Open Journal of Business and Management, 2022, 10, 3436-3454
https://www.scirp.org/journal/ojbm
ISSN Online: 2329-3292
ISSN Print: 2329-3284

Assessing the Effect of ICTs on Agriculture Productivity Based on the UTAUT Model in Developing Countries. Case Study of Southern Province in Zambia

Precious Nkandu[1], Jackson Phiri[2]

[1]Graduate School of Business, University of Zambia, Lusaka, Zambia
[2]Department of Computer Science, University of Zambia, Lusaka, Zambia
Email: nkandup@yahoo.com, jackson.phiri@cs.unza.zm

How to cite this paper: Nkandu, P., & Phiri, J. (2022). Assessing the Effect of ICTs on Agriculture Productivity Based on the UTAUT Model in Developing Countries. Case Study of Southern Province in Zambia. *Open Journal of Business and Management, 10*, 3436-3454.
https://doi.org/10.4236/ojbm.2022.106169

Received: September 20, 2022
Accepted: November 19, 2022
Published: November 22, 2022

Copyright © 2022 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/
Open Access

Abstract

The study was assessing the effect of Information and Communications Technology (ICTs) on agriculture productivity in Zambia's Southern Province based on the Unified Theory of Acceptance and Use of Technology (UTAUT) Model. Additionally, the study focused on highlighting social economic factors that influence adoption of ICTS. The sample was drawn from small scale farmers in Mazabuka and Monze districts of Southern Province. The study used a mixed method approach and used a multi-stage sampling procedure to draw the sample. Data was collected using both qualitative and quantitative responses using both closed ended and open ended questionnaire generated based on the UTAUT conceptual framework. The response rate was 94% from both Mazabuka and Monze districts. The research utilised the Statistical Package for the Social Sciences (SPSS) software and used Regression and Pearson Correlation to analyse the data. Pearson Correlation analysis showed that Performance Expectancy (R = 356**, P-Value = 0.000), Social Influence (601**, P-Value = 0.000) and Facilitating Conditions (R = 0.647**, P-Value = 0.000) and Effort Expectancy (R = 0.185**, P-Value = 0.001) are all positively correlated to behavioural intention. Similarly, regression analysis results were less than the significance level of 0.005 therefore, it was inferred that there is significant impact of all the independent variables on behavioural intention. The research also concluded that there is a relationship between ICT adoption and productivity.

Keywords

Information and Communications Technology, UTAUT Model, Agriculture, Adoption, Productivity, Zambia

1. Introduction

The global population is projected to grow from some 7.3 billion today to almost 9.8 billion by 2050, with most of that increase coming in the developing regions. In low-income countries, the population may double to 1.4 billion. Feeding humanity will require a 50 % increase in the production of food and other agricultural products between 2012 and the mid-century (United Nations, 2019).

Agriculture remains a crucial sector in ensuring food security and contributing to world economies. However, the agriculture sector continues to safer shock and cannot keep up with the growing population. New projections confirm that hunger will not be eradicated by 2030 unless bold actions are taken to accelerate progress, especially actions to address inequality in access to food (FAO, 2021).

Bank (2022) highlights that agriculture-driven growth, poverty reduction, and food security are at risk: Multiple shocks—from COVID-19 related disruptions to extreme weather, pests and conflicts—are impacting food systems, resulting in higher food prices and growing hunger.

Oyelami (2020) notes that many developing countries especially in Africa depend heavily on agricultural sector to generate employment and earn foreign incomes. Despite this huge contribution from agriculture, the sub-region is not total food secure as about 80% of the Sub Sahara Africa population's food requirements are met by regional produce.

In study Ayed (2020) highlights that weather and climate change conditions, together with the sustainable water management due to water scarcity, are crucial challenges in the next years. For these reasons, urgently, the establishment of a strategic shift from the current paradigm of enhanced agricultural productivity to agricultural sustainability is needed.

Many studies have revealed that the application of ICTs to the agricultural sector, which is mostly considered as the largest economic sector in Africa, has resulted into increase in productivity usage of new high yield variety seeds, chemical fertilizers and other inputs (Oyelami, 2020).

1.1. Statement of the Problem

About 70% of the African population depends on Agriculture for their livelihood. Nonetheless, agriculture productivity is low and food security is still a challenge (Ayim, 2022).

In Zambia, more than half of the country's 17.8 million people live below the poverty line. 48% of people are unable to meet their minimum calorie requirements and 35% of children are stunted. Climate change effects continued to impact agricultural production, especially among Zambia's 1.5 million smallholder farming households due to over-reliance on rain-fed production and maize monocropping (WFP, 2022), an equally significant note in the Eighth National Development Plan (8NDP) (Planning, 2022).

The implementation of e-agriculture in other countries shows that ICT can indeed bring benefits to the agriculture sector (Phiri et al., 2019) and that the strategic use of ICTs has significant positive effects if they are implemented within the right context and under the appropriate conditions. A study by Sennuga (2020) to establish impact of ICTs on agriculture productivity in sub-Saharan countries revealed that ICTs increased productivity and standard of living among small scale farmers. Another study undertaken in Zambia by Mwalupaso (2019) indicated that use of mobile phones had a significant and positive impact on farmers' technical efficiency and increased use led to reduced poverty and extreme poverty.

It is with this backdrop that the research will investigate the effects of ICTs on agriculture productivity using the UTAUT model.

1.2. Conceptual Framework

Technology adoption is crucial to economic growth, yet levels of technology adoption vary, with limited adoption in many countries. Countries wield considerable technology adoption power and their adoption activities can be leveraged to achieve social, economic, and environmental goals by endorsing specific technologies (Hooks et al., 2021).

