DETERMINANTS OF DIGITAL LITERACY AMONG SMALLHOLDER FARMERS: A CASE OF HAI AND MOSHI DISTRICTS, KILIMANJARO- TANZANIA

Article · April 2023

CITATIONS
0

READS
81

4 authors, including:

Hashim Mohamed
Sokoine University of Agriculture (SUA)
2 PUBLICATIONS **0** CITATIONS
SEE PROFILE

Justin Urassa
Sokoine University of Agriculture (SUA)
23 PUBLICATIONS **106** CITATIONS
SEE PROFILE

Mikidadi Muhanga
Sokoine University of Agriculture (SUA)Morogoro
97 PUBLICATIONS **221** CITATIONS
SEE PROFILE

Tengeru Community Development Journal
ISSN 1821-9853(Print) ISSN 2665-0584(online)
Vol. 9, No.2, 2022

DETERMINANTS OF DIGITAL LITERACY AMONG SMALLHOLDER FARMERS: A CASE OF HAI AND MOSHI DISTRICTS, KILIMANJARO-TANZANIA

Hassani, M. S[1], Mohamed, H.I[2], Urassa, J.K[1], and Muhanga, M.I[3]

[1]Department of Policy, Planning and Management, College of Social Sciences and [1]Humanities (CSSH), Sokoine University of Agriculture (SUA), P.O.BOX 3035, Morogoro, Tanzania
[2]Department of Language Studies, College of Social Sciences and Humanities (CSSH), SUA, P.O.BOX 3035, Morogoro, Tanzania
[3]Department of Development and Strategic Studies, College of Social Sciences and Humanities (CSSH), SUA, P.O.BOX 3024, Morogoro, Tanzania.
Corresponding Author email: mariamhassani2719@gmail.com

Abstract: Access to agricultural extension services, social media, and training on ICTs in developing countries stand a good chance of impacting significantly small-scale farmers' livelihoods and therefore, the digital literacy level of smallholder farmers is highly influential. The extent to which an opportunity for farmers to use information communication technologies (ICT) to access agricultural information for the transformation of their subsistence farming has been tapped by smallholder farmers requires empirical investigation. Therefore, the current study determined smallholder farmers' digital literacy and the factors associated with the same. The study adopted a cross-sectional research design whereby data were collected using a structured questionnaire from 200 purposefully selected smallholder farmers through a multistage sampling procedure. In addition, four focus group discussions and five key informant interviews were used to collect complementary data. An index score and Likert scale gauged digital literacy. Data were analysed by using IBM- SPSS (Version 20) while STATA software was used for binary logistic regression analysis to determine factors associated with smallholder farmers' digital literacy. Study findings show that 74.5% (95% CI: 0.68 to 0.81), 0% (95% CI: 0 to 0) and 25.5% (95% CI: 0.19 to 0.32) of the farmers fall under the category of low, moderate and high digital literacy levels respectively. Study findings show further that one's sex (p=0.068), training on ICTs (p=0.013), access to social media (p=0.001), extension services (p=0.006), and support from NGOs (p=0.000) were significantly associated with farmers' digital literacy. It is concluded the smallholder farmers had a low level of digital literacy due to a lack of training and skills to make good use of ICT. Therefore, it is recommended that the agricultural and ICT departments in Hai and Moshi Districts and other interested stakeholders should collaborate and conduct awareness campaigns and training in rural areas to enhance digital literacy among smallholder farmers to enable farmers to use ICT and transform their agricultural production.

Keywords: *Digital literacy, ICT, Smallholder farmers, agricultural productivity.*

Received August 2022
Accepted December 2022
Available online April 2023

1.0 Introduction

The fourth Industrial Revolution (4IR) has changed the way things are done globally whereby there is a shift in the way technology, communications, data, and analytics affect the way we live, work and relate to one another. However, to harness the benefits of the 4IR one needs to be digitally literate. Digital literacy is the ability to use information and communication technologies (ICT) to find, create and communicate information (Shopova, 2014). Digital literacy can be determined through technical skills, critical understanding, and communicative abilities (Landmann *et al.,* 2021). Smallholder farmers have limited exposure to digital literacy in accessing, using, and disseminating agricultural-related information with the use of available digital technologies.

Globally, the use of ICT tools such as smartphones has increased hence enabled people to easily access any information needed to improve their performance (Takahashi *et al*., 2020). Generally, the use of ICT in the agricultural sector can help in the reduction of rural poverty and incidences of food insecurity where agriculture is the main source of income (Kremer and Houngbo, 2021). Once smallholder farmers have access to ICT they can establish personal relationships with fellow farmers or actively participate in smallholder farmers' group associations and the exchange of various agricultural information, cooperate and support the production and marketing of agricultural products (Wilson, 2018; Muhangaand Mangasini, 2020).

The advent of digital technologies in sub-Saharan Africa, particularly mobile phones, has opened up new opportunities for rural households to fulfill a variety of development goals, including access to information, markets, and financial services (Aker and Ksoll, 2016). In addition, existing digital technologies provide small-scale farmers with the opportunity of promoting agricultural productivity and household income, particularly in rural areas of developing countries Tanzania included (Livondo *et al*., 2015). Also, the use of ICTs in the agricultural sector can help to achieve meaningful livelihood improvements for Africa's 250 million smallholder farmers (FAO and ITU, 2022).

The agricultural sector in Tanzania is the main employer of the national labour force and the main contributor to the national income (Bashe, 2022). Also, the sector contributes to 24.1 percent of the GDP and 30 percent of export earnings (FAO and ITU, 2022). However, the use of ICTs in this sector is still a problem regardless of the efforts made by the country to make sure that smallholder farmers benefit from their use of them. For example, realizing the value of ICTs in the agricultural sector, 384 tablets were bought by the government in Tanzania and distributed to Agricultural Extension Agents countrywide to improve the development of the agricultural sector and transformation of smallholder agriculture to reduce poverty and achieve economic development (Bashe, 2022). In addition, the government has developed a master plan requiring each village to be

Received August 2022
Accepted December 2022
Available online April 2023

provided with ICT services by 2020 to reduce poverty in rural areas (FAO and ITU, 2022). It is shown that among other factors, low levels of digital literacy have further constrained the advancement of digital transformation in the agricultural sector in developing countries Tanzania included (FAO and ITU, 2022).

