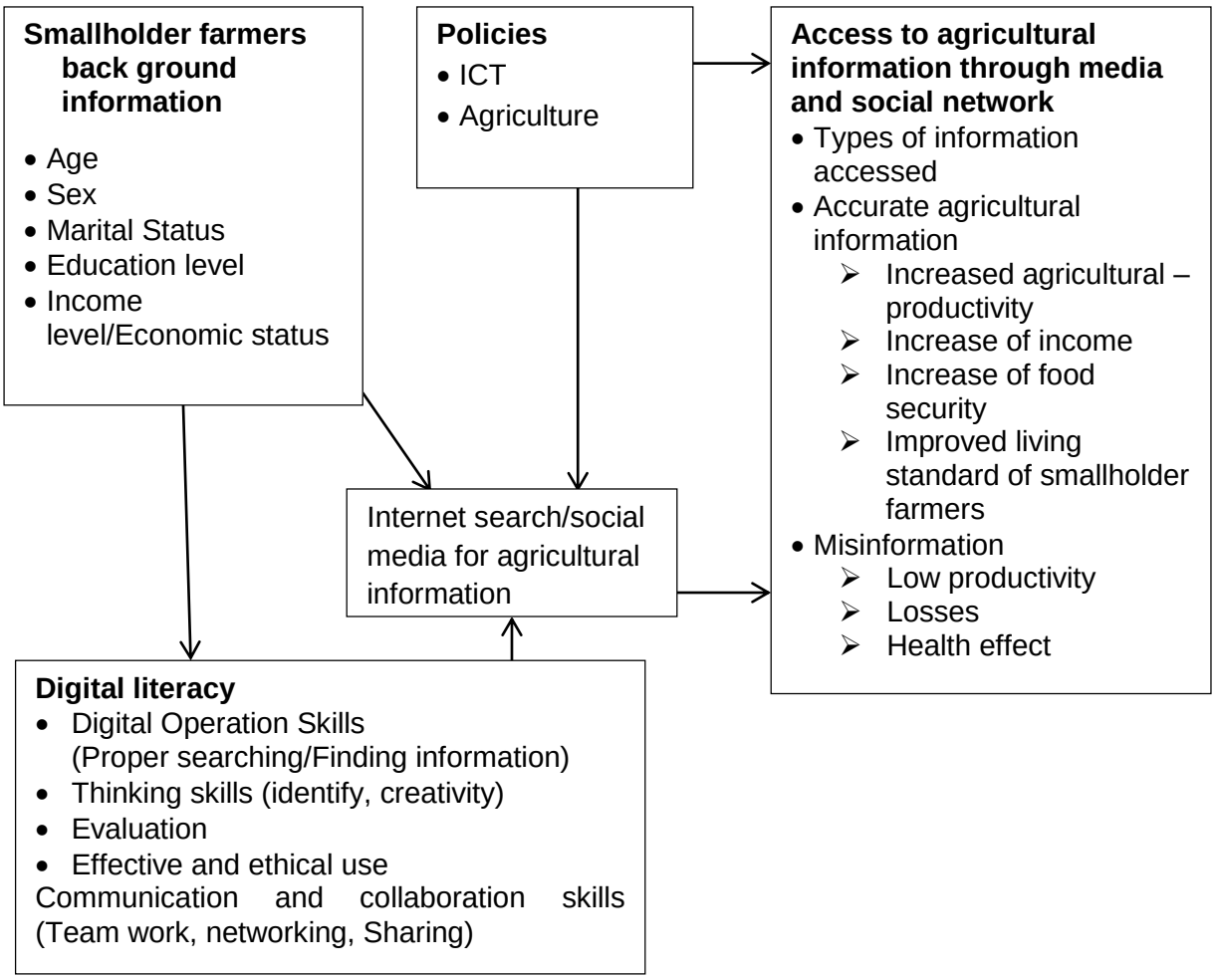

Figure 1.1: Conceptual framework of smallholder farmers' digital literacy and access to agricultural information

1.8 Study limitations

The study was limited by language barrier as most of the respondents were only conversant with the *Sambaa* language. The limitation was resolved by using village officials as translators. In addition, very few smallholder farmers owned smartphones so purposive sampling allowed to recruit others, transport problem and complicated geographical areas to some areas was solved by the researcher through walking.

1.9 Organization of the Dissertation

The dissertation is organized into five chapters.Chapter one presents the general introduction, chapter two present manuscripts one,chapter three presents manuscript two, Chapter four presents the general discussion. Lastly, chapter five presents the study's general conclusions and recommendations.

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CHAPTER TWO

MANUSCRIPT ONE

2.0 Smallholders Farmers Access to Agricultural Information: A Case of Lushoto and Korogwe Districts, Tanzania.

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Abstract
Smallholder farmers access to agricultural extension is critical for high productivity. Generally, access to these services could be through face to face encounters with extension staff or use of ICT. Therefore, the paper assesses smallholder farmers access to agricultural information in Lushoto and Korogwe Districts, Tanga Region. Specifically, it identifies types of information accessed and the respective sources. A cross-sectional research design was used whereby data were collected from 200 randomly selected smallholder farmers using a structured questionnaire, interviews and focus group discussions. Quantitative data were analysed using Statistical Package for the Social Science (SPSS) version 26, and content analysis was used for qualitative data. The findings showed that more than a half of the surveyed farmers accessed their agricultural information through their relatives/neighbours, radio, agricultural officers, and Television and only a minority (18.5%) accessed the same through social media and the internet. In addition, Pearson chi-square analysis results showed that improved seed varieties, market information, best farming methods, pest management and manure were the highly searched types of agricultural information from social media and the internet ($P \leq 0.05$). Furthermore, binary regression analysis results show that smallholder farmers' likelihood of using social media and the internet was significant ($P \leq 0.05$) in relation to information (fertilizer, improved seeds and agricultural incentives). Therefore, it is concluded that despite the challenges which smallholder farmers face in accessing agricultural extension services their use of ICT to curb the shortfall is still limited. Thus, the Government, agricultural sector stakeholders and development partners are urged to promote farmers' digital literacy so that they can use ICT in meeting their agricultural information needs hence, transformation of their subsistence farming for improved farming households well-being.

Key words: Agricultural information, CT, Smallholder farmers, Tanzania

2.1 INTRODUCTION

Information has now become a critical input in agriculture, and farmers need knowledge and information to respond to opportunities that could boost their farm yields (Nzonzo and Mogambi, 2016). Generally, information communication technology (ICT) offers developing countries hope for speeding up their agricultural development (Zhang *et al*., 2016; FAO, 2015; Gonte, 2018). Moreover, ICT enhances information sharing among stakeholders including smallholder farmers, thus allowing for quick access to business, technical and knowledge (Mojaki and Korogero, 2019). In addition, digitalization provides smallholder farmers great opportunities in their food production and trading (FAO, 2020).

Smallholder farmers[1] account for 95% of the world's farmers and produce 45% of the world's food, with Sub-Saharan Africa (SSA), Latin America, and Southeast Asia accounting for 70% (Heldreth *et al*., 2021). However, in many areas they face limited access to information sources leading to unsatisfied agricultural information delivery to farmers resulting in low yields, poverty, food insecurity and partial access to shared markets (FAO, 2017). For example, lack of agricultural market information systems and poor integration of smallholder farmers into high-value markets are underlying reasons in the current low desire to improve agricultural production (World Bank, 2020)**.**

In Tanzania, as in other SSA nations, agriculture is a critical component of food security, sustainable livelihoods, and economic development (Antony *et al*., 2020). Moreover, agricultural information provision is a vital element to advanced agricultural systems and is fundamental in the transformation of smallholder farmers production (Rahman *et al.,* 2021). Despite the ICT's potential for transformation of agricultural production through access to information on innovations/technologies and input, usage of the same among smallholder farmers remains limited (Mtega and Ngoepe, 2017).

Furthermore, many challenges encompass use of ICT in the transformation of smallholder farmers' agricultural production. For example, unsuitable schemes of agricultural information management, worthless information providers, low interest among smallholder farmers, and inconsistent farming community development (Mubofu and Eliya, 2016). In addition, transfer of agricultural knowledge to farming communities through electronic media was not much considered by responsible entities. Traditionally, smallholder farmers, neighbours, friends, relatives, radio, TV and Agro-company dealers have been important agricultural information sources (Sanga, 2018). Therefore, in order to improve agricultural information provision among smallholder farmers in rural areas, allocating adequate extension officers, strengthening telecommunication and electrical infrastructures could effectively fill in the information gap, allowing farmers to improve their knowledge, production and livelihood (Hazell and Hess, 2017; van Baardewijk, 2017).

Furthermore, despite the fact that digital literacy and access to agricultural information among smallholder farmers are very vital in increasing agricultural productivity and revenues both at the household and national levels, not much is known in Tanzania in

[1] Smallholder farmers are those who own small areas of land on which they grow subsistence crops and one or two cash crops that depend almost entirely on family labour, for instance farmers owning less than five hectares (Kamara *et al.*, 2019).

terms of the smallholder farmers' usage of social media and the internet in accessing agricultural related information. Therefore, the study on which the paper is based assessed smallholder farmers' digital literacy, sources agricultural information and types of information accessed in Lushoto and Korogwe districts, Tanga Region.

2.2 Theoretical and Conceptual Frameworks

2.2.1 Theoretical Frameworks

The Social Learning Theory (SLT) was used to guide the study. According to Groenewald, (2021), the 'Social Learning Theory' by Albert Bandura emphasizes on the significance of watching, displaying, and copying behaviours, states of mind, and passionate responses of others action. And that behaviour is learned from the environment through the method of observational learning. The SLT has often been seen as a connection between behaviourist and cognitive learning theorists because it encompasses attention, retaining, memory, and inspiration (Bandura, 1969).

However, the SLT is criticised for being artificial and ignoring biological elements on behaviour, such as hormones and heredity. This reduces a person's behaviour to either nature or nurture, rather than acknowledging that behaviour is a result of a complex interaction between biology and the environment. Furthermore, other critiques against the SLT is in relation to when a person imitates bad behaviours from criminal friends which will be motivated negatively by punishment (Griffin, 2006). Nonetheless, the study was guided by the due to the fact that individuals can learn from the positive actions of others. Therefore, it was assumed smallholder farmers could learn to access agricultural information from social media and the internet using ICT. Consequently, such access could lead to high productivity (Bandura, 1986).

2.2.2 Conceptual Framework

The study's conceptual framework (Figure 2.1) shows the types and sources used by smallholder farmers to access agricultural information which are influenced by several factors (i.e. independent and the intermediate variables). In addition, the framework shows the background variables (i.e. famers' characteristics) which can directly be associated with the independent variables hence, influencing their access to agricultural information) through social media and the internet. Moreover, the dependent variable is influenced by other intermediate variables such as the agriculture and ICT policies. However, the influence of these on the dependent variable are beyond the current study's scope. Generally, it is expected that farmers who use multiple information sources including social media and the internet are able to access the required types agricultural information which may then enable them to increase agricultural productivity and households living general standards (Hudson *et al*., 2017)

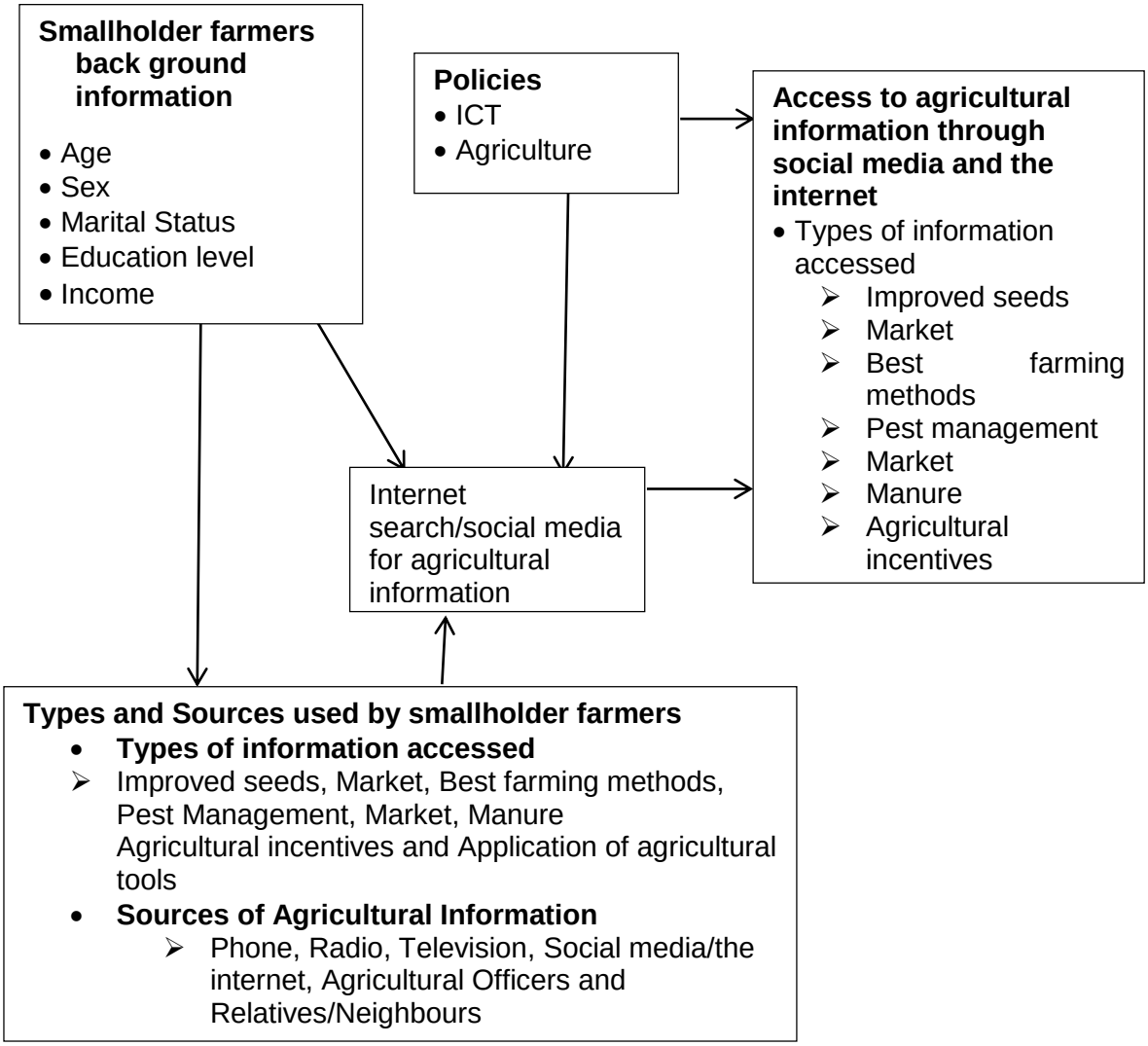

Figure 2.1: Conceptual framework on types and sources of smallholder farmers access to agricultural information