While adoption of technology in agriculture is fundamental to improving farm productivity, vast literature shows that adoption levels of externally promoted technologies remain low and the pace of adoption is very slow among small-scale farmers in developing countries (Curry et al., 2021). Determinants of adoption are highly dependent on unobserved cultural, contextual, and policy factors, which is evidenced by the small average effects, the large amount of unexplained heterogeneity in all of the average results presented, and the inability of observed factors to explain much of this variability (Ruzzante, 2021).

The proposed conceptual framework for this research is the Unified Theory of Acceptance and Use of Technology (UTAUT) Model. This model consists of six main constructs, namely performance expectancy ("PE" hereafter), effort expectancy ("EE" hereafter), social influence (SI), facilitating conditions (FC), behavioral intention ("BI" hereafter) to use the system, and usage behavior. The UTAUT model contains four essential determining components and four moderators. According to the model, the four determining components of BI and usage behavior are PE, EE, SI, and FC (Venkatesh et al., 2003).

PE refers to "the degree to which an individual believes that using the system will help him or her to attain gains in job performance. SI refers to "the degree to which an individual perceives those important others believe he or she should use the new system". EE refers to "the degree of ease associated with the use of the system" and FC to "the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system" (Abbad, 2021).

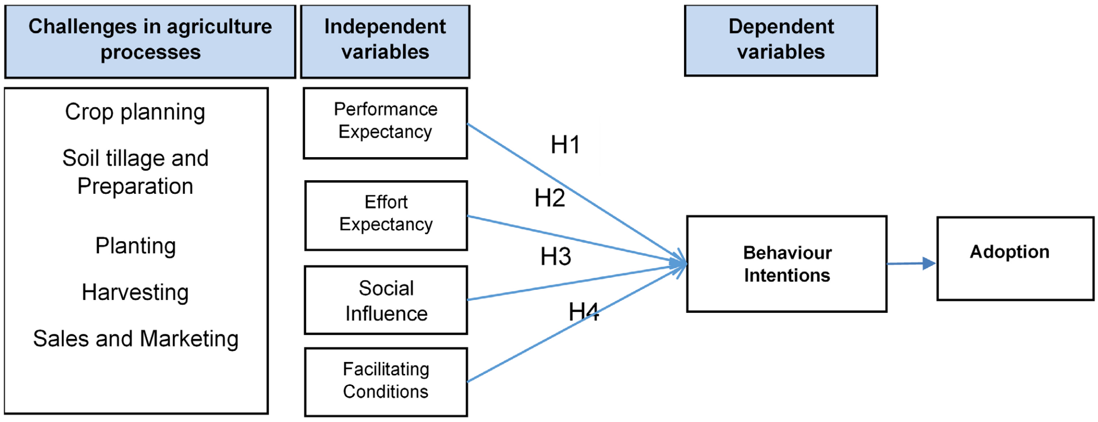

Figure 1. Adapted UTAUT model.

Using the UTAUT model (**Figure 1**), Venkatesh refers to the extent to which an individual believes that the use of technology facilitates performing a task of improves his or her job performance and has a positive effect on an individual's behavioral intention to use (Michels et al., 2019).

2. Literature Review

Various studies have concluded that the use of ICTs in agriculture has valuable and positive contributions in terms of increasing efficiency and productivity. Understanding the socio-economic factors that influence adoption of ICTs in agriculture is the focus of this research coupled with assessing effect on productivity. The literature for this research explores studies undertaken on this topic, major findings and gaps.

2.1. Definition of ICTs

There is no single definition for Information & Communication Technology. Pratt (2022) defines ICTs as the infrastructure and components that enable modern computing. UNESCO (2009) defined Information and Communication Technology (ICT) as the use of computers and other electronic equipment and systems to collect, store, use, and send data electronically.

For the purpose of this research, ICT will be defined as any communication device or application, encompassing radio, television, cellular phones, computer and network hardware and software, satellite systems used in the agriculture sector.

2.2. Use of ICT in Agriculture

There is an increasing body of evidence that demonstrates that the strategic use of Information and Communication Technologies (ICTs) have a great impact on agricultural productivity.

Hanson (2020) in their study assessed the impact of ICTs on Agriculture in rural resilience acknowledged that Agriculture is the key economic livelihood in developing countries. Agriculture further presents the best mechanism to alleviate poverty, improve food security and more generally improve the livelihoods of rural populations. However, due to lack of access to resources and the weakness of their institutions, rural communities are particularly vulnerable to both short and long term shocks.

In another study, Domguia (2021) showed empirical results that ICT use measured by Internet, mobile and fixed-line telephone penetration boosts the agricultural sector enormously. In addition, the mediation analysis revealed that ICTs not only have a direct positive effect on agriculture but also a positive indirect effect through its impact on financial development and trade openness and a negative indirect effect through energy consumption. However, the total effect is positive and shows that ICTs are supporting the development of the agricultural sector in sub-Saharan Africa.

Masambuka-Kanchewa et al. (2020) in a study undertaken in Malawi and Kenya to examine farmers' perceptions regarding the role of extension agents in the diffusion of innovations, agriculture is acknowledged as an important sector for these countries' economies. Unfortunately, the low productivity of small farms is still cited as a challenge in these countries (as well as other developing countries) despite the existence and implementation of new extension policies due to the low adoption rates of improved technologies. Addressing this challenge requires a shift in approach when delivering agricultural extension services through ICTs.

A study carried out by Chowhan (2020) in Bangladeshi on the role of ICT in agriculture and its future scope noted that ICT was highlighted as a dispensable tool to fight poverty. Consequently, it is also understood that ICT can enhance the contribution to agriculture and rural development tremendously. ICTs can efficiently be used for collecting and sharing timely and accurate news on weather, inputs, markets, and prices; by feeding information into research and development initiatives.