Several new digital applications in Tanzania are helping to boost agricultural productivity and growth (Warshauer, 2016). According to Mushtaq *et al*. (2017), digital technology increases access to high-quality inputs, increases access to machinery rental services, individualizes input guidance, improves pest and disease management, and precision farming, and smart farm management and when smallholder farmers have digital literacy it is easy for them to access and disseminate agricultural information to improve their productivity. Although the use of ICT can help bring positive changes in the agricultural sector and hence, improve the well-being of farming households, for this to be a reality, digital literacy is critical (Pye-Smith, 2018). Moreover, many smallholder farmers have a low level of digital literacy and this has hindered their ability to improve their productivity because digital literacy improves farmers' awareness and use of digital technology such as ICTs, and this helps smallholder farmers to obtain the correct information to improve their productivity but this becomes a problem because if they have low digital literacy their productivity will remain low since they cannot obtain important information such as price information and thus increase the exploitation that smallholder farmers face in the market due to lack of access to correct information on prices (Kroese, 2019). According to Ifukor (2013), low digital literacy is a major hindrance to people's use of ICT in improving their livelihoods.

A review of the literature shows that various studies have been conducted on the levels and factors influencing digital literacy among smallholder farmers. For example, Iskandar *et al.* (2020) researched the factors affecting digital literacy in Indonesia, and Kiarie (2020) researched on determinants of digital technologies adoption among small-scale farmers in Kenya. Also, Eskia (2019) researched factors influencing the use of ICTs in accessing market information among smallholder rice farmers in Kilombero District. In addition, AbRahman *et al.* (2021) researched social media literacy among oil palm smallholders in East Malaysia and its association with oil palm integration practices. However, more information on digital literacy levels is supposed to be imparted in Tanzania. Therefore, the current study aimed at determining smallholder farmers' digital literacy and the factors associated with the same using Hai and Moshi Districts as case studies. The two districts are famous for food cash crops and high-value horticultural products hence, the possibility of comparing digital literacy levels by type of crop farmed.

Received August 2022
Accepted December 2022
Available online April 2023

1.2 Theoretical Framework

The study was guided by the Technology Acceptance Model (TAM). The TAM is an information systems theory that shows how users come to accept and use a technology (Chuttur, 2009). In addition, the theory provides an understanding of the predictors of human behaviour towards rejection of, for example, the use of ICT (Eskia, 2019). The TAM suggests that when users are presented with new technology, several factors influence their decision on how and when to use it, such factors include perceived usefulness (if a certain technology will improve their performance), attitude towards the use of a system as well as perceived ease-of-use (if technology is easy to use without putting a lot of efforts). However, the perception may change depending on age and sex because everyone is different (Fathema *et al.,* 2015). The TAM is good at explaining the attitude toward using a certain technology; it also allows the prediction of the intention of use (Assegaff, 2015). In this study, user motivation factors will be applied by looking at perceived usefulness, attitude towards the use of the system, and perceived ease of use.

1.3 Conceptual Framework

In this study, the independent variables were background characteristics of smallholder farmers such as sex, training, extension services, support from NGOs as well as access to social media while the dependent variable was digital literacy. The conceptual framework (Figure 1) for the study assumes digital literacy among smallholder farmers is influenced by their background information such as sex, training, and access to social media. Also on the other hand the farmers' background characteristics can be shaped by extension services and support from NGOs to help get accurate agricultural information. However, the government policy on ICT affects the extension services and NGOs towards supporting farmers in using ICT for agricultural purposes.

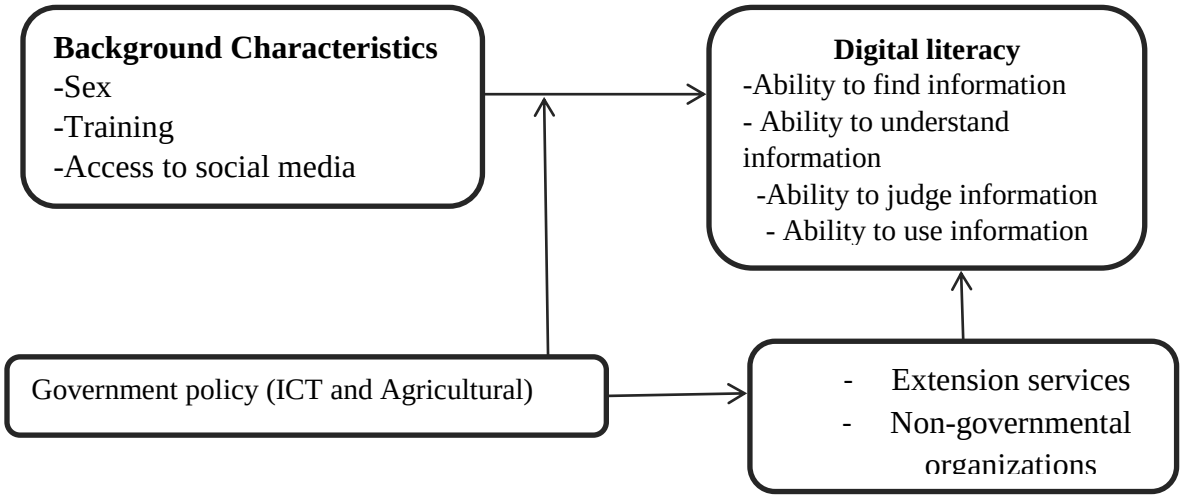

Figure 1: Conceptual framework for the determinants of smallholder farmers' digital literacy

Received August 2022
Accepted December 2022
Available online April 2023

The Conceptual framework of this study assumes that digital literacy among smallholder farmers is positively or negatively associated with individual variables on the use of ICTs. For example, Jotta (2021) found that sex, support from NGOs, and training, have a positive impact on the use of ICTs towards the adoption of agricultural practices. Also, Anoop et al. (2015) found that extension services have a positive impact on the use of ICTs towards the adoption of agricultural practices. In addition, Khumoetsile (2021) found that access to social media has a positive impact on the use of ICTs towards the adoption of agricultural practices. The hypothesized relationships between the independent and the dependent variable are summarized in Figure 1.

