RELEVANCE OF INFORMATION AND COMMUNICATION TECHNOLOGY ON CASSAVA PRODUCTION IN ASA LOCAL GOVERNMENT AREA OF KWARA STATE, NIGERIA

BY

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CERTIFICATION

This is to certify that this research project has been read and approved as meeting the requirement of Award of National Diploma (ND) in Agricultural Technology, Institute of Applied Science (IAS), Kwara State Polytechnic, Ilorin.

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DEDICATION

This research work is dedicated to God Almighty, my mum and to the betterment of agriculture

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My greatest appreciation and thanks are solely given to Almighty God, who by his mercy has spared me to keep on pushing both academically and in all areas.

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ABSTRACT

This study focused on the Relevance of Information and Communication Technology (ICT) on cassava production in Asa Local Government Area, Kwara State. Twenty (20) respondents were randomly selected from six (6) communities in the study area to make a total sample size of 120 respondents. Date were collected with the aid of questionnaire, which was analyzed using frequency counts and percentages. Pearson Product Moment Correlation (PPMC) was used to test the hypothesis. Findings revealed that the mean age of respondents was 46.7 years, with an average of 20.2 years of cassava-growing experience on plots averaging 4.30 hectares. Farmer groups (75.0%), friends and family (67.5%) were cited as the most important source of information on cassava production. In term of ICT adoption, mobile phones, radio, and television dominate daily practice, with 73.3–82.5% of respondents using these tools regularly. The study further revealed that ICT is relevant to cassava production in areas of information on pre-planting and planting activities such as planting methods and timing (3.10), and appropriate time for fertilizer application (3.00). Correlation analysis indicated significant relationships between adoption level of ICT and age, farming experience, education level, household size and farm size ($p<0.05$). The study concluded that Information and Communication Technology (ICT) clearly holds substantial promise for improving cassava production in Asa Local Government Area, especially in the domains of pre-planting activities, crop management, and real-time information dissemination. Tools such as mobile phones, radio, and television have already gained strong acceptance among farmers, serving as critical conduits for transmitting agricultural advice and farming techniques. The study recommended that ICT-related content should be mainstreamed into existing agricultural extension frameworks and farmer group trainings, with practical, hands-on sessions tailored to different literacy levels.

CHAPTER ONE
INTRODUCTION
1.1 Background to the Study

Cassava is one of the world's most important food crops with an annual output of over 34 million tonnes of tuberous roots (Onemolease, Ehilenboadiaye and Omoregie, 2021). In the tropics, cassava roots and leaves provide basic calories and income. In Africa over 600 million people are dependent on cassava for food (Apata, 2019). Cassava is produced majorly by small-scale farmers using simple farm implements. Bulk of the cassava produced is consumed while only about 5% is used in industries as raw materials. Cassava consumption in Nigeria is very high and provides about 80% of the total energy intake of her citizens (Onyenma and Aroyehun, 2020). As a food crop, cassava is tolerant to low soil fertility and drought as well as pest and diseases. Cassava production in Nigeria is all year round majorly by smallholder farmers. This enhances the availability of cassava products throughout the year. In Nigeria, bulk of the total national output of cassava comes from the South-South region where many households depend on it as their major source of food and income and Cassava also provides livestock feeds, as well as industrial raw material for producing bakery products and ethanol in cosmetic and drug industries (Belonwu, Onemolease and Igene,2020).

The growing demand for cassava products throughout the world necessitates increased cassava production which can result from adoption of innovations from research into various areas of cassava production. This cannot be attained if research findings do not get to the end-users, that is, the cassava farmers. The extension agents are grossly inadequate to meet the information needs of numerous farmers in different parts of Nigerian States (Albert and Joseph,2020). A plausible way to overcome this human resource shortage is by using Information and Communication Technology (ICT) to access innovation information about different aspect of cassava production. The adoption of such innovations will certainly boost cassava production in the study area and Nigeria in general. Information and Communication Technology (ICT) refers to a system of disseminating and managing information using computer, telephone and other audio-visual networks. ICTS gadgets majorly used in different parts of the world include but not limited to computers, telephones, televisions, radios satellite systems, internet and the social media. High usage of ICT by farmers to source for innovation information can enhance their productivity if adopted.

Information and communication technologies (ICTs) are new technologies that cannot be ignored in Africa especially for development in all sector, agriculture inclusive. This is because, ICT is one of the main driving forces that can bring about development and change in this present digital age. It was in the light of this that Emenari (2004) noted that, the great transformation in the lives of the people especially in the developing countries depends on the advancement of ICTs. The rapid development of ICTs continues to have major influence on the livelihood of people across the world. Social research has shown that, adoption of ICTs can be a major fuel for economic and community development in rural areas (Osiakade et al., 2010). As noted by Onwubalili (2004) the tremendous changes are quite glaring in every facet of our lives and touches simplest of domestic services to corporate and limitless industrial applications.

ICTs such as Internet could create and meet demands which satisfies human and corporate needs at all times and levels (Nwajinka, 2004). Infact, ICTs are what rural dwellers need to climb to the heights developed continent had reached. The recent development in ICT has broken national and international barriers and turned the world into a global village, making information available to everyone, everywhere and at any time it is needed (Onasanya et al., 2011). Generally, agriculture is an information intensive industry. The sector draws upon infinite sources of widely dispersed, locally contextualized knowledge and considerable body of research materials. It also relies upon continuous flow of information from local, regional and world markets.

1.2 Statement of the Problem

Balderama (2009) pointed out that, there is a dearth of knowledge and information on new technologies in agriculture that is yet to be exploited especially in most of the developing countries of which Nigeria is included. It is expected that, there should be a flow of knowledge and new information from various research institutes to the farmers. With the explosion in ICTs in the world, there is an expectation that, knowledge producers would be substantially empowered to channel information to farmers. As suggested by Erhabor and Emokaro (2007), that there has to be a tremendous increase in the current agricultural output in the country in order to meet the increasing demand both locally and internationally. Therefore, it is highly imperative to determine the level of usage/ accessibility and impact of ICTs on cassava production with the focus of ensuring improved production capacity of farmers in the study area.

1.3 Research Questions

i. What are the socio-economic characteristics of cassava farmers in the study area?
ii. What are the farmers sources of information on cassava production techniques?
iii. What is the level of utilization of ICT among cassava farmers in the study area?
iv. Of what relevance is ICT to cassava farmers in the study area?
v. What are the perceived barriers in the adoption of ICTs among farmers in the study area?

1.4 Objectives of the study

The general objective of the study is to access the relevance of Information and communication technologies on cassava production in Asa local Government Area of Kwara State. While the specific objectives are to;

i. describe the socio-economic characteristics of the respondents
ii. Identify the farmers source of information on cassava production techniques
iii. Determine the level of utilization of ICT among cassava farmers in the study area
iv. Ascertain the relevance of ICT to cassava production in the study area
v. Identify the constraints to the adoption of ICTs among cassava farmers

1.5 Hypothesis

- Ho: There is no significant relationship between the socio-economic characteristics of the respondents and usage of ICT.

1.6 Significance of the study

The study on the relevance of Information and Communication Technologies (ICT) among cassava farmers in Asa Local Government Area (LGA) of Kwara State, Nigeria, holds significant importance for several stakeholders in the following key area;

Enhanced Productivity: The study can reveal how ICT tools such as mobile phones, the internet, and agricultural apps help farmers access vital information on modern farming techniques, weather forecasts, pest control, and improved cassava varieties. Market Access: ICT enables farmers to access market prices, reducing exploitation by middlemen and ensuring fair trade. Cost Reduction: Awareness of ICT use can help farmers adopt cost-effective farming methods through digital learning platforms.

For Agricultural Policymakers and Extension Services. Policy Development: The findings can inform policies aimed at integrating ICT into agricultural extension services. Targeted Training: Policymakers can design training programs to educate farmers on the use of ICT for farming and marketing. Infrastructure Planning: Understanding ICT gaps among farmers can guide investments in telecommunications infrastructure in rural areas.

For Agricultural Development Organizations: Program Design: NGOs and development agencies can use the study to design ICT-based interventions tailored to the needs of cassava farmers. Sustainability: Encouraging the use of ICT for agriculture fosters sustainable practices and community empowerment.

For the Local Economy: Economic Growth: Improved productivity and market access can boost the income of cassava farmers, thereby contributing to the local economy. Poverty Reduction: Enhanced ICT use can help reduce poverty levels in rural areas by empowering farmers with information and market opportunities.

For Technology Developers: Tailored Solutions: The study can guide tech developers in designing ICT tools and platforms that address the specific needs of cassava farmers, such as user-friendly interfaces and localized content. This study underscores the transformative potential of ICT in improving agricultural practices, reducing poverty, and fostering sustainable development in rural communities, with a specific focus on the cassava farmers of Asa LGA.

1.7 Definition of terms

Information and Communication Technologies (ICT): Refers to technologies that provide access to information through telecommunications. It includes tools such as mobile phones, the internet, computers, radios, and agricultural apps that facilitate the exchange of information relevant to farming practices, marketing, and decision-making.

Relevance: The degree to which ICT tools and platforms are useful, applicable, and beneficial in enhancing the agricultural activities and livelihoods of cassava farmers in the study area.

Cassava Farmers: Farmers engaged in the cultivation, harvesting, and processing of cassava, a staple crop in Nigeria, particularly in Asa Local Government Area. These farmers are the primary stakeholders in the study.

Agricultural Extension Services: Services provided to farmers to improve their productivity and profitability by disseminating information on modern farming techniques, pest control, and market trends, often facilitated by ICT.

ICT Adoption: The process by which cassava farmers in Asa LGA incorporate ICT tools and platforms into their agricultural practices to enhance productivity, efficiency, and market access.

CHAPTER TWO

LITERATURE REVIEW

2.1 ICT as a tool for knowledge Dissemination

Information Communication Technology (ICT) has revolutionized the way information is disseminated, accessed, and utilized. ICT tools have become essential for disseminating information to various stakeholders, including farmers, extension agents, researchers, and policymakers. Information need is a natural phenomenon that is triggered by several factors beyond cognition, psychology and emotion (Wilson, 2006). Information need, the upshot of information seeking, is most times influenced by changes in the society that bring about information and its accompanying importance. The availability of such information and its relevant purpose constitute the state of information need among people and lead to information seeking (Prasad, 2000).

Current and available studies provide insights into assorted sources and channels of information communication to farmers in Nigeria and other developing countries. The studies of Umunna (2008), Lwoga, Stilwell & Ngulube, (2011), Okwu and Daudu (2011), Uzuegbu (2016) contain lists of diverse information communication sources and channels of rural farmers. This review identifies some the various listings, separates duplicate items and discusses them in view of their effectiveness in communicating farming-related information to rural farmers. Farmers' friends and relatives is the first source of information identified in this review. Rural farmers depend mainly on their family members, neighbours and colleagues to access farming related information (Lwoga, Stilwell & Ngulube, 2011). Friends and relatives manifest what Okwu and Daudu (2011) identified as part of interpersonal channels of information communication. Its effectiveness depends on the individual ability of farmers to interact with others. In rural settings the most obvious form of this communication method occur as face-toface verbal interactions. Scholars in medical science find this method of communication effective but laments on its cost and time-consuming implications (Shannon, 2012; Shannon & Myers, 2012).