Empirical analysis from a study undertaken to review the impact of ICTs on agricultural production in Bangladesh on various food crops suggests that ICTs play a significant role in enhancing agricultural production. The ICT tools are regarded as the best means of communication which play a vital role in making agriculture more efficient and effective. Data on the production aspects were analysed and correlated with the ICT and non-ICT groups and with the counterfactual conditionals which take the generic form of difference in differences was carried out. The research results highlighted that the use of ICT tools remains a significant contributor to agricultural growth. The survey results show that the use of ICT tools varies from the ICT service area to the non-ICT one (Das, 2017).

Chibsa (2020) in a study to review the impact of ICTs on improving agricultural productivity and rural incomes in Ethiopia highlighted the positive relation between ICTs and agricultural production. Specific to note was the rapid development of ICT and how it facilitated the flow of data and information and tremendously enhanced the knowledge management practice in agriculture.

Sennuga (2020) stated that the use of ICTs and specifically SMS text reminders had a significant impact on productivity among small scale farmers. A large proportion (92%) of the respondents reported that the ICT use specifically, SMS text reminders was beneficial and prompted them to adopt and implement the recommended Good Agricultural Practice (GAP) technologies, which could be attributed to substantially increase yields.

A study to investigate the impact of land accessibility and ICTs on agricultural production in South Africa by David & Grobler (2019) highlights that access to information and communication technology (ICT) for agricultural activities can be promoted and made easier since ICT promotes productivity.

A study by Ali (2016) carried out in Kapiri Mposhi of Zambia's central province on the impact of ICTs on agricultural productivity revealed that the use of ICTs on agricultural productivity was positive. Out of 117 farmers sampled, 87.17% were using a mobile phone; 71.79% were using radio and 47% were using television. For this study, two ICTs have been identified namely mobile phones and radio as they are the most commonly used and accessible among small scale farmers.

Shrivastava (2018) reveals that ICTs deliver clear gains for rural households. Studies of the impacts of ICTs on rural households have shown a wide range of positive impacts, including time and cost savings. The study suggests that where a vast section of the population is below the poverty line, ICT offers a chance to empower these people and transform them into productive human capital.

Kumar (2018) in a study undertaken in India also demonstrated that ICTs provides simple and cost-effective techniques for farmers to enable precision agriculture and proposed the state of art in agriculture field which will guide the rural farmers to use ICTs. Big data analytics can be customized to improve the quality of crops which improves the overall production rate.

2.3. Factors that Influence Adoption of ICTs

Several factors have been identified that affect and influence the adoption of ICT among small scale farmers.

Technology adoption and innovation amongst small-scale farmers in developing countries are often associated with modernisation and development which can challenge indigenous moral values and agricultural practices in fundamental ways. For example, with modernisation there is generally a pull towards an emphasis on the individual, market relations, individual property rights and monocropping agricultural systems: such transitions may not be easy to make for communities where importance is placed on the group, indigenous economic relations, collective property rights and mixed cropping systems (Curry et al., 2021).

In another study undertaken in Cape town South Africa, it was established that socio-economic and institutional factors influence the use and adoption of

ICTs by livestock farmers. 76 % of the respondents indicated poor eyesight as a barrier to using Lack of internet connectivity, access and education were the major barriers listed in the study (Mdoda, 2022).

In a similar study carried out in Kenya to assess use of ICT among extension, workers, it was established that improved productivity expectancy was the greatest indicator of technology adoption in the context of extension farmers (Kahenya, 2014).

In a study carried out by El Bilali & Allahyari (2018), it was concluded that ICT can contribute to agro-food sustainability transition by increasing resource productivity, reducing inefficiencies, decreasing management costs, and improving food chain coordination which encouraged adoption among farmers.

2.4. Status of ICT in Zambia's Agriculture

The ICT sector saw growth following the establishment of a National ICT policy for regulating the telecom sector in Zambia in 2006. Like other countries in the region, Zambia has devised strategies to implement e-government at a full scale (Undi-Phiri & Phiri, 2022).

Currently, ICTs are gaining millage especially under the Farmer Input Support Programme (FISP) for input redeeming and dissemination of extension messages. Following the launch of E-FISP, government switched from in-kind agricultural input subsidies to an electronic voucher was intended to improve farmers' access to and use of modern inputs, and, by allowing them choice over what inputs to purchase, and allow them to move away from maize (Tossou, 2021).

The e-FISP has been implemented in a bid to transform the agricultural sector by having an input subsidy programme that addresses the diverse needs of different farmers country-wide and thus spur agricultural diversification. However, citing some implementation challenges such as limited access to information technology, telecommunications connectivity, and challenges in the provision of financial services, the government decided to scale down the e-FISP implementation from 100% in the 2017/2018 season to 60% in the 2018/2019 season, and further down to 40% in the 2019/2020 agricultural season (IAPRI, 2020). Through ICT, government has been able to have an electronic database for all small scale farmers on FISP.

The ICTs have also been instrumental in extension service provision through radio and television. Under the Ministry of Agriculture, National Agriculture Information Service (NAIS) (Curry et al., 2021).

2.5. Communication and ICT

Communication is very critical to community development in the participating communities in the society. Without communication no information will be provided to relevant stakeholders as a guide for effective promotion of community development. Communication in more elaborate terms is a process whereby people influence each other, create and maintain a basis of shared information and ideas which they use as a guide (Aruma, 2018).

Several theories and models have been developed to support communication to gain desirable behaviour. One of these approaches is the P Process which is a five step-by-step roadmap that can guide to defined concepts about changing behaviour to a strategic and participatory program that is grounded in theory and has measurable impact (University, 2013).

2.6. Influence of the Digital Divide in ICT Adoption

Basso & Antle (2020) indicate that digitalization may cause the next agricultural revolution as it has a unique potential to make crop and livestock production more efficient and environmentally friendly, thereby creating substantial benefits for farmers, consumers, and society at large.

The digital divide is the distinction between those who have internet and/or mobile access and are able to make use of digital communications services, and those who are excluded from these services (USAID, 2020).

