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**THE ROLE OF DIGITAL COMMUNICATION IN PROMOTING SUSTAINABLE
AGRICULTURAL PRACTICES AMONG SMALLHOLDER FARMERS IN GHANA**

BY

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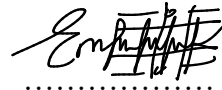
DECEMBER, 2025

DECLARATION BY STUDENT – DISSERTATION

I hereby declare that this research is a result of my own original research and that no part of it has been presented for another degree in this university or any other higher education institute. I further declare that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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CERTIFICATION BY SUPERVISOR

This Dissertation has been prepared and presented under my supervision according to the guidelines for supervision and formatting of dissertations laid down by the University of Media, Arts and Communication, UniMAC.

Dr. Joseph Obeng-Baah
Supervisor


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DEDICATION

I dedicate this dissertation to my dearest mother, Rev. Rejoice Aseye Emeko Mansu, for her prayers love, encouragement, and sacrifices that have shaped my life. This dedication also honors the cherished memory of my late father, whose dreams for his children continue to guide my steps. His vision is still in progress, and this achievement marks the beginning of greater things to come.

To my siblings Selassie, Courage, Benard, Etorko, Awoenam, and Sedinam, thank you for your encouragement and belief in my potential.

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ABSTRACT

This study examined the role of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana. Guided by the Technology Adoption Model (TAM), the study explored how farmers' perceptions of the usefulness and ease of use of digital communication tools influence their adoption of sustainable agricultural practices. It also examined the socio-economic, institutional, and technological factors that shape digital engagement and the strategies needed to enhance the effectiveness of digital communication in rural agriculture.

A qualitative research approach and case study design were adopted, involving twelve participants: eight female smallholder farmers, two agricultural extension officers, and two officials from the Ministry of Food and Agriculture (MoFA). Data were collected through semi-structured interviews and analysed thematically. Findings revealed that farmers use a mix of traditional and digital platforms including radio, voice calls, SMS, WhatsApp, Facebook, and online videos to access timely agricultural information. These platforms improved farmers' knowledge of sustainable practices such as soil conservation, composting, organic fertiliser application, and water management, while also enabling interactive learning and access to expert advice.

However, digital engagement was constrained by socio-economic barriers (low income, limited digital literacy, and language challenges), technological limitations (poor network connectivity, high data costs, and inadequate access to smartphones), and institutional gaps such as insufficient training and follow-up support.

To improve digital agricultural extension, the study recommends the development of local-language and audio-based content, continuous digital literacy training, improved rural network infrastructure, and subsidies for data and digital devices

Overall, the study concludes that digital communication holds substantial potential to promote sustainable agriculture in Ghana. Realising this potential requires targeted policy interventions, inclusive content delivery, and strengthened institutional support systems. The findings offer valuable insights for policymakers, development practitioners, and agricultural stakeholders working to enhance digital agricultural extension and advance sustainable farming among smallholder farmers

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Agriculture serves as Ghana's largest employment sector and is dominated by smallholder farmers who face significant challenges and inequalities (Darfour & Rosentrater, 2016). Smallholder farmers exhibit considerable heterogeneity, with strong inequalities in landholding distributions across all regions, where smaller landholders demonstrate lower input use, reduced market engagement, and lower welfare rates (Chamberlin, 2008). The sector has driven poverty reduction through agricultural growth averaging 5.5% annually, outpacing the overall economic growth of 5.2% (Diao, Hazell & Kolavalli, 2010). However, this growth remains heavily dependent on rainfall patterns and land expansion rather than productivity improvements (Darfour & Rosentrater, 2016).

Ghana produces only 51% of its cereal needs and faces food security challenges affecting 5% of the population (Darfour & Rosentrater, 2016). Recent research suggests that agricultural digitalisation can significantly enhance smallholder livelihoods, although adoption varies by gender, education, and access to digital infrastructure (Addison et al., 2024).

Digital technologies have revolutionised agricultural extension services by providing farmers with timely access to technical advice, market information, and peer learning opportunities. Mobile-based platforms, SMS services, and e-learning systems have demonstrated significant impact, with productivity improvements of 20-30% reported (Priya et al., 2025). Meta-analyses indicate that digital agricultural information transmission increased yields by 4% and adoption of recommended inputs by 22% (Fabregas et al., 2019). A cluster-randomised trial in India found that mobile channels significantly improved farmers' recall, knowledge, and adoption of

new techniques compared to video-only approaches (Singh et al., 2023). Social media platforms like WhatsApp and Telegram have emerged as important channels for peer-to-peer knowledge exchange, particularly where traditional extension services are inadequate (Djanibekov et al., 2023). However, challenges persist, including the digital divide, with 37% of the global population lacking internet access, limited digital literacy, and infrastructure gaps that particularly affect rural areas (Priya et al., 2025).

Ghana has emerged as a leader in agricultural digitalisation across West Africa, with significant government and stakeholder initiatives transforming smallholder farming (Abdulai, 2025). Research demonstrates that agricultural digitalization in Ghana positively impacts farmers' livelihoods, with higher educational attainment, cooperative membership, and access to reliable electricity and internet services driving adoption (Addison et al., 2024). However, the digital agriculture background involves difficult interconnected players, including numerous agritech companies that have proliferated as the state withdraws from extension services, raising concerns about farmer exploitation despite social enterprise discourse (Akorsu & Britwum, 2022). Comparative analysis across five West African countries shows Ghana demonstrating strong efforts in internet and electricity access, particularly in rural areas, with a focus on blockchain, artificial intelligence, and big data deployment (Degila et al., 2023). Ghana's mobile connectivity index remains below 60, but the country shows steady progress in mobile internet adoption and digital agriculture initiatives (Degila et al., 2023).

Abubakari et al. (2023) found that mobile phone usage, particularly for agricultural purposes, significantly increased crop income among 2,662 farmers, with effects varying by gender, education, and livestock ownership. Similarly, Addison et al. (2024) showed that agricultural digitalization improved livelihood assets and outcomes for 525 smallholder farmers, though female farmers lagged in adoption intensity. Shaibu et al. (2018) confirmed that digital technology adoption among 212 peasant farmers enhanced social capital and emergency

response capabilities, influenced by age, cost, and technology availability. However, Abdulai et al. (2023) revealed significant limitations in a study of 1,565 farmers, finding that despite growing digital opportunities, farmers remain confined to simple devices due to limited internet access, low literacy, and inadequate digital competencies, suggesting transformation claims may be disconnected from smallholders' realities.

1.2 Problem Statement

Ghana's smallholder agriculture faces significant vulnerability to climate variability, with farmers experiencing a "double tragedy" of both droughts and heavy precipitation events that adversely affect crops and livestock (Derbile et al., 2016). Climate variability substantially impacts subsistence agriculture by reducing yields and leading to household food insecurity, with 58% of households experiencing food anxiety and 62% unable to access preferred food quality and quantity (Asare-Nuamah, 2021). The Northern, Upper West, and Upper East regions are most vulnerable to drought impacts (Antwi-Agyei, 2012). Despite agriculture being the largest employment source and driving poverty reduction through 5.5% annual growth, approximately 5% of Ghana's population remains food insecure, with 2 million people vulnerable to food insecurity (Darfour & Rosentrater, 2016). Farmers employ various adaptation strategies including changing planting timing, using drought-tolerant varieties, livelihood diversification, and temporary migration, though they face barriers including limited financial resources, poor information access, and inadequate institutional support (Antwi-Agyei, 2012).

Research demonstrates Ghana's growing potential for digital agricultural extension services, supported by rapidly expanding telecommunications infrastructure and mobile phone adoption rates exceeding Sub-Saharan Africa averages (Ayisi-Nyarko et al., 2024). The COVID-19

pandemic highlighted limitations of traditional extension methods, accelerating interest in e-extension solutions (Ayisi-Nyarko et al., 2024).

According to Osei et al (2018), digital platforms like AgroTech have shown promise, with interactive radio broadcasts reaching approximately 300,000 smallholders and demonstrating yield improvements among participants. However, comparative studies reveal that while both public and private ICT platforms aim to support innovation intermediation, their potential remains largely unrealised due to social, organisational, and institutional constraints rather than technological limitations (Munthali et al., 2018). Informal platforms like WhatsApp show greater transformative potential for enhancing interaction patterns (Munthali et al., 2018). Extension agents demonstrate high demand for ICTs and understand their advantages, but require training, infrastructure, financial resources, and technical support for effective implementation (Annor-Frempong & Kwarteng, 2006).

This study, therefore, addresses an urgent applied research need, to evaluate the role of digital communication in promoting adoption and sustained use of sustainable agricultural practices among smallholder farmers in Ghana, identify barriers to equitable access and uptake, and generate actionable recommendations for integrating digital advisories with extension, finance, input systems, and gender-responsive programming. The findings will inform MoFA, extension agencies, donors, and digital service providers seeking to design more effective and inclusive digital pathways that genuinely advance sustainable agriculture at scale. The gap lies in the limited evidence connecting digital communication tools to sustainable farming behaviour, and the insufficient understanding of how digital advisories can be integrated with extension systems, finance, input delivery, and gender-responsive programming. This study therefore, fills this gap by examining the effectiveness of digital communication in promoting sustainable practices, identifying adoption barriers, and generating actionable recommendations to strengthen digital agricultural extension in Ghana.

1.3 Research Objectives

1. To examine how digital communication platforms and channels influence smallholder farmers' awareness, knowledge, and adoption of sustainable agricultural practices in Ghana.
2. To assess the socio-economic, institutional, and technological factors that facilitate or hinder the effective use of digital communication for promoting sustainable agricultural practices among smallholder farmers.
3. To identify strategies and policy measures for integrating digital communication into agricultural extension systems to enhance the adoption of sustainable practices among smallholder farmers in Ghana.