2.0 Methodology

2.1 Description of the Study Areas

The study was conducted in Hai and Moshi Districts in Kilimanjaro region. Hai District is located in the northern part of Tanzania (latitude 2º 50' -3º 29'S and longitude 30º 30' -37º 10'E) with a mean annual rainfall of 521±188 mm (n=40 years) and a mean annual temperature of 23.3ºC ± 0.66ºC (URT, 2012). Moshi District is located in the northeastern part of Kilimanjaro region of Tanzania with a latitude of 3º 20' 5.5788"S and a longitude of 37º 20' 25.3752"E (Kajembe *et al*. 2016). Hai and Moshi Districts were purposefully selected due to the high production of both food-cash crops and high-value horticultural products (KIRG, 2017); hence, there was a possibility of comparing digital literacy levels by the type of crop farmed. In addition, the two are not very far from Kenya, which is a good importer of agricultural products such as maize, onions, and tomatoes; hence, there is the availability of markets for their products, and this could be instrumental for use of ICT among smallholder farmers in seeking agricultural information to transform their productivity.

2.2 Research Design, Sampling and Sampling Techniques

The study adopted a cross-sectional research design whereby data were collected once. The design was preferred because it allowed the collection of data once through many ways such as surveys, observation, and interviews (Setia, 2016). The design fits best the current study over the other designs as it allows external validity and can capture and control a large number of variables (Setia, 2016). In addition, data collected using the design can be used to prove or disprove assumptions or can be analyzed to create new theories (Setia, 2016).

The study used a multistage sampling technique to select respondents in the study area. The two districts which were believed to provide useful information for this study were selected purposively in the first stage, followed by a purposeful selection of four administrative wards from each district in the second stage. The third stage which was the last involved the purposeful selection of smallholder farmers with Smartphones and

Received August 2022
Accepted December 2022
Available online April 2023

access to the internet in the study areas. A sample size of 200 respondents was determined by using Cochran's formula (1963) when estimating sample size for an infinite population whereby;

$$n= \frac{z^2 * p * (1-p)}{(d)^2}$$

n=size of sample size,
z= 95% confidence interval (i.e., 1.96),
p= Assumed maximum variability of population proportion which is 15.4%, and
d= acceptable margin error (i.e., 0.05)
Hence n which is a sample size was:

$$n= \frac{1.96^2 \text{ x } 0.154\ (1-0.154)}{(0.05)^2}$$

$$n= \frac{3.8416\text{x } 0.130284}{0.0025} =200.1996058=200$$

Therefore, the study sample size was 200 respondents, 100 from each District.

2.3 Data Collection and Analysis

The study collected both quantitative and qualitative data whereby the former was through the use of a pre-structured questionnaire and the latter was through focus group discussions (FGDs) and key informant interviews (KIIs) from the above-mentioned four wards. The four FGDs involved between six and eight participants which provided room for them to provide their general understanding of digital devices and how they are using them in their production activities. The FGDs were guided by an FGD guide. In addition, according to Nyumba *et al.* (2018), focus groups should not exceed ten participants because large groups are difficult to control and limit each person's opportunity to share insights and observations. Five KIIs were held with people believed to have an in-depth understanding and knowledge about smallholder farmers' digital literacy: this included the District and Ward Extension Officers. A semi-structured interview checklist was prepared to capture important information about main economic activities and sources of income, NGOs and the local government efforts about raising awareness on the use of ICTs, challenges faced by smallholder farmers in the use of ICTs and whether they seek help from experts once they experience those challenges, including, for example, agricultural misinformation.

Quantitative data from the questionnaire were analysed using IBM-SPSS (version 20) whereby descriptive statistics (frequencies, means, standard deviations, and percentages) were determined. Additionally, to measure the level of digital literacy, the study adopted an approach employed by Muhanga, (2020) in his study on health literacy conducted in Morogoro, Tanzania. In his study, health literacy was measured by asking the respondents to state how easy it is to: i.e (find information about symptoms of disease prevention, and health care) and information processing stages (acquisition, comprehension, appraisal,

Received August 2022
Accepted December 2022
Available online April 2023

application) related to health-relevant decision-making and tasks on health and other associated aspects under the interface of environment, animals, and humans. The respondents were required to rank their responses on a scale from very easy to very difficult. A context-specific health literacy assessment tool was developed and employed to assess health literacy, also a matrix that measured health literacy through a 4- point self-reporting scale (very easy, easy, difficult, and very difficult). In addition, an index score to measure health literacy was created. The scores were distributed as: "very easy" response (4 points), "easy" response (3 points), "difficult" response (2 points), and "very difficult" response (1 point). Thus, the above criteria were followed by the computation of scores and categorization of the scores. Also by using IBM-SPSS functions the scores were cut into 3 equal groups to represent health literacy categories inadequate health literacy (IHL), marginal health literacy (MHL), and adequate health literacy (AHL). He also used percentiles values to categorize health literacy. In this study, scores were cut into 3 equal groups to represent digital literacy categories low digital literacy (LDL), moderate digital literacy (MDL), and high digital literacy (HDL).