2.6.1. Digital Divide between Developed and Developing Countries

Khanal (2021) notes that the global digital divide shows global disparities, mainly between the countries with developed and emerging economies, in regard to access to data and information resources such as the Internet and the opportunities obtained from such access. Developed countries have not only more progressive economies, but also more highly developed infrastructures of Information and Communication Technology (ICT).

Information Technology University (ITU) estimates that at the end of 2019, 53.6 % of the global population, or 4.1 billion people, were using the internet. Developed countries account for 86.6 per cent of the population and Developing countries account for just 47% of the population using the internet through different means.

2.6.2. Gender in Digital Divide

Despite a significant increase in usage of the internet and other ICTs around the world, women, especially in developing countries, tend to be on the wrong side of the digital divide. The results indicate that while there are still gender differences in access to ICT in developing countries, second-level digital divide issues are more of a concern in developed countries (Acilar, 2021).

The (Forum, 2022) report further notes that while Internet adoption and mobile phone ownership are on the rise, figures show staggering gaps in access for women in many regions of the world. The GSMA Mobile Gender Gap Report 2020 highlights that more than 300 million more men than women access the mobile Internet in low- and middle-income countries, and smartphone ownership, a principal way of accessing the Internet, is 20 % lower for women than men.

The HRBDT (2011) also notes that existing inequalities are reflected in discrepancies in the access to and use of ICTs, thereby transposing offline divides into the digital space.

2.6.3. Access Divide

Whilst there are serious differences in terms of accessing ICTs in developed and developing countries, it is important to acknowledge the disparities that exists between male and female farmers and between farmers in urban and rural areas. ICT invention to farmers in rural areas has unfortunately increased digital divide created by illiterate and low income, which creates a gap between groups or individuals with ability and inability to use ICTs effectively (Evance, 2022).

3. Research Methodology

This research used a mixed methodology of both quantitative and descriptive methods.

A multi-stage sampling procedure was used to determine a manageable sample size.

The geographical area for the research was Monze and Mazabuka districts of Southern Province in Zambia. The two districts have a population of 66,390 and 34,074 recorded small scale farmers respectively. Like most small scale farmers in Zambia, the population for this research rely on agriculture activities for their livelihood and own between 2 to 5 hectares of land as shown in survey results by the Crop Forecast (CFS) and the Rural Agriculture Livelihood Surveys (IAPRI, 2015).

Mazabuka and Monze were purposefully sampled out of the 15 districts in Southern province based on exposure to ICT interventions, proximity and availability of resources. The second stage of sampling was purposive sampling of farmers based on their use of ICTs for agriculture.

The sample size of respondents was determined by using the Cochran formula below.

$$\text{no} = \left(z^2 \times p(1-p)\right) / e^2$$

In order to estimate the appropriate district level sample size for farmers, we base on the total population of farmers in the two districts and using the following formula for calculating the sample size below:

$$n = \text{DEFF} * \left(z^2 * (p)(1-p)\right) / d^2$$

where:

DEFF = Design effect (1.2)

Z value = 1.645 for $p = 0.1$ or 90% confidence intervals

P = Estimated is not known, so we assume that 50%

$q = 1 - p$

$= 1 - 0.5$

$= 0.5$

Therefore, the sample size required was calculated as follow:

$$n = \text{DEFF} * \left(z^2 * (p)(1-p)\right) / d^2$$

$$n = 1.2 * \left(\left(\left(1.645^2\right) * (0.5) * (0.5)\right) / \left(0.05^2\right)\right)$$

$$n = 324.7$$

$$n = 325$$

Data was received from 325 farmers using Likert Scale styled questionnaire and 30 Agriculture Extension Officers using an open-ended self-administered questionnaire. Both questionnaires were generated based on the UTAUT conceptual framework.

4. Results

The data was collected during the 2021/2022 agricultural season. A total of 325 questionnaires were successfully administered to farmers. After data cleaning, 306 out of 325 questionnaires were deemed valid, representing a 94 % response rate. All questionnaires from the 30 extension officers were valid.

4.1. Demographic Data

The presentation of the data from the questionnaire administered to respondents began with the identification of the respondents in terms of their gender, educational background and duration of employment in the organization.

Out of the valid data set, 65% were Male, and 35% were Female and study hence concludes that use of ICT in the agriculture sector is male dominated in line with global trends (**Figure 2**).

Most of the respondents were in the middle age range between 41 and 50 years followed by the 31 - 40 years age group. Research concludes that agriculture sector in the two district is yet to attract the youth as shown in **Figure 3** below.

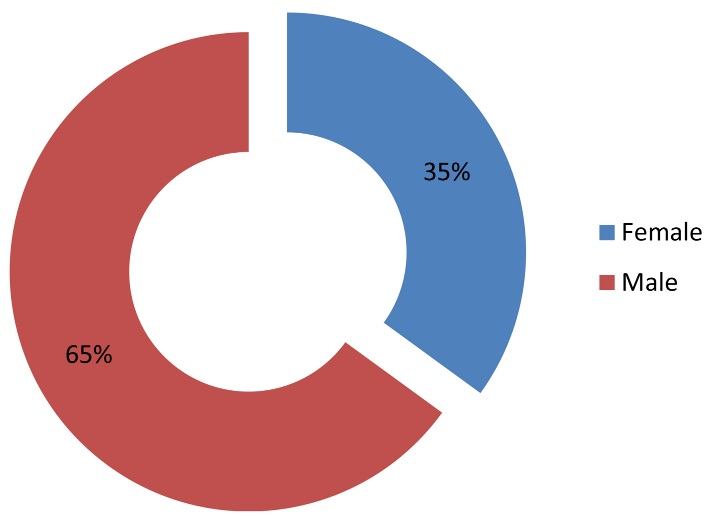

Figure 2. Gender distribution of the respondents. Source: Survey data (2022).