1.4 Research Questions

1. How do different digital communication platforms and channels influence smallholder farmers' awareness, knowledge, and adoption of sustainable agricultural practices in Ghana?
2. What socio-economic, institutional, and technological factors affect smallholder farmers' access to and effective use of digital communication tools for sustainable agriculture?
3. What strategies and policy interventions can enhance the integration and effectiveness of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana?

1.5 Significance of the Study

This study is significant because it addresses a crucial gap in understanding how digital communication contributes to the promotion and adoption of sustainable agricultural practices (SAPs) among smallholder farmers in Ghana. Agriculture remains the backbone of Ghana's

economy, employing more than half of the workforce and contributing significantly to GDP (MoFA, 2022). However, environmental degradation, low productivity, and climate change continue to threaten the sector's sustainability. The adoption of sustainable practices such as conservation agriculture, organic fertilizer use, and efficient water management is therefore vital for achieving long-term food security and ecological balance (FAO, 2020).

Despite ongoing government and donor-led interventions to digitise agricultural extension, there remains limited empirical evidence on how effectively digital communication influences farmers' behaviour, particularly toward sustainable practices. When this relationship is examined, the study provides critical insights into the extent to which mobile phones, SMS platforms, social media, and other ICT tools enhance farmers' access to agricultural knowledge and their willingness to adopt sustainable techniques. The findings will help policymakers, researchers, and extension officers to design more targeted, inclusive, and context-specific communication strategies that bridge the information gap among smallholder farmers.

Moreover, the study contributes to the broader field of agricultural communication and digital development, offering a model for how communication technologies can be integrated into national agricultural extension systems. Development agencies, NGOs, and digital service providers can also use the findings to improve program implementation, ensuring that digital interventions promote not only productivity but also environmental stewardship and resilience. From an academic perspective, the research adds to the growing body of literature on ICT for Development (ICT4D) and sustainable agriculture in Sub-Saharan Africa, particularly within Ghana's socio-economic and policy context.

1.6 Scope of the Study

The scope of this study is specifically limited to the agricultural sector in Ghana, with a particular focus on smallholder farmers and key stakeholders involved in promoting sustainable agricultural practices. The research will collect data from 12 targeted groups of respondents, including small-scale farmers, agricultural extension officers, digital communication experts, and staff of the Ministry of Food and Agriculture (MoFA) and Presidential Initiatives in Agriculture and Agribusiness who are directly engaged in agricultural communication, sustainability initiatives, and digital extension programs. This selection ensures that the participants possess relevant knowledge and practical experience in using digital communication tools to promote sustainable farming practices.

The study will primarily explore the use and effectiveness of digital communication channels such as mobile phones, SMS platforms, WhatsApp groups, social media, radio programs, and agricultural mobile applications in disseminating information about sustainable agricultural practices.

Geographically, the research will cover selected agricultural regions of Ghana, such as Bono East, Northern, Ashanti, and Eastern Regions, which reflect varying levels of digital penetration, agricultural intensity, and ecological conditions. These regions were chosen to capture diverse perspectives and experiences across different agro-ecological zones and socio-economic contexts.

Given this specific focus, it is important to recognise that the findings and conclusions of this study will primarily reflect the experiences of individuals within the Ghanaian agricultural communication ecosystem. Consequently, the results may not be fully generalizable to the entire agricultural sector in Ghana or other countries with different agricultural and digital communication infrastructures.

Furthermore, the study is limited to the current use and understanding of digital communication tools, including mobile-based platforms, online applications, and digital extension systems, among the selected participants. It will not examine all possible digital technologies in agriculture, such as artificial intelligence (AI) systems, blockchain traceability, or precision farming tools, except where these intersect directly with communication processes for sustainability. Therefore, the conclusions of this research should be interpreted within this defined scope, acknowledging the contextual and technological boundaries set for the study.

1.7 Organisation of the Study

This study is structured into five main chapters, each focusing on a specific aspect of the research process to ensure a logical and coherent presentation of ideas.

Chapter One introduces the study by providing the background and context of the research, identifying the main problem, and outlining the purpose and objectives of the study. It also presents the research questions, significance of the study, scope, and the overall organisation of the report. This chapter establishes the foundation upon which the entire research is built.

Chapter Two reviews related literature and theoretical frameworks relevant to the study. It explores existing research, concepts, and theories on digital communication and sustainable agricultural practices, particularly in the context of smallholder farmers in Ghana and Sub-Saharan Africa. The chapter identifies gaps in previous studies that this research seeks to fill and highlights how digital communication can influence agricultural sustainability and development outcomes.

Chapter Three outlines the research methodology adopted for the study. It explains the research design, target population, sampling methods, and sample size. The chapter also describes the data collection instruments, procedures for gathering data, and methods of data analysis. Additionally, it discusses the ethical considerations that guided the conduct of the research.

Chapter Four presents the results and analysis of the data collected. It organizes and interprets the findings in relation to the research questions and objectives. The chapter highlights patterns, relationships, and emerging themes regarding the role of digital communication in promoting sustainable agricultural practices among smallholder farmers, supported by relevant tables, charts, and narratives.

Chapter Five concludes the study by summarising the key findings, drawing conclusions, and making practical recommendations for policymakers, agricultural stakeholders, and researchers. It also discusses the limitations encountered during the research and suggests areas for future investigation to deepen understanding of how digital communication can enhance sustainable agriculture in Ghana and beyond.

1.8 Chapter Summary

This chapter provided an overview of the study and its conceptual foundation. It began with the background of the study, which highlighted the importance of sustainable agriculture and the emergence of digital communication as a transformative tool in agricultural extension. The problem statement established the persistent challenges of low adoption of sustainable practices, limited access to credible information, and uneven digital inclusion among smallholder farmers in Ghana.

The chapter further outlined the research objectives and questions, which guide the investigation into how digital communication influences the adoption of sustainable agricultural practices, the factors affecting its effectiveness, and potential policy interventions. The significance of the study emphasised the contribution of this research to academic knowledge, agricultural policy, and practical extension work, while the scope defined the geographical, thematic, and conceptual boundaries of the research.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

This chapter reviews existing scholarly and empirical literature related to the role of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana. It provides a conceptual understanding of key terms, theoretical foundations, and relevant empirical studies that guide the research. The chapter begins by examining the meaning and scope of digital communication in the agricultural sector, exploring the different digital channels and their applications in facilitating agricultural development. It then discusses the concept of sustainable agricultural practices (SAPs), outlining their principles, relevance, and examples within the Ghanaian context.

2.2 Digital communication in Agriculture

Digital communication technologies in agriculture, or e-extension, have emerged as promising solutions to overcome limitations of traditional agricultural advisory services. ICT-based approaches include mobile applications, SMS advisories, video demonstrations, interactive voice response systems, and AI-powered tools that provide real-time agricultural information, market linkages, and capacity-building programs (Campenhout et al., 2018; Dujali et al., 2025; Singh et al., 2023). Research demonstrates that these technologies effectively deliver agricultural knowledge, with video-based extension showing significant improvements in farmer knowledge, practice adoption, and maize yields of approximately 10 per cent (Campenhout et al., 2018). According to Singh et al (2023), digital platforms facilitate data-driven decision-making, reduce information gaps, and promote equitable access to agricultural

information through local language support and regional adaptation. However, barriers including limited digital literacy, poor internet connectivity, and socioeconomic constraints hinder widespread adoption (Dujali et al., 2025; Aker, 2010).

Digital communication channels in agriculture include various technologies that enable information delivery to smallholder farmers. Key channels include video content, interactive voice response (IVR) systems, and short message services (SMS). Campenhout et al. (2018) demonstrated that video effectively delivers agricultural information, improving knowledge test performance and increasing maize yields by 10%, though IVR and SMS showed limited incremental effects. Riaz et al. (2017) found that simple menu-based IVR systems are viable for disseminating agricultural information like weather forecasts and fertiliser guidance to farmers in Pakistan. Radio combined with SMS proves particularly effective, with Silvestri et al. (2020) showing that SMS-supported radio campaigns boost both awareness and adoption of sustainable agricultural practices in Tanzania, though radio alone remains most cost-effective.

With the spread of smartphones and improved internet connectivity, smartphone applications and social media platforms have become increasingly important in agricultural communication. Mobile apps such as Esoko, Farmerline, and CocoaLink in Ghana provide farmers with real-time market information, weather data, and extension advice, while also allowing for two-way communication between farmers and experts (Asenso-Okyere & Mekonnen, 2012; GIZ, 2020). Social media and chat applications, notably WhatsApp, Facebook, and Telegram are also transforming peer-to-peer learning and knowledge sharing, allowing farmers to exchange experiences, share pictures of farm conditions, and crowdsource solutions to agricultural challenges (Tsan et al., 2019).

In addition to mobile platforms, traditional media such as radio and television remain powerful communication tools, especially when integrated with digital systems. Initiatives such as Farm

Radio International's "radio + digital" model combine community radio broadcasts with SMS feedback and IVR systems to create interactive learning experiences for rural farmers. These hybrid models help bridge the digital divide by ensuring that even those without internet access can participate in digital agricultural communication networks (Farm Radio International, 2021).

Moreover, web-based platforms and portals have been developed to facilitate the dissemination of multimedia agricultural content, text, audio, video, and infographics to broader audiences. These platforms, often managed by government agencies or private organizations, support knowledge management and data-driven decision-making. For instance, Ghana's Ministry of Food and Agriculture (MoFA) operates digital platforms that connect farmers with extension officers and provide access to agricultural databases and policy updates (MoFA, 2022).

Despite these advancements, disparities in digital literacy, infrastructure, and affordability continue to shape the effectiveness of digital communication in agriculture. While smartphone-based applications and web platforms are expanding, feature phones, radio, and SMS remain dominant among smallholder farmers due to accessibility and simplicity. Therefore, the adoption and impact of digital communication depend on the contextual realities of connectivity, education, and socio-economic conditions (World Bank, 2021).