2.3 METHODOLOGY

2.3.1 Description of the Study Areas

The study was conducted in 10 wards of Lushoto and Korogwe districts, Tanga Region. These are Ubiri, Lukozi, Gare, Kwemashai, Malindi (Lushoto district) and Mkomazi, Mazinde, Mombo, Kerenge and Hale (Korogwe district). The main economic activity of both districts is crop production i.e. production of maize, paddy, beans and potatoes (the most important food/cash crops), and cash crops including sisal and tropical fruits (i.e., mangoes, oranges, and tangerines) (URT, 2017). The districts were purposely selected due to being in the project area of "The digital literacy and misinformation among smallholder farmers in Tanzania being implemented by staff from Sokoine University of Agriculture (SUA) under the sponsorship of Facebook Foundational Integrity Research (Under Facebook Inc.). In addition, Lushoto was chosen for its high value agricultural crops (vegetables and fruits as well as potatoes). Likewise, Korogwe was selected for its high worth agricultural crops such as vegetables, fruits, maize, cassava and sisal among others.

2.3.2 Research Design

The study adopted the cross-sectional research design whereby data were collected once from the above-mentioned ten (10) wards. The design allowed collection of both quantitative and qualitative data within a short period of time. In addition, the design allows for cost, human and time effectiveness when it comes to data collection (Aktar and Millia, 2016). Furthermore, the collected information is used in a variety of ways including to determine association between variables as well as approve and disapprove assumptions/hypotheses (Setia, 2016)

2.3.3 Sample Size and Sampling Techniques

The study's sample of 200 respondents was obtained through calculation using the Cochran's formula for continuous data, which is commonly used for infinite and unknown population sizes (Cochran, 1963; Israel, 1992). Thereafter, 100 respondents were obtained from both Korogwe and Lushoto districts to allow equal representation from both districts.

$n = \frac{\left(Z\alpha_{/2}\right)^2 p*(1-p)}{e^2}$,

Where:

n = sample size,

$Z\alpha_{/2}$ = 95% confidence interval (i.e., 1.96),

p = Assumed maximum variability of population proportion which is 15.4%, and

e = Margin error (i.e., 0.0692)

Therefore,

$n = \frac{1.96^2 \times 0.5(1-0.5)}{(0.0692)^2}$

$= \frac{3.8416 \times 0.130284}{0.0025} = 200.$

2.4 Data Collection

The study employed the mixed methods approach in data collection whereby quantitative qualitative data were collected concurrently so as to get more information to help answer the research questions. Primary data were collected using a structured questionnaire; key informant interviews (KIIs) and focus group discussions (FGDs). The KIIs and the FGDs were guided by a checklist and an FGD guide respectively. A total of ten (10) key informants were interviewed, five (5) in each district (4 Village Executive Officers, 4 Ward Executive Officers and 2 District Agricultural Officers). Moreover, ten (10) FGDs, each involving 8 participants, were conducted, i.e. five (5) FGDs in each district.

2.5 Data Analysis

The study intended to identify types of agricultural information accessed by smallholder farmers from the internet and social media and other sources of agricultural information. Quantitative data from the questionnaire were analysed using IBM-SPSS Statistics software version 26 whereby descriptive statistics; (i.e. frequencies, percent, means) were determined in order to answer objective one and two. Moreover, chi-square analysis was conducted to determine association between types and sources of agricultural information. Furthermore, binary logistic regression analysis was used because of its predictive power of estimating the likelihood of independent variables being associated

with the dependent variable (i.e. use or non-use of social media and the internet to access agricultural information) (Makau and Akaranga, 2016). The model equation was specified as:

$$Y = ln\left(\frac{p}{1-p}\right) \frac{e^{\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}+\beta_{12}X_{12}+\beta_{13}X_{13}+\beta_{14}X_{14}+\beta_{15}X_{15}+\beta_{16}X_{16}}}{1-e^{\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}+\beta_{12}X_{12}+\beta_{13}X_{13}+\beta_{14}X_{14}+\beta_{15}X_{15}+\beta_{16}X_{16}}}$$

Where:

$Y =$ Farmers use of social media/internet to access agricultural information,

$1-p$ the probability that farmers will not use social media/internet (Y) to access agricultural information,

$\beta_0 =$ constant coefficient,

$\beta_1 - \beta_{16}$ = logit coefficients of corresponding independent variables (Xs);

X_1 = Sex, measured in nominal scale as 1 = Male, 0 = Female; X_2 = Education level, measured in nominal scale as 0=No formal education and Primary,1=Post primary education(secondary, Diploma,Bachelor degree); X_3 = Marital status, measured in nominal scale as 0-Not Married(Widowed, Divorced, Separated and Single) and 1-Married; X_4 = Age, measured in ratio scale as number of years since birth; X_5 = Income, measured in ratio scale as an amount of income obtained by a farmer per month; X_6 = Improved seeds, measured in nominal scale 1=Yes, 0=No; X_7 = Market information, measured in nominal scale 1 = Yes , 0 = No; X_8 = Best farming methods, measured in nominal scale 1 = Yes , 0 = No; X_9 = Pest management measured in nominal scale 1 = Yes , 0 = No; X_{10} = Agricultural incentives (credits and loans), measured in nominal scale 1 = Yes and 0 = No; X_{11} = Manure, measured in nominal scale 1 = Yes and 0 = No; X_{12} = Agricultural tools measured in nominal scale 1 = Yes, 0 = No; X_{13} = District measured in nominal scale 0-Lushoto,1 = Korogwe.

Content analysis was used to analyse the qualitative data from the KIIs and FGDs in form of notes that were transcribed, coded; and the codes were combined into themes (Asamoah *et al*., 2021).

2.6 FINDINGS AND DISCUSSION

2.6.1 Respondents' Socio-economic and Demographic Characteristics and their sources of Agricultural Information

Respondents' socio-economic and demographic characteristics such as sex, education level, marital status, age and income and access to agricultural information are as shown in Table 2.1 and Figures 2.1-2.5. Generally, these characteristics have some influence on smallholder farmer's access to sources of agricultural information (Silayo, 2016). For example, income is a variable, which can influence a farmer access to a particular type of agricultural information from a certain source such as social media and internet (Franzel *et al*., 2018). In addition, one's education influences his/her digital knowledge and preferences of whether or not to access information from a certain source (Gonte, 2018).

Results in Table 2.1 show the frequency distribution among male and female smallholder farmers' uses of different sources in accessing agricultural information for daily agricultural practices. With regard to education level, overall both male and female majority (62%) had the primary level of education,and most of them use the radio and relatives/neighbours in

accessing agricultural information; hence, the distribution of Smallholder farmers' education at all levels tend to use radio (72%) and relatives/neighbours (63.6%). Generally, literature shows one's sex and education background can influence or restrict their access to farming resources (Aldosari *et al*, 2017) including access through relatives, radio, TV, internet and social media (Godwin *et al*., 2018). The findings from the survey are in line with what was pointed out during the FGDs and key informant interviews as shown in the quotes below:

> *Smallholder farmers don't have enough knowledge of using smartphones, social media and internet, particularly for searching agricultural information* (FGD, Kerenge Ward May, 2022).

> *Lack of electricity and telecommunication generally limits farmers from accessing digital information, hence their information needs (*Key informant, Ubiri Ward, March,2022).

Table 2.1 further shows that with regards to marital status, overall the majority (69.5%) were married and most use the radio (73.3%) and relatives/neighbours (69%) in accessing the agricultural information. According to Yaseen *et al.,* (2016) a smallholder farmers being married or not married can influence his/her access to a certain source of agricultural information for example, social media and the internet. Furthermore, the findings are consistent with literature which shows most smallholder farmers access agricultural information from fellow farmers, neighbours, radio, relatives and agricultural extension staff compared to social media and the internet (Mwantimwa, 2020; Isaya *et al*., 2018; Kwapong *et al*., 2020).

The study findings (Table 2.1) show that respondents age ranged between 18 and 84 years with the average being 46.5 years). The study's findings suggest both the youth and the elderly were actively involved in agricultural production in the study areas and they mostly used the radio and relatives/neighbours to access agricultural information. According to Gebru *et al*. (2016) one's age is associated with how he/she can access agricultural information using a certain source especially social media and the internet.

The study findings further show that earned income per smallholder farmers was Tanzania shillings 436,320/= and the minimum income was 30,000/= while the maximum income was 3,150,000. However, income ranged from 30,000/= to 3,150,000/= and 150,000/= to 1,500,000/= in Lushoto and Korogwe districts respectively. The study's findings conform to the to the purpose of random sampling which allows including smallholder farmers with low, middle and high-income earning characteristics (both above and below average) (Table 2.1). Nonetheless, the earned minimum income seems to be higher in Korogwe District than Lushoto. However, the maximum income in Lushoto was higher than in Korogwe District (Figure 2.1). The study's findings suggest smallholder farmers in the above and below average income levels used radio and relatives/neighbours to access agricultural information (Table 2.1). According to Misaki *et al*. (2017),smallholder farmers' digital agricultural information requirements are determined by a variety of features income being one of them. Generally, the results suggest underutilization of most sources such as social media and the internet when it comes to access agricultural information by smallholder farmers. The study's observation

from qualitative data is supported by what was pointed out in one of the FGDs as shown below:

> *Smallholder farmers can't afford buying enough social media and internet bundles; that's why they don't search for agricultural information from social media and the internet* (FGD, Gare Ward March, 2022).

Table 2.1: Respondents Socio-economic and Demographic Characteristics and their Source of Agricultural Information (n = 200)

Characteristic		Phone(n_p=64)	Radio(n_R=161)	TV(n_T=108)	Social media/internet(n_s=37)	Agricultural officer(n_{AO}=113)	Relatives/ Neighbours($n_{R/N}$=184)	Agro-dealers(n_{AD}=2)
Education Level	No formal education	2 (3.1)	9 (5.6)	0 (0)	1(2.7)	6 (5.3)	8 (4.3)	0 (0)
	Primary education	18 (28.1)	116 (72)	57 (52.8)	5 (13.5)	65 (57.5)	117 (63.6)	1 (50)
	Secondary education	29 (45.3)	26 (16.1)	37 (34.3)	21 (56.8)	29 (25.7)	43 (23.4)	1 (50)
	Diploma	9(14.1)	6 (3.7)	9 (8.3)	5 (13.5)	8 (7.1)	10 (5.4)	0 (0)
	Bachelor Degree	6 (9.4)	4 (2.5)	5 (4.6)	5 (13.5)	5 (4.4)	6 (3.3)	0 (0)
Marital status	Single	21 (32.8)	18 (11.2)	26 (24.1)	14 (37.8)	20 (17.7)	33 (17.9)	0 (0)
	Married	40 (62.5)	118 (73.3)	73 (67.6)	22 (59.5)	84 (74.3)	127 (69)	2 (100)
	Widowed	2 (3.1)	18 (11.2)	7 (6.5)	0 (0.0)	7 (6.2)	18 (9.8)	0 (0)
	Divorced	0 (0)	4 (2.5)	0 (0.0)	0 (0.0)	2 (1.8)	3 (1.6)	0 (0)
	Separated	1 (1.6)	3(1.9)	2 (1.9)	1 (2.7)	0 (0.0)	3 (1.6)	0 (0)
Age category	Working age population	60 (93.8)	143 (88.8)	102(94.4)	37 (100)	102 (90.3)	166 (90.2)	2 (100)
	Older age population	4 (6.3)	18 (11.2)	6 (5.6)	0 (0)	11 (9.7)	18 (9.8)	0 (0)
Income	Below average	29 (45.3)	106 (65.8)	59 (54.6)	13 (35.1)	65 (57.5)	117 (64)	2 (100)
	Above average	35 (55)	55 (34)	49 (45.4)	24 (65)	48 (42)	67 (36)	0 (0)
Sex	Male	43 (67.2)	77 (48)	59 (55)	29 (78.4)	64 (57)	101 (55)	0 (0)
	Female	21 (32.8)	84 (52.2)	49 (45.4)	8 (21.6)	49 (43.4)	83 (45)	2 (100)

NB: numbers in brackets indicate column percent (%) of smallholder farmers with different characteristics responded yes in a specific source of agricultural information

2.6.2 Respondents Socio-economic and Demographic Characteristics and their Source of Agricultural Information

Results in Table 2.2 show the frequency distribution among male and female smallholders farmers use of different sources in accessing agricultural information for daily agricultural practices in Lushoto and Korogwe district respectively. Result in table 2.2 shows more than half (64.1%) and (56.7%) with primary level of education used radio and relatives to access agricultural information. Furthermore, very few respondents (11.8%) used social media and the internet in Korogwe district compared to Lushoto district. According to Öztürk, (2021), Low digital literacy hinders smallholder farmers from participating on agriculture e -learning which would improve their production.