Agricultural extension workers are staff of agricultural institutions recruited, trained and deployed to rural communities to propagate innovative farming methods and practices (Ayoola, 2001; Iwuchukwu & Igbokwe, 2005). This is the situation in Nigeria as well as in other developing countries. In Nigeria, Umunna (2008) finds that rural farmers depend more on agricultural extension workers for information access, contrary to the report of Anderson and Feder (2004) who find agricultural extension services ineffective for transforming rural farming in developing countries. In corroborating the latter, researchers have outlined the reasons for the ineffectiveness of agricultural extension workers to include poor education background (Aina, 2007; Chukwuemeka & Nzewi, 2011), use of unsuitable communication strategies (Uzuegbu, 2016), job conditions of extension workers, particularly on the quotient of farmers and village extension workers are required to cover (Agbamu, 2005; Iwuchukwu & Igbokwe, 2012). Television (TV) is consistently listed as an information channel or source to all rural dwellers (Bachhav, 2012; Bello and Obinne, 2012; Elly and Silayo, 2013; Ifukor, 2013; Kamba, 2009; Meyer, 2004). TVs are audio-visual technologies which appeal to the senses of sight and hearing (Koumi, 1994). However, Uzuegbu (2016) doubts the effectiveness of TVs in communicating farming related information to rural dwellers, TVs are audio-visual information resources, they enhance creativity and flexibility. Besides, TV requires one's attention to watch it and therefore may not be utilized more by busy people such as rural dwellers… Moreover, where there is no electricity or power supply the use of TV as a channel of information service delivery is largely defeated.

information communication channel that is frequently associated to rural farmers is the radio. Radios are electronic media. They are cheap as compared to TVs, and are flexible to use. Using a radio allows convenience in that one can tune in to prefer stations and listen to news and programmes at workplaces, homes, in cars while on transit and in other places (Kellow & Steeves, 1998). Nevertheless, the sparing use of radio as information source among rural farmers in developing countries has been spotted in several studies. Perhaps, if not for the oral nature of radio, its low cost and independence of electricity (Lwoga, Stilwell & Ngulube, 2011), there might not be traces of its use among rural farmers. The negligible use of radio among rural farmers is notable and arouses the need to find out why it cannot be depended upon for effective information communication to rural farmers.

2.2 Relevance of ICT in Improving Agricultural Productivity

Information and Communication Technology (ICT) plays a critical role in enhancing agricultural productivity by improving access to timely, accurate, and actionable information. In rural agricultural communities such as those in Asa Local Government Area of Kwara State, ICT tools—including mobile phones, computers, and internet-based platforms—have become essential in helping farmers make informed decisions regarding farm management, input use, and marketing strategies.

Access to real-time information on weather forecasts, pest outbreaks, market prices, and crop management practices enables farmers to respond proactively to changing conditions. Aker (2011) found that mobile phone use in rural Africa significantly improved market access by narrowing the price gaps between rural and urban areas, thus empowering farmers to make more profitable decisions.

ICT also plays a transformative role in agricultural extension and capacity building. It facilitates remote delivery of expert advice and training, allowing farmers to improve their knowledge and adopt modern farming techniques. For example, the Digital Green initiative utilizes video-based extension services to train farmers on best practices in soil health, pest control, and resource management, leading to higher adoption rates of improved agricultural techniques (Gandhi et al., 2017).

Furthermore, ICT contributes directly to productivity through precision agriculture tools and mobile applications that offer tailored recommendations for soil management, irrigation scheduling, pest and disease control, and crop rotation planning. These technologies optimize input use, minimize crop losses, and enhance yield quality.

ICT also strengthens market linkages by connecting farmers to consumers, input suppliers, and financial institutions. By improving access to market information and reducing the influence of middlemen, ICT enables farmers to negotiate better prices and increase their income. Akinyemi and Yusuf (2019) affirm that these digital innovations are particularly vital in rural settings, where agriculture remains the main source of livelihood.

2.3 Access and use of ICT

Cassava farmers can benefit from using ICT tools, such as web tools, to improve their productivity and efficiency, However, the accessibility and use of these tools can be influenced by various factors, including socio-economic characteristics, farm size, and level of education.

The benefits of using ICT tools among cassava farmers, including improved access to market information, enhanced decision-making, and increased productivity, However, there are also constraints to the adoption of ICT tools, such as high costs, limited technical expertise, and poor infrastructure. ICT tools have the potential to improve the productivity and efficiency of cassava farmers, but their adoption is influenced by various factors, including accessibility, awareness, and relevance. However, the level of access to and use of ICT among cassava farmers remains a critical factor influencing the effectiveness of modern farming practices and overall crop yield (Akinyemi et al., 2020). Many cassava farmers, particularly in rural areas, face challenges in accessing the necessary technological resources such as mobile phones, computers, or reliable internet connections, which are essential for accessing information on weather patterns, market prices, and modern agricultural practices (Munyua, 2018).

The adoption of ICT in cassava farming can greatly enhance productivity by providing farmers with real-time information on pest control, disease management, and soil fertility, which are crucial factors in ensuring a healthy crop (Odebiyi et al., 2020). Despite these advantages, a significant proportion of farmers in rural regions often experience difficulties due to limited infrastructure, low literacy levels, and a lack of technical training, all of which hinder their ability to effectively utilize ICT tools in their daily farming activities (Obi et al., 2019).Studies have shown that farmers with better access to ICT tend to adopt improved farming techniques more quickly, leading to higher yields and increased income (Oladele & Akinyemi, 2021). For example, mobile phone applications designed to deliver agricultural advice, market prices, and weather forecasts have been particularly useful in helping farmers make informed decisions and respond promptly to changing conditions. However, the penetration of such technologies in rural cassava farming communities is often low due to factors such as poor network coverage and the high cost of mobile data services (Chigbu et al., 2020).

Moreover, the use of ICT in agricultural extension services has been shown to enhance communication between farmers and extension officers, thereby improving the delivery of agricultural knowledge and support (Nwachukwu et al., 2021). This is especially important in regions where traditional methods of extension services are limited or not easily accessible. The increasing integration of ICT in agricultural extension services allows for more timely and accurate advice to be delivered to farmers, thus improving their decision-making process (Ayanwale et al., 2022). While some initiatives have been put in place to improve ICT access among farmers, such as providing subsidized mobile phones and internet connectivity, there is still a significant gap in the widespread adoption of ICT tools among cassava farmers. The government and private sector must play a pivotal role in enhancing infrastructure and creating affordable solutions tailored to the specific needs of smallholder farmers (Akinbile et al., 2021). For instance, the provision of rural ICT training centers and workshops could enhance the technological literacy of farmers, thereby facilitating the adoption of ICT tools and improving agricultural outcomes (Kahiigi et al., 2020).

2.3.1 The Role of ICT in Agriculture

ICTs in agriculture, often referred to as "e-agriculture," include a broad spectrum of digital tools designed to provide farmers with information, services, and connections to markets and financial systems. According to Oladipo et al. (2020), ICTs enable farmers to access agricultural extension services, weather forecasts, market prices, and financial support through mobile phones, the internet, and other digital platforms. These technologies help bridge the information gap, which has been a major challenge for smallholder farmers. One notable contribution of ICT is its role in enhancing cassava farmers' access to financial services. Digital payment platforms, such as mobile banking and fintech solutions, enable farmers to save, borrow, and receive payments for their produce securely and efficiently. This financial inclusion supports investment in improved farming inputs, such as high-yield seeds and fertilizers, which ultimately boost production. As observed by Mittal et al. (2010), ICT-based financial services reduce farmers' reliance on informal credit systems that often charge exorbitant interest rates.

Furthermore, ICT enables cassava farmers to participate in e-commerce platforms, which expand their market reach beyond local boundaries. Through online marketplaces, farmers can sell their cassava products to processors, wholesalers, and even international buyers, reducing post-harvest losses and increasing incomes. In a study by Agwu and Kalu (2014), farmers using ICT to access markets reported a significant reduction in post-harvest losses compared to those relying solely on traditional methods. For cassava farmers in rural areas, ICT bridges the gap between local agricultural knowledge and modern innovations. Farmers can access video tutorials and online training materials to adopt improved farming techniques, such as disease-resistant cassava varieties, thereby increasing yields. Additionally, ICT platforms connect farmers to extension services, where they receive expert advice on issues like pest management and soil fertility (Qiang et al., 2012). For instance, SMS-based services provide farmers with timely reminders on when to apply fertilizers or harvest their crops. Despite its benefits, the use of ICT among cassava farmers faces certain challenges, such as limited internet connectivity in rural areas, high costs of ICT devices, and low digital literacy among farmers. These barriers restrict the full potential of ICT adoption, particularly in developing countries. Addressing these issues through investments in rural ICT infrastructure and farmer education programs will help maximize the impact of ICT on cassava farming.

2.3.2 Cassava Farming and Its Importance

Cassava is one of the most important staple crops in many developing countries, including Nigeria, where it plays a crucial role in food security and economic development. Cassava farming, however, faces challenges such as low productivity, pest and disease outbreaks, inadequate access to high-quality inputs, and market inefficiencies. ICTs have been recognized as a key tool for addressing some of these challenges by providing farmers with access to better information on crop management practices, pest control, and market conditions (Akinyemi et al., 2017). According to the Food and Agriculture Organization (FAO, 2013), cassava is a highly resilient crop, capable of thriving in poor soils and drought-prone environments, making it an essential food security crop for millions of smallholder farmers. It provides a reliable source of carbohydrates, feeding over 800 million people worldwide, particularly in rural and low-income areas. Cassava farming also plays a significant role in poverty alleviation and rural economic development. The crop's versatility allows for value addition, including products such as garri, cassava flour, starch, and ethanol, which create income-generating opportunities for farmers and agro-processors (Nweke et al., 2002). Its importance extends to industries where cassava is used in food, textiles, pharmaceuticals, and biofuel production, contributing to economic diversification and industrial growth (Adebayo et al., 2010).

Moreover, cassava farming promotes employment creation in both production and processing stages, providing livelihoods to millions of people along the value chain, particularly in rural areas. Its role in sustainable agriculture is further highlighted by its ability to improve soil fertility through intercropping and its resistance to pests and diseases when improved varieties are adopted (FAO, 2013). By supporting cassava farming through improved technologies, research, and market access, it remains a vital crop for food security, economic development, and environmental resilience.

2.3.3 ICTs in Cassava Production

The use of ICTs in cassava farming is primarily aimed at improving productivity and managing the challenges faced by cassava farmers. Several studies have examined how ICTs contribute to cassava farming in various regions. For example, mobile applications and SMS-based services have been used to provide farmers with real-time weather forecasts, pest and disease alerts, and information about improved cassava varieties and best agricultural practices (Oloyede et al., 2019). Mobile phones are a key ICT tool that helps farmers access these services. According to Adewumi et al. (2018), mobile phones enable farmers to receive timely information on weather conditions, pest outbreaks, and market prices, helping them make informed decisions about when to plant, harvest, or sell their crops. In addition, mobile phones facilitate access to agricultural extension services and provide a platform for peer-to-peer knowledge exchange, which is critical for improving farming techniques and increasing yields.In cassava production, ICT platforms play a key role in disseminating modern agronomic practices, including disease management, appropriate planting techniques, and improved cassava varieties. For instance, mobile-based agricultural advisory services provide farmers with step-by-step guidance on planting schedules, pest control, and soil fertility management (Mittal & Mehar, 2012). With the availability of SMS-based alerts, farmers can address cassava diseases such as cassava mosaic virus and brown streak disease in a timely manner, thereby reducing crop losses.