2.3 Sustainable Agricultural Practices (SAPs)

The Food and Agriculture Organisation (FAO, 2017) defines sustainable agriculture as "the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations." In other words, sustainable agriculture seeks to meet current food demands without compromising the ability of future generations to meet their own needs. It integrates economic, environmental, and social dimensions,

emphasising resource efficiency, ecosystem preservation, and the resilience of farming systems to environmental stresses such as droughts and floods (FAO, 2019). Sustainable agriculture is built on principles of efficiency, ecological balance, and resilience. Efficiency ensures that resources such as water, soil nutrients, and energy are optimally used to achieve higher productivity with minimal waste. Ecological balance emphasises the protection of biodiversity and natural ecosystems that support agricultural activities, while resilience focuses on strengthening farmers' capacity to adapt to and recover from shocks such as climate variability and pest infestations (Pretty, 2012).

Sustainable agricultural practices (SAPs) represent farming approaches that enhance productivity while conserving natural resources and maintaining ecological balance (Ahtisham et al., 2025). These practices include climate-smart agriculture, regenerative agriculture, precision agriculture, organic farming, integrated pest management, crop rotation, and integrated nutrient management (Ahtisham et al., 2025). Traditional SAPs such as intercropping, mulching, and crop rotation are more readily adopted by resource-constrained farmers, while newer practices like cover cropping and minimum-tillage require greater knowledge, capital, and labour investments (Myeni et al., 2019).

In sub-Saharan Africa, crop rotation, intercropping, improved seed varieties, manure, and mulching are among the most adopted practices, while conservation tillage, agroforestry, and water harvesting remain less utilised (Sithole & Olorunfemi, 2024). Key barriers to SAP adoption include land tenure insecurity, lack of knowledge and training, limited access to credit and financial institutions, and resource constraints (Atinkut et al., 2017). Sustainable agriculture is built on principles of efficiency, ecological balance, and resilience. Efficiency ensures that resources such as water, soil nutrients, and energy are optimally used to achieve higher productivity with minimal waste. Ecological balance emphasises the protection of biodiversity and natural ecosystems that support agricultural activities, while resilience focuses

on strengthening farmers' capacity to adapt to and recover from shocks such as climate variability and pest infestations (Pretty, 2012).

Agroforestry systems, which integrate trees and shrubs into agricultural landscapes, provide multifunctional benefits for sustainable land management and climate action. These systems enhance soil quality, improve water utilization efficiency, and create favourable microclimates that protect crops from extreme weather events (Lasco et al., 2014). Agroforestry contributes significantly to climate change mitigation through carbon sequestration both above and below ground, while simultaneously reducing dependence on fossil fuels by promoting biomass fuel use (Rao & Saha, 2014). The systems improve smallholder farmers' resilience by enhancing soil productivity, nutrient cycling, pest and disease control, and diversifying income sources (Lasco et al., 2014; Satish et al., 2024). Additionally, agroforestry promotes biodiversity conservation and provides essential ecosystem services, including water regulation and pollination (Satish et al., 2024).

2.4 Smallholder Farmers in Ghana

Smallholder farmers constitute the backbone of Ghana's agricultural sector, dominating food crop production and serving as the largest source of employment for Ghanaians (Darfour & Rosentrater, 2016; Adzawla et al., 2022). These farmers are characterized by smaller landholdings, lower input use, reduced commercialization rates, and lower welfare compared to larger-scale producers (Chamberlin, 2007). Despite their central role, smallholder farmers face significant challenges including climate-related risks that increase their vulnerability (Gyimah et al., 2020). The economic viability of smallholder agriculture varies by scale, with large-scale farmers (>2 ha) achieving 8% higher yields and 96% more income than small-scale farmers (≤ 2 ha) (Adzawla et al., 2022). Agricultural growth has been a major driver of poverty reduction, expanding at 5.5% annually and outpacing overall economic growth (Darfour &

Rosentrater, 2016). However, rural households continue experiencing poverty and food insecurity, with approximately 5% of Ghana's population being food insecure (Darfour & Rosentrater, 2016).

Agriculture remains a key pillar of Ghana's economy, contributing about 20% of the Gross Domestic Product (GDP) and employing close to one-third of the workforce, most of whom are smallholder farmers (World Bank, 2021). Beyond its economic contribution, smallholder agriculture plays a key role in ensuring food security, poverty reduction, and rural development. However, the productivity of these farmers has remained relatively low compared to potential output due to structural, environmental, and institutional constraints (IFAD, 2020). Smallholder farmers in Ghana exhibit several distinctive characteristics that influence their production patterns and adoption of innovation. Most operate under rain-fed conditions, making their activities highly vulnerable to climate variability such as erratic rainfall, droughts, and floods (EPA Ghana, 2020). Their farming systems are generally subsistence-oriented, aimed primarily at meeting household food needs, with limited surplus for market sales (MoFA, 2021). Access to modern inputs such as improved seeds, fertilisers, and irrigation technologies is often constrained by financial limitations and inadequate rural credit facilities (IFAD, 2020).

Smallholder farmers face significant challenges that constrain their productivity and economic growth despite their critical role in global food security. Access to finance remains a major barrier, limiting farmers' ability to purchase inputs, access post-harvest credit, and invest in quality improvements, forcing them to sell produce at low harvest prices (Onumah & Meijerink, 2012). These farmers also struggle with labour-intensive practices, low productivity, and high post-harvest losses (Olusola, 2025). Digital agriculture solutions exist but remain largely inaccessible due to underdeveloped digital ecosystems, infrastructure deficiencies, affordability issues, and limited digital literacy (Gumbi et al., 2023). Additionally,

smallholders face constraints in accessing productive resources and services, while confronting new challenges including climate change adaptation, market volatility, and integration into high-value chains (Thapa & Gaiha, 2012). Addressing these challenges requires coordinated government intervention, private sector innovation, and targeted support programs to enhance smallholder competitiveness and sustainability.

2.5 Digital Communication and Sustainable Agricultural Practices

Digital communication technologies play a crucial role in promoting sustainable agricultural practices among farmers, particularly in developing regions. ICTs provide essential market data, weather forecasts, and agricultural knowledge, with community radios and mobile phones being the most accessible options for smallholder farmers (Ngulube, 2025). These technologies facilitate timely dissemination of relevant agricultural information, enabling farmers to make informed decisions that increase productivity and support sustainable development (Lubis, 2010). Digital tools and decision support systems offer significant potential to enhance agroecological transitions by supporting soil and water management, pest control, and efficient resource use (Petraki et al., 2025). ICTs contribute to agri-food sustainability by increasing productivity, improving resource efficiency, reducing management costs, and enhancing coordination throughout the food chain (Serbulova et al., 2019). However, adoption remains limited due to barriers including low digital literacy, inadequate infrastructure, and concerns about real-world effectiveness, highlighting the need for equitable access and supportive policy frameworks (Ngulube, 2025; Petraki et al., 2025).

Mobile-based agricultural advisory systems have demonstrated significant potential for supporting sustainable farming practices across developing countries. According to Bayas et al (2020), AgroTutor application in Mexico provides geo-located, timely agricultural recommendations that contribute to UN Sustainable Development Goals by advancing

sustainable agriculture implementation. In Tamil Nadu, India, a multimedia agricultural advisory system successfully delivered personalized expert advice to 1,200 farmers through mobile interfaces, though implementation challenges were encountered (AN Exploratory Study & Muthiah, 2013). Meta-analyses indicate that mobile agricultural information systems increase yields by 4% and improve adoption of recommended inputs by 22%, with benefits exceeding transmission costs by an order of magnitude (Fabregas et al., 2019). Interactive radio programs combined with mobile phone technology have proven particularly effective, with evaluation studies across sub-Saharan Africa showing that farmers who engaged interactively were significantly more likely to adopt promoted practices, with over 90% implementation rates in Uganda's "Her Voice on Air" project (Hudson, 2018).

Research demonstrates that digital farmer-to-farmer networks using SMS communication can increase technology adoption by 14.5 percentage points when farmers actively engage with each other (Lasdun et al., 2023). Social media platforms like WhatsApp facilitate knowledge-intensive content sharing among innovative farmers, creating discussion forums that promote social constructivist learning and farmer-led extension mechanisms (Nain et al., 2019). Digital tools including mobile apps, web platforms, and data analytics, have revolutionised information dissemination, providing real-time communication and data-driven decision-making capabilities that enhance agricultural productivity and sustainability (Singh et al., 2023). These technological advances support the evolution toward pluralistic extension systems that combine public and private mechanisms, with farmer groups and virtual networks playing increasingly important roles in technology diffusion through ICT approaches (Norton & Alwang, 2020).

Digital agriculture offers significant potential for sustainable farming practices, particularly for smallholder farmers in sub-Saharan Africa, but faces substantial adoption barriers. Digital tools and decision support systems can enhance productivity, improve environmental outcomes, and

support agroecological transitions by facilitating soil and water management, pest control, and efficient resource use (Petraki et al., 2025). These technologies provide improved access to information and markets while enhancing decision-making capabilities (Choruma et al., 2024). However, widespread adoption remains limited due to critical challenges. Infrastructure limitations, including unreliable internet connectivity and inadequate digital infrastructure, represent major barriers (Petraki et al., 2025; Choruma et al., 2024; Gumbi et al., 2023; Mhlanga & Ndhlovu, 2023). Low digital literacy levels and affordability issues further impede progress (Choruma et al., 2024; Gumbi et al., 2023). Gender disparities limit equitable access to digitalization benefits (Choruma et al., 2024). Additional challenges include resource scarcity, limited expertise and training, data privacy concerns, and farmer resistance (Mhlanga & Ndhlovu, 2023).