In this study, the approach used by Muhanga (2020) was modified to measure digital literacy, the respondents were asked to state how easy it is to find information on aspects related to agriculture and information on processing stages (i.e., acquisition, comprehension, appraisal and application) related to improving agricultural productivity. The respondents were required to rank their responses on a scale from very easy to very difficult. A tool was developed by focusing on digital aspects, unlike the study by Muhanga (2020) which was on health literacy. In addition, the STATA software was used for binary logistic regression analysis to determine factors associated with smallholder farmers' digital literacy. The dependent variable was digital literacy while the independent variables were age, sex, education, training, access to social media, extension services, support from NGOs, access to credit, and household size. According to Uyanik and Güler, (2013), the binary logistic regression model used is as presented below:

$$\text{Ln}\left(\frac{\pi}{1-\pi}\right)= \beta_0 +\beta_1 X_1+\beta_2 X_2+\ldots+\beta_n X_n+\varepsilon_i,$$

Whereby:

- Ln= Natural logarithm
- π= Probability that the respondent has digital literacy overpopulation
- $1-\pi$ =Probability that the respondent has no digital literacy
- β_0=Constant
- β_1- β_n = Coefficients to be estimated
- X_1–X_n = Independent variables (Age of the respondents in years, sex, education level in number of years spent in schooling, training, access to social media,

Received August 2022
Accepted December 2022
Available online April 2023

contact with extension agent, support from NGOs, access to credit, and household size in number of respondents living together)

- ε_i= An error term representing a proportion of the variance in the dependent variable that was unexplained by the regression equation (due to inherent errors in the model and other variables which were not entered in the model)

Table 1: Description of variables used in the model

Variable	Type of variable	Expected sign
Age (X_1)	Continuous	+/-
Sex (X_2)	Dummy (1=male, 0=female)	+/-
Education (X_3)	Continuous	+
Training (X_4)	Dummy (1=Yes, 0=No)	+
Access to social media (X_5)	Dummy (1=Yes, 0=No)	+/-
Contact with extension agent (X_6)	Dummy (1=Yes, 0=No)	+/-
Support from NGOs (X_7)	Dummy (1=Yes, 0=No)	+/-
Access to credit (X_8)	Dummy (1=Yes, 0=No)	+
Household size (X_9)	Continuous	-

Content analysis was also used to analyse the Qualitative data from key informant interviews and focus group discussions which were taken in the form of notes. These were transcribed, quoted, and coded. The codes were combined into themes based on the study's specific objectives and research questions.

3.0 Findings and Discussion

3.1 Respondents' Socio-demographic and Economic Characteristics

The socio-demographic and economic characteristics of the sampled population were age, sex, marital status, level of education, household size, main occupation, and other income-generating activities. It is crucial first to comprehend the socio-demographic factors motivating smallholder farmers' level of digital literacy. The result indicates that out of the 100 percent smallholder farmers interviewed, 61.5% (95% CI: 1.32 to 1.45) were males. However, at the district level, 61 and 62 percent of Moshi and Hai Districts respectively were males (Table 2). This implies that in the study area most male farmers were using ICTs. This result is supported by the result of a study by Mazana *et al.* (2021) who found that the majority of smallholders who dominated in the survey were male farmers. Similar results are also reported by Gabriel (2021) who revealed that male farmers were the dominant sex involved in information and technology devices used and agricultural production activities in the study area.

The analysis of age showed that the appropriate classification of age groups was 0-14 years old (pediatric group), 15-47 years old (youth group), 48-64 years old (middle-aged group), and ≥64 years old (elderly group) (Lin, 2020). The study findings (Table 2)

Received August 2022
Accepted December 2022
Available online April 2023

show further that about two-thirds (67%) (95% CI: 2.31 to 2.48) of the respondents belonged to the youth age group. However, at the district level, the youth group was 78 and 56 percent for Moshi and Hai Districts respectively. The variation in age group indicates variation in the decision-making concerning the use of ICTs. This result is supported by the result of a study by Luqman *et al* (2019) who find that majority of smallholder farmers were youth and this implies that the youth age group was more inclined towards information collection/sharing by the use of ICTs.

Table 2 shows that 84% (95% CI: 1.82 to 1.96) of the respondents were married. However, at the district level, it was 84 and 84 percent for Moshi and Hai Districts respectively. The findings in Table 2 imply that married respondents in the study area use much ICT. The finding conforms to Gabriel's (2021) observation that the majority of smallholders were married and with permanent residence hence, enabling them to actively engage in agricultural production. Study findings in Table 2 show further that the majority 48% (95% CI: 2.78 to 3.09) of the smallholder farmers in the study area had primary education. However, at the district level, those with primary education were 51 and 45 percent for Moshi and Hai Districts respectively. In addition, none of the respondents' lacked formal education. Thus, all the respondents were literate hence able to read and follow up on agricultural information presented in the text. The study's finding is in line with what has been reported by Gabriel (2021) that the majority of smallholder farmers in Karagwe District had primary education which enabled them to use ICT devices such as radio, Cellphones, and Television. A study by Luqman *et al.* (2019) also reported that most of the smallholder farmers in rural Punjab and Pakistan had primary education and that very few highly educated individuals were engaged in farming.

Household size was divided into three groups as guided by the UN (2017), the first group was small households (1-2), the second was medium households (3-5) and the third group was large households (6+). Study findings in Table 2 further show about half (48.5%) (95% CI: 2.21 to 2.4) of the surveyed smallholder farmers had medium-sized households. However, at the district level, the distribution of these households was 50 and 47 percent for Moshi and Hai Districts respectively.

Lastly, findings in Table 2 show that the majority of smallholder farmers in the study area (82.5%) (95% CI: 1.22 to 1.49) were engaged in farming activity as their main occupation. However, at the district level farming activity as the main occupation was 79 and 86 percent for Moshi and Hai Districts respectively. This result is consistent with the result by Gabriel (2021) that the main economic activity by smallholder farmers in Karagwe District was farming. However, the study's observation is relatively higher when compared to what has been reported by NBS (2021) that 66 percent of Tanzania's population makes a living from agriculture-related activities.

