



SCHOOL OF GRADUATE STUDIES AND RESEARCH

**ADOPTION OF DIGITAL AGRICULTURAL EXTENSION PLATFORMS AND
THEIR CONTRIBUTION TO CROP YIELDS AMONG RURAL FARMERS IN
NKORANZA, THE BONO EAST REGION: A STUDY OF ESOKO.**

By

HANNAH LARTEN

(MADC24020)

A DISSERTATION SUBMITTED TO UNIVERSITY OF MEDIA, ARTS AND
COMMUNICATION-INSTITUTE OF JOURNALISM (UniMAC-IJ) IN PARTIAL
FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS
(MA) DEGREE IN DEVELOPMENT COMMUNICATION

NOVEMBER 2025

CANDIDATE: 25TH NOVEMBER 2025S' DECLARATION

I hereby declare that this dissertation is the result of my original research, and that no part of it has been presented for another degree in this Institute or elsewhere. I am solely responsible for any shortcomings.

Hannah Larten

MADC24020



25th/11/2025

Student

Index number

Signature

Date

CERTIFICATION BY SUPERVISOR

This dissertation has been prepared and presented under my supervision according to the guidelines for supervision and formatting of theses as laid down by the University of Media Arts and Communication - Institute of Journalism.

Kobina Ano Bedu-Addo Ph.D.

Supervisor



Signature

27/11/2025

Date

DEDICATION

To the Almighty God, the source of all wisdom and knowledge, I dedicate this work. Your guidance and blessings have been my strength and inspiration throughout this journey. May this dissertation not only be a testament to my academic achievement but also a reflection of your glory.

ACKNOWLEDGEMENT

I sincerely thank my supervisor, Dr. Kobina Ano Bedu-Addo, for his invaluable guidance, support, and encouragement throughout this study. His expertise and insights have been instrumental in shaping my ideas and refining my work.

I am also grateful to Mr. Isaac Nuamah Appiah, whose generous financial support covered my tuition fees, enabling me to focus on my studies and Mr. Fatawu Fuseini, for his timely assistance which was instrumental in helping me navigate challenging times.

I am once again grateful to the management of Esoko and the entire people of Esoko for their immeasurable guidance, reception and allowing me to use their company as a case study. It means a lot to me. My sincere thanks go to my pastor, Rev. Stephen Wilfred Arthur who kindly sponsored my data collection study in the Bono East region of Ghana.

Finally, I want to thank the respondents who participated in the study and provided insightful data to make my work complete.

Thank you all, I am truly grateful.

TABLE OF CONTENT

CANDIDATE: 20TH SEPTEMBER 2025S' DECLARATION	i
DEDICATION	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENT	v
LIST OF TABLES AND FIGURES	ix
LIST OF ACRONYMS	x
ABSTRACT	xi
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background to the Study	1
1.2 Problem Statement	3
1.3 Objectives of the Study	4
1.4 Research Questions	4
1.5 Significance of the Study	5
1.6 Scope of the Study	6
1.7 Methodology	6
1.8 Organisation of the Study	7
1.9 Chapter Summary	8
CHAPTER TWO	9
LITERATURE REVIEW	9
2.1 Introduction	9
2.2 Conceptual Clarifications	10
2.2.1 Digital Agricultural Extension	10
2.2.2 Rural Agriculture	12
2.2.3 Agricultural Yield and Productivity	13
2.2.4 Esoko Platform	15
2.3 Empirical Review	16
2.3.1 Scholarly Debates	16
2.3.2 Global Perspectives	18
2.3.3 African Experiences	19
2.3.4 Ghanaian Context	20
2.4 Theoretical Framework	22

2.4.1 Technology Acceptance Model (TAM)	23
2.4.2 Diffusion of Innovations Theory	24
2.5 Factors Influencing the Adoption of Digital Extension Platforms	25
2.6 Impact of Digital Platforms on Agricultural Yields	28
2.7 Knowledge Gaps	30
2.8 Chapter Summary	30
CHAPTER THREE	32
RESEARCH METHODOLOGY	32
3.1 Introduction	32
3.2 Research Design	33
3.3 Research Approach	35
3.4 Study Area	36
3.5 Target Population	38
3.6 Sampling Technique and Sample Size	39
3.7 Sources of Data	41
3.8 Data Collection Instruments	42
3.8.1 Questionnaire	42
3.8.2 Interview Guide	43
3.9 Validity and Reliability	45
3.9.1 Validity	45
3.9.2 Reliability	46
3.10 Data Analysis	47
3.10.1 Quantitative Analysis	47
3.10.2 Qualitative Analysis	48
3.11 Ethical Considerations	49
3.12 Methodological Challenges and Mitigation Strategies	50
3.13 Justification for Methodological Choices	51
3.14 Chapter Summary	53
CHAPTER FOUR	55
DATA PRESENTATION, ANALYSIS AND DISCUSSION	55
4.0 Introduction	55
4.1 Quantitative Data Presentation and Analysis	58
4.1.1 Demographic Characteristics of Respondents	58
Table 4.1: Demographic Characteristics of Respondents	58

Figure 4.1: Age Distribution of Respondents	60
Figure 4.2: Gender Distribution of Respondents	61
Figure 4.3: Educational Level of Respondents	62
Figure 4.4: Type of Phone Owned by Respondents	63
4.1.2 Familiarity and Access to Esoko	64
Table 4.2: Familiarity and Access to Esoko Services	64
Figure 4.5 Channels Through Which Respondents First Heard About Esoko	66
Figure 4.6 Familiarity, Registration, and Duration of Esoko Usage Among Respondents	67
4.1.3 Usage Patterns and Services Accessed	68
Table 4.3: Farmers’ Perceptions and Constraints Toward the Use of Esoko	68
Figure 4.7: Mean Ratings on Farmers’ Perceptions and Constraints Toward Esoko Services	70
Table 4.4: Summary of Outcomes of Esoko Usage	71
Table 4.4: Summary of Outcomes of Esoko Usage	71
Figure 4.8: Reported Outcomes of Esoko Usage Among Rural Farmers in Nkoranza	73
4.2 Qualitative Findings and Thematic Analysis	74
4.2.1 Coding Process and Development of Themes	76
Table 4.5: Codebook for Thematic Analysis of Farmers’ Experiences with Esoko	76
4.2.2 Farmers’ Experiences and Motivations for Using Esoko	79
4.2.3 Perceived Benefits and Practical Contributions to Farming	81
4.2.4 Challenges and Constraints in Using Esoko Services	84
4.2.5 Comparison Between Esoko and Traditional Agricultural Extension Systems	87
4.2.6 Suggestions for Improvement and Future Expectations	89
4.3 Integration of Quantitative and Qualitative Findings	92
4.5 Summary of Key Findings	95
CHAPTER FIVE	98
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	98
5.0 Introduction	98
5.1 Summary of the Study	99
5.2 Conclusions	101
5.3 Recommendations	103
5.4 Suggestions for Further Research	105
REFERENCE	108
APPENDIX A: SURVEY QUESTIONNAIRE (QUANTITATIVE INSTRUMENT)	113
APPENDIX B: INTERVIEW GUIDE (QUALITATIVE INSTRUMENT)	118

APPENDIX C: INFORMED CONSENT FORM	120
APPENDIX D: DESCRIPTIVE STATISTICS OUTPUT	121
APPENDIX E: FIGURES AND CHARTS	124
APPENDIX F: QUALITATIVE CODEBOOK	129
APPENDIX G: SAMPLE CODED EXTRACTS	131

LIST OF TABLES AND FIGURES

Table 4.1: Demographic Characteristics of Respondents	54
Table 4.2: Familiarity and Access to Esoko Services	64
Table 4.3: Farmers' Perceptions and Constraints Toward the Use of Esoko	68
Table 4.4: Summary of Outcomes of Esoko Usage	71
Table 4.5: Codebook for Thematic Analysis of Farmers' Experiences with Esoko	78
Figure 4.1: Age Distribution of Respondents	60
Figure 4.2: Gender Distribution of Respondents	61
Figure 4.3: Educational Level of Respondents	62
Figure 4.4: Type of Phone Owned by Respondents	63
Figure 4.5 Channels Through Which Respondents First Heard About Esoko	66
Figure 4.6 Familiarity, Registration, and Duration of Esoko Usage Among Respondents	67
Figure 4.7: Mean Ratings on Farmers' Perceptions and Constraints Toward Esoko Services	70
Figure 4.8: Reported Outcomes of Esoko Usage Among Rural Farmers in Nkoranza	73

LIST OF ACRONYMS

DOI – Diffusion of Innovations

FAO – Food and Agriculture Organization

GSMA – Global System for Mobile Communications Association

GSS – Ghana Statistical Service

ICT – Information and Communication Technology

IFAD – International Fund for Agricultural Development

IoT – Internet of Things

MA – Master of Arts

MoFA – Ministry of Food and Agriculture

NGO – Non-Governmental Organisation

RCM – Rice Crop Manager

SDGs – Sustainable Development Goals

SMS – Short Message Service

SoGS – School of Graduate Studies

TAM – Technology Acceptance Model

UN – United Nations

UniMAC-IJ – University of Media, Arts and Communication – Institute of Journalism

USAID – United States Agency for International Development

WB – World Bank

ABSTRACT

The growing integration of digital technologies in agricultural extension presents new possibilities for enhancing access to timely information and improving farm productivity among smallholder farmers. This study examines the adoption of Esoko, a digital agricultural extension platform, and its contribution to farming outcomes among rural farmers in Nkoranza in the Bono East Region of Ghana. A convergent parallel mixed-methods design was employed, combining survey data with qualitative insights from interviews to explore farmers' experiences, perceptions, and challenges.

The study found generally high awareness and use of Esoko's core services, particularly weather updates, agronomic advisories, and market price information. Farmers perceived the platform as useful, reliable, and supportive of daily farming decisions. Qualitative accounts underscored Esoko's role in informing key practices such as planting, input application, and marketing. Nonetheless, users reported challenges related to network connectivity, message timing, and language preferences.

The study highlights the need for continued investment in digital infrastructure, improved localisation of content, and stronger integration between digital and traditional extension delivery.

KEYWORDS: Esoko, Digital agricultural extension, Technology adoption, Crop yields, Rural farmers, Bono East Region, Mixed-methods research.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Agriculture remains the single most important sector in many developing economies, including Ghana, not only as a source of food security but also as a major driver of employment and rural development. The Food and Agriculture Organization (FAO, 2019, p. 22) notes that agriculture employs over 60% of Africa's labour force, with smallholder farmers producing about 80% of the continent's food. In Ghana, agriculture contributes around 19.7% to Gross Domestic Product (GDP) and serves as a livelihood for the majority of rural households (Ghana Statistical Service, 2021, p. 45).

In the Bono East Region, agriculture is the backbone of rural livelihoods and local economic development. The region is known for its fertile lands and favourable climatic conditions that support the cultivation of crops such as maize, yam, cassava, groundnuts, rice, and plantain. Major farming communities in and around districts like Nkoranza rely heavily on smallholder agriculture for subsistence and income generation. Despite this potential, agricultural productivity in the Bono East Region remains relatively low due to several persistent challenges such as overreliance on rainfall, limited access to irrigation facilities, low levels of mechanisation, inadequate access to improved seeds and fertilisers, and insufficient extension services (MoFA, 2019, p. 12).

The challenge is further compounded by the effects of climate variability, erratic rainfall, and occasional pest infestations, which expose smallholder farmers to high production risks (IFAD, 2020, p. 34). These structural constraints hinder the ability of rural farmers to adopt improved practices and technologies that could increase yields and resilience.

Agricultural extension services have traditionally been essential in bridging the information gap between farmers and research institutions. Extension officers provide farmers with training and advice on improved agronomic practices, pest and disease management, post-harvest handling, and market information. However, Ghana's extension system faces serious resource limitations. The World Bank (2020, p. 78) reports that the ratio of extension officers to farmers in Ghana is about 1:1500, far below the FAO's recommended ratio of 1:500. In Bono East, where many farming settlements are scattered across wide areas, this challenge is even more evident. Consequently, rural farmers often depend on informal sources such as traders, fellow farmers, and radio programmes for agricultural information, which may not always be accurate or timely.

To overcome these challenges, digital agricultural extension platforms have emerged as innovative tools for disseminating relevant agricultural information to farmers. Mobile phone ownership in Ghana has grown significantly, offering an opportunity to deliver agricultural messages directly to farmers through voice, SMS, or mobile applications (GSMA, 2020, p. 56).

One notable innovation in this space is Esoko, a mobile and web-based platform established in Ghana in 2005 to provide farmers with timely information. Esoko offers services such as weather forecasts, pest alerts, market prices, and good agricultural practices through SMS, voice messages, and mobile apps. Studies such as Aker (2011, p. 1049) and Subervie and Galtier (2014, p. 19) have shown that access to such digital information improves farmers' decision-making, enhances market participation, and reduces information asymmetry.

Despite these benefits, the adoption of Esoko among smallholder farmers varies widely across Ghana. Barriers such as limited digital literacy, poor network connectivity in remote villages, and the cost of mobile services continue to hinder usage (Fabregas et al., 2023, p. 11). Moreover, while existing studies have explored Esoko's role in some northern and southern

areas, little research has been conducted in the Bono East Region, which is one of Ghana's major food-producing areas.