2.6 Challenges in Implementing Digital Communication for Sustainable Agriculture

Digital agriculture offers significant potential for sustainable farming practices, particularly for smallholder farmers in sub-Saharan Africa, but faces substantial adoption barriers. Digital tools and decision support systems can enhance productivity, improve environmental outcomes, and support agroecological transitions by facilitating soil and water management, pest control, and efficient resource use (Petraki et al., 2025). These technologies provide improved access to information and markets while enhancing decision-making capabilities (Choruma et al., 2024). However, widespread adoption remains limited due to critical challenges. Infrastructure limitations, including unreliable internet connectivity and inadequate digital infrastructure, represent major barriers (Gumbi et al., 2023; Mhlanga & Ndhlovu, 2023). Low digital literacy levels and affordability issues further impede progress (Choruma et al., 2024; Gumbi et al., 2023). Gender disparities limit equitable access to digitalization benefits (Choruma et al.,

2024). Additional challenges include resource scarcity, limited expertise and training, data privacy concerns, and farmer resistance (Mhlanga & Ndhlovu, 2023).

2.7 Theoretical Framework

A theoretical framework serves as the foundational structure that guides research by identifying and describing major elements, variables, or constructs that organize scholarship (Ennis, 1999). It functions as a "blueprint" for research, influencing topic selection, research question development, literature review conceptualization, design approach, and analysis planning (Grant & Osanloo, 2016).

2.7.1 Technology Adoption Model

The Technology Adoption Model (TAM), developed by Davis (1986, 1989), is one of the most key frameworks for understanding how users come to accept and use new technologies. The model posits that two primary factors, Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), determine an individual's intention to adopt and subsequently use a technology. Perceived usefulness refers to the degree to which a person believes that using a particular system will enhance their performance, while perceived ease of use describes how effortless or user-friendly the system is perceived to be (Davis, 1989). These constructs jointly influence the attitude toward usage, which subsequently predicts behavioral intention to use, leading to actual system use (Venkatesh & Davis, 2000).

The TAM provides a theoretical perspective for understanding how smallholder farmers in Ghana adopt and use digital communication tool, such as mobile phones, SMS platforms, agricultural apps, and social media in promoting sustainable agricultural practices (SAPs). In the agricultural context, perceived usefulness can be interpreted as the extent to which farmers believe that digital communication technologies will improve their farming efficiency, productivity, and access to information about sustainable practices. For example, a farmer who

perceives that using a mobile-based advisory service can help optimize fertilizer use or improve soil management is more likely to adopt and integrate such technology into their farming activities (Aker, 2011; Furuholt & Matotay, 2011).

Similarly, perceived ease of use is key in determining farmers' willingness to use digital communication tools. Many smallholders in Ghana have limited formal education and digital literacy, which can influence their perception of how easy or difficult these technologies are to operate (CTA, 2018). When platforms are designed in local languages, use simple interfaces, and rely on accessible media such as voice messages or interactive radio, they are perceived as easier to use, thereby increasing adoption rates (Asongu & Odhiambo, 2019).

In the context of promoting sustainable agricultural practices, perceived usefulness plays a pivotal role. Farmers are more likely to use digital communication platforms when they perceive that such tools contribute directly to improving crop yields, resource management, pest control, or climate adaptation strategies. For example, platforms such as Esoko and Farmerline in Ghana have shown that when farmers receive timely information on weather forecasts, market prices, and eco-friendly farming techniques, their confidence in the technology's utility increases significantly (GIZ, 2020; FAO, 2019). Thus, the perceived benefits of digital tools in enhancing decision-making and improving farm outcomes are key determinants of their sustained use among smallholders.

Perceived ease of use is particularly relevant in rural Ghana, where literacy levels and exposure to digital technologies vary widely. If smallholder farmers find digital tools difficult to navigate, they may revert to traditional methods of information sharing, such as interpersonal communication and local radio programs. Therefore, designing user-friendly, language-sensitive, and culturally relevant interfaces is essential for promoting adoption (Kante et al., 2021). For instance, mobile-based agricultural services that provide voice prompts in local

dialects or integrate interactive radio discussions can help overcome literacy barriers and promote inclusivity in the digital communication ecosystem (Farm Radio International, 2021).

TAM further posits that perceived usefulness and ease of use shape the user's attitude toward the technology, which in turn influences their behavioural intention to use it (Davis, 1989). In agricultural contexts, this means that when farmers develop a positive attitude toward digital platforms viewing them as reliable, trustworthy, and beneficial, they are more inclined to use them consistently (Nadlifatin et al., 2016). Conversely, if farmers perceive digital communication tools as complicated or irrelevant to their immediate needs, their attitude and intention toward adoption will remain low.

For smallholder farmers, trust in the source of information is also a critical factor influencing attitude. Studies indicate that when farmers believe that digital messages originate from credible sources such as the Ministry of Food and Agriculture, universities, or trusted NGOs, they are more likely to accept and apply the recommended sustainable practices (Aker, 2011; CTA, 2018). Therefore, digital communication initiatives must combine technological efficiency with credible and contextually relevant content to strengthen adoption intentions.

Over the years, researchers have extended the TAM to incorporate external variables such as social influence, facilitating conditions, trust, and perceived risk to better fit the agricultural context (Venkatesh & Bala, 2008; Ouedraogo et al., 2022). These additional constructs recognize that adoption decisions among smallholder farmers are often influenced by peer networks, community norms, and access to supporting infrastructure such as electricity and mobile connectivity. For example, if a farmer's peers successfully use digital tools to improve yields or reduce input costs, the likelihood of others adopting the same tools increases through social learning and imitation (Bandiera & Rasul, 2006).

Moreover, trust plays an integral role in technology adoption in developing-country contexts. Farmers must trust both the technology and the institutions promoting it to adopt and use it sustainably. Concerns about misinformation, data privacy, or unreliable services can significantly undermine adoption, even when perceived usefulness is high (Nadlifatin et al., 2016). Hence, fostering transparency and credibility in digital communication initiatives is essential for achieving widespread acceptance among Ghanaian smallholders.

2.7.2 Relevance of the Theory to the Study

The Technology Adoption Model is highly relevant to this study because it provides a theoretical framework for analysing how and why smallholder farmers decide to adopt or reject digital communication technologies in the promotion of sustainable agricultural practices. When the constructs of perceived usefulness, perceived ease of use, attitude toward use, and behavioural intention, are examined, the model provides insight into the factors that influence farmers' interaction with digital platforms. Furthermore, applying TAM helps identify barriers, such as low digital literacy or lack of infrastructure, that affect the effectiveness of digital communication interventions in rural areas.

2.8 Chapter Summary

This chapter has reviewed relevant literature and theoretical perspectives that inform the study. It explored the concept of digital communication in agriculture, outlining various communication tools such as mobile phones, social media platforms, and radio-based ICT systems that facilitate agricultural information sharing. It also discussed the importance of sustainable agricultural practices (SAPs), emphasizing their role in ensuring environmental protection, resource efficiency, and long-term food security in Ghana. Furthermore, the review analyzed the socio-economic characteristics of smallholder farmers, highlighting the constraints they face in accessing and using digital technologies effectively. The Technology

Adoption Model (TAM) was identified as the guiding theoretical framework for understanding how farmers' perceptions of technology influence their adoption of digital communication tools in promoting sustainable farming.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presented the research methodology that was adopted to investigate the role of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana. The methodology provided the framework for collecting, analysing, and interpreting data systematically and credibly. It described the qualitative research approach employed, the case study design, sampling strategy, population, sample size, data collection techniques, and the methods used to ensure validity and reliability. The chapter also discussed the ethical considerations that guided the conduct of the study.

3.2 Research Method

This study employed a qualitative research method to explore how digital communication influences the adoption of sustainable agricultural practices among smallholder farmers. The qualitative approach was considered appropriate because it allowed for an in-depth exploration of participants' experiences, perceptions, and interpretations of the phenomenon under investigation (Creswell & Poth, 2018). Quantitative research, though useful for measurement and statistical analysis, would not have adequately captured the contextual, behavioural, and attitudinal nuances that characterise the interactions between farmers and digital communication platforms.

The qualitative method enabled the researcher to gain insights into how smallholder farmers used digital communication tools such as mobile phones, WhatsApp groups, and radio-based ICT programs to acquire knowledge about sustainable practices. This method facilitated the collection of rich and descriptive data through direct engagement with participants. According

to Merriam and Tisdell (2016), qualitative research is particularly useful when the aim is to understand meanings and processes rather than outcomes or frequencies.

The interpretivist paradigm underpinned the qualitative method, emphasizing that reality is socially constructed and best understood through the lived experiences of individuals (Bryman, 2016). The researcher therefore sought to interpret how farmers made sense of digital communication technologies and how such understanding influenced their decision-making in adopting sustainable agricultural practices. This method also allowed flexibility in data collection and analysis, making it possible to adapt the inquiry process as new themes emerged during interviews.

3.3 Research Design

A case study design was adopted for this research. The case study approach provided an opportunity to examine the phenomenon of digital communication in a real-life agricultural context. Yin (2018) defined a case study as an empirical study that investigates a contemporary issue within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident. In this study, the case study approach enabled the researcher to explore the interactions between farmers, agricultural officers, and digital platforms in promoting sustainable practices within Ghana's agricultural sector.

The case study design was particularly suitable because it allowed for the integration of multiple data sources, including interviews and document analysis, to gain a comprehensive understanding of the subject matter. The focus was on a purposively selected agricultural community where digital communication initiatives had been introduced. This design provided a platform to capture the diversity of participants' perspectives and identify patterns related to communication effectiveness, behavioural change, and challenges encountered in adopting digital tools for sustainability purposes.

Moreover, the case study approach was instrumental in contextualizing findings within specific cultural, economic, and environmental settings of Ghana. As Stake (1995) noted, case studies help researchers to understand the complexity and particularity of a case in its natural environment. The findings derived from the case study, therefore, provided an in-depth understanding of the role of digital communication in fostering sustainable agricultural behaviour among smallholder farmers.

3.4 Sampling Strategy

The study used a purposive sampling strategy to select participants who were most relevant to the research objectives. Purposive sampling involves selecting participants based on their knowledge, experiences, and relevance to the research question rather than through random selection (Patton, 2015). This approach was appropriate because it allowed the researcher to identify individuals directly involved in or affected by digital communication in agriculture, ensuring that data collected were both rich and meaningful.