Table 2.2: Respondents Socio-economic and Demographic Characteristics and their Source of Agricultural Information (n = 100)

District	Characteristics		Phone	Radio	TV	Social media/ the internet	Agricultural officer	Relatives/neighbours	Agro-Dealers
Lushoto	**Education Level**	No formal education	1(2.3)	6(7.7)	0(0)	0(0)	3(8.3)	5(5.6)	0(0)
		Primary school	15(34.1)	50(64.1)	33(50)	3(15)	13(36.1)	51(56.7)	1(100)
		Secondary education	19(43.2)	16(20.5)	23(34.8)	12(60)	14(38.9)	24(26.7)	0(0)
		Ordinary diploma	5(11.4)	3(3.8)	6(9.1)	2(10)	3(8.3)	6(6.7)	0(0)
		Bachelor's degree	4(9.1)	3(3.8)	4(6.1)	3(15)	3(8.3)	4(4.4)	0(0)
	Marital status	Single	12(27.3)	10(12.8)	14(21.2)	6(30)	5(13.9)	16(17.8)	0(0)
		Married	29(65.9)	51(65.4)	45(68.2)	13(65)	28(77.8)	58(64.4)	1(100)
		Widowed	2(4.5)	13(16.7)	5(7.6)	0(0)	3(8.3)	13(14.4)	0(0)
		Divorced	0(0)	2(2.6)	0(0)	0(0)	0(0)	1(1.1)	0(0)
		Separated	1(2)	2(2.6)	2(3)	1(5)	0(0)	2(2.2)	0(0)
	Age category	Working age population	41(93)	69(88.5)	62(93.9)	20(100)	33(91.7)	81(90)	1(100)
		Older age population	3(7)	9(11.5)	4(6)	0(0)	3(8)	9(10)	0(0)
	Income Level	Below average	25(57)	49(62.8)	35(53)	9(45)	20(55.5)	55(61.1)	1(1)
		Above average	19(43)	29(37.1)	31(46.9)	11(55)	16(44.4)	35(38.8)	0(0)
	Sex	Male	27(61)	33(42.3)	34(51.5)	15(75)	21(58.3)	47(52.2)	0(0)
		Female	17(39)	45(57.7)	32(48.5)	5(25)	15(41.7)	43(47.8)	1(100)
Korogwe	**Education Level**	No formal education	1(5)	3(3.6)	0(0)	1(5.9)	3(3.9)	3(3.2)	0(0)
		Primary school	3(15)	66(79.5)	24(57.1)	2(11.8)	52(67.5)	66(70.2)	0(0)
		Secondary education	10(50)	10(12)	14(33.3)	9(52.9)	15(19.5)	19(20.2)	1(100)
		Ordinary diploma	4(21.1)	3(3.6)	3(7.1)	3(17.6)	5(6.5)	4(4.3)	0(0)
		Bachelor's degree	2(10)	1(1.2)	1(2.4)	2(11.8)	2(2.6)	2(2.1)	0(0)
	Marital status	Single	9(45)	8(9.6)	12(28.6)	8(47.1)	15(19.5)	17(18.1)	0(0)
		Married	11(55)	67(81)	28(66.7)	9(53)	56(73)	69(73)	1(100)
		Widowed	0(0)	5(6)	2(5)	0(0)	4(5)	5(5)	0(0)
		Divorced	0(0)	2(2)	0(0)	0(0)	2(3)	2(2)	0(0)
		Separated	0(0)	1(1)	0(0)	0(0)	0(0)	1(1)	0(0)
	Age category	Working age population	19(95)	74(89)	40(95)	17(100)	69(90)	85(90)	1(100)
		Older age population	1(5)	9(11)	2(5)	0(0)	8(10)	9(10)	0(0)
	Income Level	Below average	4(20)	57(69)	24(57)	4(24)	45(58)	62(66)	1(100)
		Above average	16(80)	26(31)	18(43)	13(76)	32(42)	32(34)	0(0)
	Sex	Male	16(80)	44(53)	25(60)	14(82)	43(56)	54(57)	0(0)
		Female	4(20)	39(47)	17(40)	3(18)	34(44)	40(43)	1(100)

NB: numbers in brackets indicate column percent (%) of smallholder farmers with different characteristics responded yes in a specific source of agricultural information

2.7 Type of Crops Grown by Smallholder farmers in Tanga Region

The results in Table 2.3 show the overall distribution of types of crops grown by the surveyed smallholder farmers in both Lushoto and Korogwe Districts. The overall findings show that, the majority (75.5%) and over a half (52%) were growing maize and beans respectively. Few farmers grew other crops such as cabbage, tomatoes, paddy and potatoes. At the district level, the majority were growing maize and beans in Lushoto and Korogwe districts as shown in Table 2.3.

Table 2.3: Types of crops grown(n=200)

Types of crops grown	Korogwe (n_l=100)	Lushoto(n_k=100)	Overall (n=200)
Maize	65	86	151
Paddy	48	0	48
Beans	33	71	104
Cassava	2	1	3
Potatoes	1	40	41
Sisal	3	0	3
Mangoes	2	0	2
Oranges	16	0	16
Tangerines	12	3	15
Cabbage	8	47	55
Tomatoes	26	24	50
Banana	2	3	5
Avocado	0	3	3
Apples	0	6	6

***NB*: n_L and n_k refer to the sample sizes for Lushoto and Korogwe districts respectively.**

2.8 Types of Agricultural Information Accessed by Smallholder Farmers from Social Media and the Internet

The study findings (Figure 2.2) show that on average less than a quarter (1 – 23.5%) of all the respondents accessed their agricultural information needs on improved seeds varieties, market, best farming methods, pest management, agricultural incentives, fertilizers and agricultural tools from social media and the internet. Generally, at the district level 3 – 33% and 1 – 20% did so in Lushoto and korogwe districts respectively. The study's observation somehow aligns with the Idiku *et al.* (2021) who found that less than a half (48.9%) of smallholder farmers in southern Nigeria used the internet to access agricultural information in relation to early warning and management of pests/diseases, manure, credit facilities, and weather forecast. In addition, literature (Makawia, 2018; Brown, 2018), has shown that smallholder farmers search more on pest and disease control, markets, and enhanced seed types information from friends, personal experience, neighbours and brokers rather than social media and the internet. The study findings from the household survey are in line with what was observed in FDGs as shown in the quote below:

> *Smallholder farmers search more of fertilizers information from social media and internet for getting quality and price as it is no longer provided by government as subsides and agro dealers' sale it at high prices* (FDG, Mombo ward May, 2022).

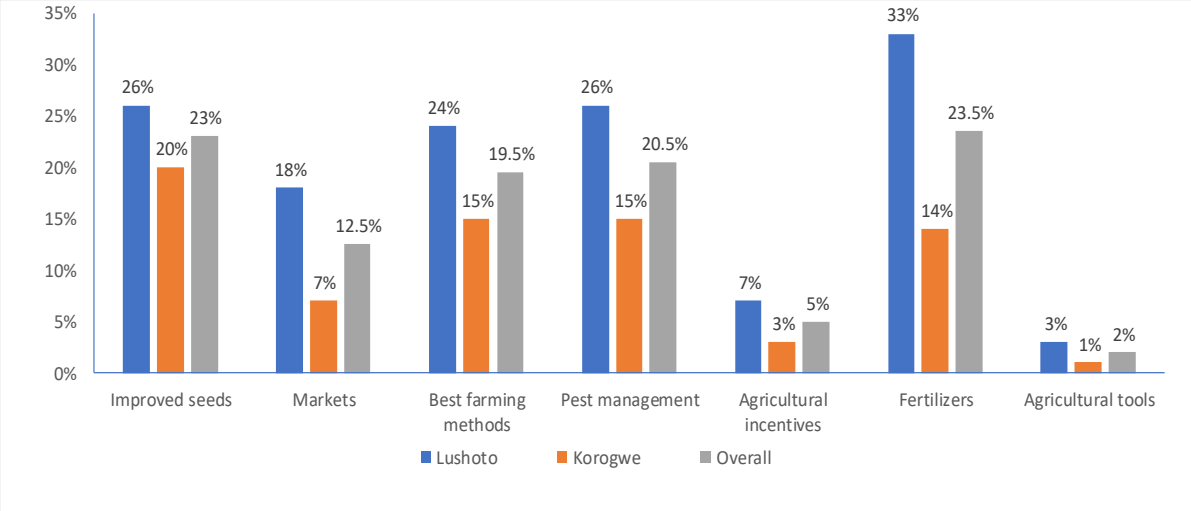

Figure 2.2: Types of agricultural information accessed by smallholder farmers from social media and the internet

2.8.1 Smallholder Farmers access to Agricultural Information by type of Social Media and the Internet

Study findings in Table 2.4 show the overall distribution of respondents and at district level with regards to type of social media used.The findings show that the most (percent wise) sought after information on WhatsApp, Facebook, YouTube and Google was on improved seeds, pest management, fertilizers and markets respectively. In addition, Korogwe district did relatively better compared to Lushoto district as shown in Table 2.4. Nonetheless, as reported earlier (Figure 2.2) less than a fifth (18.5%) of the surveyed smallholder farmers accessed social media and the internet. Therefore, one may question the digital literacy level of the other farmers as ICT is a good avenue when it comes to access of production enhancing information among others agricultural productivity. The study's observation conforms to what has been reported in literature (Kanjina, 2021; Thar *et al*., 2021) that smallholder farmers do not prefer the use of social media such as Facebook and YouTube when searching market information, but rather mainly for ordinary communication and updates. The above results are supported by observations from the FGDs and key informant interviews as shown in the quotes below:

> *Smallholder farmers use social media such as Facebook and YouTube mainly for communication, fashion and learning new cooking recipes rather than searching for agricultural information* (FDG, Kwemashai Ward, May, 2022).

> *Smallholder farmers do not access information from social media and internet as they are not sensitized enough to use them for that purpose, but rather they access such information from fellow farmers, middlemen and other sources around them* (Key informant, Mkomazi Village, May ,2022).

> *Very few smallholder farmers accessed banana farming methods in Jamaica through You tube (*Key informant, District Agricultural Officer, Korogwe district, May 2022).

Table 2.4: Distribution of the surveyed smallholder farmers by percentage types of agricultural information accessed from social media and the internet (n=200)

Type of information	Area	Social media and internet			
		WhatsApp	Facebook	YouTube	Google
Improved seeds	Lushoto	2	12	18	13
	Korogwe	16	20	8	12
	Overall	9	16	13	12.5
Market information	Lushoto	2	5	7	4
	Korogwe	14	16	9	6
	Overall	8	10.5	8	5
Best farming methods	Lushoto	0	9	13	9
	Korogwe	14	18	7	11
	Overall	7	13.5	10	10
Pest management	Lushoto	0	8	13	10
	Korogwe	16	18	9	12
	Overall	8	13	11	11
Agricultural incentives	Lushoto	0	3	3	2
	Korogwe	3	6	3	3
	Overall	1.5	4.5	3	2.5
Fertilizers information	Lushoto	1	8	13	9
	Korogwe	20	25	13	13
	Overall	10.5	16.5	13	11
Agricultural tools	Lushoto	0	1	1	0
	Korogwe	1	3	1	1
	Overall	0.5	2	1	0.5

2.8.2 Frequency Distribution for Farmers Access of Agricultural Information through Social Media and the Internet

The study found supportive statistical evidence of association between the types of agricultural information accessed by farmers through social media and the internet through Pearson chi-square test of association.The results in Table 2.5 show that improved seed varieties, market information, best farming methods, pest management and manure were highly searched through social media and internet as observed ($P \leq 0.05$).The findings in Table 2.5 shows that less than quarter (18.5%) used social media and the internet to search for agricultural information such as improved seeds varieties, market information, best farming methods, pest management, agricultural incentives, manure and agricultural tools. The significant ($P \leq 0.05$) chi-square test statistic values imply that farmers are less likely to use social media and internet when searching for the above-mentioned agricultural information($P \leq 0.05$). Also, at the district level, the difference in frequency between farmers who searched for agricultural information through social media and internet was less in Lushoto and Korogwe. This implies that farmers' use social media and the internet for searching agricultural information was weak. The study's observation conforms to the observation by Idiku *et al.* (2021) that less than 50% (48.9%) of smallholder farmers used internet to access agricultural information such as early warning and management of pests/diseases, manure, credit facilities, weather forecast in Nigeria.