This study, therefore, focuses on rural farmers in Bono East and its surrounding villages, assessing how they adopt Esoko and the extent to which its use contributes to improved productivity and crop yields.

1.2 Problem Statement

Agriculture in the Bono East Region, though vital to livelihoods, faces persistent productivity challenges. Farmers contend with poor access to quality inputs, weak infrastructure, limited access to extension support, and unpredictable weather patterns. The International Fund for Agricultural Development (IFAD, 2020, p. 34) notes that rural poverty remains relatively high in Ghana's middle-belt regions due to agriculture's central role and low productivity levels.

The conventional agricultural extension system has struggled to adequately serve the needs of smallholder farmers, especially those in remote villages. Limited staffing, logistical constraints, and inadequate funding have left many communities underserved (MoFA, 2019, p. 17). As a result, many farmers depend on informal and sometimes unreliable information sources such as traders, friends, or radio broadcasts.

Digital platforms like Esoko present an opportunity to bridge this gap by providing real-time, relevant, and location-specific agricultural information directly to farmers through mobile phones. Evidence from studies such as Cole and Fernando (2012, p. 17) and Subervie and Galtier (2014, p. 19) suggests that such tools can improve farmers' planning, market participation, and income levels.

However, there is limited empirical evidence on how farmers in the Bono East Region, particularly in its rural areas like Nkoranza engaging with Esoko. Adoption levels, usage patterns, and perceived impacts are not well documented. Without region-specific data, policymakers and development partners may not fully understand how to tailor digital extension interventions to the realities of Bono East's rural communities.

This study therefore fills that gap by examining the adoption, challenges, and impact of Esoko among smallholder farmers in Nkoranza, Bono East Region.

1.3 Objectives of the Study

General Objective:

To assess the adoption of digital agricultural extension platforms and their potential contribution to increased crop yields among rural farmers in Nkoranza, Bono East Region of Ghana.

Specific Objectives:

1. To examine the extent of adoption of Esoko digital platforms or tools among rural farmers in Nkoranza.
2. To identify the challenges faced by rural farmers in adopting and using Esoko digital platforms or tools.
3. To determine whether the adoption of Esoko digital platforms or tools contributes to increased yields and productivity among rural farmers in Nkoranza.

1.4 Research Questions

1. To what extent have rural farmers in Nkoranza adopted the Esoko digital platforms or tools?
2. What challenges do rural farmers face in using Esoko platforms or tools?

3. Does adoption of Esoko digital platforms or tools lead to improved yields and productivity among rural farmers in the Nkoranza?

1.5 Significance of the Study

There is limited empirical research on the adoption of digital agricultural platforms among rural farmers in specific regions of Ghana. Most existing studies focus on national-level adoption trends or on peri-urban farmers (Aker, 2011, p. 1051; Fabregas et al., 2023, p. 14). By focusing specifically on Bono East and its surrounding villages, this study contributes new knowledge that enriches the literature on digital agricultural extension.

The study provides evidence that can inform agricultural policy at both regional and national levels. The Ministry of Food and Agriculture (MoFA), development partners, and NGOs will benefit from findings that highlight the specific challenges and opportunities associated with digital extension platforms in Bono East and its surrounding villages. This is particularly important as the government pursues agricultural modernisation under programmes such as Planting for Food and Jobs.

For Esoko, the findings will provide insights into adoption patterns, user challenges, and the platform's impact in a key agricultural region. Such feedback can help the organisation tailor its services more effectively to rural farmers.

At the community level, improved access to agricultural information can enhance food security, increase incomes, and reduce poverty. By focusing on rural farmers who are among the most vulnerable, the study aligns with the Sustainable Development Goals (SDGs), particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 9 (Industry, Innovation, and Infrastructure).

1.6 Scope of the Study

The study focuses on rural farmers in Bono East Region, specific areas such as Nkoranza. The geographical scope is limited to this area because of its agricultural significance and the presence of Esoko digital platform interventions. The population scope covers smallholder rural farmers, both users and non-users of Esoko digital platforms, to allow comparison. The thematic scope is limited to three dimensions: the extent of adoption of Esoko digital platforms, the challenges farmers face in using it, and its impact on yields and productivity.

1.7 Methodology

This study will employ a mixed-methods research approach, combining both quantitative and qualitative data collection techniques. This approach is appropriate because it allows for a comprehensive understanding of both the statistical trends and the deeper contextual factors influencing adoption of digital agricultural platforms.

Quantitative data will be collected through structured questionnaires administered to a sample of rural farmers in Nkoranza, Bono East Region, including both users and non-users of the Esoko platform. This will help measure adoption levels, frequency of use, and perceived impact on productivity.

Qualitative data will be gathered through in-depth interviews with key stakeholders, including Esoko staff, agricultural extension officers, leaders of farmer groups, and selected rural farmers. This will provide deeper insights into the motivations, experiences, and challenges associated with using the platform.

The quantitative data will be analysed using descriptive statistics (such as frequencies, percentages, and means) and inferential statistics (such as chi-square tests, t-tests, and regression analysis) to understand relationships between variables. The qualitative data will be analysed thematically to identify recurring patterns and insights relevant to the research

questions. Additionally, secondary data such as policy documents, academic publications, and reports from development organisations will be used to support the analysis and provide broader context.

1.8 Organisation of the Study

The structure of this research has been carefully organised into five interrelated chapters, each contributing to a holistic understanding of the study. Chapter One introduces the research by outlining the background, identifying the problem that necessitated the study, and stating the specific research objectives and questions. It also provides an overview of the methodology adopted and describes how the subsequent chapters are structured.

Chapter Two provides a comprehensive review of existing literature relevant to the study. It explores scholarly discussions and empirical findings on digital agricultural platforms, agricultural extension services, and the theoretical frameworks underpinning technology adoption. Key models such as the Technology Acceptance Model (TAM) and the Diffusion of Innovations Theory are examined to offer a conceptual foundation for understanding how and why farmers adopt digital tools like Esoko.

Chapter Three details the methodology employed to achieve the research objectives. It outlines the research design, describes the sampling strategy and data collection instruments used, and explains the analytical techniques applied to both qualitative and quantitative data. This chapter also discusses ethical considerations and the rationale for adopting a mixed-methods approach.

Chapter Four presents the results of the research. It includes a detailed analysis of the data collected from farmers and key stakeholders, offering interpretations of the findings in relation to the research questions. Patterns of adoption, impact on productivity, and barriers to usage are explored and discussed in light of existing literature.

Finally, Chapter Five concludes the study by summarising the main findings and drawing conclusions. It discusses the policy implications of the research, offering strategic recommendations aimed at enhancing the adoption and effectiveness of digital agricultural extension platforms in Ghana. This chapter also suggests areas for future research that could build on the findings of the present study.

1.9 Chapter Summary

This chapter has laid the foundation for understanding the role of digital agricultural extension platforms in improving farm productivity, particularly among rural farmers in Nkoranza, Bono East Region. It has clarified key concepts such as digital agriculture, smallholder farming, and the Esoko platform, while identifying a critical gap in empirical research related to their adoption and effectiveness in rural settings. The persistence of low usage of digital platforms among rural farmers, despite their potential to enhance yields and improve livelihoods, makes this study timely and relevant. By employing a mixed-methods approach, the study aims to generate actionable insights that can guide both policy and practice in advancing the digital transformation of Ghana's agricultural sector, especially in vulnerable rural communities.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Agricultural transformation in developing economies has increasingly relied on the integration of information and communication technologies (ICTs) to strengthen the connection between farmers, researchers, and agricultural extension agents. Historically, Ghana's agricultural extension system has depended largely on face-to-face communication and demonstration methods that, while effective in some cases, have often excluded remote and marginalised farming communities due to logistical and financial constraints (Anderson & Feder, 2007, p. 2345). Over the past two decades, however, the advent of digital communication and mobile technology has significantly revolutionised how agricultural information is transmitted and accessed. As Aker (2011, p. 633) explains, ICTs have created new opportunities to bridge the informational and geographical divide between farmers and agricultural experts, enhancing both efficiency and responsiveness in extension delivery.

In Ghana, digital agricultural platforms such as Esoko, Farmerline, and CocoaLink have become instrumental in reshaping agricultural communication and extension delivery. Among these, Esoko, launched in 2005, remains one of the most widely used and effective digital systems designed to provide real-time information on market prices, weather forecasts, pest alerts, and agronomic practices through SMS, voice, and mobile applications (IFC, 2018, p. 6). The Bono East Region, a fertile agricultural hub located in central Ghana, provides an ideal case for exploring the transformative impact of such digital tools. Known as one of Ghana's key food-producing areas, Bono East supports the cultivation of crops such as maize, yam, cassava, rice, and groundnuts. However, despite its vast agricultural potential, farmers in the region continue to face significant challenges including climate variability, inadequate mechanisation, limited access to improved inputs, and insufficient extension coverage (MoFA,

2022, p. 11). These challenges make digital platforms like Esoko particularly relevant in bridging information gaps and supporting data-driven decision-making among smallholder farmers.

The World Bank (2020, p. 77) observes that digital extension models have proven effective in expanding the reach of agricultural knowledge, particularly in areas where traditional extension coverage is weak. For the Bono East Region, where the ratio of extension agents to farmers remains far below the recommended standard of one officer to every five hundred farmers, digital technologies offer a practical alternative for information dissemination. Similarly, the Food and Agriculture Organization (FAO, 2023, p. 18) emphasises that digital platforms do not only provide agronomic advice but also facilitate inclusivity by connecting farmers to market actors, financial institutions, and policy frameworks. For rural farmers in Bono East and its surrounding villages, many of whom rely heavily on smallholder farming systems, digital platforms offer a pathway to improved productivity, efficiency, and income stability.

This chapter reviews existing literature on digital agricultural extension with particular emphasis on its application and adoption among rural farmers. It begins with a discussion of key conceptual issues, followed by theoretical underpinnings that explain technology adoption behaviour. The review then synthesises empirical evidence from global, African, and Ghanaian contexts, concluding with an identification of existing knowledge gaps that justify the present study's focus on Nkoranza in the Bono East Region.

2.2 Conceptual Clarifications

2.2.1 Digital Agricultural Extension

Digital agricultural extension refers to the use of ICT tools such as mobile phones, internet platforms, and digital applications to deliver agricultural information and advisory services to farmers. Sen, Choudhury, and Tripathy (2025, p. 3008) define it as a contemporary mechanism that complements and strengthens traditional extension by using digital channels to overcome

challenges of distance, time, and cost. In contexts such as rural Bono East, Nkoranza where poor road networks and dispersed settlements often hinder regular physical visits by extension officers, digital platforms offer a reliable medium for disseminating information.

According to Aker (2011, p. 635), digital extension tools enhance the timeliness and accuracy of agricultural information, thereby enabling farmers to make more informed decisions regarding input use, planting schedules, and market sales. Similarly, the World Bank (2017, p. 19) notes that mobile-based agricultural platforms provide customised and location-specific messages that account for climatic and ecological variations. For example, Esoko's system allows agricultural officers to send region-specific weather forecasts and pest alerts, which are critical for managing risks associated with climate change in Nkoranza, Bono East.

Qiang et al. (2012, p. 47) add that digital extension is inherently scalable and cost-effective because it allows governments and development agencies to reach thousands of farmers simultaneously at minimal cost. Moreover, the participatory and interactive nature of platforms like Esoko where farmers can seek clarification, request additional information, or share feedback makes them more inclusive and user-centred than traditional one-way communication models. The design of such platforms also accommodates voice messaging and local languages, ensuring that even farmers with limited literacy in Nkoranza, Bono East can benefit from extension advice.

Platforms like Esoko exemplify this shift by leveraging both push mechanisms (e.g., SMS alerts) and pull mechanisms (e.g., interactive voice response systems). These mechanisms ensure that rural farmers not only receive information but can also seek clarification and provide feedback. This dual flow of information is instrumental in reinforcing trust and ensuring continuous learning among farming communities, ultimately helping rural

smallholders in Nkoranza, Bono East to make more informed and productive farming decisions.

2.2.2 Rural Agriculture

Rural agriculture encompasses small-scale farming practices carried out predominantly in non-urban communities. It is often characterised by family-based production systems that rely on rainfall and simple technologies. According to the FAO (2019, p. 22), rural agriculture in sub-Saharan Africa is the backbone of food security and rural livelihoods, employing more than 60% of the labour force. In the Nkoranza, Bono East Region, agriculture remains the primary economic activity, with most residents engaged in the cultivation of staple crops such as yam, cassava, maize, rice, and plantain (MoFA, 2022, p. 9).

Despite this prominence, rural farmers in Nkoranza, Bono East face persistent constraints, including limited access to credit, low levels of mechanisation, post-harvest losses, and unreliable market information. IFAD (2020, p. 34) observes that poor infrastructure and weak market linkages have long hindered rural productivity in Ghana. Climate-related challenges such as erratic rainfall and prolonged dry spells have also affected crop yields and livelihoods. For this reason, rural farmers depend heavily on external sources of information to guide planting, pest control, and marketing decisions. Digital agricultural platforms like Esoko thus play a vital role in bridging these gaps by providing real-time updates that improve planning and efficiency.