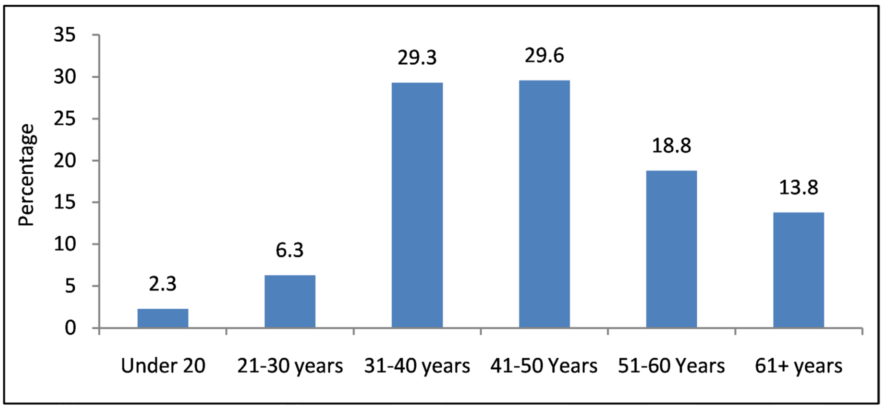

Figure 3. Age of the Respondents. Source: Survey data (2022).

62% of the respondents were married followed by those single (24%) and 11.8% of those divorced. 2% could not state their marital status at the time of the interview (**Figure 4**).

91% of the respondents had a high school certificate or less as shown in **Figure 5** below. This clearly shows the low education attainment among small scale farmers (**Figure 5**).

In terms of employment status, 79% indicated they are not in formal employment.

4.2. General Knowledge on Information and Communications Technology (ICT)

All the respondents confirmed use of ICT. Slightly below half (47%) of the respondents indicated they had good general knowledge on ICT.

4.3. Actual use of Information and Communications Technology (ICT)

64% of the respondents reported having experience of between 3 years and above. The frequently used type of ICT was radio followed by mobile phone. In terms of areas of ICT use in agriculture activities, the majority of respondents at 63.7 % indicated they always use ICT for marketing and price monitoring followed by 57.8 who indicated they always use ICT for input redeeming and post-harvest management (52%).

As can be seen from **Figure 6** below, there is very low use of ICTs for information on land tillage/planting (0.3%) and breeding/rearing methodologies (0.3%). Almost one-third (62.7%) indicated they rarely use ICT for land tillage or planting whilst 48.4 indicated they have never used ICT for breeding or rearing. About half (52.3%) of the respondents indicated they often use ICT for pest/disease control.

More than half of the respondents agreed that ICT can improve productivity. 40 percent of the respondents agreed that interaction with ICTs is clear and easily understandable (**Table 1**).

73.2 percent of the respondents agreed that people who influence their behaviors think that they should use ICTs (Table 1). Interesting to note is that close to half of the respondents (43.1%) think that people who are important to them think they should use ICTs (Table 2).

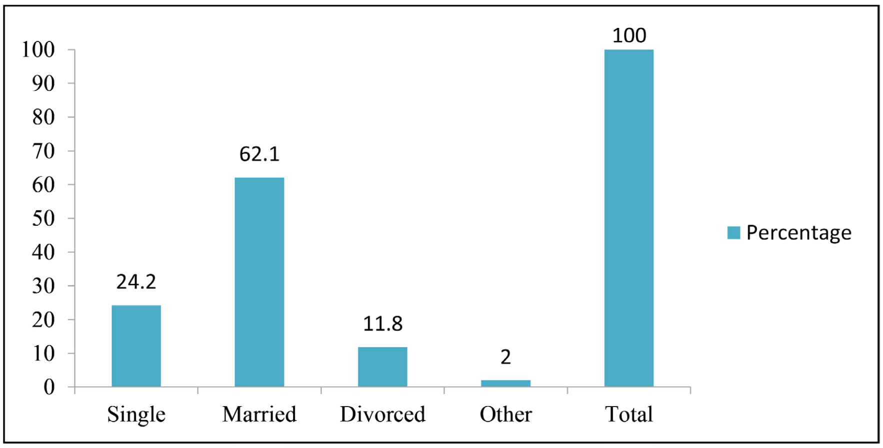

Figure 4. Marital status of the Respondents. Source: Survey data (2022).

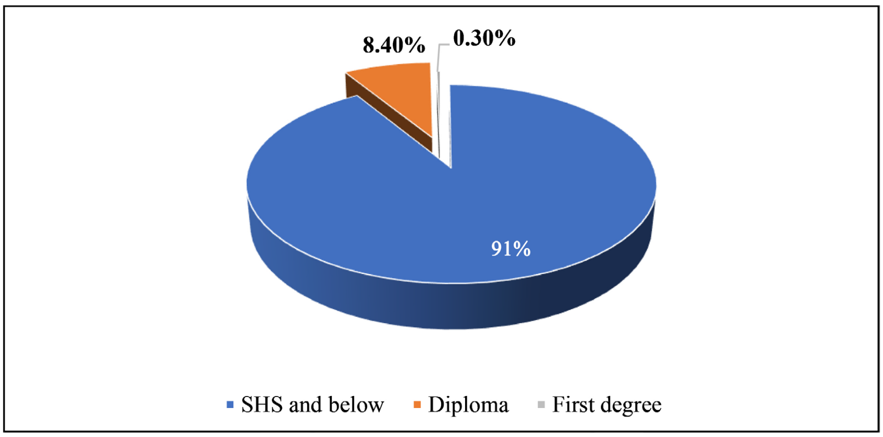

Figure 5. Education levels of the Respondents. Source: Survey data (2022).