Table 2.5: Cross-tabulation results, for the frequency distribution for the farmers access of agricultural information through social media and the internet (n = 200)

		District						Difference		
		Lushoto		Korogwe		Overall				
Variables		**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**Chi-square**	**Df**	**P-value**
Marital status	Not married	23	11	17	10	40	21	0.819	1	0.366
	Married	38	28	62	11	100	39			
Sex of respondent	Female	39	14	37	4	76	18	9.944	1	.002*
	Male	22	25	42	17	64	42			
Age	Working age population	54	37	70	20	124	57	2.019	1	.155[b]
	Older age population	7	2	9	1	16	3			
	Children	0	0	0	0	0	0			
Education level	No formal education	6	0	2	1	8	1	1.601	1	.206[b]
	Formal education	55	39	77	20	132	59			
Income level	Below average	38	22	59	5	97	27	10.514	1	.001*
	Above average	23	17	20	16	43	33			
Improved seeds varieties	No	53	15	79	0	132	15	121.985	1	.000*
	Yes	2	24	0	21	2	45			
Market information	No	54	22	79	13	133	35	59.794	1	.000*
	Yes	1	17	0	8	1	25			
Best farming methods	No	53	17	79	5	132	22	96.834	1	.000*
	Yes	2	22	0	16	2	38			
Pest management	No	52	16	79	5	131	21	96.238	1	.000*
	Yes	3	23	0	16	3	39			
Agricultural incentives	No	54	33	79	18	133	51	17.223	1	.000*,[b]
	Yes	1	6	0	3	1	9			
Manure	No	51	10	79	6	130	16	110.146	1	.000*
	Yes	4	29	0	15	4	44			
Agricultural tools	No	55	36	79	20	134	56	9.121	1	.003*,[b]
	Yes	0	3	0	1	0	4			

*. The Chi-square statistic is significant at the .05 level.

2.8.3 Binary Logistic Regression of Factors Associated with Farmers use of Social media and the Internet to Access Agricultural Information

Binary logistic regression results (Table 2.6) show that the model was able to explain 85% of the factors associated with smallholder farmers use of social media and the internet to access agricultural information. In addition, the model (96.4%) correctly specified with the model fit as per the omnibus test being significant ($p \leq 0.000$). The estimated coefficients and odds ratio are as presented in Table 2.6.

Table 2.6 shows that there was a high likelihood of smallholder farmers using social media and the internet to access information on improved seeds and this was significant ($p \leq 0.05$). The results suggest that a farmer's search for improved seeds varieties related information increased their odds of using social media and the internet by 81.561 times ($p \leq 0.05$). This means that a farmers searching for improved seed varieties information were more likely to use social media and the internet. The above finding was in conformity with information from key informant interviews as shown in the quote below:

> *Smallholder farmers access improved seed related information from social media and internet for the purpose of getting the quality ones with good prices as agro dealers sometimes sell fake ones with high prices'* (Key informant, Mkomazi Ward, May, 2022).

The binary logistic findings (Table 2.6) show that there was a significant ($p \leq 0.05$) decrease in the odds for smallholder farmers use of social media and the internet to search for agricultural incentives related information suggesting farmers were less likely to use social media and the internet to access agricultural incentives associated information and *vice versa*. However, the observation contradicts what was pointed out during the FGDs as shown in the quote below:

> *Smallholder farmers search for credits and loans from social media as agricultural subsidized are no longer provided by the government* (FDG, Malindi Ward, April, 2022).

The findings in Table 2.6 further show that smallholder farmers' likelihood of using social media and the internet to search for information on fertilizers was significant ($p \leq 0.05$). Generally, if a farmer searches for fertilizer related information his/her odds of using the social media and internet increases by 42.868 times ($p \leq 0.05$). This means a farmer searching for fertilizer related information is more likely to use social media and the internet compared to those not. The above observation is supported by what was pointed out in a key informant interview as shown in the quote below:

> *Few smallholder farmers with digital literacy search for agricultural information including on fertilizers/manure proper use from Facebook and Youtube* (Key informants, Lushoto district, April, 2022).

Lastly, the binary logistic findings show a significant difference between smallholder farmers use of social media and the internet in their search for agricultural information between the two districts covered by the study. For example, the odds of farmers in

Korogwe district were less likely to social media and the internet to search for agricultural information decreased by 0.147 times ($p \leq 0.05$). However, farmers in Lushoto district were relatively more forthcoming when it came to seeking information (See Figure, 2.2). The district's relative higher use of social media and the internet could also be explained by the district's higher involvement in food crops such as maize and beans as well as high value of horticultural crops such as tomatoes, cabbage.

Table 2.6: Binary Logistic Regression of factors influencing farmers access or not access agricultural information through social media and internet (n=200)

Independent variables	B	S.E.	Wald	Df	Sig.	Exp (B)	95%C.I.for EXP(B)	
							Lower	Upper
Sex: (Male) Base: Female	-1.410	0.904	2.433	1	0.119	0.244	0.042	1.436
Education level: (post-secondary) Base: No formal/primary)	1.014	0.955	1.128	1	0.288	2.757	0.424	17.924
Marital status (Married) Base: Not Married	0.790	0.866	0.833	1	0.361	2.204	0.404	12.023
Age	-1.071	1.235	0.753	1	0.385	0.343	0.030	3.851
Income	0.038	0.656	0.003	1	0.954	1.038	0.287	3.756
Improved seeds (Yes) Base: No	4.401	1.566	7.897	1	0.005***	81.561	3.787	1756.551
Market (Yes) Base: No	0.763	1.671	0.209	1	0.648	2.145	0.081	56.722
Best farming (Yes) Base: No	1.031	1.585	0.423	1	0.515	2.803	0.126	62.591
Pest management (Yes) Base: No	0.956	1.183	0.653	1	0.419	2.601	0.256	26.437
Agricultural incentives (Yes) Base: No	-6.692	2.198	9.275	1	0.002***	0.001	0.000	0.092
Manure (Yes) Base: No	3.758	1.091	11.855	1	0.001***	42.868	5.047	364.076
Agricultural tools (Yes) Base: No	20.499	16627.156	0.000	1	0.999	799006667.94	0.000	
District (Lushoto) Base: Korogwe	-1.919	0.901	4.539	1	0.033**	0.147	0.025	0.858
Constant	0.940	9.611	0.010	1	0.922	2.559		

Model summary: -2 log-likelihood=60.750, Cox&Snell Pseudo R-squared=0.603 and Negelkerke Pseudo R-squared=0.850

Model Classification: Overall correct classified 96.4% when constant included in the model and cut off point is 50%

Omnibus tests of model coefficients: Chi-squared test statistic=157.032, Degree of freedom=8 and P-value=0.000

Hosmer and Lemeshow test: Chi-squared test=2.587, Degree of freedom=8 and P-value=0.958

****** p<.01, ** p<.05, * p<.1***

2.10 Conclusion and Recomendation

Despite the challenges faced by smallholder farmers in accessing agricultural extension services, their use of ICT to control the shortfall is still limited. Very few smallholder farmers access agricultural information from multiple sources including social media and internet. Thus, Government, agricultural sector stakeholders and development partners are urged to promote farmers' digital literacy so that they can use ICT rather than relying on few sources. Farmers will become more informed and access the required agricultural information and transformation of subsistence farming for improved farming households well-being.

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CHAPTER THREE

MANUSCRIPT TWO

3.0 Smallholders Farmers' Digital Literacy and Access to Reliable Agricultural Information: A Case of Lushoto and Korogwe Districts, Tanzania[2]

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Abstract
Digital literacy enables smallholder farmers to get access to reliable agricultural information for improved productivity. Nevertheless, farmers' have differing digital literacy levels. Thus, the paper assesses how smallholder farmers' digital literacy is associated with access to agricultural information from social media and the internet and reliability of the same. Specifically, it assesses smallholder farmers' digital literacy and the reliability of agricultural information accessed. A cross-sectional research design was used whereby data were collected from 200 randomly selected farmers using a pre-structured questionnaire. In addition, key informant interviews and focus group discussions were used to complement the above. Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) while content analysis was used for qualitative data.The findings showed that the majority (72.5%) had a moderate (fair) level of digital literacy. Logit results further show that age was strongly associated with one's digital literacy and access to reliable agricultural information from social media and the internet. In addition, about a tenth (11.5%) of the respondent's found unreliable agricultural information (i.e., fake manure and pesticide information), and (8%) were of the opinion the social media and internet sources from which agricultural information was sourced were unreliable. Thus, it is concluded that farmers' digital literacy was moderate suggesting a possibility of the farmers being able to effectively use digital resources in accessing reliable agricultural information. Therefore, it is recommended that the local governments in the study are, as through their ICT and agricultural departments and other interested stakeholders,should come up with training programmes aimed at raising smallholder farmers' digital literacy to instill the requisite skills for the search, evaluation and effective use of information accessed through social media and the internet.

Key words: Agricultural information, Digital literacy, ICT, Smallholder farmers, Tanzania.

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3.1 Introduction

Information and communication technology (ICT) is currently used in almost every aspect of human effort, including agriculture (Abay *et al*., 2017). In addition, digital revolution in the agricultural sector is very promising as it allows transformation of farmers' productivity and profitability (Himesh *et al*., 2018; Ma and Wang, 2020). Currently, ICT's development is rapidly transforming the agricultural sector in terms of data collection, communication, analysis, and decision-making (Surya *et al*., 2016; Mbwangu, 2018). Moreover, the transformation of traditional agriculture into digital agriculture is being accelerated by the rapid increase of internet connected devices and mobile data penetration which has expanded farmers' use of digital tools and services (Antony *et al.,* 2020). Furthermore, farmers can reliably use readily available information to make more informed decisions (crop choice, irrigation, market, seeds, fertilizers etc.) (Sebakira and Qaim, 2017; Ndimbwa *et al*., 2020).

However, many smallholder farmers in rural areas lack access to high-speed internet; about half of the world's population, especially in developing countries, do not have access to the internet and reliable electricity (World Bank, 2019). Nonetheless, the issue is improving whereby, by the end of 2018, the mobile coverage gap had shrunk to 10% of the global population, down from 24% in 2014 despite its continued existence in low and middle-income countries especially rural areas (Hackfort, 2021).

Smallholder farmers provide livelihoods to 2 billion people in Sub-Saharan Africa (SSA) and Asia producing nearly 80% of the food (Megerssa, *et al*., 2020). However, the majority are digitally illiterate, and their technological knowledge is limited as a result; digital solutions must be affordable (Hazell, 2017). In addition, farmers' failure to obtain reliable information essential for production and market decisions is one of the most critical issues in Tanzania (Temba *et al*., 2016). Furthermore, inadequate information, knowledge sharing, and infrastructure, hinders agricultural progress in poor countries (Neha, 2018). According to Schirone (2016) wise use of ICT in agricultural production can lower farmers' associated production costs while at the same time enhancing productivity. Moreover, a smooth utilization of reliable agricultural information helps in the adoption of new agricultural technologies (Asongu and Asongu, 2018). Aldosari *et al*. (2017) argued that farmers with better access to extension and technological services earn more money and profit than their competitors. Thus, emphasizing on the need for use of ICT in the agricultural industry to expand access to reliable ICTs for increased production and commercialization (Ase *et al*., 2017). Nonetheless, smallholder farmers' use of agricultural information is dependent on the perceived information's trust and validity (Muema *et al*., 2018). Therefore, the paper assesses smallholder farmers' digital literacy and their access to reliable agricultural information. Digital literacy in the current study entails smallholder farmers' ability to search, understand, evaluate and their effective use of agricultural information from social media and the internet.

3.2 THEORETICAL AND CONCEPTUAL FRAMEWORKS

3.2.1 Theoretical Framework

The Loftus Theory (LT) of memory and effect of misinformation guided the study. According to Loftus (2005) the LT theory was introduced by Elizabeth Loftus, an American psychologist who claimed that feeding someone false information about an experience

they may have experienced can distort, corrupt, or change their memory. Nonetheless, Loftus' critics have frequently questioned whether her conclusions can be applied to real-world situations. In the study's context the LT is applicable as farmers have the possibility of coming across misinformation on the internet or through social media hence, affecting their production**.**

3.2.2 Conceptual Framework

The study's conceptual framework (Figure 3.1) shows that smallholder farmers' digital literacy and access to reliable agricultural information (dependent variable) can be influenced by several factors, i.e. the independent and intermediate variables. Furthermore, the framework shows the background variables (i.e., famer's features) which can directly (positively or negatively) be associated with the independent variables hence, influencing the farmers' access to reliable agricultural information through social media and the internet. For example, it is expected that farmers with high levels of digital literacy are more capable of accessing reliable agricultural information required for increased agricultural productivity and ultimately improved households' well-being (Ayim et al., 2022). In addition, the dependent variable is dependent on other intermediate variables such as policies. Generally, Country's ICT and Agricultural Policies can influence farmers access to reliable agricultural information. Nonetheless, the issue of policies is beyond the scope of current study.