Aker (2011, p. 639) emphasises that the introduction of digital tools has significantly improved farmers' autonomy by enabling them to directly access market data, reducing dependence on middlemen. However, digital adoption is not without challenges; factors such as poor mobile connectivity, low-income levels, and limited digital literacy often restrict participation among rural populations. Fabregas, Kremer, and Schilbach (2023, p. 12) argue that while ICT

penetration is rising in Africa, sustained adoption requires affordability, training, and cultural adaptation. In Bono East, where smallholder farmers dominate, integrating digital literacy training into agricultural development initiatives could greatly enhance platform usage and impact.

Unlike urban and peri-urban farming, rural agriculture is constrained by limited access to infrastructure, inadequate extension services, poor road networks, and weaker ICT connectivity. Farmers in these areas often face difficulties accessing timely information on weather, pests, and markets, which affects productivity and resilience to climate shocks (IFAD, 2020, p. 34). Despite these challenges, rural farmers benefit from relatively larger land sizes compared to urban farmers, which allows them to scale up production if given access to improved technologies and information.

According to Aker (2011, p. 22), digital platforms such as Esoko can play a transformative role by bridging information gaps for rural farmers, particularly where traditional extension services are weak or absent. However, adoption rates tend to be lower in rural areas due to barriers such as digital illiteracy, poor network coverage, and affordability constraints (Fabregas et al., 2023, p. 11). Addressing these barriers is therefore central to unlocking the potential of digital agricultural extension in Nkronza, Bono East and beyond.

2.2.3 Agricultural Yield and Productivity

Agricultural yield is commonly defined as the amount of crop output harvested per unit of land area, usually measured in kilograms or tons per hectare. Productivity, a broader concept, refers to the efficiency of production, encompassing the ratio of total output to total input used. Increasing agricultural productivity is central to food security, poverty reduction, and economic development in agrarian societies, especially in rural Ghana where the majority of livelihoods depend on farming. Fuglie and Rada (2013, p. 1) highlight that productivity growth has

historically been driven by innovations in seed technology, irrigation, and improved agronomic practices, but more recently, the emphasis has shifted toward the role of information and knowledge dissemination.

In Nkoranza, Bono East, where smallholder farmers form the majority, access to timely and reliable agricultural information determines the extent to which they can respond to changing weather patterns and pest outbreaks. Digital platforms like Esoko contribute to productivity improvement by sending weather forecasts, price alerts, and agronomic recommendations directly to farmers' phones, enabling proactive decision-making.

Anderson and Feder (2007, p. 2347) note that such information improves farmers' ability to plan cropping cycles, manage inputs efficiently, and minimise losses. Moreover, Esoko's market price information helps farmers negotiate better prices, enhancing their income and resilience against market shocks.

However, the impact of digital platforms on productivity is mediated by contextual factors such as education, access to inputs, and institutional support. The FAO (2023, p. 27) stresses that the full potential of digital agricultural tools can only be realised when supported by adequate infrastructure, extension capacity, and farmer training programmes. Thus, while digital agricultural extension holds immense promise for improving yields in Nkoranza, Bono East, its effectiveness depends on broader systemic support.

According to Anderson and Feder (2007, p. 2347), timely and actionable agricultural information empowers farmers to make better-informed decisions, thereby reducing risks and improving outcomes. The delivery of site-specific information, as opposed to generalised advisories, ensures that farmers adopt practices suited to their local agroecological conditions, thereby enhancing both productivity and resilience. In Bono East's rural farming communities,

where agroecological conditions differ significantly from urban centres, this targeted approach is particularly valuable.

Platforms such as Esoko demonstrate how digital tools can support rural farmers by delivering customised messages via SMS or voice services, enabling them to adjust planting schedules, select appropriate crop varieties, and time market sales more effectively. Thus, digital agricultural extension is not only a driver of improved yields but also a pathway to building long-term resilience in rural farming systems.

2.2.4 Esoko Platform

Esoko is a pioneering digital platform in Ghana that provides a suite of services aimed at improving agricultural outcomes for smallholder farmers. Established in 2005, the platform delivers market prices, weather forecasts, agronomic tips, and buyer linkages through SMS, voice messaging, and mobile applications. What distinguishes Esoko from other platforms is its user-centred design, which incorporates support for local languages, interactive voice capabilities, and a user interface that accommodates varying levels of literacy (IFC, 2018; GSMA, n.d.; CTCN, 2018).

The platform's relevance lies in its ability to connect fragmented agricultural actors' farmers, buyers, extension officers, and input suppliers into a coherent information ecosystem. For rural farmers in Nkoranza, Bono East Region, Esoko is particularly significant because it reduces reliance on overstretched extension officers and informal networks. According to Agyekumhene et al. (2019, p. 45), farmers using Esoko digital platforms reported greater access to market information and improved negotiation power, which subsequently led to better prices and increased income. This impact is critical in rural settings where farmers are often vulnerable to exploitation by middlemen due to information asymmetry.

Furthermore, the platform's deployment across both rural and peri-urban areas demonstrates its adaptability to diverse agricultural contexts. Researchers such as Baumüller (2018, p. 137) and Tambo & Wünscher (2017, p. 263) have recognised Esoko as a scalable model for digital agricultural extension that addresses core rural challenges such as low literacy, weak market integration, and geographic isolation. By tailoring its services to the needs of rural smallholders, Esoko exemplifies how digital platforms can foster inclusivity, resilience, and improved productivity in Ghana's agricultural sector.

2.3 Empirical Review

2.3.1 Scholarly Debates

The discourse surrounding digital agricultural extension platforms is complex and multifaceted, reflecting a wide range of scholarly perspectives. While some scholars strongly advocate for the transformative power of ICTs in agriculture, others raise concerns about inclusivity, sustainability, and the oversimplification of deeply entrenched agricultural challenges in rural farming systems.

Proponents of digital agricultural extension argue that these platforms offer a scalable and cost-effective alternative to traditional face-to-face advisory systems. Donovan and ITU (2011, p. 9) contend that mobile-based platforms can democratise access to information, enabling even smallholder farmers in remote rural areas, such as Nkoranza, Bono East to benefit from expert advice. By overcoming geographical and logistical constraints, digital tools facilitate real-time communication between farmers and extension agents, foster transparency in rural markets, and promote data-driven decision-making.

Further, scholars such as Qiang et al. (2012, p. 6) and Aker (2011, p. 2) emphasise the role of digital technologies in enhancing the efficiency of agricultural value chains. These platforms not only improve production by disseminating technical know-how but also optimise input usage and reduce post-harvest losses. Moreover, the integration of market and weather data

into advisory services helps rural farmers manage risks particularly those linked to rainfall variability and climate shocks more effectively.

However, critics have challenged the techno-optimism surrounding digital agriculture. Birner et al. (2009, p. 9) argue that ICT-based extension often fails to reach the most vulnerable farmers, including women, the elderly, and those in marginalised rural regions. Access to digital tools is not uniformly distributed, and disparities in mobile phone ownership, literacy, and language proficiency can reinforce existing inequalities. In Ghana, although platforms like Esoko attempt to address such barriers through voice-based messages and local language support, their reach and effectiveness in rural Bono East Region remain uneven.

Sceptics also question the long-term sustainability of donor-driven digital platforms. Chapman and Slaymaker (2002, p. 13) caution that while pilot programs often show promising results, many fail to scale or sustain operations once external funding ends. This concern is echoed by Baumüller (2018, p. 14), who notes that the institutional embedding of digital platforms into national extension frameworks is often weak or absent. In rural Ghana, where extension structures are already stretched, the lack of integration makes sustainability even more challenging.

Another important debate centres on content design and relevance. Generic and top-down messaging, though efficient, may not resonate with the local realities of diverse farming communities. Scholars like van Campenhout et al. (2021, p. 184) advocate for participatory content development that involves farmers in the design and evaluation of extension messages. For rural smallholders in Bono East, contextualising advice considering crop type, soil conditions, climate patterns, and cultural practices is essential to ensuring that the information provided is both actionable and impactful.

Ultimately, the scholarly debates suggest that while digital agricultural extension platforms hold great promise, they are not panaceas. Their effectiveness depends on careful design, inclusive delivery, institutional alignment, and responsiveness to local needs. Recognising these nuances is critical for researchers, policymakers, and practitioners aiming to harness the full potential of platforms like Esoko for rural farming communities in Ghana.

2.3.2 Global Perspectives

Globally, digital agricultural platforms have revolutionised extension systems by providing innovative approaches to knowledge dissemination and farmer engagement. These global experiences highlight the diversity of digital solutions and offer lessons that are relevant for rural farming contexts such as Bono East Region Ghana.

In India, the Digital Green initiative has demonstrated success by using participatory videos to educate farmers on improved practices. Gandhi et al. (2009, p. 11) found that farmers who watched videos created by fellow farmers were significantly more likely to adopt new techniques compared to those who relied solely on conventional extension methods. The participatory model underscores the importance of peer learning, which could be adapted to rural Ghanaian contexts where trust in fellow farmers often outweighs trust in formal institutions.

In Brazil, Agrosmart leverages Internet of Things (IoT) sensors to monitor crop conditions and deliver real-time recommendations. Through advanced data analytics, farmers receive actionable insights on irrigation, fertilisation, and pest control, which enhance productivity and reduce environmental risks. While IoT infrastructure may be limited in rural Ghana, the model illustrates how tailored, data-driven services can bridge critical knowledge gaps in smallholder systems.

Similarly, in the Philippines, the Rice Crop Manager (RCM) platform offers SMS-based customised advice on planting and fertilisation. Labarta et al. (2017, p. 2343) reported that farmers using RCM experienced higher yields and profitability compared to non-users. The success of this intervention demonstrates that simple mobile-based solutions, when well contextualised, can significantly improve agricultural outcomes.

Collectively, these global perspectives suggest that digital platforms are most effective when they are participatory, context-specific, and embedded within local agricultural systems. The lessons from India, Brazil, and the Philippines highlight the potential for platforms like Esoko in Ghana to adapt global innovations to local realities. For rural farmers in Bono East, these examples reinforce the need for digital tools that are affordable, user-friendly, and responsive to farmers' socio-economic and agroecological conditions.

2.3.3 African Experiences

Across sub-Saharan Africa, digital platforms are increasingly being deployed to address inefficiencies in traditional extension systems and improve smallholder farmers' access to information. Evidence shows that these platforms can reduce information asymmetries, improve market participation, and strengthen resilience among farming communities.

In Niger, Aker and Fafchamps (2015, p. 262) found that mobile phones enabled farmers to obtain better market prices and reduced uncertainty by improving communication across dispersed rural markets. This demonstrates how even basic mobile technologies can empower rural farmers by enhancing their bargaining power and market integration. Such findings are particularly relevant to Nkoranza, Bono East Ghana, where farmers often rely on middlemen and face similar challenges of information asymmetry.

In Kenya, the iCow SMS platform has provided dairy farmers with practical advice on breeding and feeding schedules. By delivering timely and context-specific information, iCow improved

livestock management practices and farm profitability. The Kenyan example illustrates how simple mobile-based interventions can deliver significant impacts when they are tailored to farmers' production needs and local contexts.

Despite these successes, scholars caution against an overly optimistic view of digital agricultural platforms in Africa. Baumüller (2018, p. 143) highlights that many services remain heavily donor-dependent, which raises concerns about their long-term sustainability once external funding ends. Similarly, Tambo and Wünscher (2017, p. 116) note that localisation remains a critical challenge, as advisory content is often too generic and does not fully reflect the diverse agroecological and socio-economic realities of African farmers.

Moreover, persistent barriers such as language, affordability, and low digital literacy limit inclusivity. Women, the elderly, and farmers in more remote rural areas are particularly disadvantaged, as they often face multiple layers of exclusion (Baumüller, 2018, p. 144).

In Ghana, while platforms like Esoko attempt to address these barriers through voice-based messages and local language support, adoption levels in rural Bono East Region still lag behind potential due to affordability constraints and varying literacy levels.

African experiences demonstrate that digital agricultural platforms can be transformative, but their impact is mediated by issues of sustainability, inclusivity, and localisation. For rural farmers in Nkoranza, these lessons underscore the importance of designing interventions that are not only technologically sound but also socially and culturally appropriate.

2.3.4 Ghanaian Context

In Ghana, several digital platforms have emerged as key actors in agricultural extension, notably Esoko, CocoaLink, and Farmerline, each providing advisory services such as weather alerts, market price information, and good agricultural practices. These platforms have sought

to fill gaps in the traditional extension system, which is often constrained by limited personnel and inadequate resources.

Esoko, one of the earliest and most widely recognised platforms, has demonstrated significant potential in improving rural farmers' livelihoods. Asenso-Okyere and Mekonnen (2012, p. 10) found that farmers who engaged with Esoko achieved higher incomes through improved access to market information, enabling them to negotiate better prices and reduce dependence on middlemen. Similarly, Agyekumhene et al. (2019, p. 46) reported that farmers valued Esoko's use of voice calls in local languages, which facilitated inclusivity by reaching users with limited literacy. This feature is particularly relevant for rural farmers in Bono East Region, Ghana, where literacy levels are lower than the national average, and oral communication remains central to knowledge transfer.

Other platforms such as CocoaLink have tailored their services to specific value chains by providing cocoa farmers with agronomic and market-related information. Meanwhile, Farmerline integrates mobile advisory with financial services and input supply linkages, creating a more holistic ecosystem for farmers. These models highlight the diversity of Ghanaian digital extension initiatives and their potential to reach farmers across different agricultural sectors.