Received August 2022
Accepted December 2022
Available online April 2023

Table 2: Socio-demographic and economic characteristics of respondents categorized by district level (n=200)

Characteristic	Categories	District		Overall	95% Confidence Interval of the Difference	
		Moshi (n_m=100)	Hai (n_H=100)		Lower	Upper
Sex	Male	61(61)	62(62)	123(61.5)		
	Female	39(39)	38(38)	77(38.5)	1.32	1.45
Age	Youth group(15-47)	78(78)	56(56)	134(67)		
	Middle-aged group (48-64)	19(19)	34(34)	53(26.5)	2.31	2.48
	Elderly group (≥64)	3(3)	10(10)	13(6.5)		
Marital Status	Single	16(16)	13(13)	29(14.5)		
	Married	84(84)	84(84)	168(84)	1.82	1.96
	Widowed	0(0)	1(1)	1(0.5)		
	Separated	0(0)	2(2)	2(1)		
Education level	Primary education	51(51)	45(45)	96(48)		
	Secondary education	31(31)	31(31)	62(31)	2.78	3.09
	Secondary Education (A-Level)	0(0)	1(1)	1(0.5)		
	Tertiary Education	18(18)	23(23)	41(20.5)		
Household size	Small households (1-2)	12(12)	9(9)	21(10.5)		
	Medium households (3-5)	50(50)	47(47)	97(48.5)	2.21	2.4
	Large households (6+)	38(38)	44(44)	82(41)		
Main occupation	Farming	79(79)	86(86)	165(82.5)		
	Small businesses (shops, Kiosk, food vending, and mini-market)	13(13)	5(5)	18(9)	1.22	1.49
	Employed	5(5)	3(3)	8(4)		
	Construction technicians	3(3)	5(5)	8(4)		
	Electrician	0(0)	1(1)	1(0.5)		

Note: numbers in the bracket represent percentage n_m and n_H are sample sizes for Moshi and Hai districts respectively.

Received August 2022
Accepted December 2022
Available online April 2023

Study findings (Table 3) show further that apart from agriculture-related activities, smallholder farmers are also engaged in other income-generating activities that help them to get extra money which could be used to meet ICT's cost to improve agricultural production. A total of eight different activities were mentioned by smallholder farmers. The major ones were small businesses (shops, food vending, and mini-market) which had 25.5%. (95% CI: 4.45 to 5.40) However, at the district level, small business was 33 and 18 percent for Moshi and Hai Districts respectively. This result is in contrast with the result obtained by Urassa (2010) indicating that apart from farming activity, the majority of smallholder farmers are engaged in livestock keeping.

Table 3: Other income-generating activities categorized by district level (n=200)

Characteristic	District		Overall	95% Confidence Interval of the Difference	
	Moshi (n_m=100)	Hai (n_H= 100)		Lower	Upper
Small businesses (shops, Kiosk, food vending, and mini-market)	33(33)	18(18)	51(25.5)	4.45	5.40
Farming	21(21)	14 (14)	35(17.5)	4.45	5.40
Employed	5(5)	6(6)	11(5.5)	4.45	5.40
Construction technician	2(2)	3(3)	5(2.5)	4.45	5.40
Tailor	1(1)	1(1)	2(1)	4.45	5.40
Motorcycle mechanic	3(3)	0(0)	3(1.5)	4.45	5.40
Farm laborer	1(1)	8(8)	9(4.5)	4.45	5.40
Livestock keeping	7(7)	29(29)	36(18)	4.45	5.40

Note: Numbers in the bracket indicate percentages

3.2 Smallholder Farmers' Digital Literacy Levels

Table 3 shows that the mean digital literacy (DL) score is 67.68 per cent while the highest and lowest scores are 188 and 47 per cent respectively with a standard deviation of 39.32. Table 3 further shows that about three quarters (74.5%) (95% CI: 0.68 to 0.81) of the respondents had low digital literacy (LDL), while 0 per cent (95% CI: 0 to 0) were noted to have moderate digital literacy (MDL) and 25.5% (95% CI: 0.19 to 0.32) had high digital literacy (HDL). Table 3 presents DL results into categories.

Table 4: Digital Literacy (DL) Categories (n=200)

DL Categories	Frequency	Percent (%)	95% Confidence Interval	
			Lower Bound	Upper Bound
LDL	149	74.5	0.68	0.81
MDL	0	0	0	0
HDL	51	25.5	0.19	0.32

Received August 2022
Accepted December 2022
Available online April 2023

The study's findings compare with those reported by Iskandar *et al.* (2020) that the highest percentage of farmers belonged to the category of very low thus, suggesting farmers were not yet able to access the internet and use the information available on the internet properly. In addition, AbRahman *et al.* (2021) reported that the highest percentage of oil palm smallholder farmers belonged to the category of low-level digital literacy. Generally, the low digital literacy levels could be a result of many factors including a failure by a large percentage of smallholder farmers to use their ICTs such as smartphones. According to Literature (Iskandar *et al.* 2020; Adamides *et al.* 2013), the farmers' lack of ability to use ICT in the search for agricultural information is mainly caused by a lack of skills and training on the internet. As pointed out in the introduction (sub-section 1.1) access to agricultural extension services in most developing countries Tanzania included is limited. Therefore, to harness the potential benefits of ICT in the transformation of smallholder agriculture there is a need for consorted efforts by governments in developing countries to improve digital literacy and the use of ICT in accessing agricultural information for increased productivity. And if this is not done, the reduction of rural poverty and food insecurity will not be achieved. The above observation is in line with what was observed during one of the KIIs as shown in the quote below;

> *'…The biggest challenge is that many smallholder farmers do not know how to use their smartphones to search for various agricultural information'* (Key Informant, Kahe West, August 2022).