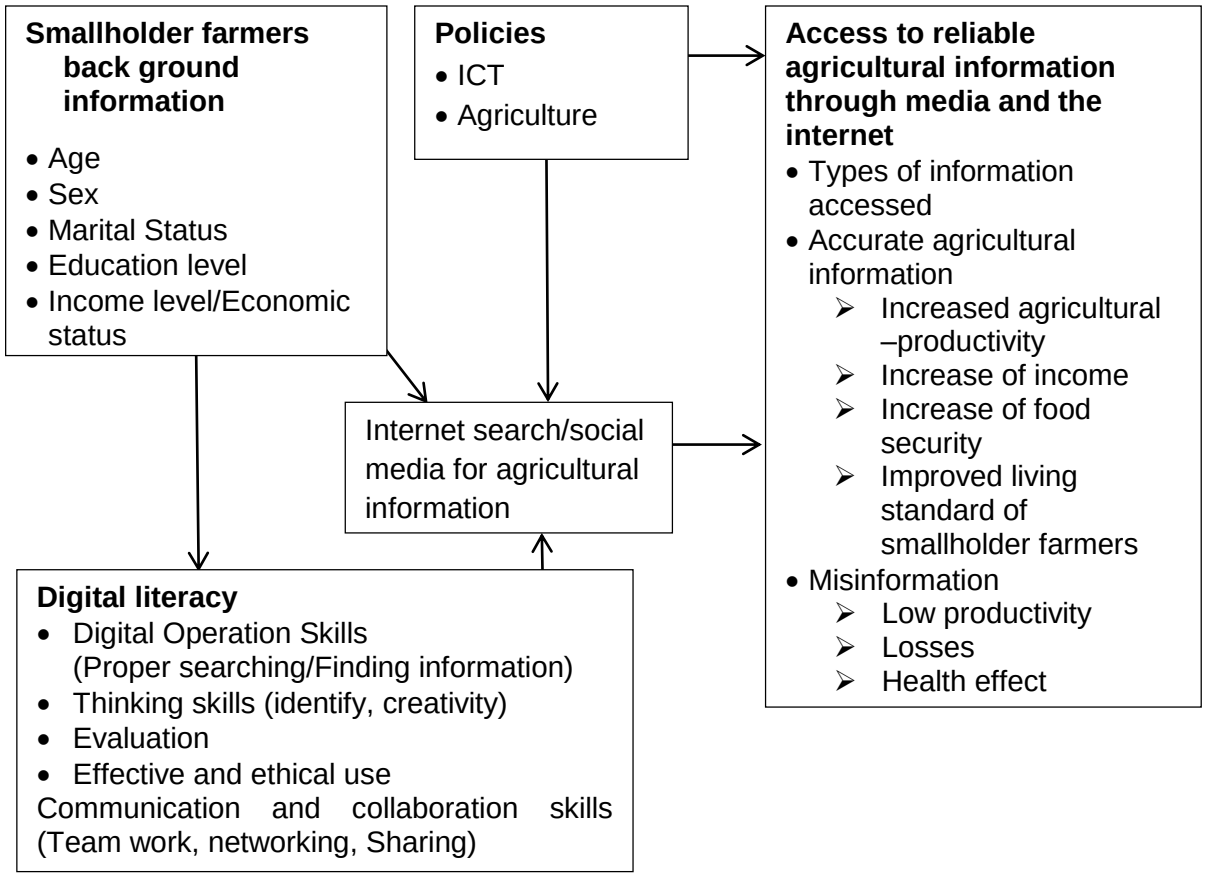

Figure 3.1: Conceptual framework for smallholder farmers' Digital literacy and Access to reliable agricultural information

3.3 METHODOLOGY

3.3.1 Description of the Study Areas

The study was conducted in 10 wards of Lushoto and Korogwe districts in Tanga Region. These are Ubiri, Lukozi, Gare, Kwemashai, Malindi (Lushoto district) and Mkomazi, Mazinde, Mombo, Kerenge and Hale (Korogwe district). The key economic activities in both districts is crop production (i.e., maize, paddy, beans and potatoes (the most important food cash crops), and cash crops include sisal and tropical fruits (i.e., mangoes, oranges, and tangerines) (URT, 2017). The districts were purposely selected due to being in the project area of "The digital literacy and misinformation among smallholder farmers in Tanzania being implemented by staff from Sokoine University of Agriculture (SUA) under the sponsorship of Facebook Foundational Integrity Research (Under Facebook Inc.). In addition, Lushoto was chosen for its high value agricultural crops (vegetables and fruits). Likewise, Korogwe was selected for its high worth agricultural crops such as vegetables, fruits, maize, sisal and cassava among others.

3.3.2 Research Design

The study adopted the cross-sectional research design whereby data were collected once from the above-mentioned ten (10) wards. In addition, a mixed method approach was used which allowed collection of both quantitative and qualitative data within a short period of time (Aktar and Millia, 2016). Generally, the cross sectional design is suitable in situations of limited resources such as time, finance and human. Furthermore, the design allows collected information to be used in a variety of ways including determination of association between variables, as well as to approve and disapprove assumptions/hypotheses (Setia, 2016; Asamoah *et al*., 2021).

3.3.3 Sample size

The study's sample of 200 respondents was obtained through calculation using the Cochran's formula for continuous data, which is commonly used for infinite/unknown population sizes (Cochran, 1963; Israel, 1992). Thereafter, 100 respondents were randomly obtained from each district.

$$n = \frac{\left(Z_{\alpha/2}\right)^2 p*(1-p)}{e^2},$$

Where:

n = sample size,

$Z_{\alpha/2}$ = 95% confidence interval (i.e., 1.96),

p = Assumed maximum variability of population proportion which is 15.4%, and

e = Margin error (i.e., 0.0692)

Therefore,

$$n = \frac{1.96^2 \times 0.5(1-0.5)}{(0.0692)^2}$$

$$= \frac{3.8416 \times 0.130284}{0.0025} = 200.$$

3.4 Data Collection

The study employed the mixed method approach in data collection to get both qualitative and quantitative data to allow a better understanding of farmers' digital literacy is associated with their effective use of social media and the internet to access reliable agricultural information. The quantitative and qualitative data were concurrently collected. Therefore, primary data were collected using a pre-structured questionnaire, key informant interviews (KIIs) and focus group discussions (FGDs). The KIIs and the FGDs were guided by a checklist and an FGD guide respectively. A total of ten (10) key informants were interviewed, five from each district (i.e. 2 Village Executive Officers, 2 Ward Executive Officers and 1 District Agricultural Officer). In addition, ten (10) FGDs, each involving 8 participants, were conducted, i.e., five (5) FGDs in each district.

3.5 Data analysis

Content analysis was used to analyse the Qualitative data from the KIIs and FGDs in form of notes that were transcribed, coded; and the codes were combined into meaningful themes (Dyck and Slyvestre, 2019). Quantitative data from the questionnaire was also analysed using IBM-SPSS Statistics software version 26 whereby descriptive statistics; (i.e., frequencies, percent and averages) were determined in order to answer the study's objectives. In addition, binary logistic regression analysis was used because of its predictive power to estimate the likelihood of the independent variables being associated with the dependent (i.e., ones use or none use of social media/internet to access reliable agricultural information). The logit model used is as shown below:

$$\text{logit}\big(\pi(x)\big) = \ln\left\{\frac{\Pr(\text{Y} = \text{High}|x=1)}{\Pr(\text{Y} = \text{Low}|x=0)}\right\} = \alpha + \beta_1\text{X}_1 + \beta_2\text{X}_2 + \beta_3\text{X}_3 + \beta_4\text{X}_4 + \beta_5\text{X}_5 + \beta_6\text{X}_6$$

Where:

$Pr(\text{Y} = \text{High}|\, x=1)$= probability that a smallholder farmer had access to reliable agricultural information.

$\Pr(\text{Y} = \text{Low}|\, x=0)$= probability that a smallholder farmer had no access to reliable agricultural information.

X1 = Age
X2 = Sex
X3 = Education level
X4 = Marital Status
X5 = Income level
X6=Digital literacy
X7=District
B0 = constant parameter.
B1-Bk = parameter estimates of each k independent variable.

To assess the digital literacy level, the digital literacy index (DLI) was calculated as follows;

$$\text{DLI} = \frac{\sum_{i=1}^{50} X_i}{50}$$

Where X_i refers to the constructs formulated for assessing farmers ability to search, understand, evaluate and their effective use of agricultural information from social media and the internet. The constructs were measured using 5-point Likert scale: 1=not at all,

2=fair, 3=good, 4=very good and 5=Excellent. And then the Digital Literacy Index (DLI) is categorized into fair (1-2.4), good (2.5-3.4), very good (3.5-4.4) and excellent (4.5-5).

3.6 Findings and Discussion

3.6.1 Respondents Digital Literacy and other Socio-Demographic Characteristics

Generally, the study findings (Table 3.1) show the majority (72.5%) of the respondents were fairly digital literate based on the study's criteria of using the DLI as presented in the methodology section. Table 3.1 further shows that the rest fell under good (12%), very good (14.5%) and excellent digital literacy (1%). In addition, the majority (76.4%) of those with good and above digital literacy levels were having had secondary school level education and above: as expected none of those without formal education fell under to good and above categories of digital literacy (Table 3.1). The study's observation conforms to what has been reported in literature that education background was found a driver of digital literacy among smallholder farmers in South Africa (Ugochukwu *et al.,* 2020). In addition, the observation is supported by what was reported in one of the FGDs as shown in the quote below: -

> *Farmers use their smartphones for communication such as making video calls compared to searching for agricultural information and most use their experience in daily agricultural practices due to low digital knowledge (FGD, Hale Ward, May, 2022).*

Study findings in Table 3.1 further show that the majority (71.7%) and over a quarter (28.3%) of those not in marriage (single, separated, divorced or being a widow) had a fair level of digital literacy: about a third (63.6%) and over a third (36.4) had good and above digital literacy levels respectively. The observation suggests that being in marriage may allow spouses to learn from each other. In addition, households with grown up children and who are living with their parents or guardians and if digital literate could also be instrumental in providing the requisite training and skill to their parents and or guardians. The observation differs that of Bastue *et al.,* (2020) who reported single women are more likely to have a higher digital literacy than married women in Ethiopia. The above is conform to observation from the Key informant as shown in the quote below:

> *Smartphone ownership among female farmers is low that's why digital literacy in Terms of operation is low as they don't obviously use the tool. Moreover, inadequate infrastructures, high cost of bundles, unstable internet limit them from accessing agricultural information* (Key informant, Korogwe district, May 2022).

With regard to farmers' age, findings in table 3.1 show the majority under working age (88.3%) and (71%) below average age had fair levels of digital literacy compared to (0%) of farmers' age fell under below average category who had excellent levels of digital literacy. Therefore, the study findings show that there are fair levels of digital literacy for all age groups of respondents. According to Alant and Bakare, (2021) there were negative significant association between age and level of digital of digital literacy among smallholder farmers.

In relation to a households' income level, findings in Table 3.1 show that the majority (83.1%) and over a half (55.3%) of those in the below average and above average income levels (categories) had a fair level of digital literacy: and under a fifth (16.9%) and over two

fifths (44.73) had good and above digital literacy levels respectively. The findings seem respondents from better-off households are more digital literate. The study's observation conforms to observations by Sanga and Eliya (2020) that income level was among the socio-demographic features that influencing access to climate change information from social media and the internet.

Findings in Table 3.1 further show that the majority (81.9%) and (64.2%) of female and male respondents had fair levels of digital literacy compared to under a fifth (18.1%) and just over a third (35.8 %) who had good and above digital literacy levels respectively. The observation suggest that males have higher digital literacy levels compared to their female counterparts. The former's low digital literacy levels could be a result of many factors such as education level and access to resources. And this is supported by the observation from one of the key informants as shown in the quote below: -

> *Smartphone ownership among female farmers is low that's why digital literacy in terms of operation is low as they don't obviously use the tool. Moreover, inadequate infrastructures, high cost of bundles, unstable internet limit them from accessing agricultural information* (Key informant, Korogwe district, May 2022).