Nevertheless, challenges persist. Unreliable mobile network coverage in many rural areas hampers the delivery of timely information. Additionally, issues of trust in the accuracy of data provided through these platforms limit adoption among some farmers (Agyekumhene et al., 2019, p. 48). Affordability of mobile services also remains a significant barrier, as many rural households in Bono East, Ghana operate on low and unstable incomes. These structural constraints explain why adoption rates, despite strong potential, remain below expectations.

Overall, while digital platforms in Ghana demonstrate strong potential to transform extension delivery, their success depends on context-specific tailoring, affordability, and institutional alignment with national agricultural policies. For rural farming in Nkoranza, this means digital solutions must not only provide information but also be affordable, trustworthy, and adaptable to local agroecological and socio-cultural realities.

2.4 Theoretical Framework

The adoption and diffusion of digital agricultural extension platforms among farmers, particularly in rural contexts such as Bono East Region of Ghana, can be better understood through established theoretical models that explain technology acceptance and innovation diffusion. This section draws on the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) Theory, both of which offer conceptual lenses for analysing farmers' behavioural responses, systemic changes, and the socio-technical dynamics surrounding digital tools in agriculture.

The Technology Acceptance Model (TAM), originally developed by Davis (1989, p. 320), posits that technology adoption is primarily influenced by two key factors: perceived usefulness and perceived ease of use. In rural agricultural settings, this means that farmers are more likely to adopt platforms such as Esoko if they believe the technology will improve their productivity, income, or decision-making, and if the platform is easy to use regardless of literacy level. TAM is therefore highly relevant in contexts like Bono East Ghana, where farmers' willingness to adopt new technologies depends not only on functionality but also on accessibility features such as local language support and voice-based services.

Complementing this, the Diffusion of Innovations (DOI) Theory (Rogers, 2003, p. 15) explains how new ideas, practices, or technologies spread within a community over time. The theory identifies categories of adopters' innovators, early adopters, early majority, late majority, and

laggards each with distinct characteristics and adoption behaviours. Applying DOI to rural Ghana highlights the importance of peer influence and social networks, as farmers often rely on trusted peers and local opinion leaders when deciding whether to adopt a new digital tool. Furthermore, Rogers emphasises five attributes of innovations: relative advantage, compatibility, complexity, trialability, and observability that determine the rate of adoption. For platforms like Esoko, these attributes are critical in rural contexts, where observable benefits such as higher yields or better prices can accelerate diffusion among smallholder farmers.

Together, TAM and DOI provide a complementary framework for this study. While TAM focuses on individual perceptions and attitudes towards digital platforms, DOI situates adoption within broader social and institutional contexts. By combining these perspectives, this research can better capture the dynamics influencing rural farmers' adoption of Esoko in Tamale, including individual-level drivers (e.g., perceived usefulness) and community-level enablers (e.g., trust, peer learning, and institutional support).

2.4.1 Technology Acceptance Model (TAM)

Developed by Davis (1989, p. 321), the Technology Acceptance Model (TAM) posits that two key factors perceived usefulness and perceived ease of use determine whether individuals will accept and effectively utilise a new technology. In the context of digital agricultural platforms such as Esoko, perceived usefulness refers to the extent to which rural farmers believe that using the platform will enhance their farming efficiency, yields, and profitability. Perceived ease of use, on the other hand, relates to how effortless farmers believe it is to operate the technology, particularly when considering barriers such as low literacy and limited prior exposure to digital tools.

Empirical studies across Africa have adapted TAM to understand the behavioural patterns of farmers toward mobile extension services. For example, Kante et al. (2019, p. 28) applied TAM in Mali and found that ease of navigation, simplicity of message content, and multilingual options significantly contributed to user satisfaction and continued use of mobile platforms. These findings resonate strongly in Bono East Ghana, where rural farmers often prefer agricultural advisories that are short, clear, and delivered in local languages through voice calls or SMS.

One of TAM's strengths lies in its flexibility, the model allows for the inclusion of external variables such as digital literacy, mobile phone ownership, income levels, and socio-cultural attitudes, making it highly versatile and context-sensitive (Davis, 1989, p. 325). In rural Ghana, these external variables are critical in explaining why adoption rates vary across communities. For instance, farmers with higher mobile ownership and exposure to extension agents are more likely to adopt Esoko than those with limited access to technology.

Thus, TAM provides a valuable theoretical lens for this study. It not only explains adoption at the individual level but also sheds light on why some rural farmers in Tamale readily embrace platforms like Esoko, while others remain sceptical or disengaged. By focusing on both perceptions and external influences, TAM helps identify the factors that must be addressed to ensure inclusive adoption of digital agricultural technologies in rural farming communities.

2.4.2 Diffusion of Innovations Theory

Rogers' Diffusion of Innovations (DOI) Theory (2003, p. 21) is a foundational framework for understanding how new ideas and technologies spread through social systems over time. The theory identifies five key characteristics of innovations that influence adoption: relative advantage, compatibility, complexity, trialability, and observability.

In the case of Esoko in rural Ghana, like Nkoranza, Bono East its relative advantage lies in providing timely and location-specific information, such as market prices and weather forecasts, that farmers might otherwise struggle to access. Compatibility is evident when Esoko's services align with farmers' existing practices and cultural norms, for example, aligning planting schedules with rainfall forecasts. Complexity is mitigated by the platform's use of voice calls and local dialects, which reduces barriers for farmers with low literacy levels. Trialability is supported when farmers are given opportunities to test the platform on a small scale before fully committing, while observability is strengthened when rural farmers witness tangible benefits among peers, such as higher yields or better prices.

The theory also categorises adopters into innovators, early adopters, early majority, late majority, and laggards. In rural communities such as those in Nkoranza, innovators and early adopters often include digitally literate youth and lead farmers, who act as “digital champions” in demonstrating the value of Esoko to their peers. The early majority may then follow once they observe the positive outcomes, while the late majority and laggards may require targeted support, training, or subsidies to overcome resistance.

By applying Diffusion of Innovations Theory (DOI), this study recognises that adoption is not only an individual decision but also a socially embedded process shaped by networks of trust, peer learning, and community leadership. In Nkoranza, Bono East Ghana, where information often spreads through informal social structures, Diffusion of Innovations Theory (DOI) provides a valuable lens for understanding how Esoko can diffuse effectively within farming communities.

2.5 Factors Influencing the Adoption of Digital Extension Platforms

Understanding the factors that influence the adoption of digital agricultural extension platforms such as Esoko is essential for designing interventions that are both effective and sustainable.

These factors are multifaceted and can be broadly categorised into socio-demographic, technological, institutional, and perceptual dimensions.

Socio-demographic factors play a foundational role in shaping adoption behaviour. Education, age, gender, and income levels significantly influence a farmer's ability to access and utilise digital tools. Educated farmers are generally more open to experimenting with new technologies because they can comprehend and process the information delivered via digital means (Kante et al., 2019, p. 33). Conversely, older farmers and those with low literacy may find digital platforms intimidating or irrelevant. Gender disparities are also pronounced; women farmers, particularly in sub-Saharan Africa, often have limited access to mobile phones and are less likely to receive training on digital tools (Baumüller, 2018, p. 145). These patterns are evident in Nkoranza, Bono East Ghana, where low literacy levels and socio-economic inequalities continue to shape digital inclusion.

Technological factors are equally critical. The availability of mobile phones, network connectivity, and electricity infrastructure directly affects the feasibility of platform usage. While urban farmers often enjoy better infrastructural access, rural farmers in Nkoranza, Bono East and surrounding communities face challenges such as weak network coverage and unreliable electricity. Affordability also plays a decisive role: the cost of smartphones and mobile data can deter smallholders from subscribing to digital services, particularly when perceived benefits are unclear or delayed.

Institutional support, comprising government agencies, non-governmental organisations (NGOs), community-based organisations, and private sector actors, can facilitate or hinder adoption. Training workshops, field demonstrations, and community sensitisation efforts play a crucial role in building user capacity and confidence. Tambo and Wünscher (2017, p. 9) found that farmers who participated in digital literacy programs or had direct contact with extension

agents were significantly more likely to adopt digital tools. In rural Ghana, where extension officers are often overstretched, partnerships with NGOs and private actors such as Esoko become particularly valuable.

Perceptions of usefulness and trust also determine whether farmers continue to use a platform after initial exposure. According to the Technology Acceptance Model (TAM), users must perceive the technology as both useful and easy to use.

Davis (1989, p. 320) defines perceived usefulness as “the degree to which a person believes that using a particular system would enhance their job performance,” while perceived ease of use refers to the degree to which a person believes that using the system would be free of effort. Empirical applications of TAM in agriculture confirm that both constructs significantly influence farmers’ adoption behaviour.

Folorunso and Ogunseye (2008, p. 32) found that simplicity and clarity in digital interfaces enhance adoption, while McCormack et al. (2022, p. 7) reported that farmers are more likely to engage with platforms like Esoko when they believe it leads to tangible improvements in productivity, income, or decision-making.

Furthermore, trust in the platform, shaped by past experience, peer influence, and the credibility of content providers, is vital for sustained engagement. Ravikumar and Narayanan (2022, p. 2) show that trust directly influences perceptions of usefulness and farmers’ intention to continue using agricultural ICT platforms. Platforms that incorporate user feedback mechanisms and adapt their content to reflect local contexts tend to foster greater trust and loyalty among users (Van Campenhout et al., 2021, p. 184). For rural farmers in Bono East, trust is reinforced when information is validated by peers or local leaders and when the benefits of adoption are visible within the community.

The adoption of digital agricultural extension platforms is not solely determined by technological availability, It is shaped by a confluence of individual capabilities, socio-cultural norms, infrastructural realities, and institutional environments. Tailoring digital interventions to these diverse conditions is essential to maximise their reach and effectiveness (Tambo & Wünscher, 2017, p. 5).

2.6 Impact of Digital Platforms on Agricultural Yields

One of the central arguments in favour of digital agricultural extension platforms is their potential to enhance productivity and increase yields among smallholder farmers. A growing body of empirical research supports the claim that timely, accurate, and locally relevant information delivered through digital means can significantly improve farm-level decision-making and outcomes.

Digital platforms like Esoko equip farmers with access to weather forecasts, pest and disease alerts, market prices, and best agronomic practices, all of which contribute to improved planning and resource allocation. Cole and Fernando (2012, p. 17) demonstrated that farmers who received timely weather information via SMS were able to adjust planting and harvesting schedules, thereby reducing crop failure risks and enhancing yields. Similarly, access to market information enables farmers to make informed choices about when and where to sell their produce, potentially increasing income that can be reinvested in inputs such as fertilisers, improved seeds, and irrigation (Etwire et al., 2017, p. 80).

In Ghana, several studies have shown a positive correlation between the use of platforms like Esoko and improved agricultural performance. Agyekumhene et al. (2019, p. 14) found that farmers who consistently engaged with Esoko's SMS and voice services were more knowledgeable about integrated pest management and soil fertility practices. This knowledge translated into more effective use of agricultural inputs and better crop health. Moreover,

Asenso-Okyere and Mekonnen (2012, p. 97) reported that Esoko users were able to synchronise their planting periods with forecasted rainfall patterns, which enhanced productivity and reduced losses.

Digital tools also empower farmers by enhancing their autonomy and reducing dependence on middlemen. By providing access to price trends and buyer networks, platforms like Esoko strengthen farmers' negotiating power and market orientation. For example, a study in Bono East Ghana found that farmers using Esoko's market price alerts received 10% more for maize and 7% more for groundnuts compared to non-users (Courtois & Subervie, 2014, as cited in Galtier et al., 2014, p. 239). This market empowerment encourages smallholders to adopt high-value crops or technologies, contributing to better land-use efficiency and income generation.

However, the relationship between digital extension and yield is not automatic. Several mediating variables, such as farmers' capacity to interpret information, access to complementary inputs, and environmental variability, can influence outcomes. For instance, even when farmers receive high-quality information, a lack of access to fertilisers or certified seeds may limit their ability to act on the advice. Additionally, climate change-induced unpredictability can diminish the efficacy of forecasts and advisory content (Galtier et al., 2014, pp. 240–241).

In peri-urban settings, where farmers cultivate smaller plots with higher intensity and closer market orientation, digital platforms show significant promise. Technologies such as IoT sensors, mobile applications, and AI-based systems provide real-time monitoring of soil, water, and crop health, enabling more precise input use and better production timing. These innovations help reduce input waste and align harvests with peak market demand. Although conclusive yield-per-hectare studies are still limited, emerging evidence suggests that digital tools are enhancing productivity and sustainability in peri-urban agriculture (Nahiduzzaman et

al., 2024, p. 3). While digital agricultural platforms like Esoko are not a panacea, they represent a significant advancement in knowledge dissemination that, when coupled with enabling infrastructure and support, can lead to substantial yield improvements. Their integration into a broader agricultural innovation system enhances their ability to contribute meaningfully to food security and economic resilience (Galtier et al., 2014, pp. 241–242).