Furthermore, ICT tools support cassava processors in improving the quality and efficiency of value-added products. Processing cassava into flour, starch, chips, and ethanol requires technical knowledge, which ICT-based training platforms help provide. Online video tutorials and mobile apps allow small-scale processors to learn modern techniques for cassava drying, milling, and packaging (Adejo et al., 2016). As a result, cassava processors are able to produce higher quality products that meet market standards, thus increasing demand and profitability.

ICT has also revolutionized the supply chain management of cassava products. With technologies like Geographic Information Systems (GIS), farmers and processors can monitor cassava production trends, predict harvest times, and identify high-demand regions for cassava products. Digital tools like blockchain are increasingly being used to ensure transparency and traceability in the cassava supply chain, particularly for export markets (Kumar et al., 2020). This is particularly important as cassava products, such as flour and ethanol, are gaining significance in global trade. Financial inclusion through ICT is another key factor driving the development of cassava products. Mobile money platforms, such as

M-Pesa, allow farmers and processors to access loans, savings, and insurance services without the need for traditional banking systems (Donner & Escobari, 2010). These financial tools enable cassava stakeholders to invest in high-quality inputs, such as machinery for processing or improved cassava varieties, which are critical for increasing the volume and quality of cassava products.

However, the integration of ICT in cassava product development is not without challenges. Limited access to the internet in rural areas, low digital literacy, and the high cost of ICT tools remain barriers for many smallholder farmers and processors. To address these challenges, governments and development organizations need to invest in rural ICT infrastructure, provide training programs on digital skills, and promote affordable ICT solutions for cassava stakeholders (Dlodlo & Kalezhi, 2015).

2.3.4. Impact of ICT on Cassava Farmers' Productivity

The use of ICTs has been linked to improved productivity in cassava farming. Research by Ojo et al. (2017) found that farmers who adopted ICT tools experienced better yields due to increased access to information on crop management, pest control, and market conditions. In particular, mobile-based information services have enabled farmers to make timely and informed decisions about their crop production, such as adjusting planting dates and choosing appropriate varieties that are resistant to pests and diseases. In cassava farming, productivity is significantly influenced by the farmer's ability to access and apply accurate information. ICT-based advisory services, such as mobile phones, radio, and internet platforms, provide cassava farmers with critical information on weather forecasts, planting techniques, pest control, and soil management (Mittal et al., 2010). For example, mobile SMS alerts allow farmers to plan their activities effectively, ensuring optimal planting and harvesting schedules that improve yields. The theory of access to information (Stigler, 1961) supports this by emphasizing that the availability of accurate and timely information reduces uncertainty and improves decision-making, ultimately enhancing productivity.

A theoretical framework that highlights the role of ICT in cassava productivity is the Transaction Cost Economics theory (Williamson, 1981). ICT reduces transaction costs by providing cassava farmers with access to market prices, enabling them to make informed decisions about where and when to sell their produce. By reducing their dependence on intermediaries, farmers can negotiate better prices and increase their profit margins. Mobile platforms and agricultural apps, such as Esoko and Farmers' Friend, allow cassava farmers to access real-time market information, which contributes to improving their economic efficiency (Aker & Mbiti, 2010).

The concept of human capital theory (Becker, 1964) also aligns with the impact of ICT on cassava farmers' productivity. According to this theory, investment in skills and knowledge enhances productivity and economic performance. ICT platforms, such as video tutorials, e-extension services, and agricultural training apps, enable farmers to acquire new skills and knowledge on cassava production techniques. For instance, online learning modules can provide farmers with guidance on post-harvest handling, disease management, and the use of mechanized tools to boost productivity (Qiang et al., 2012). This knowledge reduces inefficiencies and enhances the adoption of modern farming techniques that improve cassava yields.

ICT also promotes better resource management, which aligns with the principles of precision agriculture. Precision agriculture theory emphasizes the use of technology to optimize resource allocation, such as land, water, and fertilizers, based on real-time data (Gebbers & Adamchuk, 2010). Through ICT tools like Geographic Information Systems (GIS) and satellite mapping, cassava farmers can monitor soil conditions, detect crop health issues, and apply inputs more efficiently. This reduces resource wastage and increases productivity, especially in regions with limited resources.

Moreover, ICTs have contributed to improving cassava farmers' knowledge about soil fertility management, crop rotation, and sustainable farming practices. These factors, in turn, help increase the overall productivity of cassava farms. A study by Oladipo et al. (2020) highlighted that farmers who used ICT tools such as mobile apps and online forums gained knowledge on modern agronomic practices, which contributed to better land management and increased crop yield.

2.3.5 Market Access and Financial Inclusion

Market access and financial inclusion are vital factors that influence the productivity and income levels of cassava farmers, particularly smallholder farmers in rural areas. Limited market access and restricted financial inclusion often lead to lower returns, lack of capital investment, and overall inefficiencies in cassava production. ICT innovations, such as mobile phones, e-commerce platforms, and mobile financial services, are increasingly addressing these challenges by creating opportunities for farmers to participate in markets and access financial resources. According to Aker and Mbiti (2010), ICT tools bridge the information gap, enabling farmers to make informed decisions about where, when, and how to sell their produce.

Market access allows cassava farmers to connect with buyers directly, reducing reliance on middlemen who often exploit farmers by offering below-market prices. Digital platforms like Esoko and AgriMarket provide cassava farmers with real-time information on market prices, demand trends, and buyer locations (Mittal & Mehar, 2012). By using these platforms, cassava farmers can compare prices across markets, negotiate better deals, and transport their produce to higher-paying markets, thereby increasing profitability. E-commerce tools also enable farmers to sell value-added cassava products, such as cassava flour and starch, to national and international buyers, opening new revenue streams.

Financial inclusion complements market access by addressing the need for capital, savings, and risk mitigation. Traditionally, smallholder cassava farmers have been excluded from formal financial systems due to their lack of collateral, irregular incomes, and perceived risks (Demirguc-Kunt et al., 2018). However, ICT-based financial services, including mobile money platforms like M-Pesa and Airtel Money, have revolutionized financial access for farmers. These platforms allow cassava farmers to perform cashless transactions, save money, and receive payments for their produce in real time, enhancing financial security and efficiency (Donner & Escobari, 2010).

ICTs also enhance financial inclusion by providing farmers with access to digital banking services, mobile money, and micro-loans. This is particularly important in rural areas, where access to formal financial institutions is limited. According to Akinyemi et al. (2017), mobile money services have enabled cassava farmers to receive payments, transfer funds, and access credit, which has helped improve their financial stability and enable investments in their farms.

Theoretical frameworks explaining market access and financial inclusion among cassava farmers are grounded in various economic, social, and technological theories that highlight their interconnected impact on agricultural productivity and farmer livelihoods. These theories provide a foundation for understanding the role of Information and Communication Technology (ICT), institutions, and infrastructure in addressing challenges faced by cassava farmers.

Transaction Cost Economics Theory (Williamson, 1981) explains that market access is often hindered by high transaction costs, such as transportation expenses, price asymmetry, and information gaps. Cassava farmers, especially in rural areas, face challenges accessing markets due to distance and reliance on intermediaries who exploit their lack of price information. ICT tools, such as mobile market platforms and price dissemination services, reduce transaction costs by offering real-time market information and creating linkages between farmers and buyers. This allows cassava farmers to make informed decisions, sell their produce at competitive prices, and reduce dependency on middlemen.

2.3.6 Challenges in ICT Adoption among Cassava Farmers

cassava farmers can be analyzed using various theoretical frameworks that highlight barriers related to technology, infrastructure, socio-economic factors, and human behavior. The Diffusion of Innovation Theory (Rogers, 2003) explains how the adoption of new technologies, such as ICT tools, is influenced by factors like perceived benefits, ease of use, and the socio-economic environment. For cassava farmers, limited awareness and technical knowledge about ICT tools hinder their ability to adopt innovations that improve productivity and market access. Many farmers remain skeptical about the potential benefits of digital tools, which slows the adoption process. The Technology Acceptance Model (TAM) (Davis, 1989) further identifies two critical determinants of ICT adoption: perceived ease of use and perceived usefulness. Cassava farmers in rural areas often find ICT tools difficult to use due to low digital literacy and limited technical support. If farmers do not see immediate and tangible benefits, they may resist adopting mobile platforms, e-commerce tools, or digital financial services, regardless of their potential.

Infrastructure challenges are another significant barrier, which can be examined through the Digital Divide Theory (Norris, 2001). This theory highlights the gap between those who have access to digital tools and those who do not, particularly in rural and underdeveloped areas. Poor internet connectivity, unreliable electricity, and the high cost of mobile devices limit ICT adoption among cassava farmers (Aker & Mbiti, 2010). Without sufficient infrastructure, farmers cannot access critical information on market prices, weather conditions, or financial services.Socio-economic factors, such as poverty and lack of financial resources, also contribute to low ICT adoption. The Capability Approach (Sen, 1999) emphasizes that individuals must have the necessary capabilities—such as education, income, and access to infrastructure—to utilize technology effectively. Many cassava farmers struggle with low incomes, making it difficult to afford smartphones, data plans, or subscription-based digital platforms. This economic constraint further widens the digital divide.

Despite the potential benefits, the adoption of ICTs among cassava farmers remains limited due to several challenges. The most significant barriers include low literacy rates, lack of digital skills, inadequate infrastructure, and limited access to affordable ICT devices (Abiodun, 2018). Many farmers, particularly in rural areas, face difficulties in accessing the internet, and unreliable electricity can make it difficult to charge mobile phones or use ICT tools effectively. Additionally, many farmers lack the technical skills to operate ICT tools, which hinders the full utilization of available technologies (Ibrahim et al., 2020). Furthermore, the cost of smartphones and data services can be prohibitive for smallholder farmers, especially in low-income regions. The absence of localized content and services that address the specific needs of cassava farmers also limits the effectiveness of ICT interventions.

Challenges related to the Information Asymmetry Theory (Akerlof, 1970) arise when farmers lack adequate knowledge about the benefits and functions of ICT tools. Poor dissemination of information about digital solutions and training opportunities limits farmers' ability to harness ICT for agricultural productivity, market access, and financial inclusion.

2.3.6 Educational Outreach

ICT enables broader educational outreach programs for rural cassava farmers, reaching even remote areas (Oseni, 2021). These programs promote agricultural literacy and empower farmers to make more informed decisions. Educational content is often delivered through mobile phones, which are more accessible to rural farmers (Okorie et al., 2019).

Human Capital Theory (Becker, 1964), which posits that investing in education and training enhances individuals' knowledge, skills, and productivity. For cassava farmers, educational outreach programs provide technical training, digital literacy, and awareness of innovative agricultural practices, enabling them to adopt modern tools and technologies for improved productivity. The Diffusion of Innovation Theory (Rogers, 2003) also emphasizes the importance of communication channels in spreading knowledge, suggesting that outreach programs serve as a means to accelerate the adoption of improved farming techniques and ICT solutions. Additionally, Constructivist Learning Theory (Vygotsky, 1978) highlights that outreach programs using interactive and collaborative methods enhance farmer learning and long-term retention of knowledge. Educational outreach, therefore, serves as a critical intervention to empower cassava farmers, improving their decision-making and productivity.