The participants included smallholder farmers, agricultural extension officers, and staff from the Ministry of Food and Agriculture (MoFA) and Presidential Initiatives in Agriculture and Agribusiness. These groups were chosen because they were actively engaged in agricultural communication processes and had firsthand experience with digital tools used for promoting sustainable practices. The purposive strategy also enabled the inclusion of participants with varying degrees of digital literacy and access, providing a balanced view of both opportunities and constraints associated with digital communication in agriculture.

During the selection process, the researcher considered factors such as gender, age, and farming experience to ensure diversity and representativeness within the small sample. According to Ritchie, Lewis, Nicholls, and Ormston (2014), purposive sampling in qualitative studies

enhances the depth of understanding rather than breadth, making it suitable for exploratory research such as this one.

3.5 Population

The population of the study consisted of smallholder farmers, agricultural extension officers, and MoFA staff involved in agricultural communication initiatives in Ghana. This population was considered appropriate because it represented the key stakeholders responsible for or influenced by the dissemination and adoption of sustainable agricultural practices through digital communication platforms.

Smallholder farmers formed the primary unit of analysis, as they constitute about 70 percent of Ghana's agricultural workforce and play a pivotal role in food security and rural livelihoods (World Bank, 2021). Extension officers and MoFA staff were included because they act as intermediaries, facilitating the flow of agricultural information from institutions to farmers via digital channels. Engaging these stakeholders allowed the study to capture multiple perspectives on the effectiveness and challenges of using digital communication in agriculture.

The chosen population thus reflected a cross-section of actors involved in the information ecosystem that supports agricultural sustainability in Ghana. As Cohen et al (2018) noted, identifying a clearly defined population enhances the credibility and transferability of qualitative research findings.

3.6 Sample Size

The study involved twelve (12) participants, including eight smallholder farmers, two agricultural extension officers, and two MoFA officials. Although the sample size was relatively small, it was adequate for qualitative research, where the goal is depth of understanding rather than statistical generalisation (Guest, Bunce, & Johnson, 2006). The

decision to limit the sample to twelve participants was based on the principle of data saturation, the point at which additional data no longer produce new insights or themes (Fusch & Ness, 2015).

This sample size enabled the researcher to engage deeply with each participant, allowing for thorough exploration of their experiences, challenges, and perspectives regarding digital communication and sustainable practices. Moreover, the manageable number facilitated detailed data transcription, coding, and analysis, ensuring accuracy and consistency in the interpretation of findings.

3.7 Data Collection Technique

Data were collected through semi-structured interviews. This technique was chosen because it provided a flexible framework that allowed the researcher to guide discussions around key themes while enabling participants to express their experiences freely (Kvale & Brinkmann, 2015). Each interview session lasted between 25 and 30 minutes and was conducted either face-to-face or via phone calls, depending on participants' availability and convenience.

The interviews were guided by an interview protocol developed based on the research objectives. Questions focused on participants' awareness of digital communication tools, their experiences in using such tools for agricultural learning, and their perceptions of how these tools influence the adoption of sustainable practices. The use of open-ended questions encouraged participants to elaborate on their responses, thereby generating rich qualitative data.

With participants' consent, the interviews were audio-recorded to ensure accuracy and completeness. Field notes were also taken to capture non-verbal cues and contextual information. All data collected were transcribed verbatim and stored securely. According to

Braun and Clarke (2019), semi-structured interviews are ideal for exploring complex social phenomena as they allow for probing and clarification during the data collection process.

3.8 Validity and Reliability

In qualitative research, validity and reliability refer to the trustworthiness and credibility of the findings rather than statistical accuracy. To enhance validity, the researcher ensured that the interview questions were aligned with the research objectives and were clearly phrased to avoid ambiguity. Pilot interviews were conducted with two farmers to test the clarity and appropriateness of the questions before the main data collection began. Adjustments were made accordingly to ensure relevance and comprehensibility.

Credibility was ensured through triangulation and member checking. Triangulation involved verifying data across different participants (farmers, extension officers, and MoFA staff) to ensure consistency in responses (Lincoln & Guba, 1985). Member checking was conducted by sharing summarised interpretations with participants to confirm the accuracy of the researcher's understanding.

Dependability was achieved by maintaining a detailed audit trail of all research procedures, including interview schedules, transcription notes, and data analysis records. This documentation allowed for transparency and potential replication of the research process.

Confirmability was maintained by ensuring that findings reflected participants' views rather than researcher bias, achieved through reflective journaling during data collection and analysis.

Finally, transferability was supported by providing rich, contextualized descriptions of the research setting and participants, allowing other researchers to assess the applicability of findings to similar contexts (Shenton, 2004).

3.9 Ethical Considerations

Ethical consideration was a key aspect of this research. Before data collection, the researcher obtained approval from the institutional review board and informed consent from all participants. Participants were briefed about the purpose of the study, their right to withdraw at any time, and how their data would be used. Consent forms were signed to indicate voluntary participation.

Confidentiality was ensured by using pseudonyms in place of participants' real names and by storing audio recordings and transcripts securely on password-protected devices. Sensitive information disclosed during interviews was handled discreetly and used solely for research purposes.

The researcher also ensured non-maleficence, meaning that no harm, physical, psychological, or social, came to participants as a result of their involvement in the study (Orb et al., 2001). Data collection was conducted with respect for cultural norms and participants' schedules, especially in rural farming communities where time constraints were significant. Additionally, findings were presented truthfully without manipulation to favour preconceived outcomes.

3.10 Chapter Summary

This chapter outlined the methodological framework employed in exploring the role of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana. A qualitative approach and case study design were adopted to enable an in-depth understanding of participants' experiences. The population consisted of smallholder farmers, agricultural extension officers, and MoFA officials, with a purposive sample of twelve participants selected for detailed interviews. Semi-structured interviews served as the primary data collection technique, while measures such as triangulation, member checking, and audit trails ensured the credibility and reliability of findings. Ethical principles, including informed

consent, confidentiality, and voluntary participation, guided the research process. The next chapter presents the data analysis and discussion of findings derived from the collected qualitative data.

CHAPER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presented and discussed the findings of the study that examined the role of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana. The analysis was based on qualitative data that had been collected from twelve respondents, made up of eight female smallholder farmers, two female agricultural extension officers, and two female officials from the Ministry of Food and Agriculture (MoFA). The chapter provided an in-depth interpretation of the participants' views and experiences, using their own words to illustrate key issues that emerged from the field. The analysis was organised around the three research questions that guided the study.

The first research question explored how different digital communication platforms and channels influenced smallholder farmers' awareness, knowledge and adoption of sustainable agricultural practices. The second research question focused on the socio-economic, institutional and technological factors that affected farmers' access to and effective use of digital communication tools for sustainable agriculture. The third research question examined the strategies and policy interventions that could enhance the integration and effectiveness of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana.

A thematic approach was used to analyse the data. Responses from all twelve participants were carefully read, coded and categorised into emerging themes and sub-themes that reflected common patterns, similarities and differences across the interviews. These themes were then discussed in relation to the existing literature and theoretical perspectives presented in the earlier chapters, particularly the Technology Adoption Model. Where appropriate, direct

quotations from respondents were used to support the discussion and to give authentic voice to the participants' experiences.

The chapter therefore moved beyond a mere description of responses and provided an interpretive discussion that connected the empirical findings to broader debates on digital communication, extension services and sustainable agriculture in Ghana. In the sections that followed, the findings were presented under each research question, with three to four major themes discussed in detail to show how digital communication is shaping, enabling and sometimes constraining the adoption of sustainable agricultural practices among smallholder farmers.

4.2 RQ1 How do different digital communication platforms and channels influence smallholder farmers' awareness, knowledge, and adoption of sustainable agricultural practices in Ghana?

Theme 1: Converging use of "old" and "new" media to build awareness

Across the responses, farmers and officers described a blended media environment in which "old" broadcast media and "new" digital tools work together to shape awareness of sustainable practices. Smallholder farmers consistently mentioned radio, mobile calls and SMS alongside WhatsApp, Facebook and occasional YouTube access. For example,

R1 explained: *"I mostly use my mobile phone to receive calls and WhatsApp messages..I also listen to the agricultural programs on Adom FM because they discuss new planting methods"* and added that her daughter helps her check *"Facebook farmer groups."*

R3 similarly noted that she uses *"WhatsApp, Facebook, and voice calls"* and also listens to *"Hello FM's agricultural shows,"* while R8 said she relies on *"WhatsApp, normal calls, and radio programs"* and follows a *cocoa farmers' group on Facebook.*

These narratives show that awareness of sustainable practices does not come from a single digital channel but from a media mix that fits the Ghanaian rural context. This pattern mirrors findings from Farm Radio International and others that interactive radio, SMS and mobile-based services are complementary rather than competing channels for farmers in sub-Saharan Africa (Farm Radio International, 2021; CTA, 2018). Rather than replacing radio, WhatsApp groups and SMS appear to extend and deepen what farmers already receive from broadcast programmes.

R7 emphasised on this complementarity clearly: *“I also listen to Radio Upper West for farming information... WhatsApp videos show new farming methods. SMS messages remind me about planting times.”*

Extension officers and MoFA officials reinforced this idea of a converging ecosystem. R9, an extension officer, explained: *“I use WhatsApp, Facebook, Telegram, and SMS platforms to communicate with farmers. I also use MoFA’s digital extension dashboard... Radio programs complement these tools.”*

R11 also described a combination of institutional platforms, SMS broadcasts and radio for national campaigns. This aligns with literature on digital agricultural ecosystems, which stresses that effective e-extension in Africa often sits on top of existing radio and community networks (Tsan et al., 2019).

In terms of sustainable agricultural practices specifically, respondents repeatedly linked this media mix to awareness of topics such as soil conservation, composting, organic inputs and climate-smart techniques.