2.7 Knowledge Gaps

Despite the growing literature on digital agricultural extension, significant knowledge gaps remain, particularly regarding rural farming contexts in Nkoranza, Bono East Ghana. Much of the existing empirical work has focused either on national-level trends or on urban and peri-urban agriculture, leaving rural settings comparatively underexplored. This is a critical omission given that rural farmers form the backbone of Ghana’s agricultural sector and face distinct challenges such as low literacy, weaker infrastructure, and high dependence on rain-fed farming.

In Ghana, while studies such as Agyekumhene et al. (2019) and Asenso-Okyere and Mekonnen (2012) provide valuable insights into the potential of platforms like Esoko, there is still limited evidence on how rural farmers in regions like Nkoranza, Bono East are engaging with these tools on a sustained basis. Few studies have systematically examined the determinants of adoption, the barriers specific to rural contexts, and the measurable impacts on yields and income. Furthermore, the role of institutional support, peer learning, and socio-cultural dynamics in influencing adoption decisions remains insufficiently explored.

This study seeks to address these gaps by investigating the extent of Esoko adoption among rural farmers in Nkoranza, Bono East, identifying the factors that enable or constrain adoption, and assessing the platform’s contribution to agricultural productivity and resilience. By doing so, it contributes original insights to the literature on digital agriculture in sub-Saharan Africa,

while also offering practical implications for policy, extension programming, and digital innovation in Ghana's rural agricultural sector.

2.8 Chapter Summary

This chapter has presented a comprehensive review of the literature on digital agricultural extension platforms, with a particular emphasis on the Esoko platform in Ghana. It began by clarifying key concepts such as digital extension, rural agriculture, and agricultural productivity. Theoretical frameworks, including the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) Theory, were employed to frame the study's analytical lens. Empirical evidence from global, African, and Ghanaian contexts was reviewed to provide insights into how digital platforms are transforming agricultural practices, particularly for smallholder farmers in rural communities.

The review reveals strong evidence supporting the positive influence of digital extension services on farmers' knowledge, decision-making capabilities, market access, and ultimately, crop yields. Platforms like Esoko have demonstrated the potential to bridge information gaps, strengthen resilience, and empower farmers economically. At the same time, the literature identifies persistent barriers such as digital illiteracy, gender exclusion, infrastructural limitations, and questions of financial and institutional sustainability, which continue to affect adoption, particularly in Nkoranza, Bono East Ghana.

Several scholarly debates further highlight the complexity of digital extension. While some researchers celebrate digital tools as transformative innovations capable of reshaping agricultural systems, others caution that without adequate institutional support, participatory content design, and contextual adaptation, these platforms may reinforce existing inequities. Questions around localisation of content, affordability, scalability, and the integration of farmer feedback remain particularly salient.

The chapter underscores both the promise and limitations of digital agricultural platforms such as Esoko. By identifying the gaps in the literature particularly regarding adoption in Nkoranza, Bono East, it lays the foundation for the present study, which seeks to explore the factors shaping adoption and the measurable impacts of Esoko on agricultural productivity. The next chapter presents the methodology adopted to investigate these issues in depth.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presented the methodological framework adopted to examine the adoption and impact of the Esoko digital agricultural extension platform among rural farmers in the Bono East Region of Ghana, with particular attention to districts like Nkronza, it described the research design, approach, study area, target population, sampling procedures, data sources, instruments, and methods of data analysis. The methodology was guided by the study's conceptual and theoretical framework and aligned with both positivist and interpretivist paradigms, consistent with the pragmatist philosophical stance adopted.

The methodological choices were anchored in two major theoretical perspectives: the Technology Acceptance Model (TAM) and the Diffusion of Innovations Theory (DOI).

These frameworks provided analytical lenses for understanding how rural farmers perceived, evaluated, and adopted the Esoko platform (Davis, 1989, p. 320; Rogers, 2003, p. 221). Key constructs such as perceived usefulness, ease of use, relative advantage, and compatibility were employed to operationalise the theoretical assumptions and inform both the design and interpretation of data collection instruments.

Given the multidimensional nature of digital technology adoption, the study employed a convergent parallel mixed-methods design, allowing for the simultaneous collection and independent analysis of quantitative and qualitative data. This design facilitated a comprehensive investigation of both structural trends and lived experiences, thereby ensuring analytical rigour and contextual depth. As such, the research methodology was designed not only to test theoretical propositions but also to generate context-specific insights into rural farmers' interactions with digital agricultural platforms.

The chapter engaged with broader scholarly debates on methodological rigour in digital agriculture research, particularly regarding the challenges of ensuring validity, credibility, and reliability in mixed-methods studies (Zhou & Bery, 2021, p. 45; Ogunleye & Jegede, 2020, p. 17). It emphasized the importance of methodological triangulation, ethical sensitivity, and culturally appropriate research practices in studying marginalized farming populations. These considerations were especially relevant in Nkoranza, Bono East Region, Ghana, where infrastructural constraints, literacy barriers, and traditional farming practices significantly shaped the reception and use of digital innovations.

Also, it provided a coherent and theoretically grounded methodological foundation for the study. The next section presented the research design in detail, justifying its suitability for addressing the research objectives and research questions.

3.2 Research Design

This study employed a convergent parallel mixed-methods research design to investigate the adoption and impact of the Esoko digital agricultural extension platform among rural farmers in Bono East Region, Nkoranza to be specific. The convergent design allowed for the simultaneous collection and independent analysis of quantitative and qualitative data, with integration occurring during the interpretation phase. This methodological structure was appropriate for addressing the multidimensional nature of technology adoption in rural agricultural contexts, where both measurable patterns and experiential realities influence user behaviour.

As Creswell and Plano Clark (2017, pp. 7 - 8) argue, the use of mixed methods provides richer, more comprehensive insights by integrating the generalisability of quantitative data with the depth and context offered by qualitative inquiry. In this study, the quantitative component of a structured survey enabled the identification of adoption trends, demographic correlations, and

institutional influences. In contrast, the qualitative component, based on semi-structured interviews, provided access to farmers' subjective experiences, challenges, and motivations regarding the use of the Esoko platform.

The rationale for adopting a mixed-methods approach was grounded in pragmatist epistemology, which prioritizes methodological pluralism and situates the choice of methods within the logic of the research question (Tashakkori & Teddlie, 2010, p. 15). This epistemological stance recognises that neither quantitative nor qualitative methods alone would sufficiently address the research problem. Specifically, adoption behaviour involves both structural determinants such as age, gender, education, income, and digital access and interpretive processes such as perceived trustworthiness, social endorsement, and relevance of information.

The methodological integration served to enhance the validity and robustness of findings through triangulation, which allows researchers to corroborate evidence across different sources. As Greene (2007, p. 14) explains, triangulation reduces bias and increases confidence in the conclusions drawn by identifying points of convergence and divergence between datasets. For instance, if statistical analysis revealed that younger farmers were more likely to adopt Esoko, the qualitative findings could contextualize this result by highlighting generational differences in mobile device usage, digital literacy, or peer influence.

Moreover, the mixed-methods framework allowed for the development of meta-inferences, wherein theoretical understanding was extended through the integration of complementary findings. Guetterman and Fetters (2018, p. 555) emphasize that such meta-inferences are only achievable when methodological strands are treated with equal importance and their integration is guided by conceptual coherence. In this study, each strand contributed distinct yet interrelated perspectives that, when combined, enhanced the explanatory power of the research.

The convergent parallel mixed-methods design was methodologically justified based on the nature of the research problem, the theoretical framework adopted, and the need to generate both empirical generalisations and context-sensitive explanations. The design facilitated a holistic investigation of Esoko adoption, making it possible to assess the interplay between individual-level perceptions and broader socio-economic structures.

3.3 Research Approach

This study employed a deductive research approach, grounded in the Technology Acceptance Model (TAM) and Diffusion of Innovations Theory (DOI), to guide the formulation of research objectives, data collection instruments, and analytical procedures. The deductive orientation enabled the researcher to apply established theoretical constructs such as perceived usefulness, perceived ease of use, compatibility, and trialability as predefined variables for investigation within the context of Esoko adoption among rural farmers in Bono East, Nkoranza and its surrounding communities (Davis, 1989, p. 320; Rogers, 2003, p. 221).

Through this deductive structure, the study sought to empirically test the explanatory power of these constructs in determining adoption behaviour. Questionnaires and interview protocols were designed to operationalize the constructs in a measurable form, ensuring that the theoretical model was systematically applied across both the quantitative and qualitative components of the research. This allowed for the validation or modification of theoretical assumptions in a rural agricultural context.

Notwithstanding the deductive emphasis, the study also recognized the relevance of inductive reasoning, particularly within the qualitative strand. Yin (2018, p. 20) notes that applied research often necessitates a pragmatic integration of deductive and inductive strategies, given the complexity and unpredictability of real-world settings. In line with this, the study remained

analytically responsive to unanticipated insights emerging from participants' narratives, including themes not captured by TAM or DOI.

For example, while TAM prioritizes perceptions of usefulness and ease of use, qualitative data revealed emergent factors such as trust in the credibility of Esoko information, inconsistent access to mobile infrastructure, and gender-based inequalities in technology access variables not originally defined within the theoretical framework. These context-specific dimensions offered additional explanatory value and indicated potential areas for theoretical extension or adaptation.

By integrating deductive rigour with inductive sensitivity, the research maintained both analytical validity and contextual relevance. This approach ensured that theoretical constructs were not imposed uncritically, but were empirically scrutinized and complemented by grounded insights from the lived experiences of rural farmers. As such, the dual logic of deduction and induction enhanced the study's methodological robustness and its contribution to both theory and practice.

3.4 Study Area

The research was conducted in the Bono East Region of Ghana, specifically Nkoranza and its surrounding, this region was purposely selected based on several key factors related to the study's objectives. First, it represents one of the most agriculturally active zones in Ghana, where farming remains the dominant economic activity and a primary source of livelihood for the majority of the population (GSS, 2021, p. 33). Second, although the Bono East Region has historically lagged in digital infrastructure development, recent efforts by both governmental and non-governmental actors have led to increased access to mobile phones and digital platforms, including Esoko.

Nkoranza serves as a commercial hub. It acts as a point of convergence between rural producers and urban markets, thereby facilitating the dissemination and potential adoption of digital agricultural innovations. These areas also experience infrastructural challenges, such as intermittent network coverage and limited access to extension services, which make them appropriate for assessing the barriers and opportunities associated with Esoko use.

The relevance of the Bono East Region is further supported by the presence of Esoko's field operations in selected districts within and around Nkoranza, through its SMS and voice message platforms, Esoko disseminates market prices, weather updates, and agronomic advice to farmers. This digital extension model is particularly significant in rural contexts where face-to-face access to extension officers remains limited. As such, studying Esoko adoption in this environment allowed for an evaluation of how digital tools can complement or substitute traditional agricultural support systems.

Moreover, the socio-economic and infrastructural characteristics of the study area provided a nuanced context for exploring digital innovation adoption. Rural farmers in the region face persistent challenges, including low formal education levels, limited access to credit, and vulnerability to climate variability. Yet, they also demonstrate resilience and a willingness to adopt technologies that promise increased productivity and income stability. As Tambo and Wünscher (2017, p. 86) observed, the context in which agricultural innovations are introduced including market access, infrastructural development, and cultural receptivity plays a critical role in shaping adoption outcomes.

The selection of Nkoranza and its surrounding rural communities as the study area offered a strategically relevant setting for examining the factors influencing the adoption and impact of the Esoko platform. The region's agricultural intensity, evolving digital landscape, and ongoing

infrastructural development made it a fitting case for assessing digital agricultural extension in rural Ghana.

3.5 Target Population

The target population for this study comprised rural crop and livestock farmers residing in Nkoranza. The population included individuals engaged in the cultivation of cereals, legumes, vegetables, and tubers, as well as livestock producers operating under both subsistence and semi-commercial systems. This group represented both current users and potential users of the Esoko digital agricultural extension platform, allowing for a comprehensive analysis of awareness, access, adoption, and impact.

The decision to include both adopters and non-adopters of Esoko was informed by the need to capture a wide range of adoption behaviours and constraints, in line with Diffusion of Innovations Theory, which posits that populations comprise innovators, early adopters, the majority, and laggards (Rogers, 2003, p. 221). This segmentation was crucial in enabling the study to assess not only the determinants of Esoko adoption but also the barriers faced by farmers who had not yet engaged with the platform.

According to estimates from the Ministry of Food and Agriculture (MOFA), the Bono East Region had over 70,000 smallholder farmers engaged in various forms of agricultural production as of 2021 (MOFA, 2021, p. 12). A significant proportion of these farmers operated within the selected district and met the inclusion criteria of the study, which required that participants be 18 years or older, actively involved in farming, and have access to a mobile device. The region's agricultural diversity and Esoko's operational presence in Nkoranza provided a relevant context for evaluating the reach and relevance of digital extension services.

The inclusion of both crop and livestock farmers ensured that the study captured the heterogeneity of farming practices and user needs. As Asenso-Okyere and Mekonnen (2012,

p. 18) assert, examining ICT adoption across varied agricultural systems enhances the representativeness of findings and allows researchers to account for different information needs, risk perceptions, and decision-making cycles. For instance, crop farmers often base adoption decisions on seasonality, market prices, and input availability, while livestock farmers may prioritize information on veterinary services, disease prevention, and animal husbandry techniques.