2.3.7 Government and NGO Involvement in Promoting ICT Adoption

Governments and NGOs have played a crucial role in promoting ICT adoption among farmers. In Nigeria, for example, the government has launched several initiatives to encourage the use of ICTs in agriculture, including the National e-Agriculture Strategy and various ICT-based extension programs. NGOs like the International Institute of Tropical Agriculture (IITA) have also been involved in providing ICT solutions tailored to the needs of cassava farmers, such as mobile apps for pest management, agronomy advice, and market access, government and NGO efforts, community-based training programs are essential to improve farmers' digital literacy and help them learn how to use ICT tools effectively. Such programs can increase the adoption rate of ICTs and ensure that farmers derive maximum benefit from digital tools.

prompting ICT adoption can be understood through the Institutional Theory (North, 1990), which highlights the role of formal institutions, policies, and organizations in driving technological change. Governments provide enabling environments by investing in ICT infrastructure, subsidizing technology costs, and formulating policies that encourage digital inclusion among rural farmers. NGOs complement these efforts through capacity-building programs, awareness campaigns, and provision of resources, helping farmers overcome digital literacy and affordability barriers (Aker & Mbiti, 2010).

The Public-Private Partnership (PPP) Framework (Osborne, 2000) further explains how collaboration between governments, NGOs, and private sector players accelerates ICT adoption by leveraging resources, expertise, and innovation. For example, governments may build ICT infrastructure while NGOs deliver training programs tailored to cassava farmers' needs, ensuring they can effectively use ICT tools for market access and financial inclusion (Donner & Escobari, 2010).

Additionally, Diffusion of Innovation Theory (Rogers, 2003) highlights that government and NGO

led initiatives act as change agents, spreading awareness about ICT solutions and facilitating their adoption. By addressing barriers such as limited access, affordability, and skills, these interventions promote technology use among cassava farmers, driving productivity and improving livelihoods.

2.3.8 Collaboration and Entry

Cassava farmers with ICT platforms are pivotal to the success of ICT adoption in agriculture. These factors help strengthen networks, increase the flow of information, and ultimately support farmers in achieving better productivity and livelihoods. The synergy created between farmers and various ICT stakeholders plays a crucial role in advancing the agricultural sector, particularly in rural areas where cassava is a staple crop

Resource-Based View (RBV) theory (Barney, 1991), which highlights that organizations and individuals can achieve competitive advantage by pooling resources and leveraging complementary capabilities. In the context of ICT adoption among farmers, collaboration between stakeholders such as governments, NGOs, and private organizations enables the entry of new technologies into rural markets, ensuring access to knowledge, tools, and infrastructure.

The Network Theory (Granovetter, 1983) further emphasizes that collaboration through networks and partnerships fosters knowledge sharing, reduces information asymmetry, and facilitates the entry of innovative solutions. For example, partnerships between ICT firms and agricultural cooperatives help cassava farmers adopt digital tools, bridging gaps in market access and financial inclusion. From a behavioral perspective, the Diffusion of Innovation Theory (Rogers, 2003) explains that collaboration acts as a catalyst for the entry of new technologies, as trusted networks accelerate awareness and adoption among farmers. By working together, stakeholders can reduce entry barriers such as costs, technical complexity, and resistance to change, ensuring a smoother transition to ICT-based solutions.

2.3.9 Cultural Alignment

ICT adoption among cassava farmers involves tailoring technological tools and solutions to align with local traditions, farming practices, and social structures. Studies show that when ICT interventions respect cultural values, farmers are more likely to embrace and effectively use new technologies in their agricultural practices. Ensuring that ICT tools are culturally relevant fosters trust, improves knowledge exchange, and ultimately enhances productivity in cassava farming communities.

Cultural Dimensions Theory (Hofstede, 1980), which explores how cultural values such as collectivism, power distance, and uncertainty avoidance shape behavior. In many cassava farming communities, collectivist cultures promote group decision-making, meaning ICT adoption or new farming methods succeed when aligned with shared community interests and values. This highlights the need for culturally sensitive outreach approaches that engage community leaders and involve group-based learning, ensuring collective acceptance of innovations (Rogers, 2003).

The Symbolic Interactionism Theory (Blumer, 1969) further explains that cultural meanings attached to technology and practices influence farmers' perceptions and adoption. For cassava farmers, ICT tools must be presented in a way that aligns with their cultural symbols and day-to-day experiences to foster trust and relevance. Additionally, the Adaptive Structuration Theory (DeSanctis & Poole, 1994) suggests that technologies must adapt to local cultural contexts to be effective; farmers are more likely to integrate tools when these align with their traditional farming systems and practices.

The Social Exchange Theory (Homans, 1961) posits that farmers adopt new behaviors when they perceive the benefits outweigh the costs. In culturally aligned settings, innovations are more likely to be seen as beneficial and less disruptive to farmers' traditional systems, improving acceptance and adoption. Cultural alignment, therefore, ensures that ICT adoption among cassava farmers is context-specific, fostering trust, relevance, and long-term success.

2.4 Outcome of Agriculture Intervention for Rural Farmers

The outcome of Agricultural intervention among cassava farmers in Kwara State, Ilorin, reveals that the adoption of ICT tools has led to improved agricultural practices, better access to market information, and enhanced productivity. Agricultural interventions, particularly those leveraging ICT, have empowered rural farmers by providing timely weather updates, improved farming techniques, and access to financial resources, which contribute to better outcomes. Studies have shown that these ICT-driven interventions help bridge the information gap and enable farmers to make informed decisions, ultimately improving their livelihoods and food security. The Sustainable Livelihood Framework (Chambers & Conway, 1992) highlights how interventions such as access to improved seeds, fertilizers, training, and technology empower farmers by enhancing their assets and resilience to shocks. These interventions lead to higher yields, reduced post-harvest losses, and improved food security, contributing to overall rural development (Pretty, 1995).

According to the Human Capital Theory (Becker, 1964), training and capacity-building programs increase farmers' knowledge and skills, enabling them to adopt modern practices that enhance productivity. Additionally, interventions that integrate ICT tools provide real-time information on weather, market prices, and extension services, improving decision-making and market access (Aker & Mbiti, 2010). Financial interventions, such as access to credit and savings, also allow farmers to invest in quality inputs and infrastructure, resulting in increased incomes and economic stability (Demirguc-Kunt et al., 2018). The overall, agricultural interventions strengthen the capacity of cassava farmers to overcome challenges, enhance production efficiency, and improve their socio-economic well-being.

2.4.1 Improved Resource Management

Through ICT, cassava farmers gain access to tools that help them manage resources such as water, fertilizers, and labor more efficiently (Ajayi et al., 2020). Applications for farm management help optimize resource usage, improving sustainability. ICT has also helped farmers identify the most cost-effective and resource-efficient farming techniques (Alabi et al., 2018). The Resource-Based View (RBV) (Barney, 1991) emphasizes that effective management of available resources, including natural and financial assets, can provide farmers with a competitive advantage by improving yields and reducing costs. Interventions such as training on sustainable agricultural practices, like crop rotation, efficient water usage, and integrated soil fertility management, enable cassava farmers to optimize resource use while maintaining soil health and productivity (Pretty, 1995).

The Sustainable Agriculture Framework (Tilman et al., 2002) further highlights that adopting technologies such as precision farming tools, organic fertilizers, and improved irrigation systems helps farmers reduce resource wastage while enhancing production efficiency. Additionally, ICT-based tools for monitoring weather, soil quality, and market demands allow cassava farmers to make informed decisions about resource allocation, resulting in reduced input costs and minimized environmental impact (Aker, 2011). By managing their resources effectively, cassava farmers not only increase yields but also contribute to long-term agricultural sustainability and improved livelihoods.

2.4.2 Supply Chain Transparency

ICT-based systems enhance transparency in the cassava supply chain, improving trust between farmers, suppliers, and buyers (Olaniyan & Eniola, 2020). These systems allow for better tracking of products from farm to market, ensuring quality and timely deliveries. Transparency in the supply chain also helps reduce fraud and corruption (Olawale & Olorunsola, 2020).

The Global Value Chain (GVC) Theory (Gereffi et al., 2005) emphasizes that transparency enables stakeholders to trace cassava products throughout the supply chain, ensuring compliance with quality, safety, and sustainability standards. By adopting ICT tools such as blockchain systems, digital tracking, and mobile applications, cassava farmers can provide verifiable information on production processes, inputs, and logistics, fostering trust between producers, processors, and buyers (Bosona & Gebresenbet, 2013).

The Transaction Cost Economics Theory (Williamson, 1981) highlights that transparency reduces information asymmetry and operational risks by ensuring that all supply chain actors have access to reliable data. This lowers transaction costs, minimizes fraud, and improves efficiency. Additionally, transparency enhances farmers' ability to access premium markets, particularly where certification and traceability are mandatory for product export (Hobbs, 2004).

Supply chain transparency empowers cassava farmers to negotiate better prices, reduce losses from inefficiencies, and align their practices with global standards, leading to improved incomes and livelihoods.

2.4.3. Access to Research and Innovation

ICT allows cassava farmers to access agricultural research findings and innovations faster, helping them adopt new farming techniques (Akinyemi et al., 2017). These innovations include the development of new cassava varieties resistant to diseases and pests. By leveraging ICT, farmers can stay at the forefront of agricultural advancements (Bamidele et al., 2020). According to the Innovation Diffusion Theory (Rogers, 2003), farmers' adoption of new practices and technologies is influenced by their access to research findings, which help them implement improved methods like high-yield cassava varieties, disease-resistant crops, and sustainable farming techniques. Research institutions and extension services play a key role in disseminating innovations to farmers, bridging the gap between knowledge creation and practical application (Feder et al., 2004).

The Agricultural Knowledge and Information System (AKIS) framework (Röling & Engel, 1991) highlights that collaboration between researchers, farmers, and policymakers enhances the dissemination of innovations, ensuring cassava farmers access tools, resources, and updated farming techniques. For instance, research-driven innovations like mechanized processing, digital tools for soil analysis, and improved fertilizers reduce production costs and post-harvest losses (Aker, 2011).

Furthermore, access to research strengthens farmers' ability to address challenges such as climate change, pests, and diseases, enabling them to adopt resilient and efficient farming systems. Such innovations ultimately contribute to improved yields, higher incomes, and rural development.

2.4.4 Support for Women Farmers

ICT has been particularly beneficial for female cassava farmers by providing platforms that offer flexible access to training and financial services (Iwuoha et al., 2020). These platforms allow women to balance farm work with family responsibilities while improving their farm productivity. ICT also provides women farmers with networking opportunities (Ogunlade &Adegboye, 2018). The Empowerment Theory (Kabeer, 1999) highlights that empowering women through access to resources, knowledge, and decision-making opportunities enables them to contribute effectively to cassava farming systems. Women often play significant roles in cassava production, processing, and marketing, yet they face challenges such as limited access to land, credit, and extension services (FAO, 2011). Addressing these barriers through targeted support programs, such as financial inclusion, training, and cooperative membership, enhances their productivity and economic participation.

