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. Therefore, the paper assesses smallholder farmer's 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 (SPSS) version 26, and content analysis was used for qualitative data. The findings show 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 show 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 types of agricultural information using multiple sources, 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.

Keywords: Agricultural information, ICT, Smallholder farmers, Tanzania.

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 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, although access to agricultural information is crucial for smallholder farmers to increase agricultural productivity and revenues at both household and national levels, there is a lack of knowledge regarding the usage of social media and the internet to access agricultural-related information among smallholder farmers in Tanzania. Therefore, the study, upon which this paper is based, aimed to assess the sources and types of agricultural information accessed by smallholder farmers in Lushoto and Korogwe districts, Tanga Region 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; Kamara, 2017).

Furthermore, although access to agricultural information is crucial for smallholder farmers to increase agricultural productivity and revenues at both household and national levels, there is a lack of knowledge regarding the usage of social media and the internet to access agricultural-related information among smallholder farmers in Tanzania. Therefore, the study, upon which this paper is based, aimed to assess the sources and types of agricultural information accessed by smallholder farmers in Lushoto and Korogwe districts, Tanga Region.

Materials and Methods

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 the most important food/cash crops including maize, paddy, beans and potatoes, and cash crops such as 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.

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; Groenewald, 2021).

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.

$$\left(Z_{\frac{\alpha}{2}}\right)^2 P \times \left(\frac{1-P}{e^2}\right) \quad (1)$$

Where:

n = sample size,

$\left(Z_{\frac{\alpha}{2}}\right)$ = 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,

$$n = \frac{1.962 \text{ x } 0.5(1-0.5)}{(0.0692)^2}$$

= 3.8416 x 0.130284 = 200.

Data Collection

The study employed the mixed methods approach in data collection whereby quantitative and 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.

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:

$$Y = ln\left(\frac{p}{1-p}\right) \frac{e^{\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\cdots+\beta_{16}X_{16}}}{1-e^{\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\cdots+\beta_{16}X_{16}}}$$

Where:

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

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

β_0= constant coefficient,

β_1-β_{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).

Results

Respondents' Socio-economic and Demographic Characteristics and the 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 1 and Figure 1. Results in Table 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%). Table 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.

The study findings (Table 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. 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 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. 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 1).

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

Results in Table 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. More than half (64.1%) and (56.7%) smallholders' farmers 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.

Type of Crops Grown by Smallholder farmers in Tanga Region

The results in Table 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 3.

Types of Agricultural Information Accessed by Smallholder Farmers from social media and the Internet

The study findings (Fig. 1) show that on average less than a quarter (1 – 23.5%) of all the respondents accessed their agricultural information on improved seed varieties, market, best farming methods, pest management, agricultural incentives, fertilizers and agricultural tools from social media and the

Table 1: Respondents Socio-economic and Demographic Characteristics and their Source of Agricultural Information (n = 200)

	Characteristic	Phone (n_p=64)	Radio (n_R=1)	TV (n_T=10)	Social media/ internet (n=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's 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

Table 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)

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

Table 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
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

internet. Generally, at the district level 3 – 33% and 1 – 20% did so in Lushoto and korogwe districts respectively.

pest management, fertilizers and markets respectively. In addition, Korogwe district did relatively better compared to Lushoto district

Table 3.Frequencies on 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: nL and nk refer to the sample sizes for Lushoto and Korogwe districts respectively.

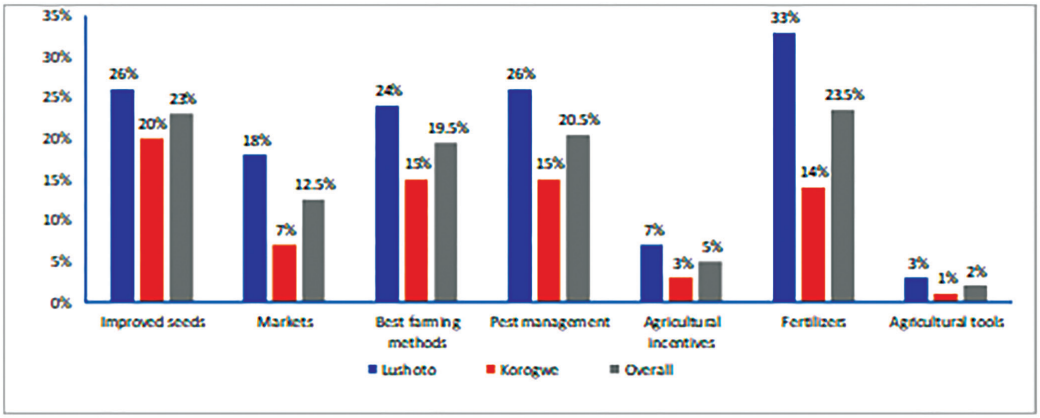

Figure 1: Types of agricultural information accessed by smallholder farmers from social media and the internet

Smallholder Farmers access to Agricultural Information by type of social media and the Internet

Study findings in Table 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, as shown in Table 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.