Furthermore, rural farming households in the Bono East Region often engage in diversified livelihoods, combining crop cultivation with animal rearing, agro-processing, or informal trade. This complexity necessitated the selection of a target population that reflected the multi-sectoral realities of rural agrarian life. By capturing this diversity, the study was better positioned to evaluate how the Esoko platform met or failed to meet the diverse informational and operational needs of rural farmers.

The study's target population was intentionally defined to include a cross-section of rural farmers in Nkranza and its environs, differentiated by gender, age, production system, and Esoko usage status. This inclusive approach strengthened the external validity of the research and allowed for nuanced interpretation of findings across different farmer sub-groups.

3.6 Sampling Technique and Sample Size

The study employed a multi-stage sampling technique to enhance representativeness and minimize potential sampling bias. The sampling process was designed to reflect the geographic, demographic, and technological diversity of rural farming communities in Nkoranza. This approach facilitated systematic inclusion of farmers from areas where the Esoko platform was either actively in use or available for adoption.

In the first stage, the Bono East Region was stratified into administrative zones, focusing specifically on districts with predominantly rural characteristics and active agricultural activity.

Stratification ensured that key sub-groups such as farmers from more remote areas and those closer to Nkranza were proportionally represented in the sample.

As Fuglie and Rada (2013, p. 22) suggest, stratified sampling improves representativeness by guaranteeing that different geographic and socio-economic segments are adequately covered.

In the second stage, purposive sampling was applied to select specific communities and localities within each stratum that had either confirmed participation in Esoko programs or demonstrated access to the platform's services. This step was essential to ensure that participants had relevant exposure to the subject under investigation. As Patton (2015, p. 264) notes, purposive sampling is appropriate when the selection criteria are tied to participants' ability to provide meaningful, information-rich responses aligned with the research objectives.

In the third and final stage, simple random sampling was employed within the purposively selected communities to identify individual farmer respondents. This approach ensured equal probability of selection, thereby minimizing personal bias and enhancing the internal validity of the findings. The combination of purposive and random sampling enabled the study to balance theoretical relevance with statistical rigour.

For the quantitative survey, the sample size was determined using the Krejcie and Morgan (1970, p. 608) table, which provides reference values for appropriate sample sizes at a 95% confidence level and a 5% margin of error. For an estimated population of approximately N = 2,500 to 3,000 rural farmers with access to Esoko in the study area, the table recommended a minimum sample size of 341. However, in line with logistical and financial constraints, and consistent with Cohen, Manion, and Morrison's (2011, p. 125) assertion that "practicality may dictate smaller but still sufficient sample sizes," the study targeted 200 respondents. This figure was considered adequate for conducting both descriptive and inferential statistical analysis, while remaining feasible within the project's timeframe and resource constraints.

For the qualitative component, a total of 23 farmers were selected for in-depth semi-structured interviews. The qualitative sample was drawn to ensure variation across gender, age, farming experience, and crop type, thereby enriching the thematic diversity of the narratives. According to Guest, Bunce, and Johnson (2006, p. 74), data saturation in qualitative research is typically achieved within 12 to 20 interviews, validating the adequacy of the sample for capturing recurring patterns and unique experiences within the study population.

This sampling framework thus combined quantitative breadth and qualitative depth, enabling the study to produce findings that were both statistically generalisable and contextually grounded. The mixed sampling design contributed to the methodological robustness of the research and aligned with best practices in studies exploring technology adoption in rural agricultural contexts.

3.7 Sources of Data

The study relied on both primary and secondary data sources to support its mixed-methods framework and ensure methodological triangulation. Primary data were collected through the administration of structured questionnaires and the conduct of semi-structured interviews with rural farmers in Nkoranza and surrounding towns. The structured questionnaires provided quantitative data on variables such as Esoko usage patterns, demographic attributes, and perceptions of the platform's usefulness and ease of use. The semi-structured interviews, on the other hand, generated qualitative data that offered deeper insights into farmers' lived experiences, motivations, barriers to adoption, and contextual factors influencing their interaction with the Esoko platform.

Secondary data were derived from a range of scholarly and institutional sources. These included peer-reviewed academic literature on ICT adoption and digital agriculture, national policy documents, and operational reports from relevant institutions such as the Food and

Agriculture Organization (FAO), the Ministry of Food and Agriculture (MOFA), and Esoko Ghana Limited. These documents provided contextual and theoretical grounding for the study, as well as comparative benchmarks for interpreting the empirical findings.

The integration of both data sources was essential for enhancing the analytical depth and credibility of the research.

As noted by the World Bank (2017, p. 6), triangulating primary and secondary data enriches analysis by situating empirical findings within broader discourses on information and communication technologies (ICTs) in agriculture. This approach enabled the researcher to assess not only the micro-level experiences of rural farmers but also the alignment of those experiences with national development strategies and theoretical expectations within the field of agricultural innovation.

3.8 Data Collection Instruments

3.8.1 Questionnaire

The study utilised a structured questionnaire as the primary instrument for quantitative data collection. The questionnaire was systematically organised into multiple sections, each targeting specific constructs aligned with the theoretical framework and research objectives. The first section collected data on demographic characteristics, including age, gender, education level, farming experience, and type of agricultural activity. Subsequent sections focused on awareness and usage of the Esoko platform, measuring the extent to which respondents were familiar with and had adopted its services.

Additional components assessed theoretical constructs derived from the Technology Acceptance Model (TAM), including perceived usefulness and perceived ease of use. These items were operationalised using five-point Likert scales, where respondents rated their level of agreement with statements related to the benefits and usability of Esoko. Other items

explored barriers to adoption, such as technological literacy, trust in the information provided, network coverage, and cost of access. Finally, the questionnaire included items that captured farmers' perceptions of Esoko's impact on farm productivity, decision-making, and market access, thereby allowing the study to evaluate the platform's practical outcomes.

Prior to full-scale data collection, the questionnaire was pre-tested with 30 rural farmers in the Nkoranza, which shares socio-economic characteristics with the main study area. The pre-test aimed to assess the clarity, coherence, and contextual appropriateness of the questionnaire items. Feedback obtained during the pre-testing phase informed several revisions to wording, item sequencing, and translation accuracy, thereby improving the instrument's overall quality. As Nunnally (1978, p. 245) argues, pre-testing enhances both reliability and validity by ensuring that the instrument captures intended constructs and aligns with the study's objectives.

The instrument demonstrated internal consistency, relevance to the local agricultural context, and practical feasibility for administration among rural populations. Its design allowed for efficient data collection while ensuring the comparability of responses across diverse demographic groups within the target population.

3.8.2 Interview Guide

The study employed a semi-structured interview guide as the principal instrument for qualitative data collection. This guide was designed to elicit in-depth, context-specific insights from farmers regarding their interactions with the Esoko digital agricultural extension platform. It allowed for flexibility in probing emergent themes while maintaining consistency across interviews in terms of core topics addressed.

The interview questions explored several thematic areas, including farmers' personal experiences with Esoko, perceptions of the reliability and relevance of the information provided, institutional support mechanisms, and the influence of community norms and peer

interactions on technology adoption. This structure enabled the researcher to examine both individual motivations and broader social factors shaping the uptake of digital agricultural services.

Interviews were conducted in English, and Twi, depending on the linguistic preference of each participant. This multilingual approach ensured the inclusion of farmers who might otherwise be excluded due to language barriers, thereby enhancing the authenticity and inclusiveness of the data. As Braun and Clarke (2006, p. 79) emphasize, qualitative research must strive for cultural and linguistic inclusivity to fully capture the lived realities of participants. Conducting interviews in farmers' preferred languages facilitated more natural expression and improved the reliability of the responses.

The guide comprised open-ended questions that allowed respondents to describe their experiences in their own words. This approach encouraged the generation of rich, narrative data, illuminating the complexities, challenges, and enabling conditions that shaped Esoko adoption across different farming contexts. The format also permitted the researcher to probe for clarification and follow up on unexpected or particularly insightful responses, thereby enhancing the depth and richness of the qualitative strand.

Overall, the semi-structured interview guide functioned as a flexible yet systematic tool for capturing subjective interpretations of digital extension services. It complemented the questionnaire by providing explanatory depth and context to the patterns identified in the quantitative data.

3.9 Validity and Reliability

3.9.1 Validity

The validity of the study was ensured through the adoption of multiple, complementary strategies that enhanced the credibility and trustworthiness of both the quantitative and qualitative components.

To establish content validity, the data collection instruments underwent expert review by three professionals with relevant domain expertise: an agricultural extension officer, a communication scholar, and a digital technology researcher. These individuals evaluated the instruments for clarity, relevance, and alignment with the study's conceptual framework. Feedback from this review process led to the refinement of questionnaire items and interview prompts, ensuring they were contextually appropriate and capable of capturing the constructs under investigation.

Construct validity was addressed through the rigorous operationalization of theoretical variables based on the Technology Acceptance Model (TAM). Specifically, the questionnaire included measures of perceived usefulness and perceived ease of use, which are core constructs of the model (Davis, 1989, p. 321). The alignment between these constructs and the instrument items was systematically verified to ensure that responses accurately reflected the theoretical domains being examined.

To enhance external validity, the study employed stratified and random sampling techniques during the selection of participants for the quantitative survey. Stratification across different rural districts in the Bono East Region, combined with random selection within each stratum, improved the representativeness of the sample. This methodological choice increased the generalisability of the findings to the wider population of rural farmers in Nkoranza and its surrounding communities, thereby reinforcing the robustness of inferential conclusions.

In addition, the study incorporated methodological triangulation through the integration of quantitative and qualitative findings. The use of a convergent mixed-methods design allowed patterns identified through statistical analysis to be cross-validated and further contextualised through narrative data from interviews. As Creswell and Plano Clark (2017, p. 67) argue, triangulation enhances validity by enabling convergence of evidence from independent sources, thereby providing a more comprehensive and reliable interpretation of the phenomenon under investigation.

Collectively, these strategies strengthened the internal, external, and construct validity of the research, ensuring that the conclusions drawn were both empirically grounded and theoretically sound.

3.9.2 Reliability

The reliability of the quantitative instrument was assessed using Cronbach's Alpha, a statistical measure of internal consistency. The computed alpha coefficient for the scaled items was 0.81, indicating a high level of reliability. This value exceeded the conventional threshold of 0.70 recommended by Nunnally (1978, p. 245) for acceptable internal consistency in social science research.

The result demonstrated that the questionnaire items were consistently measuring the intended constructs particularly perceived usefulness, perceived ease of use, and barriers to adoption and that the scale items were not producing erratic or contradictory responses. The high reliability score validated the internal coherence of the survey instrument and justified its use for statistical analysis in addressing the study's objectives.

The instrument was further reviewed during the pre-testing phase, as described earlier, to ensure item clarity, remove ambiguity, and confirm the stability of responses across different

sub-groups within the target population. This iterative process enhanced the precision of measurement and supported the overall dependability of the data collected.

3.10 Data Analysis

3.10.1 Quantitative Analysis

The quantitative data collected through the structured questionnaires were first cleaned, coded, and then analysed using Statistical Package for the Social Sciences (SPSS). The analysis followed a two-stage process: descriptive analysis to explore general patterns, and inferential analysis to examine relationships between key variables.

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarise demographic characteristics of respondents and provide a preliminary overview of adoption patterns, usage frequency, and perceived benefits of the Esoko platform. This level of analysis offered insight into the general trends within the study population and facilitated comparisons across demographic categories such as age, gender, education, and farming type.

Inferential statistical techniques were then applied to examine the associations and predictive relationships between independent variables and Esoko adoption. Specifically, Chi-square tests were conducted to assess the statistical significance of associations between categorical variables such as gender and adoption status. In addition, multiple regression analysis was employed to identify the extent to which variables such as age, level of education, gender, digital literacy, and perceived usefulness predicted the likelihood of Esoko adoption.

Regression modelling was selected due to its ability to isolate the influence of each independent variable while controlling for others. As noted by Field (2013, p. 298), regression analysis is particularly valuable in social science research because it allows for the identification of key

predictors of behavioural outcomes, making it highly appropriate for studies investigating technology adoption patterns.

3.10.2 Qualitative Analysis

The qualitative data obtained from semi-structured interviews were analysed using thematic analysis, following the six-phase process proposed by Braun and Clarke (2006, p. 87). This analytic approach involved familiarisation with the data, initial coding, generation of themes, reviewing of themes, defining and naming themes, and finally, producing the report. The process allowed for a systematic and interpretive examination of narrative data to uncover patterns and meanings relevant to the adoption and usage of the Esoko digital platform.

To support the organisation and management of qualitative data, the study utilised NVivo 12 software. This software facilitated the coding process and allowed for the efficient categorisation of recurring ideas, sentiments, and concerns expressed by participants. Through iterative coding and theme development, key themes such as trust in digital information, community influence, perceived relevance of Esoko content, and digital literacy levels were identified. These themes provided critical explanatory insights into how rural farmers in the Nkoranza, Bono East Region perceived and interacted with digital agricultural extension platforms.

Furthermore, the emergent qualitative findings were compared and integrated with the quantitative results through a process of triangulation. This methodological integration enriched the study by enabling convergence, divergence, and elaboration across data strands. As noted by Onwuegbuzie and Leech (2004, p. 772), the integration of qualitative and quantitative findings enhances interpretive richness and contributes to the development of stronger meta-inferences. In this study, such integration allowed for a deeper understanding of

the socio-cultural and psychological dimensions underpinning technology adoption, which could not have been fully captured by quantitative data alone.