The Gender and Development (GAD) Approach emphasizes the importance of integrating gender-sensitive policies into agricultural interventions to ensure women cassava farmers receive equitable support and resources (Razavi & Miller, 1995). Initiatives such as providing access to improved cassava varieties, digital tools, and market information can help women farmers reduce labor burdens and increase yields (Quisumbing & Pandolfelli, 2010). Additionally, empowering women through capacity-building programs and leadership opportunities strengthens their role in decision-making, benefiting both family welfare and the broader agricultural economy.

By supporting women cassava farmers, interventions contribute to improved household food security, poverty reduction, and sustainable rural development.

2.4.5. Integration with Agro-Industries

ICT helps cassava farmers integrate more effectively into agro-industries, facilitating partnerships that improve the processing and commercialization of cassava (Ogunlade & Ajayi, 2018). These collaborations enable farmers to access better technology, processing methods, and higher-quality markets. Integration with agro-industries increases the profitability of cassava farming (Adebayo, 2020). According to the Value Chain Development Theory (Kaplinsky & Morris, 2000), integrating cassava farmers into agro-industrial processes—such as starch, flour, ethanol, and animal feed production—creates linkages that add economic value, reduce post-harvest losses, and improve farmers' incomes. By participating in agro-industries, farmers shift from subsistence production to commercialized farming, aligning with market demands and increasing their competitiveness (FAO, 2013).

The Industrialization of Agriculture Concept (Goodman et al., 1987) explains how agro-industrial integration introduces mechanization, modern technologies, and infrastructure that enable cassava farmers to improve efficiency in production and processing. This integration encourages farmers to adopt quality standards and sustainable practices, ensuring that cassava products meet the requirements of local and international markets (Gereffi et al., 2005). Moreover, access to agro-industrial markets provides cassava farmers with better prices, employment opportunities, and long-term contracts, fostering economic stability and rural development. Supporting this integration through policies, research, and investment can strengthen the cassava value chain, benefiting both smallholder farmers and agro-industrial stakeholders.

2.4.6 Sustainable Agriculture

ICT tools promote sustainable agricultural practices among cassava farmers by providing information on soil conservation, water management, and organic farming (Alabi et al., 2018). Through ICT, farmers can access information that encourages environmentally friendly farming methods. Sustainable practices result in long-term productivity gains and environmental benefits (Ogunlade & Ajayi, 2018). Sustainable Livelihood Framework (Chambers & Conway, 1992), sustainable practices allow farmers to utilize resources efficiently, ensuring long-term food security and income stability. Techniques such as crop rotation, agroforestry, organic fertilizers, and integrated pest management help cassava farmers maintain soil fertility, minimize environmental degradation, and improve resilience to climate change (Pretty, 1995).

The Ecological Modernization Theory (Hajer, 1995) emphasizes how the adoption of technology and innovation, such as drought-tolerant cassava varieties, water-efficient irrigation systems, and mechanized processing, contributes to sustainable agricultural intensification. Sustainable practices reduce input costs, such as chemical fertilizers, while increasing yields and minimizing negative environmental impacts (Tilman et al., 2002). Furthermore, integrating cassava farmers into sustainable value chains ensures that production aligns with global sustainability standards, providing access to premium markets and enhancing livelihoods (FAO, 2013). Support through training, policies, and access to technology is critical to enabling farmers to adopt sustainable approaches, balancing productivity with long-term resource conservation.

2.5 Advocacy and Policy Influence

ICT has enabled cassava farmers to organize and advocate for better policies, contributing to improved agricultural policies and rural development (Adebayo, 2020). Platforms for collective action and advocacy help farmers voice their concerns to government agencies and NGOs. ICT has empowered farmers to engage more actively in policy discussions (Nwachukwu & Ifeoma, 2020). Effective advocacy enables cassava farmers to voice their needs, such as access to credit, inputs, technology, and markets, influencing policies that directly impact their productivity and economic stability. Through collective action, farmer cooperatives and organizations can lobby for supportive government policies, such as subsidies, improved infrastructure, and extension services (World Bank, 2013).

The Stakeholder Theory (Freeman, 1984) highlights the importance of collaboration among farmers, policymakers, NGOs, and private actors to develop policies that prioritize cassava production and processing. For instance, advocacy for favorable trade policies, research funding, and ICT adoption enhances cassava farmers' ability to compete in domestic and international markets (FAO, 2011). Additionally, empowering farmers with education on policy frameworks ensures they can actively participate in decision-making processes that shape agricultural development (Pretty, 1995). By influencing policies, cassava farmers can secure equitable access to resources, fair pricing, and sustainable production systems, fostering rural economic growth and poverty reduction.

2.5.1 Innovation in Processing

ICT supports cassava farmers in adopting innovative processing technologies, which improve the quality and shelf life of cassava products (Akinlolu, 2020). Access to processing equipment information has increased the commercialization of cassava and its by-products. These innovations have created new value-added products, benefiting farmers economically (Adedeji & Olorunfemi, 2019). According to the Innovation Diffusion Theory (Rogers, 2003), adopting new processing technologies, such as mechanized cassava peelers, dryers, and milling machines, accelerates efficiency and product quality, enabling farmers to meet market demands. Innovations like improved drying techniques and fermentation processes also ensure cassava by-products, such as starch, flour, and ethanol, are produced at higher standards (FAO, 2013).

The Value Addition Framework (Kaplinsky & Morris, 2000) emphasizes that innovation in cassava processing transforms raw cassava into marketable products, such as gari, high-quality cassava flour, animal feed, and biofuels. This shift not only increases profitability but also aligns production with industrial and global market needs. Additionally, innovations like solar dryers and mobile processing units allow smallholder farmers to process cassava efficiently, reducing spoilage and extending shelf life (Adebayo et al., 2010). Support through research, capacity building, and access to technology ensures cassava farmers can integrate these innovations into their operations, leading to higher productivity, reduced waste, and improved livelihoods.

2.5.2 Mobile Agriculture Applications

Mobile phones have become vital tools for cassava farmers to access agricultural advice, weather forecasts, and market prices (Nwachukwu & Abiola, 2021). Many farmers now rely on mobile apps to access real-time information on their crops. These applications have improved decision-making and resource management for farmers (Adebayo, 2020). Technology Acceptance Model (TAM) (Davis, 1989), mobile applications are widely adopted when they provide perceived usefulness and ease of use, such as offering real-time weather updates, pest control advice, market prices, and extension services. Applications like e-Extension and digital farming platforms enable cassava farmers to make informed decisions, reducing risks and optimizing production processes (Aker, 2011).

The Information Communication Technology for Development (ICT4D) framework highlights that mobile applications bridge the knowledge gap by providing critical agricultural information, especially in rural areas with limited access to traditional extension services (Qiang et al., 2012). For example, mobile platforms allow cassava farmers to connect directly with buyers, reducing the role of intermediaries and increasing their bargaining power.

However, mobile tools offer financial inclusion through mobile banking, enabling farmers to access credit, savings, and payment systems for purchasing inputs or receiving payments (Jack & Suri, 2014). By integrating mobile agriculture applications into their farming practices, cassava farmers can improve efficiency, enhance market access, and strengthen their livelihoods sustainably.

2.5.3 Knowledge Dissemination

ICT facilitates the rapid dissemination of agricultural knowledge, allowing farmers to learn about new techniques and innovations (Oluwatayo et al., 2019). Through online forums and social media, cassava farmers can stay updated on the latest research and practices. Digital platforms are also used for disseminating government policies and agricultural updates (Akinyemi et al., 2017). Agricultural Knowledge and Information Systems (AKIS) framework (Röling & Engel, 1991), knowledge is effectively shared through collaboration among researchers, extension agents, and farmers. Extension services, farmer field schools, and ICT tools such as mobile applications, radio programs, and social media platforms are essential channels for disseminating innovations in cassava farming, such as improved varieties, pest management techniques, and processing technologies (Aker, 2011).

The Diffusion of Innovations Theory (Rogers, 2003) highlights that knowledge uptake among cassava farmers depends on the relevance, simplicity, and perceived benefits of the shared information. For instance, introducing knowledge about high-yield cassava varieties or sustainable farming practices enables farmers to make informed decisions, enhancing their productivity and resource management (Feder et al., 2004).

Furthermore, participatory knowledge-sharing approaches, such as farmer-to-farmer learning and cooperative networks, empower farmers to adapt innovations to their local contexts, fostering collective progress. By improving access to timely and relevant agricultural knowledge, cassava farmers can achieve higher yields, reduce post-harvest losses, and access better markets, ultimately enhancing rural livelihoods.

2.5.4 Cost Reduction

ICT adoption helps reduce the costs of production for cassava farmers by providing access to cheaper and more efficient farming tools (Ajayi & Olorunfemi, 2019). Mobile applications help farmers purchase inputs at competitive prices, cutting down on costs. The digitalization of agricultural services has streamlined many processes, saving both time and money (Alabi et al., 2018). The Resource-Based View (RBV) Theory (Barney, 1991) suggests that farmers can reduce costs by efficiently utilizing resources such as land, labor, and inputs. For instance, adopting high-yield cassava varieties, which require fewer inputs per unit of output, can significantly lower production costs while increasing yields (FAO, 2013). Mechanization, such as cassava harvesters and peelers, reduces labor costs and post-harvest losses, thus improving efficiency and productivity (Adebayo et al., 2010).

The Economies of Scale principle highlights that collective actions, such as forming cooperatives, allow cassava farmers to pool resources, negotiate better input prices, and share processing facilities, reducing individual costs (Dorward et al., 2004). Additionally, integrated pest management (IPM) techniques and precision agriculture tools enable farmers to minimize expenses on pesticides and fertilizers while maintaining productivity. Also, adopting digital tools and mobile agriculture platforms helps cassava farmers access market prices, weather forecasts, and input suppliers, enabling cost-effective decision-making (Aker, 2011). By leveraging innovative technologies and sustainable practices, cassava farmers can reduce costs, improve production efficiency, and increase their overall incomes.

2.5.5. Traceability and Certification

ICT systems enable cassava farmers to document and trace the entire production process, which is crucial for certifications and organic farming standards (Akinlolu, 2020). These systems help farmers maintain quality control, ensuring that their produce meets international standards. Traceability systems have enhanced the value of cassava in both local and export markets (Okorie et al., 2019), and enhancing the competitiveness and sustainability of cassava farmers in global and local markets. The Institutional Theory (North, 1990) explains that certification systems establish formal standards and rules, ensuring cassava farmers comply with regulatory and quality requirements. Traceability systems, supported by ICT tools, enable farmers to monitor and document the journey of cassava products, thereby promoting transparency and accountability throughout the supply chain (Bosona & Gebresenbet, 2013).

According to the Resource-Based View (Barney, 1991), certification provides a strategic advantage by differentiating cassava products through quality assurance, safety, and sustainability labels, allowing farmers to access premium markets and achieve higher income. The Signaling Theory (Spence, 1973) suggests that certification serves as a signal of quality and reliability to buyers, strengthening trust and enhancing marketability. Traceability systems also facilitate compliance with food safety regulations and sustainability standards, particularly in export markets where demand for accountability is high (Hobbs, 2004).

Moreover, certification and traceability reduce risks of contamination or fraud, aligning with the Transaction Cost Economics Theory (Williamson, 1981), which highlights how such mechanisms minimize uncertainty and operational costs. These systems encourage cassava farmers to adopt improved production practices, increasing productivity and ensuring long-term sustainability. By improving market access and fostering buyer confidence, traceability and certification contribute to the economic empowerment and resilience of cassava farmers.