R2 reported learning *“organic fertilisers using poultry droppings and plant waste”* and *drip irrigation for pepper from WhatsApp and YouTube, while radio taught her how “to prevent soil erosion on sloped lands.”*

R4 associated WhatsApp videos and Radio Savannah with learning about “zai pits and composting” and preventing soil degradation. The coherence between channels, the same concepts appearing on radio, WhatsApp and SMS seems to strengthen farmers’ awareness and confidence in these practices, which is consistent with research on message reinforcement and multi-channel extension (Aker, 2011; Asenso-Okyere & Mekonnen, 2012).

The data suggest that digital communication is not experienced as a stand-alone innovation but as part of a layered communication environment where radio, SMS, voice calls, WhatsApp and Facebook collectively shape farmers’ awareness of sustainable agriculture.

Theme 2: Visual and audio content as catalysts for practical learning and adoption

A second strong theme is that specific content formats, short videos, photos and voice notes, are seen as particularly powerful for learning and adopting new practices. Many farmers explicitly described changing how they farm after being exposed to visual or audio explanations of sustainable techniques.

R1 recounted that *“after watching a video shared by another farmer, I started mulching my maize farm and it has really improved soil moisture”* and added that radio programmes have changed *“the way I approach my farming.”*

R3 similarly said, *“I learned how to mulch my tomato farm from a video I saw,”* while R6 explained that *“WhatsApp videos have shown me how to control weeds naturally”* and that radio programmes taught her soil conservation and composting of kitchen waste.

These accounts emphasise findings from studies on video-mediated agricultural extension, where farmers often report that “seeing” practices in action makes them more likely to experiment and adopt, especially when literacy is low (Bentley & Van Mele, 2011).

Visual formats appear to bridge the gap between abstract recommendations and concrete, field-level application. The extension officers' responses confirm this.

R9 explained: *"I share videos and voice notes that demonstrate sustainable practices visually. Farmers respond quickly when the information is relatable. These platforms have increased adoption rates."*

Likewise, R10 stated, *"I share videos demonstrating conservation agriculture and water-saving techniques. Farmers understand better when they see real examples. It improves adoption significantly."*

Audio formats are equally important in contexts with limited literacy. Several farmers emphasised a preference for voice notes and local-language explanations.

R4 stated, *"My education is low, so I prefer voice messages,"* while R8 mentioned that she likes "voice notes" because her education is limited. Extension officers are aware of this and deliberately use local-language audio.

R1 noted that *"local extension officers... explain information in Twi,"* and R2 pointed out that officers *"explain information in Ewe,"* which *"makes it easier for us."* This practice reflects the long-standing principle in extension literature that localisation and language adaptation are essential for effective communication of technical content (Röling & Pretty, 1997; FAO, 2019).

In relation to sustainable practices, the farmers' stories consistently connect video and audio content with specific changes in behaviour, mulching, composting, organic fertiliser preparation, water-saving techniques and improved pest management.

For example, R2 explained that WhatsApp groups taught her organic fertiliser and drip irrigation; R5 described learning to "apply organic manure" from WhatsApp and to "reduce water wastage during irrigation" from Facebook videos; R8 associated WhatsApp and

Facebook content with “organic pest control for cocoa” and “new planting techniques.” These accounts align with research on ICT-enabled climate-smart agriculture that found mobile and video-based advisories can increase adoption of improved practices when combined with local facilitation (Abdulai et al., 2023; Kante et al., 2021).

Thus, the data show that digital communication influences not just awareness but concrete adoption through practical, demonstrative content delivered in accessible formats.

Theme 3: Digital platforms as interactive spaces for real-time problem solving and peer learning

Beyond one-way information transfer, the respondents portrayed digital tools, especially WhatsApp, as interactive spaces for continuous dialogue, peer-learning and real-time troubleshooting. Almost every farmer and both extension officers referred to sending pictures of pests, diseases or field conditions for advice, as well as sharing experiences with fellow farmers.

R1 described how *“we share pictures of diseases and pests so that officers can advise us immediately”* and said that these interactions *“make it easier to solve problems quickly.”*

R3 highlighted this, saying that *“farmers in our group also share photos of problems on their farms. This helps us get quick answers. We learn a lot from each other.”*

R8 further explained that cocoa farmers “share pictures of diseases,” and that “digital communication makes learning easier.”

Extension officers confirmed that this two-way interaction has changed extension practice. R9 noted, *“Many send pictures of pests and diseases. It helps me provide quick diagnosis. This digital link has improved extension delivery.”*

R10 similarly highlighted that farmers *“contact me through WhatsApp calls and voice notes. We solve problems faster than before. Digital engagement enhances extension effectiveness.”* This reflects the shift described in recent literature from top-down information dissemination toward more dialogical and demand-driven extension models facilitated by digital tools (Davis & Sulaiman, 2014; FAO, 2019).

Farmers also reported using digital platforms to coordinate planting dates, share innovations and collectively interpret advisory messages.

R1 mentioned calling “colleague farmers to discuss planting dates,” while R2 spoke of WhatsApp groups where *“we share experiences on pests and diseases”* and even hold *“group video calls when something urgent comes up.”*

R7 reported that farmers “exchange ideas” by phone and sometimes send pictures via a relative’s smartphone. These practices suggest that digital platforms are strengthening social learning networks - what diffusion scholars describe as peer influence and opinion leadership, which are crucial for adoption of new agricultural practices (Bandiera & Rasul, 2006).

In many cases, digital interaction also intersects with market and climate risk management. R1, R2, R3 and others described receiving weather forecasts, market prices and seasonal warnings via WhatsApp, SMS and apps, which helped them plan when to harvest or send produce to market. This aligns with evidence that ICT-based weather and price information can reduce uncertainty and enable more informed decisions, especially under climate change (Aker, 2011; World Bank, 2021). When combined with the peer exchanges described above, digital platforms are not just information channels but shared spaces where farmers interpret signals, negotiate risks and decide on sustainable practices collectively.

Under this first research question, the qualitative data show that digital communication platforms influence awareness, knowledge and adoption of sustainable agricultural practices

by 1) forming part of a converging media mix with radio and SMS, 2) providing visual and audio demonstrations that make practices tangible, and 3) enabling interactive, relational exchange between farmers and extension agents.

4.3 RQ2 What socio-economic, institutional, and technological factors affect smallholder farmers' access to and effective use of digital communication tools for sustainable agriculture?

Theme 4: Poverty, farm scale, and education as key determinants of digital engagement

Aims to identify the barriers and enablers affecting smallholder farmers' digital participation, so that digital communication strategies can be tailored to improve adoption and promote sustainable agricultural practices. Across almost all farmer responses, economic status, farm size, and education emerged as central factors shaping how much and how well farmers could use digital tools. Many explicitly linked their limited income and small farm size to their inability to buy smartphones, maintain data bundles, or invest in better devices.

R1 explained, *“My income is also small because I farm only two acres... If I had a bigger farm and more money, I would invest in a better smartphone.”* R2 similarly stated, *“My farm is small, and my income is limited, so investing in digital devices is difficult,”* and R6 said, *“My farm size is small, so I cannot invest much in technology. Income also affects my ability to buy data.”*

These accounts are consistent with broader evidence that adoption of digital tools in African agriculture is strongly stratified by wealth and asset ownership, with better-off farmers more likely to use smartphones and data-intensive services (CTA, 2018; IFAD, 2020).

Farm size influences both income and perceived returns from investing in technology, as suggested by R9 and R10, who both noted that farm size affects farmers' interest in adopting digital tools. R9 remarked that *“farm size also influences their interest in adopting*

technologies,” while R10 observed that “farm size and income levels... influence farmers’ willingness to invest in digital tools.”

Education, particularly literacy, is another recurring factor. Several farmers openly acknowledged literacy barriers.

R1 said, *“My level of education is low because I stopped school in JHS, so reading long messages is difficult.”* R4 noted, *“I cannot read English, so I rely on my children,”* while R7 added, *“My education level is low so I prefer voice messages.”* Even farmers with some secondary education still faced challenges with complex or technical content. R5, *who completed SHS, admitted that “sometimes, information shared is too technical,”* and R6, with JHS education, said *“complicated information is difficult.”*

Extension officers and MoFA officials confirmed that low literacy among farmers constrains technology use. R9 stated *that “some farmers’ low literacy affects how much they can benefit from our messages,”* and R10 emphasised that *“many farmers’ low literacy affects their ability to follow instructions.”* R11 similarly linked “farmers’ education levels” to limited usage of more advanced platforms. This corresponds with work showing that literacy and education are strong predictors of ICT adoption and effective use in rural settings (Aker & Mbiti, 2010; Tsan et al., 2019).

Taken together, the responses reveal a clear pattern: lower income, smaller farm size and limited education reduce farmers’ ability to 1) own appropriate devices, 2) afford regular data, and 3) independently interpret digital content. This confirms that digital agriculture in Ghana is evolving within existing inequalities rather than bypassing them, which supports arguments that digitalisation can reproduce or widen socio-economic gaps unless explicitly addressed (Fairbairn et al., 2021).

Theme 5: Infrastructure, language and device constraints as technological barriers

Technological and infrastructural constraints featured prominently in the participants' accounts, particularly poor network coverage, high data costs, weak devices and language mismatches. Many respondents mentioned unstable or weak network signals, especially in the evenings or during rains.

R1 observed that *“network is also poor in the evenings,”* R3 reported that *“the network is poor when it rains,”* and R7 described “no stable network” and a phone that “cannot download videos.” R4 noted that “messages delay for hours” due to poor coverage, while both extension officers (R9, R10) and MoFA staff (R11, R12) recognised rural connectivity as a major limitation. R11 cited “inconsistent network coverage,” and R12 referred to “poor network coverage” and the “digital divide between farmers.”