The thematic analysis thus served not only as a tool for organising qualitative narratives but also as a bridge that connected subjective interpretations to the broader behavioural patterns identified in the quantitative strand.

3.11 Ethical Considerations

The study was conducted in full compliance with established ethical standards for social research. Prior to data collection, ethical approval was obtained from the University's Institutional Review Board (IRB) to ensure that the research design and procedures met all regulatory and professional guidelines for working with human participants.

The study adhered to the principles of informed consent, confidentiality, and voluntariness, as outlined by Diener and Crandall (1978, p. 35). Participants were informed both in writing and verbally about the nature, purpose, and scope of the research, including the type of data to be collected, the expected duration of participation, and how the data would be used. Consent was obtained prior to participation through signed forms for literate respondents and verbal affirmation for those with limited literacy. Participants were assured that their involvement was entirely voluntary and that they could withdraw at any stage of the research process without incurring any penalties or consequences.

To ensure anonymity and privacy, all identifying information was removed from the data, and pseudonyms were used in the transcription and reporting of interview data. Audio recordings and digital files were stored on password-protected devices, and access was restricted to the principal investigator. Data confidentiality protocols were strictly enforced to prevent any unauthorised access, loss, or misuse of personal information.

Given the use of mobile and online platforms for both communication and data sharing in the study, additional care was taken to comply with ethical standards concerning digital data. Participants contributing content from platforms such as WhatsApp or Esoko were briefed on how their contributions would be anonymised and used solely for academic purposes.

As emphasised by Creswell (2014, p. 92), adherence to ethical principles is not only a moral obligation but also a fundamental requirement for enhancing the credibility, trustworthiness, and integrity of social research. By upholding these ethical standards, the study ensured the protection of participants' rights and contributed to the development of a research environment grounded in respect, transparency, and accountability.

3.12 Methodological Challenges and Mitigation Strategies

The process of data collection in rural areas of the Bono East Region of Ghana, specifically Nkranza and its surrounding communities, presented a number of methodological challenges. These challenges were anticipated to some extent, and mitigation strategies were developed to ensure that the quality, reliability, and validity of the data were not compromised.

One significant challenge was related to accessing respondents. Many of the targeted farmers were highly mobile due to the nature of their agricultural activities, which often required them to travel between farm sites, markets, and homes. This mobility made it difficult to reach participants at scheduled times. To address this, data collection appointments were scheduled in advance, and reminders were sent through local extension agents and community leaders. This approach improved participation and reduced attrition during fieldwork.

A second challenge concerned low levels of digital literacy among some respondents. Although the study focused on users and potential users of the Esoko digital platform, not all participants were equally proficient in using mobile technologies or interpreting digital content. To mitigate this, enumerators were trained to offer neutral and non-leading assistance to participants during

the completion of questionnaires. This included clarifying terms or helping navigate mobile-based prompts, without influencing the respondents' answers. This practice aligned with the approach recommended by Aker and Blumenstock (2015, p. 7), who argue that offering neutral support in low-literacy environments improves data accuracy while maintaining the integrity of the responses.

Additionally, network instability posed a logistical challenge, especially in more remote communities. Poor mobile and internet connectivity occasionally disrupted the scheduling of interviews and the real-time transmission of digital data. To minimise disruption, backup interview locations with better connectivity were identified in advance. In some cases, interviews were conducted offline and later uploaded securely to the project database when a stable connection became available.

Despite these operational hurdles, the adaptive field protocols employed ensured that the data collection process remained systematic, ethical, and credible. These strategies reflected the practical recommendations of Aker (2011, p. 640), who emphasises the importance of flexibility and contextual awareness in rural ICT-related research. By proactively addressing these challenges, the study safeguarded the quality of its empirical evidence, thereby strengthening the overall rigour of the research methodology.

3.13 Justification for Methodological Choices

The selection of a convergent parallel mixed-methods design was justified by the study's objective to examine both the quantifiable dimensions and the subjective complexities of Esoko adoption among rural farmers in Nkoranza, Bono East Ghana. This methodological approach allowed the researcher to collect and analyse quantitative and qualitative data simultaneously, with equal emphasis placed on both strands. The integration of results occurred during the

interpretation phase, enabling the generation of meta-inferences that reflected both statistical trends and contextual nuances.

The quantitative component of the study provided generalisable insights into adoption patterns, highlighting the influence of demographic and technological factors such as age, education, gender, digital access, and perceptions of usefulness. Conversely, the qualitative strand offered deeper explanatory power by illuminating the lived experiences, motivations, socio-cultural dynamics, and institutional constraints that shaped how farmers perceived and engaged with the Esoko platform. This dual strategy was particularly suited to the study of digital agricultural technologies, where both behavioural patterns and contextual meanings play crucial roles.

As noted by Tashakkori and Teddlie (2010, p. 22), mixed-methods designs are especially appropriate for addressing complex social phenomena, where neither quantitative nor qualitative approaches alone are sufficient to capture the full scope of the research problem. In this study, the integration of numerical and narrative data ensured methodological complementarity and increased the depth and validity of the findings.

The methodological framework was further strengthened through its alignment with the study's theoretical underpinnings namely, the Technology Acceptance Model (TAM) and the Diffusion of Innovations Theory. Constructs such as perceived usefulness, compatibility, and trialability were systematically embedded in the design of both the questionnaire and the interview guide, ensuring that theoretical concepts were directly reflected in the data collection instruments. This alignment allowed for the operationalisation of key constructs in ways that were both analytically rigorous and contextually appropriate. As highlighted by Rogers (2003, p. 223), the value of such theoretical integration lies in its ability to link empirical evidence with broader frameworks of innovation adoption.

By combining robust theoretical grounding with context-sensitive methodological strategies, the study was able to maintain both internal coherence and external relevance. The chosen research design thus provided a comprehensive platform for understanding not only whether farmers adopted Esoko, but also how and why they made those decisions within the specific socio-economic realities of rural Ghana.

3.14 Chapter Summary

This chapter presented a comprehensive outline of the methodological framework employed in the study, offering a detailed justification for each methodological choice made in the research process. It began by describing the adoption of a convergent parallel mixed-methods design, which enabled the integration of both quantitative and qualitative data to capture the multifaceted nature of Esoko adoption among rural farmers in Nkoranza Bono East Region of Ghana. The chapter also elaborated on the deductive research approach, grounded in the Technology Acceptance Model (TAM) and the Diffusion of Innovations Theory, which guided the operationalisation of key constructs such as perceived usefulness, ease of use, compatibility, and trialability.

The discussion further outlined the selection of Nkoranza and its surrounding communities as the study area, justified by the region's agricultural significance and emerging digital infrastructure. The target population, consisting of farmers aged 18 and above who were users or potential users of Esoko, was clearly defined, and multi-stage sampling techniques were employed to ensure representativeness and diversity.

Data collection instruments including structured questionnaires for the quantitative strand and semi-structured interviews for the qualitative strand were carefully developed, pre-tested, and refined to maximise clarity, reliability, and relevance. The chapter also addressed procedures for ensuring validity and reliability, including expert review, pre-testing, stratified sampling,

and the use of Cronbach's alpha to confirm internal consistency. Data analysis methods, involving the use of SPSS for statistical modelling and NVivo for thematic coding, were described in detail to highlight how both descriptive and inferential insights were drawn from the data.

Ethical considerations were rigorously observed, with attention paid to informed consent, confidentiality, and responsible data management, even in the absence of a formal institutional review board. The chapter also discussed fieldwork challenges such as mobile respondents, network instability, and low digital literacy, and explained the mitigation strategies employed to address these issues without compromising data quality.

The methodological choices reflected a strong commitment to rigour, inclusivity, and contextual sensitivity. By integrating theoretical models with a pragmatic and context-aware research design, this chapter established a solid foundation for the analysis and interpretation of findings, which will be presented in Chapter Four.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter presents and interprets the findings of the study titled “Assessing the Adoption of Digital Agricultural Extension Platforms and Their Contribution to Crop Yields Among Rural Farmers in Nkoranza, Bono East Region: A Study of Esoko.” The purpose of this chapter is to analyse the extent to which rural farmers in Nkoranza have adopted the Esoko digital agricultural platform and to evaluate how its use contributes to crop yields and overall agricultural productivity. The chapter draws on both quantitative and qualitative data collected from farmers, agricultural extension officers, and Esoko users across selected rural communities in Nkoranza.

The presentation of findings follows the convergent parallel mixed-methods design described in Chapter Three. This design allows quantitative and qualitative data to be collected and analysed separately but merged during interpretation to generate a more comprehensive understanding of the research problem (Creswell & Plano Clark, 2018, p. 71). Quantitative data were analysed using descriptive statistics such as frequencies, percentages, and means, to describe respondents’ demographic characteristics, adoption levels, and perceived outcomes of using Esoko. Complementing this, the qualitative data, drawn from open-ended interviews and responses, were analysed thematically to capture participants’ experiences, perceptions, and contextual realities that influence their adoption decisions.

The mixed-methods approach enhances the validity and richness of the study. By integrating numerical trends with lived experiences, the researcher can cross-validate findings and provide deeper explanations for observed phenomena.

As Tashakkori and Teddlie (2010, p. 34) argue, the convergence of both datasets allows for triangulation, which strengthens interpretation by reducing bias and offering multiple perspectives on the same issue. In this study, for instance, while quantitative analysis shows how many farmers use Esoko and for what purposes, qualitative narratives illuminate why farmers adopt (or fail to adopt) the platform and how its use shapes their productivity and livelihood strategies.

The quantitative component focuses on the demographic and socio-economic characteristics of respondents, their level of awareness, access to Esoko services, frequency of use, and perceived impact on crop yields. These data help to establish patterns in adoption behaviour, revealing both the reach and the limitations of Esoko among rural farmers in Nkoranza. The qualitative component, on the other hand, delves into farmers' personal experiences with the platform, their perceptions of usefulness and ease of use, the role of extension officers, and the challenges encountered in using digital tools for farming.

Following Braun and Clarke's (2006, p. 79) six-step approach to thematic analysis, the qualitative data were coded, themes were identified, reviewed, and refined, and a coherent narrative was constructed to reflect emerging insights.

The integration of both data strands is critical for drawing robust conclusions.

According to Bryman (2012, p. 633), the complementarity of quantitative and qualitative data provides a multidimensional understanding of social phenomena quantitative data quantify the extent of occurrence, while qualitative data explain the meaning and context behind it. In the case of Esoko, understanding adoption among rural farmers in Nkoranza requires both sets of insights: how many uses it, for what reasons, and under what conditions it influences their agricultural outcomes.

This chapter is organised into five sections. Section 4.1 presents the quantitative findings, including respondents' demographic characteristics, adoption levels, and perceptions of Esoko's usefulness and impact on productivity. Section 4.2 discusses the qualitative findings, identifying key themes that emerged from interviews and open-ended responses. Section 4.3 integrates both datasets, comparing and contrasting quantitative patterns with qualitative narratives to draw comprehensive insights. Section 4.4 connects the findings to the study's theoretical framework namely the Technology Acceptance Model (Davis, 1989, p. 320) and the Diffusion of Innovations Theory (Rogers, 2003, p. 21) to explain the behavioural and contextual drivers of technology adoption among rural farmers. Finally, Section 4.5 summarises the major findings, highlighting their implications for agricultural extension, policy, and practice.

This chapter seeks to present a well-rounded analysis of the factors shaping the adoption of Esoko and its effects on agricultural outcomes in Nkoranza. It provides empirical evidence that contributes to a deeper understanding of how digital platforms are transforming rural extension systems and smallholder productivity in Ghana. As scholars such as Baumüller (2018, p. 142) and Asenso-Okyere and Mekonnen (2012, p. 10) argue, digital agricultural platforms like Esoko hold great promise for addressing the long-standing challenges of access to information and extension services. However, their success depends on multiple interlinked factors, including awareness, usability, infrastructure, and trust among farmers. This chapter, therefore, not only reports empirical findings but also situates them within the broader discourse on digital innovation and rural development in Ghana.

4.1 Quantitative Data Presentation and Analysis

4.1.1 Demographic Characteristics of Respondents

The socio-demographic characteristics of the respondents provide insight into the background of the rural farmers in Nkoranza who participated in the study. Understanding these characteristics is important because factors such as age, education, and access to digital tools influence the adoption and effective use of digital agricultural platforms like Esoko (Aker, 2011, p. 1050; Fabregas et al., 2023, p. 12).

Table 4.1: Demographic Characteristics of Respondents

VARIABLE	CATEGORY	FREQUENCY	PERCENTAGE (%)
Age	30-39 years	4	17.4
	40-49 years	8	34.8
	50-59 years	7	30.4
	60 years and above	4	17.4
Gender	Male	13	56.5
	Female	10	43.5
Educational Level	No formal education	2	8.7
	Primary	6	26.1
	JHS	7	30.4
	SHS	8	34.8
Type of Farming	Crops only	13	56.5
	Crops and Livestock	10	43.5
Type of Phone	Smart phone	16	69.6
	Feature phone	7	30.4

The results show that the majority of respondents (34.8%) were between 40 and 49 years old, followed by 30.4% who were between 50 and 59 years old, indicating that most farmers in the sample are middle-aged. This age distribution suggests a relatively mature farming population that is likely to have accumulated significant agricultural experience over time. However, as noted by Baumüller (2018, p. 142), this demographic may also face digital literacy challenges that can affect their ability to fully utilise mobile-based platforms like Esoko.