2.5.6 Increased Farm Income

The adoption of ICT in cassava farming has been shown to lead to increased income through improved productivity and better market access (Adebayo, 2020). ICT tools support efficient farm management and better pricing decisions, directly impacting farmers' earnings. Studies have demonstrated that ICT-enabled marketing platforms help farmers increase their profits (Oseni & Ojo, 2019). Human Capital Theory (Becker, 1964), which highlights that investing in improved skills, education, and technologies leads to higher productivity and earnings. By adopting modern agricultural practices and ICT tools, cassava farmers gain access to market information, improved inputs, and value addition, which directly enhances their income (Aker & Mbiti, 2010). The Value Chain Theory (Kaplinsky & Morris, 2000) further emphasizes that integrating farmers into value chains—such as processing cassava into flour, starch, or ethanol—creates opportunities for higher revenue through product diversification and market expansion.

The Technology Adoption Theory (Davis, 1989) explains that tools such as mobile-based price alerts and digital financial services enable cassava farmers to reduce costs, secure better prices, and optimize resource use, leading to increased profitability. Additionally, the Theory of Comparative Advantage (Ricardo, 1817) suggests that by specializing in cassava production, farmers maximize returns by focusing on their strengths while accessing competitive markets. Access to financial inclusion, such as credit and insurance, also empowers cassava farmers to invest in quality inputs and adopt risk-reducing strategies, resulting in improved yields and income stability (Demirguc-Kunt et al., 2018).

CHAPTER THREE
METHODOLOGY

3.1 The Study Area

This study was conducted in Asa Local Government Area of Kwara State, Nigeria. Asa local government area is located in Kwara state, North-central Nigeria and has the city of Afon as its headquarters. Asa Local Government Area comprises several towns and villages which include Ogbondoroko, Afon, Laduba, Aboto, Balah, Eyenkorin, Pampo, Ogele, and Olowokere. It has an area of 1,286 km^2 and a population of 126,435. The area is characterized by tropical wet and dry seasons with a monthly average temperature of 30^oC. The month of March has the highest average temperature of 33^oC, and August has the lowest average temperature of 27.3^oC with an average annual rainfall of 990.3mm. Asa local government area lies between 260 and 480 meters above sea level. Major land forms in the state are plains, undulating hills and valleys. Agriculture is the main stay of the economy and the area is known for poultry keeping and cultivation of crops such as sweet potatoes, maize, cassava, yam, groundnuts and vegetables.

3.2 Population of the Study

The population for the study consisted of all cassava farmers in Asa Local Government Area of Kwara state, Nigeria.

3.3 Sampling Procedure and Sample Size

A two-stage sampling procedure was employed for this study. The first stage involved a simple random selection of six (6) communities (Ogbondoroko, Afon, Laduba, Balah, Pampo, and Olowokere) from the local government, while in the second stage, twenty (20) cassava farmers were randomly selected from each of the selected communities to give a total sample size of one hundred and twenty (120) respondents.

3.4 Instrument for Data Collection

A well-structured questionnaire was used as the primary instrument, incorporating both closed and open-ended questions. The questionnaire was divided into sections based on the objectives of the study.

3.5 Validity of the Instrument

Validity was done through cross examination and appropriate modification of the instrument by experts in the field of Agricultural Extension and Management to ensure both face and content validity.

3.6 Measurement of variables

The two broad groups of variables measured for the study are the dependent and independent variables.

3.6.1 Dependent Variables

The dependent variable of the study is the level of utilization of information and communication technology among cassava farmers. This was measured using a 3-point Likert scale. Lists of ICT facilities were put together and respondents were requested to indicate their level of utilization of these facilities on a scale of 1 to 3. The scale will be graduated as follows; **Never use=1, Occasionally = 2 and Regularly= 3**

3.6.2 Independent variables

Socio-economic Characteristics of cassava farmer

The independent variables consist of the socio-economic characteristics of cassava farmers, which include the following: age, sex, marital status, religion, level of education, farming experience and membership of farming association. These variables will be measured as follows;

Age: was measured in years

Sex: was measured as Male = 1, Female = 2

Marital status: measured as single=1, married =2, separated =3.

Religion: Traditional =1, Christianity = 2 Islam = 3

Level of education: Non-formal=1, primary=2, secondary=3, tertiary=4 and number of years spent in formal education

Household size: The respondents were asked to indicate the actual number of people living and feeding together in their household. This was measured at interval level and mean value was used to categorize the size into high or low.

Farming Experience: was measured in years

Farm Size: was measured in hectare/acre

Membership of Farming Association: This will be measured as dummy variable, (1) for membership and (0) for non-membership.

Source of information on cassava production techniques

Lists of information sources were provided for the respondents to choose from. This was measured on a nominal scale by assigning (2) to Yes and (1) to No

Relevance of ICT to cassava production

List of ICT relevance statement to cassava production were provided for the respondents to choose from. This was measured using a 4-point Likert scale and the respondents will be requested to indicate their level of agreement with these statements on a scale of 1 to 4. The scale was graduated as follows; **Not relevant=1, Partially relevant= 2, Relevant = 3 and Highly relevant= 4.**

Constraints militating against the use of ICT by farmers

This was measured using a 4-point Likert scale and the scale will be graduated as follows; **Not severe =1, Less severe = 2, Severe = 3 and Very severe= 4.**

3.7 Data Analysis

The collected data were subjected to both descriptive and inferential statistical analyses. Descriptive statistics, such as frequencies and percentages, was used to summarize the demographic characteristics of the farmers and their source of information on cassava production. Inferential statistic (PPMC) was used to test the hypothesis.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter is concerned with the presentation and analysis of data collected from the field. The chapter is divided into five sections. The first section described the socio-economic characteristics of the farmers, the second section examined cassava farmers source of information, the third section investigate the level of ICT utilization by farmers, the fourth section investigates the perceived relevance of ICT to cassava production, the fifth section examined the farmers' constraints to the use of ICT, while the last section focused on hypothesis testing

4.1 Socio-economic Characteristics of the Respondents

Table 1. Distribution of the Respondents by their socio-economic characteristics

Socio-economic characteristics	**Frequency (120)**	**Percentage (%)**	**Mean**
Age			
Below 30 years	18	15.0	
31-45 years	40	33.3	
46-60years	31	25.8	46.7
61years and above	31	25.8	
Gender			
Male	94	78.3	
Female	26	21.7	
Marital status			
Single	15	12.5	
Married	99	82.5	
Separated	6	5.0	

Level of education			
No formal education	38	31.7	
1 - 6 years	30	25.0	
6 – 12 years	38	31.7	
13 years and above	14	11.6	
Farming experience			
Below 5years	3	2.5	
6-15years	50	41.7	
16-30years	39	32.5	20.18
31years and above	28	23.3	
Household size			
1-5	46	38.3	
6-10	49	40.8	6.0
11-15	19	15.8	
16 and above	6	5.0	
Farm size			
1-3 hectares	37	30.8	
4-10 hectares	83	69.2	4.30

Source: Field Survey, 2025

The results presented in Table 1 above shows that 15.0% of the respondents were aged below 30 years, 33.3% were between 31-45 years, 25.8% between 46-60 years and 25.8% were aged 61 years and above. The mean age of the respondents is approximately 47 years, suggesting that the cassava farming population is largely middle-aged and older. This demographic could impact ICT adoption, as younger farmers are typically more receptive to digital technologies (Okeke, 2016).

Furthermore, results show that majority (78.3%) of the respondents were male while the few others (21.7%) were female. This gender imbalance reflects the dominance of men in cassava farming activities in the area, a trend common in many rural Nigerian communities (Adebayo & Adesope, 2007).

Regarding the marital status of the respondents. Table l shows that majority (82.5%) of the respondents were married. This status may provide opportunity for family farming and the case where children are available, they can be used as family labour. The decision to purchase any ICT gadget set and listen to farming programs among these respondents are likely to be made by the husband (male). In terms of education, 31.7% had no formal education, while 31.7% had between 6–12 years of education, with a mean of 6 years of schooling. These figures suggest that literacy and formal education could be a limiting factor in ICT adoption, as low education levels can hinder understanding and utilization of digital tools (Omotayo, 2005; Okwu et al., 2011).

Regarding farming experience, the average farm experience was 20.18 years, with most respondents (41.7%) having 6–15 years of experience. This indicates that most farmers are highly experienced in cassava production, which may positively influence their openness to adopting ICT if they perceive it as beneficial to their productivity (Agwu et al., 2008).

Household size averaged 6 persons, with the majority (40.8%) having 6–10 members. Most respondents (69.2%) operate 4–10 hectares of farmland, while 30.8% cultivate 1–3 hectares, with a mean of 4.30 hectares. This relatively large average farm size may support the relevance of ICT adoption since larger-scale operations are more likely to benefit from technologies that improve efficiency (Ibrahim et al., 2016).

4.2 Source of information on Cassava Production

Table 2. Distribution of respondents by their source of Information on Cassava Production

S/N	Source of information	Frequency (120)	Percentage (%)
1	Friends and family	81	67.50
2	Radio/Television	77	64.20
3	Farmers group	90	75.00
4	Extension Agents/ADP	64	53.30
5	Print media	57	47.50

Source: Field Survey, 2025

The results, as presented in Table 2, revealed that farmers relied on both formal and informal sources for agricultural knowledge. Farmer groups were the most prominent source, with 90 respondents, representing 75.0% of the total, indicating that they obtained information about cassava production through these organized networks. This highlights the role of collective learning and peer-to-peer knowledge exchange in farming communities. Friends and family accounted for the second most cited source, with 81 respondents (67.5%). This emphasizes the continued importance of informal social networks and interpersonal relationships in rural information sharing. Radio and television were also popular sources, utilized by 77 respondents, which makes up 64.2% of the sample. These mass media platforms remain vital in reaching a large number of farmers, especially those in remote areas. Extension agents and Agricultural Development Program (ADP) officers were cited by 64 respondents, equivalent to 53.3%, demonstrating a moderate level of engagement with formal agricultural advisory services. While their role is acknowledged, the data suggests a need for broader coverage and more frequent interactions with farmers. print media, including newspapers, magazines, and bulletins, were mentioned by 57 respondents, accounting for 47.5%. Though not as widely used as other sources, print materials still serve as a valuable medium for literate farmers who seek in-depth information.

4.3 Level of Utilization of ICT by Cassava Farmers

Table 3. Distribution of Respondents based on their Level of Utilization of ICT facilities

ICT's facilities	Regularly	Occasionally	Never	Mean	Remark
Radio	88(73.3%)	30(25.0%)	2(1.7%)	2.96	Very high
Computer	38(31.7%)	16(13.3%)	66(55.0%)	1.75	Low
Email	11(9.2%)	26(21.7%)	83(69.2%)	1.15	Low
Internet	57(47.5%)	36(30.0%)	27(22.5%)	1.81	Low
Television	97(80.8%)	21(17.5%)	2(1.7%)	2.74	Very high
Video recorder/audio cassette	30(25.0%)	28(23.3%)	62(51.7%)	1.43	Low
Flash drive	21(17.5%)	43(35.8%)	56(46.7%)	1.20	Low
Newspaper	75(62.5%)	38(31.7%)	7(5.8%)	2.37	High
Mobile Phone	99(82.5%)	20(16.7%)	1(0.8%)	2.75	Very high

Source: Field Survey, 2025

Information provided in Table 3 presents the frequency use across nine different ICT tools. The analysis shows a varying degree of adoption, with a notable preference for traditional media and mobile technologies. The most frequently used ICT tool was the radio, with 88 respondents (73.3%) using it regularly, 30 respondents (25.0%) using it occasionally, and only 2 respondents (1.7%) reporting they never used it. This gave a high mean score of 2.96, indicating a very high level of usage. Radios remain a crucial source of agricultural information, especially due to their affordability and accessibility in rural areas. This is consistent with previous studies that emphasize radio as a cost-effective and widely used medium for rural communication in Nigeria (Olowu & Oyediran, 2015). Its use does not require literacy, making it ideal for broad-based agricultural outreach.