3.3 Factors associated with Smallholder Farmers' Digital Literacy

Binary logistic regression results show that the chi-square for the Hosmer and Lemeshow test was not significant (p-value=0.9678, p>0.05) this means that the overall model was well suited to predicting the outcome (Table 5). The results show that the factors influencing smallholder farmers' digital literacy including sex, training on ICTs, access to social media, access to extension services, and support from NGOs were significant at the 1, 5, and 10 per cent levels respectively (Table 5). On the other hand, the result revealed that farmers' age, education level, access to credit, and household size were insignificant even at 10 per cent.

The coefficient for sex was positive and statistically significant at 10 per cent. The positive sign on the coefficient indicates male farmers have a higher probability of being digitally literate compared to female farmers by 2.53 units. The result suggests that male farmers were the ones who own digital devices thus, making it much easier for them to use ICT in search of agricultural information for increased productivity. The observation is also supported by what was pointed out during the FGDs as shown in the quote below;

> *'…Only a few women use their Smartphones for agricultural purposes, many do not use them because they do not know the importance of these smartphones, especially in agriculture'* (FGD, Masama South, July 2022).

Received August 2022
Accepted December 2022
Available online April 2023

Table 5: Binary logistic regression analysis on factors influencing Digital Literacy

Variable	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Age	1.372	0.804	0.54	0.589	0.435	4.324	
Sex	2.528	1.287	1.82	0.068	0.932	6.859	*
Education	1.295	0.303	1.11	0.268	0.819	2.048	
Training on ICT	6.301	4.662	2.49	0.013	1.477	26.869	**
Access to social media	0.188	0.053	3.531	0.001	0.083	0.294	***
Extension services	4.33	2.32	2.74	.006	1.515	12.375	***
Support from NGOs	0.505	0.137	3.679	0.000	0.234	0.776	***
Access to credit	0.807	0.542	-0.32	0.75	0.216	3.011	
Household size	0.71	0.495	-0.49	.624	0.181	2.787	
Constant	0.012	0.014	-3.61	0	0.001	0.13	***
Hosmer-Lemeshow chi2	2.36		Prob> chi		0.9678		

Notes: * is significant at 10% **, is significant at 5% and *** is significant at 1%

The study's observation that sex has a significant association with digital literacy conforms with what has been reported by Nyamba and Mlozi (2012) who revealed that sex has some influence on digital literacy among smallholder farmers in Kilolo District. The observation seems to suggest that men have a higher digital literacy level than their female counterparts. In addition, according to Nyamba and Mlozi (2012), women were generally categorized as not being technologically suave, and therefore there is a need for agencies and other stakeholders to initiate gender-specific projects in rural areas to promote digital literacy amongst women and reduce digital literacy gap between sexes. These findings are conforming with Technology Acceptance Model (TAM) as explained by (Fathema *et al.,* 2015).

The coefficient for training on ICTs was positive and statistically significant at 5 per cent. The positive sign indicates that smallholder farmers with training in ICTs have a higher digital literacy level than smallholder farmers with no training in ICTs by 6.3 units. Training on ICTs influences the digital literacy of smallholder farmers thus enabling them to benefit from what the internet and other social media have to offer in terms of agricultural transformation. As shown in Table 5, smallholder farmers with training on the use of ICTs were more aware of ICTs use as the source of information and were capable of sharing information with others through WhatsApp. In addition, they were also more capable of using communication tools compared to those without training. Moreover, effective use of the internet and social media needs skills and knowledge on the same. The study's observation is in line with what Iskandar *et al.* (2020) reported that training is an important factor in digital literacy as it increases one's awareness and ability to use ICT. Moreover, training increases one's effectiveness and efficiency in searching for relevant and up-to-date information.

Received August 2022
Accepted December 2022
Available online April 2023

The coefficient for access to social media was positive and statistically significant at 1 per cent. The positive sign suggests smallholder farmers with access to social media have a higher probability of digital literacy than smallholder farmers with no access to social media by 0.19 units. The results also show that smallholder farmers with access to social media such as Facebook and Twitter have a wider room to obtain various agricultural information for the improvement of their productivity compared to those who do not have access to any social media. This observation conforms to the findings by AbRahman *et al.* (2021) that access to social media influences digital literacy and an increase in access to social media also increases agriculture production.

The coefficient for access to extension services was positive and statistically significant at 1 per cent. The positive sign indicates that smallholder farmers with access to extension services have a higher probability of digital literacy than smallholder farmers with no access to extension services by 4.33 units. Table 4 shows that one's access to extension services is associated with digital literacy. Generally, the findings suggest that smallholder farmers with access to extension services are more likely to use ICT because such farmers can be educated on how to share, access, or discuss agricultural information and knowledge through digital platforms. For example, access to information on markets for their produce, prices of inputs, and amount of production demanded by consumers can enable them properly manage their production and increase their profit margins compared to those without access to extension services. The above observation is also supported by what was observed in one of the key informant interviews as shown in the quote below;

> *'…We have started the M-Kilimo programme so that smallholder farmers can get help at any time. M-Kilimo has combined extension officers of different levels from the ward to the national level and the goal is to help smallholder farmers to get information at any time to increase their productivity'* *(Key* informant, Masama South, July 2022).

The above observation is supported by Prayoga (2018) who revealed that the existence of ICT results in a positive impact as it eases farmers' access to information. However, the amount of available information might confuse farmers that, extension agents are very important since they will help them, how select the appropriate information and technologies to apply in their farms through various ways including training them.

The coefficient for support from NGOs was positive and statistically significant ($p \leq 0.001$). The positive sign suggests smallholder farmers who received support from NGOs have a higher probability of being digitally literate than those not receiving such support by 0.51 units. The result shows the support from NGOs on ICT use assisted smallholder farmers hence, a higher likelihood and ability to use ICT to search for agricultural-related

Received August 2022
Accepted December 2022
Available online April 2023

information and use the same to improve their productivity. The assisting NGOs often provided advisory services to smallholder farmers and also provided knowledge and trained them on how to search for relevant and up-to-date information concerning agriculture in general. Thus, those lacking such support were disadvantaged. The study's observation is in line with Aldosari *et al*. (2019) who have reported that NGOs can help to increase farmers' awareness of ICT use since they can train them to use and utilize the same as a source of farming information. And along with the increasing ability to use ICT, the farmers will be able to acquire important information for independent farming developments that will have a further impact on improving their farming performance.