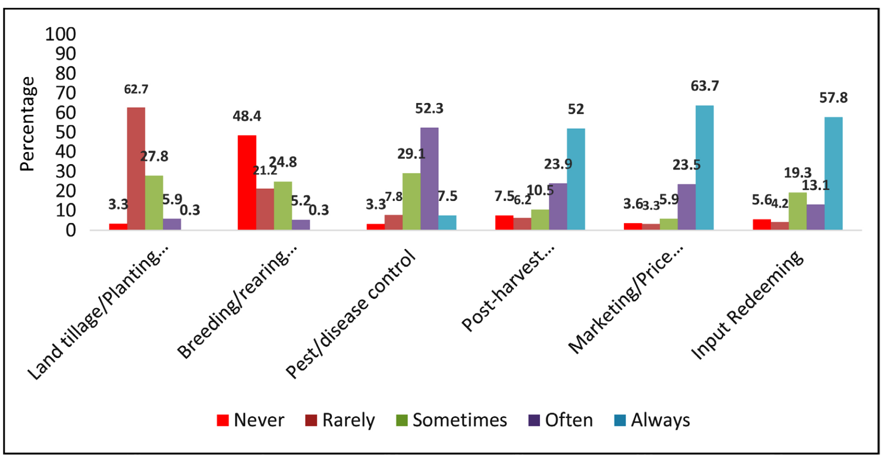

Figure 6. Area for ICT use. Source: Survey data (2022).

Table 1. People who influence behaviour think respondent should use ICTs. Source: Survey data (2022).

Responses	Frequency	Percent
Disagree	7	2.3
Neutral	40	13.1
Agree	224	73.2
Strongly Agree	35	11.4
Total	306	100

Table 2. People who are important to respondents think they should use ICTs. Source: survey data (2022).

Responses	Frequency	Percent
Strongly Disagree	1	.3
Disagree	12	3.9
Neutral	55	18
Agree	106	34.6
Strongly Agree	132	43.1
Total	306	100

4.4. Pearson Correlation Analysis

Pearson Coefficient and the P-values were used to show the strength of the relationship between the independent and dependent variables. The independent valuables are Performance Expectancy, Effort Expectancy, Facilitating conditions and Social Influence.

Table 3 below shows that Performance Expectancy, Effort Expectancy, Facilitating Conditions and Social Influence are all positively correlated to behavioral intentions. There is a large strength of association between social influence (R = 0.601, P-Value = 0.000) and facilitating conditions (R = 0.647, P-Value = 0.000) with behavioral intentions. Seen is also a medium strength of association between performance expectancy and behavioral intention (R = 0.356, P-Value = 0.000) and weak one under effort expectancy (R = 0.185, P-Value = 0.001).

4.5. Regression Analysis

Multiple Regression analysis using SPSSS was used to determine the strength of the relations between the dependent valuable and the independent variables.

The dependent variable (behavioral intentions) was regressed on predicting variables of Performance Expectancy, Effort Expectancy, Facilitating Conditions and Social Influence. The significant value was less than 0.005 therefore, we can infer that the there is significant impact of all the independent variables on behavioral intention (Table 4).

Table 3. Pearson correlation on PE, EE, FC and SI. Source: survey data (2022).

		Behavioral Intentions	Performance Expectancy	Effort Expectancy	Facilitating Conditions	Social Influence
Behavioural Intentions	Pearson Correlation	1	0.356**	0.185**	0.647**	0.601**
	Sig. (2-tailed)		0.000	0.001	0.000	0.000
	N	306		306	306	306

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed).

Table 4. Regression analysis on PE, EE, FC and SI. Source: Survey data (2022).

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Tolerance	VIF
		B	Std. Error	Beta				
	(Constant)	−0.159	0.261		−0.610	0.543		
	Performance Expectancy	0.255	0.042	0.242	6.077	0.000	0.925	1.081
1	Effort Expectancy	−0.144	0.050	−0.138	−2.908	0.004	0.646	1.548
	Facilitating Conditions	0.472	0.057	0.417	8.281	0.000	0.577	1.733
	Social Influence	0.423	0.064	0.381	6.627	0.000	0.442	2.262

[a]Dependent variable: Behavioral intentions.

4.6. Input from Agriculture Extension Officers

A total of 30 Agriculture Extension Officers from the Ministry of Agriculture provided input to this research through self-administered questionnaires.

More than half of the officers indicated that a considerable number of farmers do use ICT for agriculture activities in the two districts. Respondents indicated that the most extensively used ICT by the farmers was radio followed by mobile phones.

More than half of the extension officers interviewed indicated that farmer's knowledge of ICT was low and that farmers did not find it easy to use ICTs due to low literacy levels.

At least all extension officers interviewed indicated that use of ICTs by farmers for the agricultural activities is beneficial. The most prominent reason for importance of use of ICTs was to enable farmers to receive timely weather warning, disease and pest control and marketing information.

More than 70% of the respondents indicated that farmers who use ICTs have better yields compared to those that do not with the majority attributing this to timely information. Therefore, from the data provided by the extension officers, it was concluded that there is a relationship between ICT adoption and agriculture productivity.

Challenges highlighted as major barriers to ICT use were access to internet connectivity, purchase and maintenance costs followed by high illiteracy levels among small scale farmers. Recommendations given by the extension officers to improve use of ICTs among farmers were to improve internet connectivity in rural areas and to provide necessary ICT gadgets coupled with training.

4.7. Reliability Test

Due to the mixed method of this study, the reliability test was undertaken using both the qualitative and quantitative methods. The Cronbach's alpha test was used for the data from the farmers questionnaire in SPSS. Cronbach's alpha is a measure of the internal consistency or reliability between several items, measurements or ratings. It estimates how reliable are the responses of a questionnaire (or domain of a questionnaire), an instrumentation or rating evaluated by subjects which will indicate the stability of the tools (Virginia, 2022). The Cronbach alpha for all the reliability coefficient was higher than 0.7 and therefore concluded that the internal consistency is acceptable (**Table 5**).