Mobile phones also recorded a very high utilization rate. A total of 99 respondents (82.5%) used mobile phones regularly, 20 respondents (16.7%) occasionally, and only 1 respondent (0.8%) had never used a mobile phone for farming-related activities. The mean score of 2.75 confirms their importance as an essential communication tool among farmers, television was highly utilized, with 97 respondents (80.8%) indicating regular use, 21 respondents (17.5%) using it occasionally, and only 2 respondents (1.7%) never using it. It had a mean of 2.74, placing it in the very high utilization category as well. These findings support the conclusions of Adejo et al., (2016), who noted that mobile phones and television are increasingly being utilized by farmers for information access and peer collaboration.

The use of newspapers also showed relatively high engagement. 75 respondents (62.5%) used them regularly, 38 respondents (31.7%) occasionally, while 7 respondents (5.8%) never used them. This gave a mean score of 2.37, indicating a high level of utilization. On the other hand, digital and data-driven ICT tools recorded low levels of utilization. For example, the internet was used regularly by 57 respondents (47.5%), occasionally by 36 respondents (30.0%), and never by 27 respondents (22.5%), with a mean score of 1.81. Computers were regularly used by only 38 respondents (31.7%), occasionally by 16 respondents (13.3%), and never by 66 respondents (55.0%), resulting in a low mean score of 1.75. Even lower levels of usage were observed for email, with just 11 respondents (9.2%) using it regularly, 26 respondents (21.7%) occasionally, and 83 respondents (69.2%) never using it. This resulted in a very low mean score of 1.15. Video recorders and audio cassettes had 30 respondents (25.0%) who used them regularly, 28 respondents (23.3%) occasionally, and 62 respondents (51.7%) never used them, yielding a mean of 1.43, which also falls within the low utilization category. Flash drives were used regularly by 21 respondents (17.5%), occasionally by 43 respondents (35.8%), and never by 56 respondents (46.7%). This tool also received a low mean score of 1.20. It could be noted that the results reveal cassava farmers highly utilize ICT tools that are accessible, familiar, and affordable, such as radio, television, mobile phones, and newspapers. Conversely, digital ICT tools like computers, internet, email, and flash drives are underutilized due to potential barriers such as cost, technical literacy, and infrastructure limitations. These findings are consistent with Arokoyo (2015) and Adomi (2019), who emphasized the urban-rural divide in ICT access and capacity.

4.4 Relevance of ICT on Cassava Production

Table 4. Distribution of respondents based on their perceived relevance of ICT to Cassava Production

S/N	Relevance	Highly Relevant	Relevant	Partially Relevant	Not Relevant	Mean
1	Improved access to market information on cassava production	29(24.2%)	36(30.0%)	24(20.0%)	31(25.8%)	2.50
2	Provide information on land preparation for cassava production	50(41.7%)	52(43.3%)	10(8.3%)	8(6.7%)	3.20
3	Provide access to knowledge on fertilizer application	48(40.0%)	41(34.2%)	12(10.0%)	19(15.8%)	3.00

4	Facilitates cassava farmers access to information on the appropriate period of harvesting	31(25.8%)	50(41.7%)	14(11.7%)	25(20.8%)	2.70
5	Provide information on means of transporting cassava tuber	17(14.2%)	48(40.0%)	39(32.5%)	16(13.3%)	2.60
6	Facilitates access to information on weed and pest control	41(34.2%)	48(40.0%)	5(4.2%)	26(21.7%)	2.90
7	Improvement in cassava farmers planting method and time	46(38.3%)	53(44.2%)	10(8.3%)	11(9.2%)	3.10
8	Provides technical knowledge and support to cassava processors in the area of processing, packaging and other value addition	29(24.2%)	36(30.0%)	24(20.0%)	31(25.8%)	2.50

Source: Field Survey, 2025

The perceptions regarding the relevance of Information and Communication Technology (ICT) in various aspects of cassava production. The results, as shown in Table 4. The data revealed that the highest relevance of ICT is attributed to its role in providing information on land preparation, where 41.7% of the respondents indicated it is highly relevant, and 43.3% marked it as relevant. Only 8.3% and 6.7% perceived it as partially relevant or not relevant, respectively, resulting in a mean score of 3.20—the highest among all indicators. This suggests that cassava farmers consider pre-planting activities to be the most ICT-dependent stage of production. Following closely is the relevance of ICT in improving planting methods and timing, with 38.3% of respondents rating it highly relevant and 44.2% as relevant, while only 8.3% and 9.2% considered it partially relevant and not relevant, respectively. This indicator recorded a mean score of 3.10, reflecting the importance of ICT in optimizing agronomic practices, access to fertilizer application knowledge was seen as highly beneficial, as 40.0% of the farmers believed ICT is highly relevant and 34.2% rated it relevant. Meanwhile, 10.0% and 15.8% considered it partially relevant and not relevant, respectively, leading to a mean score of 3.00. ICT was also rated fairly well in facilitating weed and pest control information, with 34.2% of respondents rating it highly relevant and 40.0% as relevant. Only 4.2% viewed it as partially relevant, while 21.7% saw it as not relevant, yielding a mean score of 2.90.

In terms of helping farmers determine the appropriate period of harvesting, 25.8% of respondents considered ICT highly relevant, and 41.7% saw it as relevant, while 11.7% and 20.8% rated it as partially and not relevant, respectively. The mean score of 2.70 reflects a moderately positive perception. When asked about ICT's relevance in providing information on means of transporting cassava tubers, responses were more varied: only 14.2% rated it highly relevant, while 40.0% found it relevant, and 32.5% and 13.3% deemed it partially relevant and not relevant, respectively. This resulted in a mean score of 2.60, indicating moderate but lower relevance.

Conversely, the lowest relevance ratings were associated with improving access to market information and providing technical support in cassava processing and value addition. Both indicators recorded identical distributions: 24.2% of respondents considered them highly relevant, 30.0% as relevant, 20.0% as partially relevant, and 25.8% as not relevant, resulting in a relatively low mean score of 2.50 for each. This is in contrast to the findings of Usman et al., (2012) that marketing information is one of the most relevant ICT services. This suggests a significant gap in the application or awareness of ICT tools in post-harvest and market linkage stages.

4.5 Constraints to the use ICT Among Cassava Farmers

Table 5. Distribution of Respondents based on constraints to Adoption of ICT

S/N	Constraints	Very serious	Serious	Less serious	Not serious	Mean
1	Lack of access to electricity	60(50.0%)	40(33.3%)	6(5.0%)	14(11.7%)	3.20
2	Limited digital literacy	45(37.5%)	40(33.3%)	26(21.7%)	9(7.5%)	3.00
3	Lack of access to internet connectivity	65(54.2%)	46(38.3%)	6(5.0%)	3(2.5%)	3.40
4	High cost of ICT tools	72(60.0%)	36(30.0%)	8(6.7%)	4(3.3%)	3.50
5	Lack of awareness program that educate farmers about the benefit of ICT tools	53(44.2%)	49(40.8%)	13(10.8%)	5(4.2%)	3.30
6	Poor network reception	31(25.8%)	39(32.5%)	30(25.0%)	20(16.7%)	2.70
7	Limited technical expertise	45(37.5%)	31(25.8%)	27(22.5%)	17(14.2%)	2.90

Source: Field Survey, 2025

The constraints facing cassava farmers in the use of ICT are presented in Table 5. These constraints significantly limit the effective adoption and utilization of ICT tools and platforms for agricultural practices. The findings from the field survey reveal multiple challenges ranging from economic to infrastructural and knowledge-based barriers. Table 5 revealed that the most pressing constraint identified by the respondents was the high cost of ICT tools, with 60.0% of the farmers indicating it as very serious, 30.0% as serious, 6.7% as less serious, and only 3.3% considering it not serious. This category had the highest mean score of 3.50, highlighting affordability as a critical challenge to ICT adoption among cassava farmers. This finding aligns with prior study of Adebayo (2015), who emphasized affordability as a major barrier to ICT adoption among rural farmers.

Closely following is the lack of access to internet connectivity, which was rated very serious by 54.2% of the respondents and serious by 38.3%, while 5.0% and 2.5% considered it less serious and not serious, respectively. This challenge recorded a mean score of 3.40, emphasizing the infrastructural deficit in rural areas that hinders the smooth operation of ICT-based systems. Another notable constraint was the lack of awareness programs that educate farmers on the benefits of ICT tools, with 44.2% rating it as very serious, 40.8% as serious, 10.8% as less serious, and 4.2% as not serious. This resulted in a mean score of 3.30, suggesting a significant gap in outreach and sensitization programs that could otherwise enhance ICT engagement among farmers.

Lack of access to electricity also poses a substantial barrier. Half of the respondents (50.0%) rated it as very serious, 33.3% as serious, while 5.0% and 11.7% considered it less serious and not serious, respectively. The mean score of 3.20 confirms that erratic or non-existent power supply affects farmers' ability to consistently use ICT devices. Limited digital literacy emerged as another major constraint, with 37.5% of farmers identifying it as very serious, 33.3% as serious, 21.7% as less serious, and 7.5% as not serious, giving a mean score of 3.00. This implies that a considerable number of farmers lack the basic skills required to operate digital devices and applications effective. Limited technical expertise was identified by 37.5% of respondents as very serious, 25.8% as serious, 22.5% as less serious, and 14.2% as not serious, with a resulting mean score of 2.90. This reflects a shortage of trained personnel or support services to assist farmers in ICT-related challenges.

Table 5 also revealed that 25.8% of respondents considered poor network reception to be very serious, 32.5% as serious, 25.0% as less serious, and 16.7% as not serious, with a mean score of 2.70, indicating moderate concern.

4.6 Hypothesis testing

Table 6. Correlation Analysis showing the relationship between selected socio-economic characteristics and level of Respondents Utilization of ICT

Socio-economic Characteristics of Respondents	Level of utilization of ICTs for cassava farmers		
	r value	sig.(p-value)	Remark
Age	0.741	0.012	Significant
Farming experience	0.676	0.018	Significant
Educational level	0.746	0.009	Significant
Household size	0.645	0.028	Significant
Farm size	0.547	0.049	Significant

Source: field survey, 2025

The result of the correlation testing which assessed the relationship between selected socio-economic characteristics of cassava farmers and their level of utilization of ICT facilities. The analysis was conducted using Pearson Product Moment Correlation (PPMC), and the results are summarized in Table 6.