4.0 Conclusions and Recommendations

The study aimed at determining smallholder farmers' digital literacy and the factors associated with the same using Hai and Moshi districts as case studies. It can thus be concluded that the majority of the smallholder farmers had a low level of digital literacy due to a lack of training and skills to make good use of ICT. It is further concluded that there are factors that play a greater role in increasing the level of digital literacy among smallholder farmers such factors include, support from NGOs, access to social media and extension services and if these factors will not be taken into consideration smallholder farmers will suffer with low productivity because they will not be in a good position of acquiring important information such as market information and price of inputs through the use of ICTs. In addition, personal factors such as perceived usefulness, perceived ease of use, and attitude towards the use of the system influence smallholder farmers' motivation for the use of digital literacy as TAM suggests.

Therefore, it is hereby recommended that the agricultural and ICT departments in Hai and Moshi Districts and other interested stakeholders should collaborate and conduct awareness campaigns and training in rural areas to raise the level of digital literacy among smallholder farmers so that they can use ICT to transform their agricultural production. In addition, smallholder farmers need to actively engage in the acquisition of digital literacy as this has the potential of enhancing their fight against poverty and food insecurity through the transformation of their subsistence farming. Lastly, based on the findings of the current study further studies may be necessary for other regions to find other important information that will help to improve the level of digital literacy among smallholder farmers in rural areas of our country.

Received August 2022
Accepted December 2022
Available online April 2023

References

AbRahman, A. H., Abdullah, A., Selvadurai, S., Zakaria, S. Z. S., Lyndon, N., and Abidin, K. (2021).Social Media Literacy among Oil Palm Smallholders in East Malaysia and Association with Oil Palm Integration Practices.*Sustainability*, 13(24): 13802.

Adamides, G., Stylianou, A., Kosmas, P. C., and Apostolopoulos, C. D. (2013).Factors affecting PC and Internet usage by Rural Population of Cyprus. *Agricultural Economics Review*, 14(1):16-36.

Aker, J. C., and Ksoll, C. (2016). Can mobile phones improve agricultural outcomes? Evidence from a randomized experiment in Niger. Food Policy, 60, 44–51.

Aldosari, F., Al Shunaifi, M. S., Ullah, M.A., Muddassir, M., and Noor, M. A. (2019). Farmers' perceptions regarding the use of information and communication technology (ICT) in Khyber Pakhtunkhwa, Northern Pakistan. *Journal of the Saudi Society of Agricultural Sciences*, 18(2): 211-217.

Anoop,M., Ajjan, N. and Ashok, R. (2015). Information and Communication Technologies based Market Information Services in Kerala-Determinants and Barriers of Adoption. *Economic Affairs,* 60(1): 117-.121.

Assegaff, S. (2015). A literature review: acceptance models for e-learning implementation in higher institution. In 2014 International Conference on Advances in Education Technology (ICAET-14). Atlantis Press. (pp. 86-89).

Bashe, H. M. (2022). Speech to present the budget of the ministry of agriculture. [https://youtube/bpxflLMRi4U]. site visited on 1/12/2022.

Chuttur, M. Y. (2009). Overview of the Technology Acceptance Model: Origins, Developments and Future Directions, Indiana University, USA. *Sprouts: Working Papers on Information Systems,* 9(37):

Cochran, W, G., (1963). *Sampling Techniques*-2nd Ed. John Wiley and Sons Inc, New York. USA. 32(3): 100-102.

Eskia, S. (2019).Assessment of factors influencing the use of ICTs in accessing market information among smallholder rice farmers in Kilombero District, Tanzania (Doctoral dissertation, Sokoine University of Agriculture). Pp. 1-39.

Fathema, N. Shannon, D. and Ross, M. (2015)."Expanding the Technology Acceptance Model (TAM) to examine faculty use of Learning Management Systems (LMS)". *Journal of Online Learning and Teaching*, 11(2): 210-233.

Food and Agricultural (FAO) and International Telecommunication Union (ITU) (2022). Status of digital agriculture in 47 sub-Saharan African countries. Rome, Italy: FAO, ITU. [https://doi.org/10.4060/cb7943en] (Accessed: 01 December 2022).

Received August 2022
Accepted December 2022
Available online April 2023

Gabriel, K. P. (2021). Uses of ICT on Marketing of Agricultural produces among Smallholder Farmers in Karagwe District-Kagera Region-Tanzania. (A dissertation submitted in partial fulfilment of the requirements for the degree of master of business administration, agribusiness of Sokoine University of Agriculture. Morogoro, Tanzania). 28(1): 12-13.

Ifukor, M.O. (2013). Channels of information acquisition and dissemination among rural dwellers. [www.academicjournals.org/IJLIS] (accessed on 10 October 2021).

Iskandar, E., Amanah,S.,Hubeis, A.V.S.,andSadono, D. (2020). Factors affecting internet literacy of smallholder cocoa farmers in aceh, *Indonesia.Int.J.Adv.Res.Sci.Eng.Technol,* 29: 4074.

Jotta, S. A. (2021). Influence of Information and Communication Technologies usage on crop productivity among youths' agro enterprises in Misungwi and Kilosa Districts, Tanzania. (Doctoral dissertation, Sokoine University of Agriculture).

Kajembe, J., Lupala, I., Kajembe, G., Mugasha, W., andNuru, F. (2016). The role of selected agroforestry trees in temperature adaptation on coffee Arabica: a case study of the Moshi District, Tanzania. In Climate change and multi-dimensional sustainability in African agriculture. Springer, Cham. (pp. 553-566).