Data from the open ended questionnaire for the Extension Officers was done using qualitative methods. Coding and allocation of themes coupled with an objective audit trail was done through independent researchers to ensure validity and dependability of the data from the respondent transcripts.

5. Hypothesis Testing

Hypothesis testing was done using both regression analysis and Pearson correlation and yielded same results. Therefore, it can be concluded that behavioral intentions to use ICTs is influenced by performance expectancy, effort expectancy, facilitating conditions and social influence (**Table 6**, **Table 7**).

Table 5. Cronbach's alpha results. Source: survey data (2022).

Construct	Cronbach's Alpha
Performance Expectancy	0.787
Effort Expectancy	0.791
Facilitating Conditions	0.780
Social Influence	0.766
Behavioural Intentions	0.721

Table 6. Hypothesis testing using regression analysis.

Hypothesis	Regression Weights	Beta Coefficient	R2	T	P-Value	Hypothesis Tested
H1	Performance Expectancy-Behavioral Intention	0.242	0.559	−0.610	0.000	Yes
H2	Effort Expectancy-Behavioral Intention	−0.138	0.559	6.077	0.004	Yes
H3	Facilitating Conditions-Behavioral Intention	0.417	0.559	−2.908	0.000	Yes
H4	Social Influence-Behavioral Intention	0.381	0.559	8.281	0.000	Yes

Table 7. Hypothesis testing using correlation analysis.

Hypothesis	Correlations	Pearson Correlation	Sig. (2-tailed)	Hypothesis Tested
H1	Performance Expectancy-Behavioral Intention	0.356**	0.000	Yes
H2	Effort Expectancy-Behavioral Intention	0.185**	0.001	Yes
H3	Facilitating Conditions-Behavioral Intention	0.647**	0.000	Yes
H4	Social Influence-Behavioral Intention	0.601**	0.000	Yes

6. Recommendations

The recommendations of this research are based on the UTAUT model using communication approaches as follows.

- Awareness Raising: Government and cooperating partners in the agriculture sector should consider deliberate awareness raising on available ICT and their benefits. Communication can be tailored through the two highly accessible platforms, mobile phone, and radio.
- Infrastructure development: Although the coverage of internet connectivity in the country has been steadily increasing, the digital divide remains between rural and urban areas. Government and stakeholders in the area of ICT development should have deliberate programmes to spread internet connectivity to rural areas. Apart from infrastructure, access to easy to use and affordable ICTs should be considered for the small-scale farmers in full consideration of the high illiteracy levels.
- Promoters of ICTs in the country should also be deliberate in developing the communication and advocacy strategies in order to reach all the main audiences communication to reduce the digital divide in the country.
- Most farmers in the country do not have the means to meet financial institution needs to get financial support. Therefore, tailor made programmes are encouraged if farmers are to get decent financial support to acquire necessary ICT.
- Review the ICT and structural policies for integration of current trends in the field of ICTs.

7. Limitations of the Study

In consideration of COVID-19 prevention measures, data collection efforts were limited to those that limited gatherings at community level. In addition, the closed ended questionnaire for the farmers may not have yield in-depth information on ICT adoption.

Acknowledgements

Gratitude is given to all previous research work that has contributed immensely to this research. The author also acknowledges the support of the Ministry of Agriculture and all respondents that participated in this research. Special gratitude is to management and staff at the Graduate School of Business at the University of Zambia.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Abbad, M. M. (2021). Using the UTAUT Model to Understand Students' Usage of e-Learning Systems in Developing Countries. *Education and Information Technologies, 26,* 7205-7224. https://doi.org/10.1007/s10639-021-10573-5

Acilar, A. (2021, December 16). Towards Understanding the Gender Digital Divide: A Systematic Literature Review. *Global Knowledge, Memory and Communication*. https://doi.org/10.1108/GKMC-09-2021-0147

Ali, S. (2016). Impact of ICTS on Agriculture Productivity. *European Journal of Business, Economics and Accountancy, 4,* 82-96.

Aruma, E. (2018). Roles of Communication in Community Development. *International Journal of Network and Communication Research, 5,* 1-10.

Ayed, R. B. (2020). Artificial Intelligence to Improve the Food and Agriculture Sector. *Journal of Food Quality, 2021,* Article ID: 5584754.

Ayim, C. K. (2022). Adoption of ICT Innovations in the Agriculture Sector in Africa: A Review of the Literature. *Agriculture & Food Security, 11,* Article No. 22. https://doi.org/10.1186/s40066-022-00364-7

Bank, W. (2022, April 1). *World Bank*. https://www.worldbank.org/en/topic/agriculture/overview

Basso, B., & Antle, J. (2020). Digital Agriculture to Design Sustainable Agricultural Systems. *Nature Sustainability, 3,* 245-256. https://doi.org/10.1038/s41893-020-0510-0

Chibsa, L. D. (2020). Review on Impact of ICTs on Improving Agricultural Productivity and Rural Incomes in Ethiopia. *Information and Knowledge Management, 10,* 1-10.

Chowhan, S. (2020). Role of ICT on Agriculture and Its Future Scope in Bangladesh. *Journal of Scientific Research & Reports, 26,* 20-35. https://doi.org/10.9734/jsrr/2020/v26i530257

Curry, G. N. et al. (2021). Disruptive Innovation in Agriculture: Socio-Cultural Factors in Technology Adoption in the Developing World. *Journal of Rural Studies, 88,* 422-431. https://doi.org/10.1016/j.jrurstud.2021.07.022

Das, S. (2017). The Impact of ICTs on Agricultural Production in Bangladesh: A Study with Food Crops. *SAARC Journal of Agriculture, 14,* 78-89. https://doi.org/10.3329/sja.v14i2.31247

David, O. O., & Grobler, W. (2019). Agricultural Production in South Africa: Information and Communication Technology (ICT) Spillover. *International Journal of eBusiness and eGovernment Studies, 11,* 166-190. https://doi.org/10.34111/ijebeg.20191126

Domguia, E. N. (2021). *ICT and Agriculture in Sub-Saharan Africa: Effects and Transmission Channels*.