The table shows that there is a statistically significant relationship between all the selected socio-economic characteristics and the level of ICT utilization among cassava farmers, as evidenced by the p-values for all variables being less than the alpha level of 0.05. Age had a strong positive correlation with ICT utilization, with an r-value of 0.741 and a significance level (p-value) of 0.012. This suggests that as age increases, the level of ICT utilization also increases among the respondents, possibly due to older farmers having more decision-making authority or experience in adopting innovation. Farming experience was also significantly correlated with ICT utilization, yielding an r-value of 0.676 and p =

0.018. This implies that more experienced farmers tend to make greater use of ICT facilities, likely because of increased awareness of the benefits ICT offers in cassava production. Educational level showed the strongest correlation among the variables, with an r-value of 0.746 and $p = 0.009$. This indicates that higher levels of education are associated with higher levels of ICT usage, suggesting that literacy and formal education enhance a farmer's ability to understand, access, and utilize ICT tools effectively. Household size also had a significant positive correlation with ICT utilization ($r = 0.645$, $p = 0.028$), suggesting that larger households may provide more labor support or a wider network through which ICT knowledge and devices can be accessed and shared. Farm size had a moderately strong but still significant correlation ($r = 0.547$, $p = 0.049$) with ICT utilization. This implies that farmers with larger farm holdings are more likely to use ICT facilities, possibly due to the need for more efficient information management and operational decision-making.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The chapter presents the summary of the work, draws conclusions and made recommendations that will help to promote adoption of information and communication technologies in order to boost cassava production of the farmers in Kwara State and Nigeria at large.

5.1 Summary

This study evaluated how Information and Communication Technology (ICT) influences cassava production among 120 smallholder farmers in Asa Local Government Area, Kwara State. Demographically, respondents skewed toward the mature end of the farming spectrum—mean age of 46.7 years—and were overwhelmingly male (78.3%), reflecting traditional gender roles in local agriculture. Despite limited formal education (mean of 6 years), these farmers possess considerable practical know-how, with an average of 20.18 years of cassava-growing experience on plots averaging 4.30 hectares. Such a profile suggests a cohort potentially receptive to innovations, provided those innovations align with their existing skill sets and resource constraints. In terms of information acquisition, cassava growers rely primarily on social and communal channels: farmer groups (75.0%) and friends and family (67.5%) are the most cited sources, underscoring the power of peer learning and word-of-mouth in rural contexts. Traditional mass-media outlets, radio and television (64.2%) remain vital for reaching farmers at scale, while extension agents (53.3%) and print media (47.5%) play supporting roles. This multi-pronged information ecosystem highlights both the strengths (trust in peer networks, breadth of broadcast media) and gaps (limited formal advisory contact, literacy barriers for print) in current outreach efforts. When it comes to ICT adoption, mobile phones, radio, and television dominate daily practice, with 73.3–82.5% of respondents using these tools regularly. Newspapers enjoy moderate uptake (62.5%), but truly digital platforms such as internet (47.5%), computers (31.7%), email (9.2%) lag far behind. The heavy reliance on accessible, low-cost technologies reflects persistent bottlenecks: high tool costs (mean 3.50), poor connectivity (3.40), unreliable electricity (3.20), lack of awareness programs (3.30), and limited digital literacy (3.00) all severely constrain uptake.

Farmers' perceptions of ICT relevance mirror these usage patterns. ICT is deemed most valuable for pre-planting and crop management tasks—land preparation (mean 3.20), planting methods and timing (3.10), and fertilizer application (3.00)—where concrete, actionable guidance can directly improve field outcomes. In contrast, post-harvest and marketing functions such as market information and value-addition support are viewed as less pertinent (both mean 2.50), indicating untapped potential for digital tools in linking growers to buyers, optimizing transport logistics, or enhancing processing techniques.

Statistical analysis confirms that socio-economic factors significantly shape ICT engagement: education ($r = 0.746$) and age ($r = 0.741$) emerge as the strongest predictors, followed by experience ($r = 0.676$), household size ($r = 0.645$), and farm size ($r = 0.547$). In practical terms, better-educated and longer-established farmers with larger operations are more likely to invest in and utilize ICT. This underscores the need for differentiated strategies such as tiered training modules, subsidized devices, and community-led digital champions to ensure that younger, less-educated, or smaller-scale farmers are not left behind in the ICT-driven transformation of cassava production.

5.2 Conclusion

Based on the findings of this study, it can be inferred that Information and Communication Technology (ICT) clearly holds substantial promise for improving cassava production in Asa Local Government Area, especially in the domains of pre-planting activities, crop management, and real-time information dissemination. Tools such as mobile phones, radio, and television have already gained strong acceptance among farmers, serving as critical conduits for transmitting agricultural advice, weather updates, and farming techniques. These technologies have proven to be particularly effective because they are affordable, user-friendly, and compatible with the farmers' existing communication habits. However, the full transformative potential of ICT remains largely untapped due to a confluence of economic, infrastructural, and human-capacity barriers. High costs of ICT equipment, unreliable electricity supply, limited internet connectivity, and poor network reception continue to pose significant challenges. Additionally, digital literacy deficits and lack of targeted awareness programs inhibit farmers from exploring and utilizing more advanced digital tools, such as computers, internet-based platforms, and data storage technologies like flash drives and emails. This underutilization is particularly evident in post-harvest activities like marketing, processing, packaging, and value addition which remain critical yet neglected stages in the cassava value chain.

Further findings from the study confirms that ICT adoption is not evenly distributed among farmers. Instead, it is significantly influenced by socio-economic characteristics such as education level, age, farming experience, household size, and farm size. For instance, better-educated farmers or those with larger operations are more likely to access and utilize ICTs effectively. This finding suggests that blanket interventions may not work uniformly; instead, ICT-driven agricultural development must be tailored to reflect the unique capacities and limitations of different farmer groups, while ICT is already reshaping aspects of cassava farming in Asa LGA, its strategic deployment must go beyond hardware provision. It requires an integrated approach that addresses affordability, accessibility, training, and infrastructure. Only through such a holistic framework can ICT truly serve as a catalyst for sustainable, inclusive, and productivity-driven cassava farming in the region.

5.3 Recommendations

Based on conclusion drawn from the findings, the following recommendations can be made:

i. To foster widespread ICT adoption, stakeholders should design and implement awareness campaigns using local dialects and culturally familiar formats such as radio jingles, community drama, town-hall meetings, and success-story showcases. These should clearly communicate the benefits of ICT in areas like market price discovery, pest and disease management, improved planting and harvesting practices, post-harvest handling, and value addition.

ii. Government agencies, NGOs, and private-sector actors should collaborate to establish credit schemes, lease-to-own models, or cost-sharing programs that enable smallholder farmers to afford smartphones, solar-powered charging kits, and subsidized data bundles. These initiatives would lower the entry barrier for digital inclusion and ensure equitable access to essential ICT tools, especially among low-income and marginalized farmers.

iii. There is an urgent need to accelerate rural electrification projects through grid extensions or decentralized renewable energy solutions like solar mini-grids. Additionally, public-private partnerships should be formed with telecommunications companies to expand broadband and mobile network coverage, particularly in underserved or remote farming communities, ensuring consistent and reliable connectivity.

iv. ICT-related content should be mainstreamed into existing agricultural extension frameworks and farmer group trainings, with practical, hands-on sessions tailored to different literacy levels. Training should cover the use of mobile apps, internet browsing, online communication tools, and how to retrieve relevant agricultural information. Extension officers should also be upskilled to serve as digital facilitators.

v. Tech innovators and agricultural development partners should co-create localized, user-friendly digital solutions with and for farmers. These may include SMS-based market alerts, voice-based information systems for low-literacy users, pest and disease diagnostic tools using image recognition, and extension platforms that deliver real-time advisory services and weather forecasts. Such innovations must be tested in the local context and aligned with farmers' real challenges and information needs.

vi. Farmer cooperatives and associations can serve as effective platforms for peer-to-peer ICT education and support. These groups should identify and empower "ICT Champions" farmers with higher digital competence who can mentor others, lead demonstrations, troubleshoot basic issues, and share best practices. This grassroots approach will ensures sustainable skill transfer and ongoing capacity building within communities.

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APPENDIX

QUESTIONNAIRE

KWARA STATE POLYTECHNIC, ILORIN, NIGERIA

DEPARTMENT OF AGRICULTURAL TECHNOLOGY (EXTENSION AND MANAGEMENT UNIT)

Dear respondents,

I am a student of Kwara stste polytechnic, Ilorin, Nigeria presently conducting a research on the **Relevance of Information and Communication Technology on Cassava Production in Asa local government area of Kwara state, Nigeria.** I hereby solicit your sincere and honest responses on the questions below. All information supplied will be treated with utmost confidentiality and will only be used for the research purpose. Thanks for your anticipated cooperation.

SECTION A: SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

1. Age: ……………. (in years)
2. Sex: (a) Male ( ); (b) Female ( )
3. Marital status: (a) Single ( ); (b) Married ( ); (c) Divorced ( ); (d) Widowed ( )
4. Religion: (a) Islam ( ); (b) Christianity ( ); Traditional religion ( )
5. Level of education: (a) Non formal education ( ); (b) Primary education ( ); (c) Secondary education ( ); (d) Tertiary education ( ) ……………..
6. Household size (in persons):…………..
7. Years of experience in farming:…………….
8. Farm size (in hectare):……………….
9. Source of labour: (a) Communal ( ); (b) Family ( ); (c) Hired ( );(d) All of the above ( )
10. Secondary occupation: (a) Trading ( ); (b) Civil service ( ); (c) Okada riding ( ); (d) Teaching ( ); (e) Other ( )
11. Do you belong to any farmers group/association? (a) Yes ( ); (b) No ( )
12. Do you have contact(s) with extension agents? (a) Yes (b) No

SECTION B: SOURCE OF INFORMATION ON CASSAVA PRODUCTION

Please indicate the appropriate answer as it applies to you

S/N	Source of information	YES	NO
1	Friends and family		
2	Radio/ Television		
3	Farmers group		
4	Extension Agents/ADP		
5	Print media		

SECTION C: LEVEL OF UTILIZATION OF ICT'S BY CASSAVA FARMERS

Please tick as appropriate

ICT's facilities	**Regularly**	**Occasionally**	**Never**
Radio			
Computer			
VCD/Audio CD			
Internet			
Television			
Email			
Flash drive			
Newspaper			
Mobile Phone			
Other			

SECTION D: RELEVANCE OF ICT TO CASSAVA FARMERS

Please indicate the appropriate answer as it applies to you

S/N	Relevance	Highly Relevant	Relevant	Partially Relevant	Not Relevant
1	Improved access to market information on cassava production				
2	Provide information on land preparation for cassava production				
3	Provide access to knowledge on fertilizer application				
4	Facilitates cassava farmers access to information on the appropriate period of harvesting				
5	Provide information on means of transporting cassava tuber				
6	Facilitates access to information on weed and pest control				
7	Improvement in cassava farmers planting method and time				
8	Provides technical knowledge and support to cassava processors in the area of processing, packaging and other value addition				

SECTION E: CONSTRAINTS TO THE ADOPTION OF ICT AMONG CASSAVA FARMERS

Please tick as appropriate

S/N	Constraints	Very serious	Serious	Less serious	Not serious
1	Lack of access to electricity				
2	Limited digital literacy				
3	Lack of affordable devices				
4	Lack of access to internet connectivity				
5	High cost of ICT tools				
6	Poor network reception				
7	Lack of awareness program that educate farmers about the benefit of ICT tools				
8	Limited technical expertise				