Table 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

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 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 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 the internet when searching for the above-mentioned agricultural information. 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.

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

Binary logistic regression results (Table 6) show that the model was able to explain 85% of the factors associated with smallholder farmers

Table 5: Cross-tabulation results, for the frequency distribution for the farmers access of agricultural information through social media and the internet (n = 200)

Variables		District						Difference		
		Lushoto		Korogwe		Overall		Chi-square	Df	P-value
		No	Yes	No	Yes	No	Yes			
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	.155b
	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	.206b
	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.*

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 6.

Table 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 binary logistic findings (Table 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 that farmers were less likely to use social media and the internet to access agricultural incentives associated information and vice versa.

The findings in Table 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.

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 use 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 (Figure, 1). 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 horticultural crops such as tomatoes, and cabbage.

Discussion

Generally, these characteristics have some influence on smallholder farmer's access to sources of agricultural information (Silayo, 2016; Hudson *et al.,* 2017). 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).

Moreover, 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).

According to Yaseen *et al.,* (2016) a smallholder farmer 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). Furthermore, 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

Table 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*

and the internet.

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).

According to Öztürk, (2021), Low digital literacy hinders smallholder farmers from participating on agriculture e-learning which would improve their production.

The observation 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 improved seed types of 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).

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).

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.Furthermore,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).

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).

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).

Conclusion and Recommendations

This study highlights the critical importance of access to agricultural information for smallholder farmers in Lushoto and Korogwe

Districts, Tanga Region. The findings indicate that a significant number of surveyed farmers still rely on traditional sources, such as relatives/ neighbours, radio, agricultural officers, and television, to access agricultural information. Only a minority of farmers utilize social media and the internet for this purpose. The study also reveals that certain types of agricultural information, such as improved seed varieties, market information, best farming methods, pest management, and manure, are highly sought after by those who access information through social media and the internet. Additionally, binary regression analysis indicates that smallholder farmers are more likely to use social media and the internet when seeking information about fertilizer, improved seeds, and agricultural incentives.

Despite the potential benefits of information and communication technology (ICT), the research underscores that the adoption of ICT tools by smallholder farmers to address their agricultural information needs remains limited. This highlights the challenges faced by farmers in accessing agricultural extension services. To address this limitation and empower smallholder farmers with the necessary tools and knowledge, the study recommends that the government, agricultural sector stakeholders, and development partners actively promote digital literacy among farmers. By enhancing their digital skills and familiarity with ICT, farmers can leverage technology to overcome information gaps and improve agricultural productivity.

Overall, this research emphasizes the need for targeted interventions and support to bridge the digital divide in the agricultural sector. Encouraging the use of social media and the internet for accessing agricultural information can play a crucial role in enhancing smallholder farmers' livelihoods, promoting sustainable agricultural practices, and ultimately contributing to food security and economic growth in the region.

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References

Aktar, I. and Millia, J., (2016). Research in Social science interdisciplinary perspectives. Research design. Delhi-India.

Aldosari, F., Shunaifi, M.S., Ullah, M.A., Muddassir, A. and linoor, M. (2017). Farmers' perceptions regarding the use of Information and Communication Technology (ICT) in Khybe Pakhtunkhwa, Northern Pakistan. *Journal of the Saudi Society of Agricultural Sciences.Pakistan.* [https://doi.org/10.1 016/j. jssas.2017 .05.004]. [29/05/2022].

Antony, A.P., Leith, K., Jolley, C., Lu, J., and Sweeney, D. J., (2020). A Review of Practice and Implementation of the Internet of Things (IoT) for Smallholder Agriculture. USA. [https://doi.org/10.3390/ su12093750]. [26/05/2022].

Asamoah, G., Adade, A. and Ayikpah, Y., (2021). Effect of Emotional Intelligence variables on investor behaviour in Ghana. [www.researchgate.net]. [04/09/2022].