Table 3.1: Smallholder farmers distribution by their digital literacy level and other socio-demographic characteristics (n = 200)

Characteristic		Fair (n_F = 145)	Good (n_G = 24)	Very good (n_{VG} = 29)	Excellent (n_E = 2)
Education Level	No formal education(n=9)	8 (5.5)	0 (0.0)	1 (3.4)	0 (0.0)
	Primary school(n=124)	112 (77.2)	10 (41.7)	2 (3.4)	0 (0.0)
	Secondary education(n=49)	22 (15.2)	11 (45.8)	16 (55.2)	0 (0.0)
	Ordinary diploma(n=12)	3 (2.1)	3 (12.5)	6 (20.7)	0 (0.0)
	Bachelor's degree(n=6)	0 (0.0)	0 (0.0)	4 (13.8)	2 (100)
Marital status	Single(n=36)	18 (12.4)	8 (33.3)	10 (34.5)	0 (.00)
	Married(n=139)	104 (71.7)	15 (62.5)	18 (62.1)	2 (100)
	Widowed(n=18)	17 (11.7)	1 (4.2)	0 (0.0)	0 (0.0)
	Divorced(n=4)	4 (2.8)	0 (0.0)	0 (0.0)	0 (0)
	Separated(n=3)	2 (1.4)	0 (0.0)	1 (3.4)	0 (0.0)
Age category	Working age population (n=181)	128 (88.3)	24 (100)	28 (96.6)	1 (50)
	Older age population (n=19)	17 (11.7)	0 (0.0)	1 (3.4)	1 (50)
Income Level	Below average(n=124)	103 (71)	14 (58.3)	7 (24.1)	0 (0.0)
	Above average(n=76)	42 (29)	10 (41.7)	22 (75.9)	2 (100)
Sex	Male(n=106)	68 (46.9)	14 (58.3)	22 (75.9)	2 (100)
	Female(n=94)	77 (53.1)	10 (41.7)	7 (24.1)	0 (0.0)

NB: Number in bracket indicate percentages

3.6.2 Respondents Digital Literacy and other Socio-Demographic Characteristics in Lushoto and Korogwe Districts

The study findings (Table 3.2) show that the majority (81.3%) and (72.3%) respondents with primary level of education had fair digital literacy in Lushoto and Korogwe Districts. In addition, no farmer had excellent digital literacy in Korogwe District. The finding conform to what was reported by Sousa *et al.,* (2016) that low digital knowledge hindered smallholder farmers to access agricultural information through video calls using their phones in Mali and Burkina Faso countries.

Table 3.2: Smallholder farmers distribution by their digital literacy level and other socio-demographic characteristics in Lushoto and Korogwe District (n = 100)

DISTRICTS	Characteristics		Fair	Good	Very Good	Excellent
LUSHOTO	**Education level**	No formal education (n=6)	6(9.2)	0(0)	0(0)	0(0)
		Primary school (n=56)	47(72.3)	8(38.1)	1(8.3)	0(0)
		Secondary education(n=27)	10(15.4)	10(47.6)	7(58.3)	0(0)
		Ordinary diploma(n=7)	2(3.1)	3(14.3)	2(16.7)	0(0)
		Bachelor's degree(n=4)	0(0)	0(0)	2(16.7)	2(100)
	Marital status	Single(n=17)	8(12.3)	7(33.3)	2(16.7)	0(0)
		Married(n=66)	42(64.6)	13(61.9)	9(75)	2(100)
		Widowed(n=13)	12(18.5)	1(4.8)	0(0)	0(0)
		Divorced(n=2)	2(3.1)	0(0)	0(0)	0(0)
		Separated(n=2)	1(1.5)	0(0)	1(8.3)	0(0)
	Age category	Working age population(n=91)	57(87.7)	21(100)	12(100)	1(50)
		Older age population(n=9)	8(12.3)	0(0)	0(0)	1(50)
	Income Level	Below average(n=60	43(66.2)	14(66.7)	3(25)	0(0)
		Above average(n=40	22(33.8)	7(33.3)	9(75)	2(100)
	Sex	Male(n=47)	25(38.5)	12(57.1)	8(66.7)	2(100)
		Female(n=53)	40(61.5)	9(42.9)	4(33.3)	0(0)
KOROGWE	**Education Level**	No formal education(n=0)	2(2.5)	0(0)	1(5.9)	0(0)
		Primary school(n=68)	65(81.3)	2(66.7)	1(5.9)	0(0)
		Secondary education(n=22)	12(15)	1(33.3)	9(52.9)	0(0)
		Ordinary diploma(n=5)	1(1.3)	0(0)	4(23.5)	0(0)
		Bachelor's degree(n=2)	0(0)	0(0)	2(11.8)	0(0)
	Marital status	Single(n=19)	10(12.5)	1(33.3)	8(47.1)	0(0)
		Married(n=73)	62(77.5)	2(66.7)	9(52.9)	0(0)
		Widowed(n=5)	5(6.3)	0(0)	0(0)	0(0)
		Divorced(n=2)	2(2.5)	0(0)	0(0)	0(0)
		Separated(n=1)	1(1.3)	0(0)	0(0)	0(0)
	Age category	Working age population(n=90)	71(88.8)	3(100)	16(94.1)	0(0)
		Older age population(n=10)	9(11.3)	0(0)	1(5.9)	0(0)
	Income Level	Below average(n=64)	60(75)	0(0)	4(23.5)	0(0)
		Above average(n=36)	20(25)	3(100)	13(76.5)	0(0)
	Sex	Male(n=59)	43(53.8)	2(66.7)	14(82.4)	0(0)
		Female(n=41)	37(46.3)	1(33.3)	3(17.6)	0(0)

NB: Number in bracket indicate percentages

3.6.3 A Comparison of Smallholder farmers' digital literacy based on their district of residence

Findings in figure 3.2 shows the majority Korogwe District respondents had higher (80%) respondents with fair digital literacy compared to Lushoto district (65%).Furthermore, over two- fifths (44%) in Lushoto district had good and above digital literacy levels compared to one-fifth (20%) in Korogwe district. The observation was related to what was reported by

Awuor and Rambim (2020) that low level of digital literacy is one among the factors that impact smallholder farmers' decision on ICT in agriculture invention and adoption in Kenya.

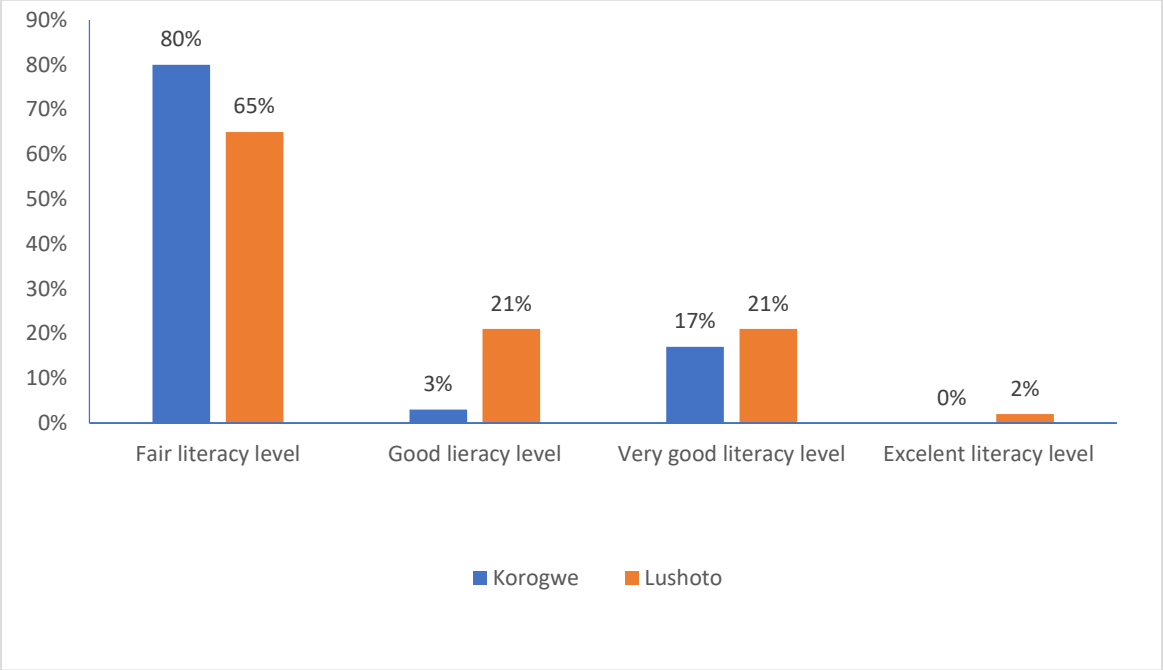

Figure 3.2: Smallholder farmers distribution by digital literacy level in Korogwe and Lushoto District

3.7 Binary logistic regression results on farmers' access to reliable agricultural information

The study findings in Table 3.3 show that farmers' age was negatively and significantly (p≤ 0.05) associated with access to reliable agricultural information whereby farmers' likelihood of accessing reliable agricultural information decreased with increase in age. Thus, suggesting that older farmers' capability to search, understand, evaluate and effective use of accessed information was lower than that of younger farmers. The study's finding conforms to what Iskandar *et al.,* (2020) reported that digital literacy levels were lower among older people compared to their younger counterparts.

Table 3.3 further shows that farmers' level of digital literacy was significantly (p≤ 0.001) and positively associated with their access and use of reliable agricultural information from social media and the internet. Generally, the more digital literate farmers were 4.4 times more capable of accessing and using agricultural information from the social media and the internet compared to their counterparts. The study's finding conform to those reported by Shemfe and Modirwa, (2018) that farmers' digital literacy was positive and significantly (P≤0.10) associated with their access to agricultural information on social media and the internet. The study's observation is supported by what was pointed out in one of the key informant interviews as shown in the quote below:

> *Many farmers are not able to evaluate information from social media and internet Thus, affecting their production*'' (Key Informant, Lushoto district, March, 2022).

Logistic regression results (Table 3.3) show farmers' in Lushoto had higher digital literacy levels suggesting they had a higher likelihood of using social media/the internet for their agricultural information needs compared to those in Korogwe district. In addition, they are more able to evaluate and effectively use the searched information.

Table 3.3: Binary logistic regression Results on Determinants for Farmers Access and Use of Reliable Agricultural Information from social media/Internet

Parameter	B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Sex (1)	-0.126	0.821	0.023	1	0.878	0.882	0.177	4.405
Year of birth/Age	-0.086	0.043	3.924	1	0.048**	0.918	0.843	0.999
Education Level (1)	-15.052	14455.546	0.000	1	0.999	1	1	1
Marital status (1)	-1.436	1.053	1.858	1	0.173	0.238	0.030	1.875
Income per month/Year	0.0001	0.0001	0.827	1	0.363	1.000	1.000	1.000
Digital Literacy	4.558	0.849	28.800	1	0.000***	95.397	18.054	504.074
District (1)	1.772	1.052	2.838	1	0.092*	5.881	0.749	46.200
Constant	-6.856	2.713	6.385	1	0.012**	0.001		

Note: Negelkerke R-Square=88.6%, Cox&Snell R-Square=56.8%, (Chi-square=167.892, p-value=0.000), (Hosmer&Lemeshow test=7.599, p-value=0.474)

3.8 Respondents Agricultural Misinformation Experience

Study findings (Figure 3.3) show farmers who found misinformation when searching for agricultural information and vice versa in second column. About a tenth (11.5%) of the respondent's found unreliable agricultural information (i.e., fake manure and pesticide information). In addition, a few (8%) of the respondents believed the social media and internets sources accessed were not reliable. At the district level access to unreliable agricultural information was relatively higher in Lushoto than Korogwe (Figure 3.3). According to (Dyck and Sylvester, 2019) Smallholder farmers face misinformation in agriculture in relation to seeds, fertilizers, suppliers, products which could affect production and market. The above is in conformity with what was observed in the FGDs as shown in the quote below:

> *There are a lot of confusing sources, content and misinformation when using social Media/internet (YouTube) to access agricultural information mostly about manure and seeds* (FDG, Kwemashai Ward, March, 2022)

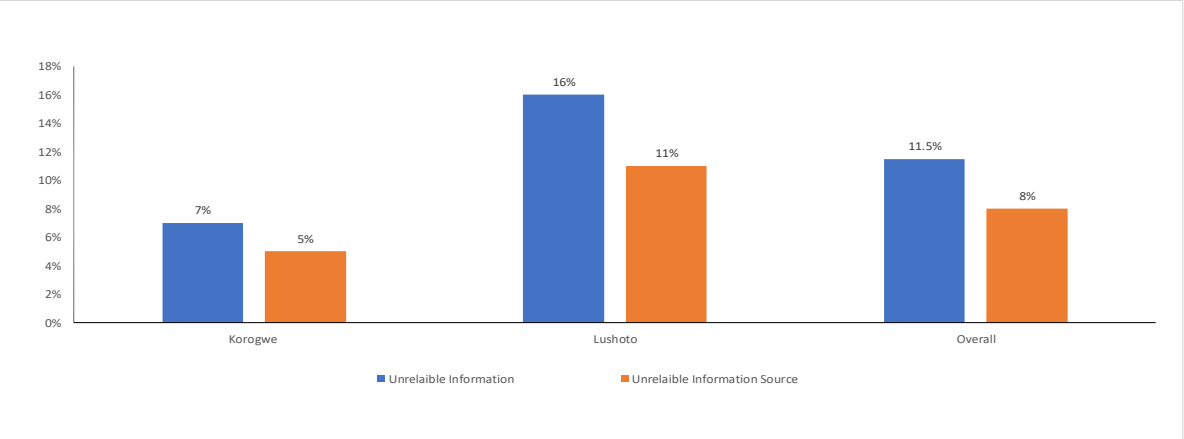

Figure 3.3: Farmers' agricultural misinformation experience

3.9 Conclusions and Recommendations

Based on the study findings it is concluded that smallholder farmers' digital literacy in the study areas is fair suggesting a possibility of the farmers being able to use digital resources in accessing their agricultural information needs from social media and the internet. It is also concluded that older farmers were relatively less digital literate compared to the younger farmers which means they are less likely to use social media and the internet to access agricultural information. It is further concluded that the more better-off farmers are digital literate the more they are capable of using the social media and the internet for their agricultural information needs. It is also concluded that female farmers were less digital literate compared to their male counterparts thus, hindering their use of social media and the internet in meeting their agricultural information needs. Lastly, it is concluded that farmers use of the social media and internet poses the challenge of them accessing agricultural misinformation either due to their limited digital literacy and or availability of unreliable information sources which could then affect their production negatively.Therefore, it is hereby recommended that the local government through their ICT and agricultural departments and other interested stakeholders should come up with training programmes aimed at raising smallholder farmers' digital literacy so as to equip them with relevant skills required in the search, evaluation and effective use of information accessed through social media and the internet. Lastly, it is hereby proposed that a study on the influence of policies on smallholder farmers use of ICT in meeting their agricultural needs should be conducted. Generally, implementation of a country's agricultural and ICT policies can either promote or hinder farmers use of ICT in their production.