El Bilali, H., & Allahyari, M. S. (2018). Transition towards Sustainability in Agriculture and Food Systems: Role of Information and Communication Technologies. *Information Processing in Agriculture, 5,* 456-464. https://doi.org/10.1016/j.inpa.2018.06.006

Evance, M. (2022). Assessment of Awareness of Farmers on Agricultural Information Services in Mara Region, Tanzania. *Library Philosophy and Practice,* Article No. 7126.

FAO (2021). *The State of Food Security and Nutrition in the World 2021.* FAO.

Forum, W. E. (2022). *Global Gender 2020.* World Economic Forum.

Hanson, W. (2020, September 15). *Impact of ICTs-in-Agriculture on Rural Resilience in Developing Countries* (pp. 1-60). https://doi.org/10.2139/ssrn.3517468 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3517468

Hooks, D., Davis, Z., Agrawal, V., & Li, Z. (2021). Exploring Factors Influencing Technology Adoption Rate at the Macro Level: A Predictive Model. *Technology in Society, 68,* Article ID: 101826. https://doi.org/10.2139/ssrn.3943624

HRBDT (2011). *Ways to Bridge the Gender Digital Divide from a Human Rights.* HRBT.

IAPRI (2015). *Agriculture in Zambia. Past, Present and Future.* IAPRI.

IAPRI (2020). *Zambia Agriculture Status Report 2020.* IAPRI.

Kahenya, D. W. (2014). Assessing Use of ICT among Agriculture Extension Workers in Kenya Using the UTAUT Model. *International Journal of Sciences: Basic and Applied Research, 16,* 11-22.

Khanal, S. (2021). Disparities between Developed and Emerging Economies in Digital Divide and ICT Gap to Bring Agricultural Sustainability. *Fundamental and Applied Agriculture, 6,* 309-322. https://doi.org/10.5455/faa.78371

Kumar, V. B. (2018). A Novel Approach Using Big Data Analytics to Improve the Crop Yield in Precision Agriculture. In *2018 3rd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT)* (pp. 824-827). IEEE.

Masambuka-Kanchewa, F. et al. (2020). Beyond Diffusion of Improved Technologies to Promoting Innovation Creation and Information Sharing for Increased Agricultural Productivity: A Case Study of Malawi and Kenya. *Journal of International Agricultural and Extension, 27,* 79-92. https://doi.org/10.5191/jiaee.2020.27106

Mdoda, L. (2022). Factors Affecting the Using Information and Communication Technologies by Livestock Farmers in the Eastern Cape Province. *Cogent Social Sciences, 8,* Article ID: 2026017. https://doi.org/10.1080/23311886.2022.2026017

Michels, M. et al. (2019). *Understanding the Adoption of Crop Protection Smartphone Apps—An Application of the Unified Theory of Acceptance and Use of Technology.*

Mwalupaso, G. E. (2019). Agricultural Informatization and Technical Efficiency in Maize Production in Zambia. *Sustainability, 11,* Article No. 2451. https://doi.org/10.3390/su11082451

Oyelami, L. O. (2020). ICT and Agricultural Sector Performance: Empirical Evidence from Sub-Saharan Africa. *Future Business Journal, 8,* Article No. 18.

Phiri, H. et al. (2019). A Review of e-Agriculture Application in Developing Countries for the Youth: Challenges and Opportunities and Open Issues. *Zicta, 1,* 5-10.

Planning, M. O. (2022). *Eight National Development Plan 2022-2026.* Ministry of Finance and National Planning.

Pratt, M. K. (2022, September 15). *ICT (Information and Communications Technology, or Technologies).* https://www.techtarget.com/searchcio/definition/ICT-information-and-communications-technology-or-technologies

Ruzzante, S. (2021). Adoption of Agricultural Technology in the Developing World: A

Meta-Analysis of the Empirical Literature. *World Development, 146,* Article ID: 105599. https://doi.org/10.1016/j.worlddev.2021.105599

Sennuga, O. S. (2020). Impact of Information and Communication Technologies (ICTs) on Agricultural Productivity among Smallholder Farmers: Evidence from Sub-Saharan African Communities. *International Journal of Agricultural Extension and Rural Development Studies, 7,* 27-43.

Shrivastava, P. P. (2018). *Reach and Use of ICT in Agriculture Sector in Madhya Pradesh*. Dept. of Advertisement & Public Relations.

Tossou, D. A. (2021). *Drivers of Adoption and Impacts of Smallholder Climate Resilient Agricultural Technologies*. Graduate Dissertations and Theses at Illinois.

Undi-Phiri, B., & Phiri, J. (2022). Assessing Factors Affecting the Adoption of E-Government Services in Developing Countries for Transport Sector, amidst the COVID-19 Pandemic. *Communications and Network, 14,* 69-90. https://doi.org/10.4236/cn.2022.142006

UNESCO (2009). *Guide to Measuring Information and Communication Technologies (ICT) in Education.* UNESCO.

United Nations D. (2019, June 17). *9.7 Billion on Earth by 2050, but Growth Rate Slowing, Says New UN Population Report*. https://news.un.org/en/story/2019/06/1040621

University, J. H. (2013). *The P Process-Five Steps to Strategic Communication.* School of Public Health Center for Communication Programs.

USAID (2020). *The Gender Digital Divide Primer.* USAID.

Venkatesh, V., Morris, M. G., Davis, G. B. et al. (2003) User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly, 27,* 425-478. https://doi.org/10.2307/30036540

Virginia, U. O. (2022, September 28). *Using and Interpreting Cronbach's Alpha*. https://data.library.virginia.edu/using-and-interpreting-cronbachs-alpha

WFP (2022). *Zambia Country Brief.* WFP.