Ayoola, B.J. and Ayoola, G.B., (2015). An Assessment of Factors Influencing the Use of Information and Communication Technologies in Maize Marketing. Institute of Food Security, University of Agriculture Makurdi. Benue State. Nigeria.

Bandura, A. (1969). Principles of Behavior Modification. New York: Holt, Rinehart and Winston. USA.

Bandura, A. (1986). Social Foundations of Thought and Action. Englewood Cliffs, NJ: Prentice-Hall. USA.

Brown, B., (2018). Why do information gaps persist in African smallholder agriculture? Perspectives from farmers lacking exposure to conservation agriculture. *The Journal of Agricultural Education and Extension. Australia.* [https://doi.org/10.1080/138922 4X.2018.1429283]. [30/05/2022].

Cochran, W,G., (1963). Sampling Techniques-2nd Ed. John Wiley and Sons Inc. New

York. USA.

FAO (Food and Agriculture Organization)., (2015). Success stories on information and communication technologies for rural development. Bangkok. Thailand. [https://www.digitalgreen.org/wpcontent]. [24/05/2022].

FAO (Food and Agriculture Organization)., (2017). Realizing the potential of digitalization to improve the agri-food system. Proposing a new International Digital Council for Food and Agriculture. A concept note. Rome. Italy.

FAO (Food and Agriculture Organization)., (2020). Realizing the potential of digitalization to improve the agri-food system. Proposing a new International Digital Council for Food and Agriculture. A concept note. Rome. Italy.

Franzel, S, Degrande, A, Kiptot, E, Kirui, J, Kugonza, J, Preissing, J, and Simpson, B., (2018). Farmer to farmer extension-What works in rural advisory services? Global good practices notes. Lausanne. Switzerland.

Gebru, B., Mammo, Y. and Aregawi, T., (2016). Agricultural Information Needs and Seeking Behaviour of Smallholder Farmers of Tanqa Abergelle Wereda Central Zone of Tigray. Ethiopia. [http://localhost:8080/xmlui/handle/123456789/3350]. [30/05/2022].

Godwin, J. L., Williams, F. E., Aslam, N., Cardey, S., Dorward, P. and Almas, M., (2018). Gender differences in use and preferences of agricultural information sources in Pakistan. Punjab. Pakistan. *The Journal of Agricultural Education and Extension.* [https://doi.org/10.1080/1389224X.2018.1491870]. [20/07/2022].

Gonte, K,D.,(2018). Application of social media in advertising fresh fruit and vegetable products in Ahmednagar district. Ahmednagar. *International Journal of Modern Trends in Business Research.* Pages 16-27.

Groenewald, C., (2021). Social Learning Theory Explained. New York. USA.

Hazell, P. and Hess, U., (2017). Beyond hype-Another look at index-based agricultural insurance. In Agriculture and Rural Development in a Globalizing World. London. United Kingdom.

Heldreth, C., Akrong, D., Holbrook, J., and Su, N,M. (2021). What does AI mean for smallholder farmers? a proposal for farmer-centered AI research. India. [doi: 10.1145/3468004]. [25/5/2022].

Hoang, H,G., (2020). Determinants of the adoption of mobile phones for fruit marketing by Vietnamese farmers. Vietnam.

Hudson, H. E., Leclair, M., Pelletier, B. and Sullivan, B., (2017). Using radio and interactive ICTs to improve food security among smallholder farmers in Sub-Saharan Africa. Telecommunications Policy. [https://doi.org/ 10.1016/ j. telpol.2017 .05.01]. Site visited 3/9/2021. Pages 41(7-8), 670–684.

Idiku, F.O., Eta, H,C, and Elemi, G.F., (2021). "Utilization of New Media for Agricultural Information by Farmers in South-South Nigeria". Library Philosophy and Practice (e-journal). Lagos. Nigeria. [6449. https://digitalcom mons.unl.edu/libphilprac/6449]. [28/05/2022].

Isaya, E.L., Agunga, L. and Sanga, C., (2018). Sources of agricultural information for women farmers in Tanzania. Morogoro. Tanzania. [doi:10.1177/0266666916675016]. [27/05/2022].

Israel, G,D., (1992). Sampling the Evidence of Extension Program Impact. Program Evaluation and Organizational Development. University of Florida. USA.

Kamara, A, Conteh, A., Rhodes, E. R. and Cooke, R, A., (2019). The Relevance of Smallholder Farming to African Agricultural Growth and Development. *African Journal of Food, Agriculture, Nutrition and Development.* [doi:10.18697/ajfand.84. blfb1010]. Site visited on 3/1/2023.