These challenges mirror national and regional findings that rural connectivity gaps remain a key barrier to digital agriculture, particularly for bandwidth-heavy services like video (World Bank, 2021; FAO, 2019). Coupled with connectivity is the issue of device quality. Several farmers described using basic phones or old smartphones that freeze or cannot handle multimedia content.

R3 explained that *“sometimes, my smartphone freezes because it is old,”* and R7 said her phone *“cannot download videos.”* Others relied on relatives' smartphones, like R4 who used her son's device, and R6 and R8 who all mentioned using nephews' or children's phones for Facebook or multimedia. This dependence limits autonomy in accessing information and is particularly pronounced among older women.

Language and content design present another layer of technological barrier. Multiple farmers noted difficulty understanding English-language messages and technical terminology.

R1 pointed out that “*sometimes the information shared is in English, which is difficult for me to understand.*” R2 added that she sometimes does “*not understand the English used in some messages,*” and R6 and R7 both mentioned struggling with English messages. Extension staff are aware of this gap and deliberately localise content.

R1 praised local officers *who “explain information in Twi,”* while R2 highlighted that *they “explain information in Ewe.”* R9 and R10 also described their role in translating digital information into local languages.

These patterns reflect longstanding critiques that many digital agriculture solutions are designed in dominant languages and not sufficiently localised (Tsan et al., 2019). The respondents themselves propose solutions that overlap with recommendations from the literature: more audio-based, local-language content and farmer-friendly interfaces. Farmers repeatedly called for “local language audio messages” (R6), “more local language-based information” (R4), and “farmer-friendly apps in Twi” (R3). Extension staff likewise suggested “user-friendly platforms in local languages” (R9) and “more local language options” (R10).

Data cost also appears as both an economic and technological barrier. Many farmers used similar phrases; “data is expensive” (R2, R5, R6, R7, R8), and extension staff noted that “data cost is also a concern” (R9; R10; R11). This confirms evidence that high tariffs relative to rural incomes constrain uptake of data services in low-income countries (GSMA, 2021). In the Ghanaian context, these technological barriers - poor connectivity, inadequate devices, language mismatches and expensive data - combine to limit the full potential of digital communication for sustainable agriculture.

Theme 6: Institutional support, NGO involvement and the centrality of extension officers

Institutional and organisational factors also heavily shape farmers' access to and effective use of digital tools. Farmers frequently referenced NGOs and MoFA as sources of training, digital agriculture initiatives and climate-smart agriculture support. R1 mentioned that "NGOs like GIZ have sometimes organized training for us... MoFA officials also support us through community meetings." R2 cited "SEND Ghana and CARE," R4 mentioned "World Vision," R5 referred to "ActionAid," R6 to "Heifer International," R7 to "Plan International," and R8 to "Solidaridad," all as organisations that provided training or support related to agriculture and, in some cases, digital tools.

However, a recurring pattern is that such support is perceived as intermittent and insufficiently sustained. Phrases like "not frequent enough" (R2), "follow-up is not always regular" (R1), "little training on how to use digital devices" (R4), "training sessions are not frequent" (R6), and "support is not frequent" (R7) indicate a gap between initial project interventions and ongoing capacity building. Extension officers and MoFA officials echoed this. R9 observed that coverage is "still limited in remote communities" and that "more investment is needed," while R10 emphasised that "more frequent training is required" and that sustainability remains "a challenge." R11 and R12 both raised concerns about "limited resources for training," "short-term" projects and the need for "sustained investment."

Within this institutional landscape, local extension officers emerge as pivotal actors who mediate digital communication and make it meaningful for farmers. Farmers repeatedly highlighted their importance. R1 described extension officers as "the link between the digital platforms and the farmers," noting that "without them, most of us would not know how to use

the information we receive.” R2 said they “guide us step by step on how to use digital tools” and “explain information in Ewe,” while R5 stressed that “extension officers explain digital messages clearly” and teach them how to use apps. R8 added that officers “interpret digital information for us,” “explain in simple terms,” and that “their support helps adoption.”

Extension officers themselves see their role similarly. R9 characterised extension officers as “translators of technology” who “explain digital information in local languages” and “teach farmers how to use the platforms.” R10 stated that they “interpret and contextualize digital information” and “facilitate group discussions through WhatsApp.” MoFA officials confirmed that “extension officers are critical in translating policy into practice” (R11) and “serve as the bridge between digital tools and farmers” (R12). This aligns with scholarship that emphasises the continuing centrality of face-to-face and relational extension in digital agriculture, rather than its replacement (Davis & Sulaiman, 2014; FAO, 2019).

In summary, under RQ2, the qualitative evidence shows that access to and effective use of digital communication is shaped by intertwined socio-economic factors (poverty, farm size, education), technological factors (connectivity, devices, language, data costs) and institutional factors (NGO programmes, MoFA policies and especially extension officers’ mediating role). These factors collectively determine who benefits from digital agriculture and to what extent.

4.4 RQ3 What strategies and policy interventions can enhance the integration and effectiveness of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana?

Theme 7: Local language, gender sensitivity and inclusive content design

A set of recommendations from both farmers and institutional actors centred on making digital communication more inclusive through local language, accessible formats and attention to

women farmers' needs. Many respondents explicitly called for content in local languages and more audio-based communication to widen participation among low-literate farmers.

R1 suggested that *“if the digital tools were in local languages and more audio-based, it would help many women like me.”*

R2 recommended that *“digital platforms use more voice messages in local languages”* to support *“low-literate farmers.”*

R4 asked for *“more local language-based information,”* and R6 emphasised *“local language audio messages”* as a way to help *“many women.”*

Extension officers reinforced this suggestion. R9 said that *“user-friendly platforms in local languages would improve adoption,”* and R10 argued for *“more local language options”* and *“audio-based content.”*

R11 called for *“more integration of local languages in digital tools,”* and R12 advocated for *“audio and video content in local languages.”* These recommendations are in line with established communication theory that stresses tailoring messages to the linguistic and cultural context of the audience (Servaes, 2008), and with empirical work showing that local-language ICT services have higher uptake among smallholders (Aker, 2011; Kante et al., 2021).

Gender sensitivity also appears as an implicit but important theme. Several respondents - especially women farmers - noted that they rely on children or relatives to access smartphone-based services, or that subsidised smartphones for women would be helpful.

R1 suggested *“subsidized smartphones for women farmers,”* while R3 and R5 both argued that *“devices should be more affordable for women.”* Many of the NGO programmes mentioned by farmers targeted women's groups specifically, such as women farmers' WhatsApp groups (R5) and regional women's groups (R2).

This reflects wider evidence that women farmers often face additional constraints in access to land, income and technology, yet play key roles in production and household food security (FAO, 2019; IFAD, 2020).

Inclusive content design also relates to simplifying technical messages and making them more practical. R5 and R8 frequently complained that information was “too technical” or in difficult English. Their suggestions for more demonstrations, voice notes and locally produced examples are consistent with adult learning principles, which emphasise experiential, context-relevant and problem-focused communication (Knowles et al., 2015).

Taken together, these recommendations suggest that a key strategy for improving the effectiveness of digital communication in promoting sustainable agriculture is to design services with and for the most marginalised users - low-literate, poorer and often female farmers, using local languages, accessible formats and participatory approaches.

Theme 8: Capacity building, digital literacy and the evolving role of extension

A second strategy dimension relates to capacity building and digital literacy, for both farmers and extension officers. Farmers repeatedly asked for more training, not only on sustainable practices but specifically on how to use digital tools.

R1 called for “*more community training programs*” to build confidence in using platforms. R2 argued that “*more training sessions for women would help,*” and R3 said “*more community workshops are needed.*”

R4 and R6 both insisted that “*more training sessions are needed*” and that “*more support is needed*” in learning to use digital devices. R7 highlighted the need for “*more regular community training,*” and R8 suggested community digital centres.

Extension officers and MoFA officials recognized the same need from the institutional side. R9 recommended that *“more training programs must be implemented,”* especially for farmers, while R10 emphasised that *“more frequent training is required.”* R11 and R12 pointed out that limited resources and short-term projects constrain how much training can be offered and that sustained investment is necessary. These recommendations align with findings that digital agriculture initiatives are most successful when accompanied by systematic capacity building for both farmers and extension personnel, rather than assuming that technology alone will drive change (Davis & Sulaiman, 2014; GIZ, 2020).

Within this capacity-building agenda, extension officers’ role is evolving but remains central. Several farmers described extension officers not just as technical advisors but as digital mediators and trainers.

R5 noted that officers *“teach us how to use apps,”* R6 said they *“show us how to interpret digital information,”* and R8 emphasised that they *“teach us how to use platforms correctly.”* R9 and R10 both described their work as explaining, translating and contextualising digital information, and facilitating group discussions through WhatsApp. MoFA officials confirmed that extension officers are *“critical in translating policy into practice”* (R11) and *“serve as the bridge between digital tools and farmers”* (R12).

These accounts point toward a strategy where extension services are deliberately positioned as hybrid, combining on-the-ground visits, group meetings and facilitation of digital communities of practice. This resonates with the concept of *“blended extension”*, where digital tools enhance but do not replace human intermediaries (FAO, 2019). For sustainable agriculture, such hybrid models can ensure that complex practices like conservation agriculture, integrated pest management or agroforestry are understood not just as technical recipes but as locally adapted systems.

Therefore, a critical policy and programme intervention is to invest in digital literacy and communication skills for both farmers and extension workers, recognising that adoption of sustainable practices depends on understanding, trust and ongoing dialogue, not just information access.

Theme 9: Affordability, infrastructure and multi-stakeholder partnerships as policy priorities

Finally, respondents consistently highlighted economic and infrastructural conditions, especially connectivity and data affordability - as areas where policy and partnerships could make a substantial difference. Many farmers called for cheaper data bundles and subsidised smartphones.