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CHAPTER FOUR

4.0 General Discussion

The study aimed at assessing smallholders farmers' digital literacy and access to agricultural information in Lushoto and Korogwe Districts, Tanga region. The study identifies sources and types accessed by smallholder farmers, assesses smallholder farmers' digital literacy and reliability of agricultural information accessed by them from social media and the internet. Data were analyzed quantitatively using statistical package for social sciences and qualitatively through content analysis.

4.1 Smallholder Farmers Information Needs

The overall study findings show that, less than a quarter (1-23.5%) of the respondents did not access their required agricultural information for example, improved seeds varieties, market, best farming methods, pest management, agricultural incentives, fertilizer as well as agricultural tools from social media and the internet. Therefore, under (23.5%) of quarter of respondents accessed manure information from social media and the internet. The finding differs from what others have reported in literature. For example, Kante *et al.,* (2017) found that types of agricultural information accessed include field acquisition, agricultural inputs, agricultural technologies, agricultural credit, agricultural marketing, and food technology. Moreover, literatures (Nkebukwa, 2018; Mtega and Mgoepe, 2016) shows that the most searched agricultural information by smallholder farmers is soil preservation and weather conditions. Radio was the mostly used source of agricultural information among them. Furthermore, according to Ngwira and Kiwila, (2018) findings showed that farmers need information on how others. In addition, the duo revealed to raise different types of crops and livestock, techniques, and storage techniques, among others. In addition, the duo revealed that agricultural extension agents, radios, and posters served as the primary information sources in Malawi.

4.2 Smallholder Farmers' Access to Agricultural Information

The study has generally shown that the majority (72%) smallholder farmers with primary education accessed information from radio and relatives /neighbours (63.6%) compared to social media and the internet (13. 9%).The observation conforms to what others have reported in literature. For example, Brhane *et al*. (2017) reported that smallholder farmers prefer to access information needed from other farmers, agricultural experts, health extension agents, radio, and cell phones. In addition, the biggest obstacles to information searching include a lack of adequate user skill and expertise, a lack of infrastructure, a lack of ICT and service fees, and a lack of interest. According to Kipkurgat *et al*., (2016), study results show that smallholder farmers in the Kesses District, Kenya acquire agricultural information from a variety of sources, including the internet, social media, and extension services. And the majority of smallholder farmers approach using social media to find agricultural information with a positive outlook, indicating that they believe social media to be good and practical source of agricultural knowledge. Furthermore, smallholder farmers in Bangladesh, India, Sri Lanka, and Thailand gathered their agricultural information from a variety of sources, including their own knowledge, that of their family and friends, agro-dealers, and collectors, as well as the social media (Mahindarathne and Min, 2019). However, other researchers Thakur and Thander, (2018) results indicate that smallholders' farmers preferred to use Facebook and Whatsup to

access information related to development of social costs despite experiencing unreliable internet connectivity and high data usage in India.

4.3 Smallholder Farmers digital literacy

General findings show that the that the majority (72.5%) of the respondents were fairly digital literate based on the study's criteria of using the DLI as presented in the methodology section. Findings further shows that the rest fell under good (12%), very good (14.5%) and excellent digital literacy (1%). In addition, the majority (76.4%) of those with good and above digital literacy levels were having secondary school level education and above. Generally, it has been reported that farmers have difficulties in accessing agricultural information due to their illiteracy level, ignorance of information sources, lack of extension workers, and the fact that agricultural information on radio and television is always broadcast at odd hours when farmers who want such information have gone to their farms (Muhanguzi and Ngubiri, 2022). In addition, other findings demonstrated how farmers saw WhatsApp as a "convenient" communication tool that solves issues with audio-visual aids especially during times of crisis in their daily agricultural activities (Naruka *et al*., 2017). Nonetheless, Distractions and exposure to unauthorized messages or information were two serious problems brought on by using WhatsApp (Muthiah, 2016].

The study findings have demonstrated that ICT usage among farmers was not significantly influenced by participant demographics ($p>0.2$) The farmers' degree of education was actually a very good indicator of how they would use the ICT resources at their disposal. According to the findings, cell phones are the most frequently used ICT equipment, followed by radio and television. The study found that the biggest issue that ultimately restricts access is the cost of ICT devices (Manku, 2020). And according to Moonsamy et al. (2020) results showed that factors including age, education, and household use of social media and the internet significantly affected how well farmers performed on the knowledge test from northern, southern and central regions of Trinidad and Tobago. Furthermore, Yulida et al. (2019) argues that, the average score for literacy among oil palm smallholder farmers is 1.72, while the average scores for three other skills technical skill, critical understanding, and communication skill are medium and basic, respectively in Riau Province, Indonesia.

4.4 Smallholder Farmers Access to Misinformation

Generally, the study findings have shown that about a tenth (11.5%) of the respondent's found unreliable agricultural information (i.e., fake manure and pesticide information) and (8%) found the unreliable information from social media and the internet. The results are in line to what have been reported in others literatures. For example, according to Coggins *et al*. (2022) study findings suggest that smallholder farmers especially women sometime access unreliable agricultural information from social media and the internet due to several challenges such as digital illiteracy of digital extension tools and apps, inaccessible device, unstable electricity, unstable mobile network, insensitivity to dig ital illiteracy, foreign language, slow access, difficult to interpret, uninteresting, insensitivity to priorities, inattentiveness to socio-economic constraints, irrelevant to farm and distrust. Also lack of communication tools and irrelevant content contribute much to smallholder farmers access to unreliable agricultural information (Ndimbwa et al., 2019).

However, agricultural information use by rice smallholder farmers depends on the trust and reliability of the perceived information (Muema *et al*., 2018; Neha, 2018; Kulyakwave *et al*., 2019). Furthermore, absence of timely agricultural information and technological practices create challenges to smallholder farmers.

CHAPTER FIVE

5.0 General Conclusions and Recommendations

The chapter presents the general conclusions and recommendations of the study. The study aimed to assess smallholder farmers' digital literacy and their use of social media and the internet to meet their agricultural information needs. Specifically, it aimed to identify the types of information accessed from social media and the internet, farmers' sources of agricultural information, farmers' digital literacy and reliability of the agricultural information accessed by smallholder farmers through social media and the internet.

5.1 Conclusions

From the findings, it is concluded that the surveyed smallholder farmers had a fair level of digital literacy in terms of their ability to search, understand, evaluate and effectively use agricultural information from social media and the internet. The majority (72.5%) of the surveyed farmers had a fair or moderate level of digital literacy. Consequently, they continued to rely on the traditional sources of agricultural information i.e. extension officers, relatives/neighbours and the radio.It is also concluded that despite the challenges faced by smallholder farmers in accessing agricultural extension services due to a lack of sufficient extension staff,, their use of ICT to mitigate the shortfall is still limited: whereby very few smallholder farmers access agricultural information from multiple sources including social media and internet. It is also concluded that older farmers were relatively less digital literate compared to younger farmers which means they are less likely to use social media and the internet to access agricultural information. It is further concluded that the more better-off farmers were more digital literate the more they are capable of using social media and the internet for their agricultural information needs. It is also concluded that female farmers are less digital literate compared to their male counterparts, thus hindering their use of social media and the internet in meeting their agricultural information needs. Lastly, it is concluded that farmers' use of the social media and internet poses the challenge of them accessing agricultural misinformation either due to their limited digital literacy and or availability of unreliable information sources which could then affect their production negatively.

5.2 Recommendations

Based on the study findings and conclusions, it is recommended that the local governments in the study are, through their ICT and agricultural departments and other interested stakeholders should come up with training programs aimed at raising smallholder farmers' digital literacy so as to equip them with the relevant skills required in their search, understanding, evaluation and effective use of agricultural information accessed through social media and the internet so that they can use ICT rather than relying on traditional sources of agricultural information. Doing the above will enhance smallholder farmers' capacity to harness the power of ICT in meeting their agricultural information needs with regards to inputs, best practices and marketing of their produce. Thus, transforming their subsistence farming hence, improving their households' well-being. It is also recommended that, smallholder farmer need to increase their use of ICT in their search for agricultural information as doing so will help in transforming the agricultural sector despite the shortage of agricultural extension staff. Lastly, it is hereby proposed that a study on the influence of policies on smallholder farmers use of ICT in meeting their agricultural needs be conducted. Generally, implementation of a country's agricultural and ICT policies can either promote or hinder farmers use of ICT in their production.

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APPENDICES

Appendix 1: A Questionnaire for Research on Smallholder Farmers' Digital Literacy and Access to Agricultural Information in Korogwe and Lushoto Districts, Tanzania

Questionnaire No.

SOKOINE UNIVERSITY OF AGRICULTURE
COLLEGE OF SOCIAL SCIENCES AND HUMANITIES (CSSH)
DEPARTMENT OF POLICY PLANNING AND MANAGEMENT
P. O. Box 3135, Morogoro, Tanzania

By
Joyce James (joycebakunda10@gmail.com)
M. A. (Project Management and Evaluation) Student

Dear respondent,

My name is Joyce James from Sokoine University of Agriculture, am pursuing masters of Arts in Project Management and Evaluation which under the Department of Policy, Planning and Management, am conducting the research as titled "**Smallholder Farmers' digital Literacy and Access to Agricultural Information in Korogwe and Lushoto Districts, Tanzania"**. I, kindly request your voluntary participation time in the survey. Data gathered from you will help me to write my dissertation for the above-mentioned degree,however could be used by the government and other development partiners to design program which for the purpose of improving digital literacy hence fasten development of agriculture through availability of information among farmers. In addition, I wish to assure you that all that you'll say will be held confidential and will not be shared by third parties without your consent.

SECTION A: RESPONDENTS' SOCIO-DEMOGRAPHIC CHARACTERISTICS
(*Please fill in the blank or tick the appropriate response)*

S/No	Question	Responses to choose from	Tick or write the number of relevant answer
1.	Region	Tanga	
2.	District	1 = Korogwe, 2 = Lushoto	
3.	Division		
4.	Ward		
5.	Sex	1 = Male	
		2 = Female	

6.	Year of birth/Age		
7.	Education Level	1. Master's degree and above	
		2. Bachelor's degree	
		3. Secondary education	
		4. Primary school	
		5. No formal education	
		6. None of the above	
8.	Marital status	1. Single	
		2. Married	
		3. Widowed	
		4. Divorced	
		5. Separated	
9.	Income (Tsh) earned by the family per month/Year		

10. Other smallholder farmers' information on their agricultural practices

Type of information needed	
Type of crop/crops grown	
Number of hectare cultivated	
Yield per year (tons/bags)	July 2019 up to June 2020 or January 2021-December 2021
Size of household	

11. Do you need agricultural information?1 = Yes 0 = No

11 (a) If yes why? .....

11 (b) If no why ……

SECTION B: FARMERS' SOURCES OF AGRICULURAL INFORMATION

12. Where do you get information related to your agricultural activities (Please tick as appropriate):
    1 = Phone
    2 = Radio
    3 = TV
    4 = Social network including; facebook,instagram,twitter and you tube
    5 = Agricultural officer
    6 = Siblings/neighbours
    7 = Others (***Specify***)
13. (a) Do you often use your ICT device for searching agricultural information ? 1 = Yes 0 = No

13 (b). If yes, what types of ICT device do you often use ?

ICT device	**Whether the respondents often use ICT device (1 = Yes, No = 0)**	**Frequency of using the devices 1 = Every day, 2 = After every two days, 3 = Once a week, 4 = Twice per week 5=Once per month 6=None**
Cellphone or smart phone		
Tablet		
Computer/laptop		
TV		
Radio		
Others (***Please specify***)		

13 (b) Reasons for not using the ICT devices that I don't use

ICT device	**Reasons for not using the ICT devices**
Cellphone or smart phone	
Tablet	
Computer/laptop	
TV	
Radio	

14. (a) Do you use social network media like Whatsup, Facebook, Telegram, YouTube, Twitter, Google, etc?