Kanjina, S., (2021). Farmers' Use of social media and its Implications for Agricultural Extension. Evidence from Thailand.Chiang Mai.Thailand. *Asian Journal of Agriculture and Rural Development.* [doi:10.18488/journal. A jard.2021.1 14.302.3 10]. Site visited on 3/9/2022.Pages 302-310.

Kwapong, N., Ankrah, D. A., Boateng-Gyambiby, D., Asenso-Agyemang, J., & Oteng Fening, L., (2020). Assessment of Agricultural Advisory Messages from Farmer-to-Farmer in Making a Case for Scaling Up Production: A Qualitative Study. The Qualitative Report, 25(8), 2011-2025.

Makau, B. K. and Akaranga, S. I., (2016). Ethical Considerations and their Application to Research: A Case of University of Nairobi. *Journal of Educational Policy and Entrepreneurship Research.* [profiles. uonobi.ac.ke]. Site visited on 2/9/2022.

Makawia, P, J., (2018). Agricultural Information Needs and Their Accessibility to Sesame Producers in Morogoro District. Morogoro. Tanzania.

Misaki, E., Apiola, M. and Gaiani, S. (2017). Technology for Small Scale Farmers in Tanzania: A Design Science Research Approach in Dodoma. Dodoma. Tanzania. [https://doi.org/10.1002/j.1681-4835.2016.tb00538.x]. [27/05/2022].

Mojaki, R.A. and Keregero, K.J.B., (2019). Turning challenges into opportunity: Potential for Information needs and accessibility by fish farmers in the southern highlands of Tanzania. Dar es salaam. Tanzania.

Mtega, W.P. and Ngoepe, M., (2017). Strengthening the flow of agricultural knowledge among agricultural stakeholders in Morogoro region Tanzania. Morogoro. Tanzania.

Mubofu, C.M. and Elia, E., (2016). Disseminating agricultural research information. Case study of farmers in Mlolo- Lupalama and Wenda villages in Iringa district Tanzania. *University of Dar es Salaam Library Journal.* Dar es salaam. Tanzania. Pages 80-97.

Mwantimwa, K., (2020). Livelihood Information and Knowledge Needs. Access and Exchange among Rural Communities in Bunda District, Tanzania. Rural Society. Mara. Tanzania. [doi: 10.1080/10371656.2020.1744271]. [05/05/2022].

Nzonzo, D., and Mogambi, H. (2016). An analysis of communication and information communication technologies adoption in irrigated rice production in Kenya. *International Journal of Education and Research.* Kenya. Pages 295-316.

Öztürk, G., (2021). Digital citizenship and its teaching: A literature review. Journal of Educational Technology & Online Learning. Balıkesir University.Turkey. [http://dergipark.org.tr/jetol]. Site visited on 27/9/2021.Page 4(1), 31-45.

Rahman, A.B. Abdullah, A.H., 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. Malyasia. [https://doi.org/10.3390/su132413802]. [25/05/2022].

Sanga, C., (2018). E-Agriculture Promising Practice. Ushauri Kilimo information system Web and mobile phones for extension services in Tanzania. Morogoro. Tanzania.

Setia, M.S.,(2016). Methodology Series module 3. Cross sectional studies. Indian journal of Dermatology 61(3).261-264.India. [www.researchgate,net.]. [04/09/2022].

Silayo, E.P., (2016). Assess to and use of agricultural information in poverty alleviation. a case of agro pastoralists in Kilosa and Monduli districts. Dar es salaam. Tanzania.

Thar, S.P. Ramilan, T., Farquharson, R.J., Pang, A. and Chen, D., (2021). An empirical analysis of the use of agricultural mobile applications among smallholder farmers in Myanmar. Mynamar. Burma.

United Republic of Tanzania (URT)., (2017). Country Programming Framework for United Republic of Tanzania. Tanzania.

World Bank (WB)., (2020). Digital solutions in a time of crisis. The World Bank Group. Washington. DC.

Yaseen, M., Xu, S., Yu, W. and Hassan, S., (2016) Farmers' Access to Agricultural Information Sources: Evidences from Rural Pakistan. *Journal of Agricultural Chemistry and Environment.* [doi: 10.4236/jacen.2016.51B003]. [28 May 2022].

Zhang, Y., Wang, L. and Duan, Y. (2016).

Agricultural information dissemination using ICTs Information Processing in Agriculture. China. [http://dx.do i.org/10.10 16/j.inpa.2015.11.0002]. [23/5/2022]. Page 17–29.