R1 suggested *“cheaper data bundles for farmers”* and R2 recommended that *“partnerships between MoFA and telecom networks can reduce data costs.”* R5 argued that *“partnerships should reduce data costs for farmers,”* while R7 proposed *“free data bundles for farmers.”* R8 called for government to *“subsidize data for farmers,”* and R12 suggested *“data packages for farmers should be subsidized.”*

At the same time, network infrastructure emerged repeatedly as a constraint and thus a policy target. Respondents across regions urged government to *“support rural network expansion”* (R1), *“invest in rural network improvement”* (R4), *“improve digital infrastructure in rural areas”* (R6), and *“invest in network expansion”* (R7).

4.5 Chapter Summary

This chapter provided an in-depth qualitative analysis of the data collected from the twelve participants, consisting of eight female smallholder farmers, two agricultural extension

officers, and two officials from the Ministry of Food and Agriculture (MoFA). The analysis was guided by the three research questions and organised into major themes that reflected how digital communication tools influence sustainable agricultural practices, the factors that shape farmers' engagement with these tools, and the strategies needed to strengthen digital agricultural communication in Ghana.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter brings the study to its final stage by presenting a summary of the research, drawing conclusions from the key findings, and offering practical recommendations for enhancing the use of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana. The chapter begins with a summary of the entire study, highlighting the core issues explored and the major insights gained from the participants. It then presents conclusions based on the analysis in Chapter Four and the research questions guiding the study. The chapter proceeds to provide recommendations for policymakers, agricultural extension officers, NGOs, digital service providers, and farmers. The chapter ends with a brief summary.

5.2 Summary of the Study

The study investigated the role of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana. It was motivated by the growing recognition that digital technologies, including mobile phones, social media platforms, SMS services, and interactive radio, have the potential to transform agricultural knowledge-sharing and improve sustainability outcomes in rural communities. Despite this potential, many farmers still face barriers that limit their engagement with digital tools.

The study adopted a qualitative research approach and a case study design, involving twelve participants: eight female smallholder farmers, two agricultural extension officers, and two officials from the Ministry of Food and Agriculture (MoFA). Data were collected through semi-structured interviews and analysed thematically.

Findings related to the first research question revealed that farmers rely on a mixture of digital and traditional media, such as mobile calls, SMS, WhatsApp, Facebook, and radio to access agricultural information. These platforms enhanced farmers' knowledge and adoption of sustainable agricultural practices through visual demonstrations, audio explanations, group chats, and real-time problem-solving interactions. Digital communication complemented traditional extension services and made information timelier, more accessible, and more practical.

The second research question identified socio-economic, technological, and institutional factors that affect farmers' ability to use digital communication tools effectively. Key barriers included low income, small farm sizes, limited digital literacy, poor network connectivity, high data costs, and lack of regular training, language limitations, and inadequate access to smartphones. Extension officers and MoFA officials confirmed that these challenges affect digital agriculture nationwide.

The third research question revealed several strategic and policy options for improving digital communication for sustainable agriculture. Participants strongly advocated for more local-language digital content, increased audio-based communication, digital literacy training, subsidised data and smartphones, strengthened rural network infrastructure, and greater involvement of extension officers and community organisations. They also emphasised the need for improved coordination among government agencies, NGOs, telecom companies, and local assemblies.

Overall, the study established that digital communication plays a significant role in enhancing awareness, knowledge, and adoption of sustainable agricultural practices. However, its full potential can only be realised when socio-economic inequalities, infrastructural challenges, and institutional constraints are adequately addressed.

5.3 Conclusion

Based on the findings, the study concludes that digital communication has become an essential component of agricultural extension in Ghana, especially in the promotion of sustainable agricultural practices among smallholder farmers. Digital tools enable farmers to access timely information, learn improved techniques, interact with experts, and benefit from peer learning networks. Platforms such as WhatsApp, SMS, and radio programmes have become critical channels where farmers receive information on soil conservation, organic farming, pest management, water harvesting, and climate-smart innovations.

However, the study further concludes that the effectiveness of digital communication is significantly shaped by contextual constraints, including poverty, low digital literacy, gender disparities, weak internet connectivity, and high data costs. These challenges limit the ability of many smallholder farmers, especially women to engage with digital advisory systems fully. Additionally, while NGOs and MoFA play critical roles in supporting digital agriculture, training programmes are often inconsistent, project-based, and insufficiently sustained.

The findings underscore that digital communication cannot replace traditional extension services, but rather must work alongside them in a blended or hybrid model. Local extension officers remain central to interpretation, localisation, and practical application of digital information. Strengthening the digital capacities of both farmers and extension officers remains crucial.

In conclusion, digital communication holds immense promise for advancing sustainable agriculture in Ghana, but unlocking this potential requires deliberate policy action, investment in rural ICT infrastructure, targeted capacity building, and more inclusive digital content development strategies.

5.4 Recommendations

1. For Government (MoFA and Policy Makers)

The study recommends an expansion of rural network infrastructure. There should be an improvement in internet connectivity in underserved farming communities to ensure reliable access to digital platforms.

There should be an introduction of farmer-friendly data bundles and support programmes that make smartphones more affordable, especially for women farmers.

There should be an established guidelines that ensure digital platforms include local-language options, audio formats, and simplified agricultural content.

There should also be a recruitment and digital training of extension officers to support blended extension models combining digital tools with face-to-face engagement.

2. For NGOs and Development Agencies

The study recommends the provision of continuous digital literacy training. The agencies should conduct regular, community-based training for farmers on how to use digital tools for sustainable agriculture.

There should be support of gender-inclusive digital programmes. The agencies and NGO should prioritise women farmers in digital agriculture initiatives and provide tailored training sessions for women's groups.

Development of local-language training materials is very key. The agencies should produce videos, audio messages, and illustrated guides in Twi, Ewe, Dagbani, Ga, and other local languages.

3. For Agricultural Extension Officers

There should be the use blended extension methods. They should combine physical farm visits with WhatsApp groups, voice notes, and phone calls to provide timely and personalised support to farmers.

Agricultural extension officers should ensure that farmers' concerns and suggestions are communicated back to MoFA and partner organisations to improve digital content and programmes.

4. For Farmers and Farmer Groups

The study recommends that farmers should participate in digital literacy and training programmes. Take advantage of community trainings provided by MoFA, NGOs, and extension officers.

Farmers should form groups that help members interpret messages, practice new digital skills, and share farming innovations.

Farmers should engage local assemblies and community leaders to advocate for improved network services and support for digital agriculture.

They should continue actively using radio, WhatsApp, SMS, and other channels for information sharing and collective learning.

5.5 Chapter Summary

This chapter summarised the study, presented the major conclusions drawn from the findings, and offered practical recommendations to enhance the use of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana. The study concluded that while digital platforms significantly support farmers' knowledge and adoption of sustainable practices, structural constraints must be addressed for farmers to fully benefit

from digital agriculture. The recommendations provided in this chapter highlight the need for improved rural ICT infrastructure, inclusive content development, sustained training, stronger extension support, and multi-stakeholder collaboration. The chapter therefore brings the study to a close while pointing toward future research and policy directions that can strengthen digital agricultural communication in Ghana.

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APPENDIX A

INTERVIEW GUIDE

Introduction to the Interview

Thank you for agreeing to participate in this study titled “*The Role of Digital Communication in Promoting Sustainable Agricultural Practices Among Smallholder Farmers in Ghana.*”

This study seeks to understand how digital communication platforms, such as mobile phones, social media, radio, and other information technologies, are being used to promote sustainable agricultural practices among smallholder farmers. It also explores the challenges farmers face in using these technologies and the kinds of strategies or policies that could help improve their effectiveness in supporting sustainable farming.

Your participation in this interview is entirely voluntary. The discussion will take approximately 25 to 30 minutes. Please note that there are no right or wrong answers, I am only interested in your honest experiences and opinions. Your responses will be treated with strict confidentiality and used solely for academic purposes. Your name and any identifying details will not appear in the final report. You may choose to withdraw at any time or skip any question you are uncomfortable answering.

With your permission, this session will be audio-recorded to ensure that your responses are captured accurately. Do I have your consent to record our discussion?

Thank you.

QUESTIONS

Section A: Understanding Digital Communication and Awareness of Sustainable Agricultural Practices

RQ 1: How do different digital communication platforms and channels influence smallholder farmers' awareness, knowledge, and adoption of sustainable agricultural practices in Ghana?

1. Can you describe the different digital communication tools or platforms you currently use to access agricultural information (e.g., mobile phones, WhatsApp, radio programs, television, or online platforms)?
2. In what ways have these digital communication platforms helped you learn about or adopt new sustainable agricultural practices (such as soil conservation, organic farming, or water management)?
3. How do you usually receive information about weather forecasts, market prices, or farming innovations through digital platforms?
4. Do you interact with agricultural officers, extension agents, or other farmers through digital channels?

Section B: Socio-Economic, Institutional, and Technological Factors Affecting Access and Use

RQ2: What socio-economic, institutional, and technological factors affect smallholder farmers' access to and effective use of digital communication tools for sustainable agriculture?

5. What challenges do you face when using digital tools or platforms for agricultural purposes?
6. How does your level of education, income, or farm size influence your ability to use digital communication tools effectively?
7. From your experience, how supportive have government agencies, NGOs, or private organisations been in helping farmers access and use digital communication technologies?

8. What role do you think local extension officers play in helping farmers understand and use digital communication platforms?

Section C: Strategies and Policy Interventions

RQ3: What strategies and policy interventions can enhance the integration and effectiveness of digital communication in promoting sustainable agricultural practices among smallholder farmers in Ghana?

9. In your opinion, what improvements or innovations could make digital communication tools more accessible and useful for smallholder farmers?
10. What kinds of government policies, community initiatives, or partnerships do you think could better support farmers in adopting digital communication for sustainable agriculture?

Closing Remarks

Thank you very much for sharing your experiences and insights. Your contributions are extremely valuable and will help improve understanding of how digital communication can support sustainable farming in Ghana. If you are interested, I can share a summary of the research findings once the study is complete.

Do you have any questions or final comments you would like to add before we end the interview?