14 (b) Which of the social network nedia do you prefer to use for accessing agricultural information?

1 = Whatsap
2 = Facebook
3 = Telegram
4 = You tube
5 = Twitter
6 = Google
7 = Others (***Specify***)

15. (a) Do you know any agricultural social networks app or page ? 1 = Yes 0 = No

15 (b) If yes, mention at least two apps or pages …….

15(c) If no why ?.....

16. (a) Are you able to identify trustful sources and untrustful sources of agricultural information in social networks/internet? 1 = Yes 0 = No

16 (b) If yes how do you identify them? …….

16 (c) If no, why? ……

17. (a). Are there Internet sevices in this area? 1 = Yes 0 = No

17 (b) If yes, explain any challenges you face in accessing internet /social network?.....

17 (c) If no, how do you get access to Internet ……..

18. What motive makes you use ICT devices for searching agricultural information from social networks/internet ?.....

19. (a) Are you able to evaluate the information you extract from social networks /internet so as to meet your needs? 1 = Yes 0 = No

19 (b) If yes, how/why……..
18 (c) If no, why……
20. (a) Are you in any social network group such as Whatsap, Facebook, etc. ?1 = Yes 0 = No
20 (b) If yes, what kind of agricultural information do you share? .....
20 (c) Is the informartion shared useful? 1 = Yes, 0 = No
…….....
20 (d) If yes, how? ……
21. Can you create a social network group for sharing agricultural information? 1 = Yes 0 = No
22. (a) Is there any agricultural information you miss from Internet/social network? 1 = Yes =No
22 (b) If yes, where do you get that missed information? .....
22 (c) If no why…….
23. What should be done to help smallholder farmers be able to search agricultural information through internet and social networks? .....

SECTION C: TYPES OF AGRICULTURAL INFORMATION ACCESSED BY SMALLHOLDER FARMERS FROM THE SOCIAL MEDIA AND INTERNET

24. What kinds of digital tools do you/do your family members own and use for communication
…….
25. (a) Have you ever accessed agricultural information from social network (s)?1 = Yes, 0 = No
25 (b) If yes why …….
25 (c) If no why? .....
26. (a) Do you use your smart phone /internet to acess agriculture information? 1 = Yes, 0 = No
26 (b) If yes ,what kind of agricultural information do you always search?
    1 = Improved seeds varieties
    2 = Market
    3 = Best farming methods
    4 = Pest management
    5 = Agricultural incentives
    6 = Manure
    7 = Application of agricultural tools
    8 = Others (***Specify***)
26 (c) If no, why……
27 (a) Have you ever come across wrong agricultural information from social media or internet?
    1 = Yes 0 = No
27 (b) I f yes, what was it about and how did you notice it ……
27 (c) If no why/how……

SECTION D: ASSESS FAMERS' DIGITAL LITERACY

28 Famers' digital literacy Assessment tool: **On the index scale below, Circle (0) Not at all (1) Fair (2) Good (3) Very good (4) Excellent**

SN	Agricultural Related Tasks	Scores
1.	I can use my own digital tool such as smartphone, tablet and computer technically	**0 1 2 3 4**
2.	I can purposely choose between various digital tools based on their functions	**0 1 2 3 4**
3.	I understand how to present information online using my own digital device	**0 1 2 3 4**
4.	I can search information on weather trends from social networks/internet	**0 1 2 3 4**
5.	I can understand all information on weather trends from social networks/internet	**0 1 2 3 4**
6.	I can understand and interpret messages on weather trends from social networks/internet	**0 1 2 3 4**
7.	I can evaluate the information on weather trends to make decision about production process	**0 1 2 3 4**
8.	I can make effective use of information extraced from social networks/interneton on weather trends to make decision about production process	**0 1 2 3 4**
9.	I can find information about utmost agricultural practices (sowing, weeding, harvesting, drying and storage)?	**0 1 2 3 4**
10.	I can understand information about the best agricultural practice offered	**0 1 2 3 4**
11.	I know the benefits and shortcomings of using new farming methods vis-à-vis old farming methods	**0 1 2 3 4**
12.	I can make decision on how the best agricultural practice offered applies to production process	
13.	I can make effective use of information on best farming methods to make agricultural production decision	**0 1 2 3 4**
14.	I can search information on improved agricultural tools and technologies	**0 1 2 3 4**
15.	I can understand information on improved tools and technologies as offered	**0 1 2 3 4**
16.	I can make evaluation on application of information relating to tools and technologies	**0 1 2 3 4**
17.	I can make decision on on benefits and shortcomings of applying improved tools and technologies in production compared to old farming methods	**0 1 2 3 4**
18.	I can make decision on whether information on agricultural tools and technologies are reliable	**0 1 2 3 4**
19.	I can make effective use of information on agricultural tools and technologies during production process	**0 1 2 3 4**
20.	I can search information about soil (temperature and nutrients)	**0 1 2 3 4**
21.	I can understand soil data as offered in social networks/ internet	**0 1 2 3 4**
22.	I can make evaluation on how soil statistics apply to agricultural production	**0 1 2 3 4**
23.	I can make decision on effective time use to apply agro-chemicals such as pesticide or a manure	**0 1 2 3 4**
24.	I can make effective use of information searched for wise production decision	**0 1 2 3 4**

25.	I can search information relating to agricultural incentives	**0 1 2 3 4**
26.	I can understand all information offered relating to agricultural incentives	**0 1 2 3 4**
27.	I can evaluate trusthworthy information relating agricultural incentives	**0 1 2 3 4**
28.	I can apply online on issues relating to agricultural incentives	**0 1 2 3 4**
29.	I can make effective use of information relating to agricultural incentives	**0 1 2 3 4**
30.	I can search and understand information on improved seeds	**0 1 2 3 4**
31.	I can evaluate benefits and weaknesses of using improved seeds compared to local seeds	**0 1 2 3 4**
32.	I can make effective use of information about improved seeds to make accurate and informed production decision	**0 1 2 3 4**
33.	I can search information on pestcides and disease management	**0 1 2 3 4**
34.	I know all information on how to control pests and diseases as offered in the internet/social network/webpage	**0 1 2 3 4**
35.	I can evaluate whether information on pestcides and disease control is reliable	**0 1 2 3 4**
36.	I can make effective use of information on pestcides and disease control to make production decision	**0 1 2 3 4**
37.	I can search information on customers location	**0 1 2 3 4**
38.	I can understand all information on market prices as offered in the internet/social network /webpages/apps	**0 1 2 3 4**
39.	I can make decision on whether information on market price in the internet is reliable	**0 1 2 3 4**
40.	I can make effective use of information on market price from the internet/social networks on customers and market price to make informed production decision	**0 1 2 3 4**
41.	I can search information about production skills and knowlegde	**0 1 2 3 4**
42.	I can understand all information on production skills and knowledge as offered in the internet/social network/app/webpage	**0 1 2 3 4**
43.	I can evaluate and make decision on whether information about production skills and knowledge is reliable or not	**0 1 2 3 4**
44.	I can make effective use of the information on production skills to make informed and accurate production decision?	**0 1 2 3 4**
45.	I can join social network group and participate in debate relating agricultural information	**0 1 2 3 4**
46.	I can search information on agricultural policies	**0 1 2 3 4**
47.	I can understand information about policies as offered in the internet	**0 1 2 3 4**
48.	I can evaluate those policies to make useful decisions	**0 1 2 3 4**
49.	I can judge whether information on agricultural policies is reliable	**0 1 2 3 4**
50.	I can make effective use of information relating policies	**0 1 2 3 4**

Key: (1) Not at all (2)Fair (3)Good (4) Very good (5)Excellent

SECTION E: RELIABILITY OF THE AGRICULTURAL ACCESSED BY SMALLHOLDER FARMERS THROUGH SOCIAL MEDIA AND SOCIAL NETWORKS(*Tick or fill in the blank any that apply*)

29 (a) Have you ever come across reliable agriculture information through mobile phone's agriculture apps and social media like Facebook, Instagram etc.? 1 = Yes 0 = No
(b) If yes, what was it about ?.....

30 How did you know that information was reliable?.....

31 (a) Was it useful to agricultural practices?.....
(b) How did it help you improve agricultural productivity? .....

32 What obstacles do you face in identifying and evaluating reliable information? .....

33 What should be done to help smallholder farmers to identify and evaluate reliable agricultural information?……

34 (a) Have you ever come across agricultural misinformation in your search ?1 = Yes, 0 = No
(b) If yes explain how ……
(c) If no, why…….

35 What are the effects of agricultural misinformation in relation to your productivity ?.....

36 How can smallhoder farmers avoid access to agricultural misinformmation?.....

37 What can be done to prevent farmers from being misinformed through social media /internet ……

THANK YOU VERY MUCH FOR YOUR COOPERATION

Appendix 2: Focus Group Discussion Guide for Smallholder Framers

SOKOINE UNIVERSITY OF AGRICULTURE
COLLEGE OF SOCIAL SCIENCES AND HUMANITIES (CSSH)
DEPARTMENT OF POLICY PLANNING AND MANAGEMENT
P. O. Box 3135, Morogoro, Tanzania

A Focus Group Discussion Guide for Research on Smallholder Farmers' Digital Literacy and Access to Agricultural Information in Korogwe and Lushoto Districts, Tanzania

By
Joyce James (joycebakunda10@gmail.com)
M. A. (Project Management and Evaluation) Student

Dear Participants,

My name is Joyce James from Sokoine University of Agriculture, am pursuing masters of Arts in Project Management and Evaluation which under the Department of Policy, Planning and Management, am conducting the research as titled "**Smallholder Farmers' digital Literacy and Access to Agricultural Information in Korogwe and Lushoto Districts, Tanzania"**. I, kindly request your voluntary participation time in the focus group discussion. Data gathered from you will help me to write my dissertation for the above-mentioned degree,however could be used by the government and other development partiners to design program which for the purpose of improving digital literacy hence fasten development of agriculture through availability of information among farmers. In addition, I wish to assure you that all that you'll say will be held confidential and will not be shared by third parties without your consent.

Location of Focus group discussion ……....
Date of Focus group discussion …….
Phone number of participants: ……

1. What are the main sources of agricultural information to smallholder farmers in your area?
2. In your area, are there any farmers who access agricultural information from the internet/social media?
3. What is the approximate per cent of smallholder farmers who own smartpohones in your area?
4. What types of agricultural information do smallholder farmers in your area access from the internet and social meda ?
5. How digital literate are smallholder farmers in your area?
6. What challenges do smallholder farmers face in accessing agricultural information through social media and internet?

7. What needs to be done to prevent/minimize smallholder farmers being misinformed due to their use of the internet and social media?
8. Does misinformation increase or decrease productivity ?
9. Do smallholder farmers understand to search/identify/evaluate/use reliable or unreliable source of information?

THANK YOU VERY MUCH FOR YOUR COOPERATION

Appendix 3: Key informant Interview checklist for District Agriculture Officer(DAICO)/WEOs/VEOs

SOKOINE UNIVERSITY OF AGRICULTURE
COLLEGE OF SOCIAL SCIENCES AND HUMANITIES (CSSH)
DEPARTMENT OF POLICY PLANNING AND MANAGEMENT
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A Key Informant Interview Guide for Research on Smallholder Farmers' Digital Literacy and Access to Agricultural Information in Korogwe and Lushoto Districts, Tanzania

By
Joyce James (joycebakunda10@gmail.com)
M. A. (Project Management and Evaluation) Student

Region ..…… **District** ……..
Division ……. **Ward** …….....
Village …… **Date of Interview** ……

Introduction

Dear Sir/Madam,

My name is Joyce James from Sokoine University of Agriculture, am pursuing masters of Arts in Project Management and Evaluation which under the Department of Policy, Planning and Management, am conducting the research as titled "**Smallholder Farmers' digital Literacy and Access to Agricultural Information in Korogwe and Lushoto Districts, Tanzania"**. I, kindly request your voluntary participation time in the interview. Data gathered from you will help me to write my dissertation for the above-mentioned degree,however could be used by the government and other development partiners to design program which for the purpose of improving digital literacy hence fasten development of agriculture through availability of information among farmers. In addition, I wish to assure you that all that you'll say will be held confidential and will not be shared by third parties without your consent.

1. How digital literate are smllaholder farmers in your area?
2. How accurate is agricultural information accessed by smallholder farmers through internet and social media.
3. What kinds of agricultural information do smallholder farmers access through the internet and social media?
4. What are the sorts of agricultural misinformation reported to VEOs,WEOs and DAICOs by farmers?
5. Is there any other agriciltural misinformation reported by WEOs/VEOs/ DAICOs?
6. What challenges do smallholder farmers face in accessing digital agricultural information through the internet/social media?
7. As a WEOs/VEOs/DAICO have you ever come across agricultural misinformation on the internet/social media?

8. What needs to be done to address digital agricultural misinfomation among smallholder farmers in you area? ……
9. Do smallholder farmers understand to search/identify/evaluate/use reliable or unreliable source of information?.....

THANKS FOR YOUR COOPERATION