Khumoetsile, O. O. (2021). Effects of Social Media Platforms' Use on Youth Participation in Agriculture in Njoro Sub-Country, Kenya (Doctoral dissertation, Egerton University). Pp. 72-73.

Kiarie, H. (2020). Determinants of digital technologies adoption among small scale farmers in Kenya-a case of Embu and Kirinyaga Countries (Doctoral dissertation, Strathmore University). Pp. 1-79.

Kilimanjaro Region Investment Guide (KRIG) (2017). The United Republic of Tanzania The President's Office Regional Administration and Local Government Kilimanjaro Region. 78pp.

Kremer M., and Houngbo G.F. (2021). World Economic Forum. Grow Back Better? Here's How Digital Agriculture Could Revolutionize Rural Communities Affected by COVID-19. [https://www.weforum.org/agenda/2020/07/digital-agriculture-techn ology] (site accessed on 14 July 2021).

Kroese, N. (2019). Get this weather app on your cell phone Grain SA/Graan SA [https://www.grainsa.co.za/get-this-weather-app-on-your-cell-phone-2] (site accessed on 14 July 2021).

Landmann, D., Lagerkvist, C. J., and Otter, V. (2021). Determinants of small-scale farmers' intention to use smartphones for generating agricultural knowledge in

Received August 2022
Accepted December 2022
Available online April 2023

developing countries: Evidence from rural India. The European Journal of Development Research, 33(6), 1435-1454.

Lin, Z., Yang, R., Li, K., Yi, G., Li, Z., Guo, J., and Huang, G. (2020). Establishment of age group classification for risk stratification in glioma patients. BMC neurology, 20(1), 1-11.

Livondo, L. J., Anderson, K., Macharia, E. W., andOduor, P. O. (2015). Factors affecting communication channels preference by farmers in access of information on the adoption of agricultural technology for Striga control: A case of Bungoma County, Kenya. *International Journal of Current Research*, 7(11), 23057–23062.

Luqman, M., Yaseen, M., Ashraf, S., Mehmood, M. U., and Karim, M. (2019). Factors influencing use of information and communication technologies among farmers in rural Punjab, Pakistan. *Journal of Agricultural Extension*, 23(2), 101-112.

Mazana, M. Y., Tambwe, M. A., Mapunda, M.A., and Kirumirah, M. H. (2021). ICT and Marketing for Agricultural Products: Determinants of Mobile Phone usage to Small Scale Orange Farmers in Tanzania. pp. 34-42.

Muhanga, M., and Mangasini, K., (2020). Resilience and Sustainability of Tobacco Co-operatives in Southern Africa: An eye into Contact Farming in Tanzania, Zimbabwe and Malawi. pp 1-3.

Muhanga. M. I. (2020). Healthy Literacy and Health Behaviour under One Health Approach in Tanzania: Connecting the Connected or Connecting the Unconnected? *East African Journal of Social and Applied Sciences*, 2(2), 124-137.

Mushtaq, S., Reardon-Smith, K., Cliffe, N., Ostini, J., Farley, H., Doyle, J., andKealley, M. (2017). Can digital discussion support tools provide cost-effective options for agricultural extension services? Information Technologies and International Development, 13, 17.

National Bureau of Statistics (NBS) (2021). National sample census of Agriculture 2019/20. National report. 889pp.

Nyamba, S. Y., and Mlozi, M.R. (2012). Factors influencing the use of mobile phones in communicating agricultural information: A case of Kilolo District, Iringa, Tanzania (Doctoral dissertation, Sokoine University of Agriculture).pp. 52-63.

Nyumba, O. T., Wilson, K., Derrick, C. J., and Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and evolution*, 9(1), 20-32.

Received August 2022
Accepted December 2022
Available online April 2023

Prayoga, K. (2018). "The Impact of Information Technology Penetration on The Agricultural Extension Systems Transformation in Indonesia", *Journal SosialEkonomiPertanian*., vol. 11, no. 1, pp. 46–59.

Pye-Smith, C. (2018). How farmers are making the most of digital technologies in East Africa: Stories from the field. CTA Stories from the field.

Setia, M.S. (2016). Methodology series module3: Cross-sectional studies. *Indian journal of dermatology*, 61(3), 261.

Shopova, T. (2014). Digital literacy of students and its improvement at the university. *Journal on Efficiency and Responsibility in Education and Science*, 7(2), 26-32.

Takahashi, K., Muraoka, R. and Otsuka, K. (2020) 'Technology adoption, impact, and extension in developing countries' agriculture: A review of the recent literature', *Agricultural Economics*. *Blackwell Publishing Ltd*, 51(1), pp. 31–45. doi: 10.1111/agec.12539.

United Nations (UN) (2017). Department of Economic and Social Affairs, Population Division. Household Size and Composition Around the World- Data Booklet (ST/ESA/SER.A/405). 36pp.

Urassa, J.K. (2010). Rural household livelihoods, crop production and well-being after a period of trade reforms: a case study of Rukwa, Tanzania (Doctoral dissertation, University of Sussex). Pp. 7-8.

Uyanic, G. K., and Güler, N. (2013). A study on multiple linear regression analysis.*Procedia-Social and Behavioral Sciences*, 106, 234-240.

Warshauer, W. (2016). How Digital Is Solving 3 Problems in Agriculture. World Economic Forum. [https://www.weforum.org/agenda/2016/01/how-digital-is-solving-3-problems-in-agriculture] (Accessed on 14 July 2021).

Wilson, M. (2018). Digital Identify for Smallholder Farmers: Insights from Sri Lanka. GSMA. [https://www.gsma.com/mobilefordevelopment/programme/digital-identify/digital-identify-for-smallholderfarmers-insights-from-sri-lanka-2]. (accessed on 01.05.2022).

Received August 2022
Accepted December 2022
Available online April 2023