In terms of gender, 56.5% were male and 43.5% female, showing a fairly balanced representation but still a slight male dominance. This finding aligns with the national trend where male farmers tend to have greater access to land and agricultural information services (World Bank, 2020, p. 78). Nonetheless, the notable participation of women highlights that female farmers in Nkoranza are increasingly engaging with modern agricultural technologies, which reflects the inclusive nature of digital platforms such as Esoko.

The educational profile indicates that 34.8% of respondents had completed Senior High School (SHS), while 30.4% had Junior High School (JHS) education. Only 8.7% had no formal education. This relatively moderate literacy level implies that most respondents possess the basic reading and comprehension skills necessary to interact with text- or voice-based mobile applications. According to Aker (2011, p. 1048), education enhances a farmer's ability to interpret agricultural information and adopt innovative technologies.

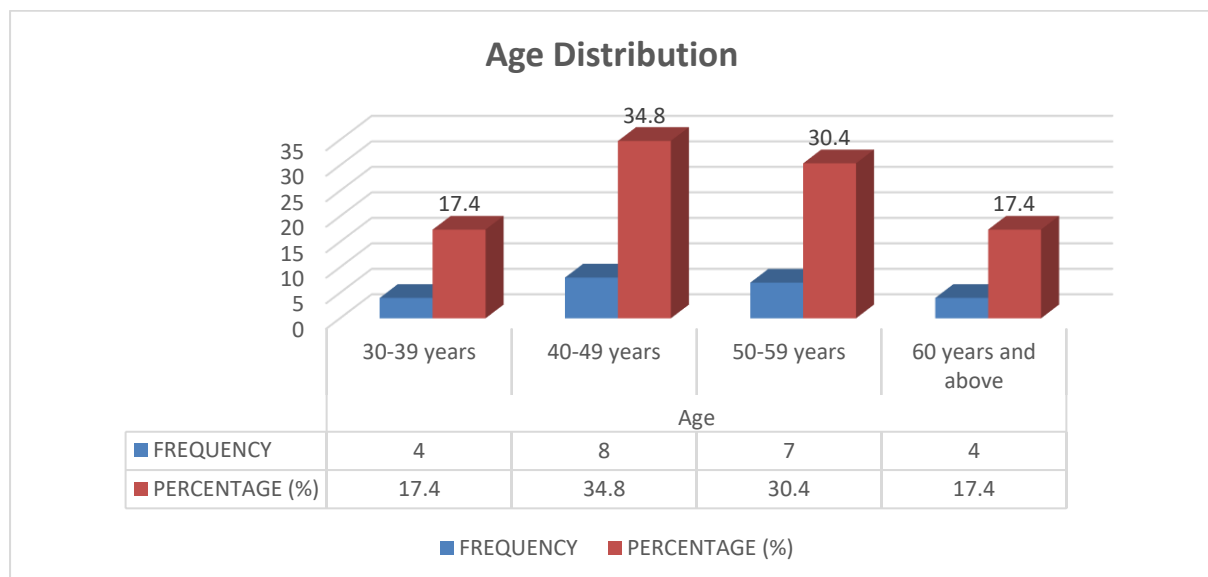
Regarding the type of farming, 56.5% of the respondents engaged solely in crop production, while 43.5% combined crops and livestock farming. This distribution reflects the mixed agricultural economy of the Bono East Region, where both cropping and livestock play complementary roles in livelihood sustainability (MoFA, 2019, p. 12).

Finally, the findings show that 69.6% of respondents owned smartphones, compared to 30.4% using feature phones. The high proportion of smartphone users suggests a favourable

environment for digital extension services such as Esoko, which rely on mobile-based communication. As GSMA (2020, p. 56) observes, increased smartphone ownership among rural farmers has expanded opportunities for delivering agricultural information through apps, SMS, and voice messages.

These demographic results establish a strong foundation for understanding the adoption potential of Esoko among farmers in Nkoranza. The combination of middle-aged, moderately educated farmers with high phone ownership creates an enabling context for digital agricultural interventions.

Figure 4.1: Age Distribution of Respondents



As shown in Figure 4.1, the age distribution of respondents reveals that the majority (34.8%) were aged between 40 and 49 years, followed by 30.4% between 50 and 59 years. Respondents aged 30–39 and those 60 years and above each constituted 17.4%. This distribution suggests that most farmers in Nkoranza are middle-aged and experienced, representing a population segment often characterized by practical farming knowledge but moderate technology adoption (Baumüller, 2018, p. 142).

According to Fabregas et al. (2023, p. 14), this demographic group is highly responsive to innovations that clearly demonstrate productivity gains. Therefore, the Esoko platform’s adoption potential is strong among this age cohort, particularly when digital literacy support is provided.

Figure 4.2: Gender Distribution of Respondents

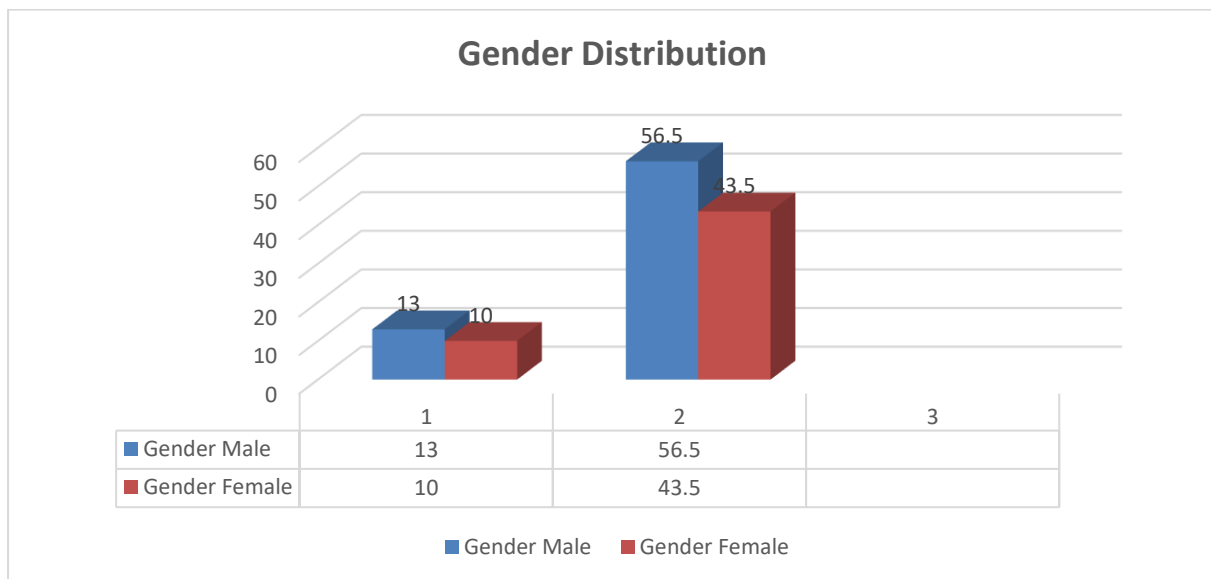
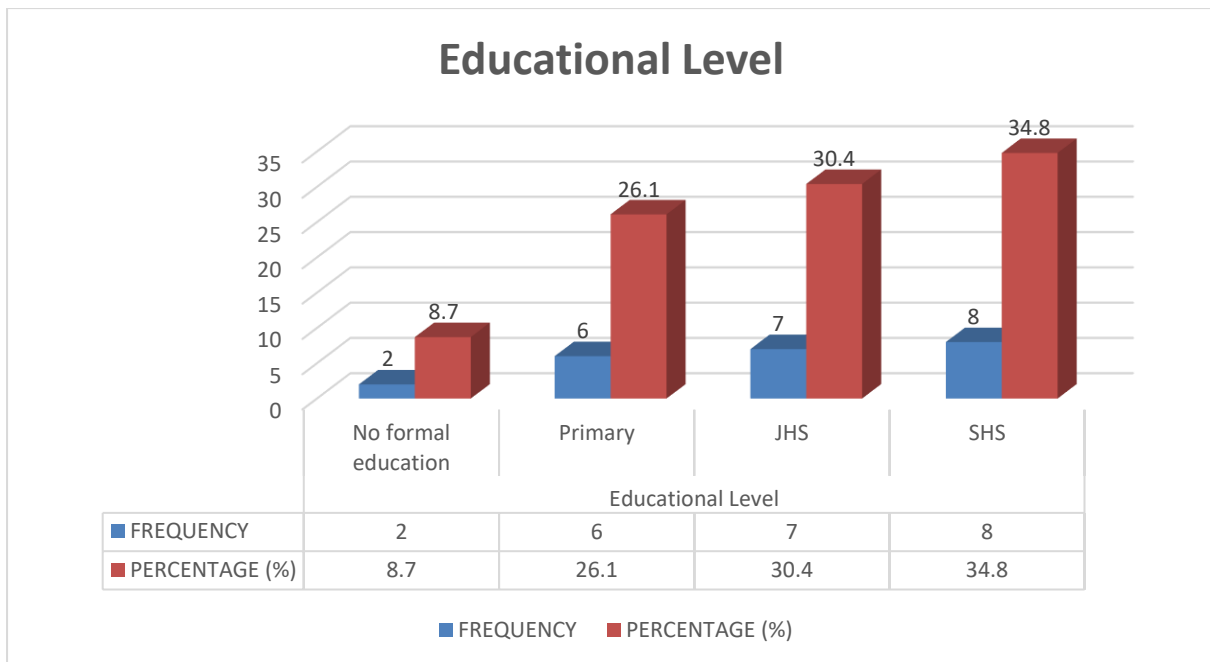


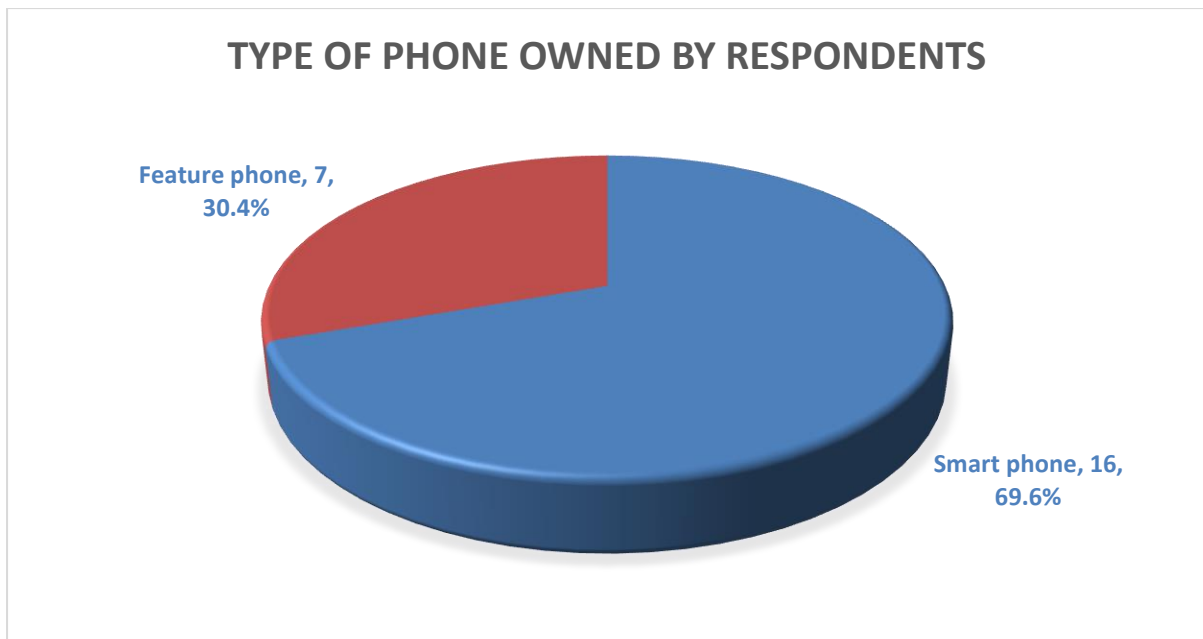
Figure 4.2 illustrates that males accounted for 56.5% of respondents, while females constituted 43.5%. The relatively balanced gender representation reflects the increasing participation of women in agricultural production in the Bono East Region. This trend is consistent with national patterns where female farmers form a substantial proportion of Ghana’s agricultural workforce (World Bank, 2020, p. 78). However, men still dominate access to land and financial resources, which can influence their ability to adopt digital agricultural platforms (Asenso-Okyere & Mekonnen, 2012, p. 11). The notable participation of women in this study highlights a gradual but positive shift toward gender inclusivity in digital extension adoption.

Figure 4.3: Educational Level of Respondents



As depicted in Figure 4.3, 34.8% of respondents had completed Senior High School (SHS), 30.4% had Junior High School (JHS) education, 26.1% had Primary education, and 8.7% had no formal education. This educational profile indicates a moderately literate farming population. According to Aker (2011, p. 1048), education enhances farmers’ cognitive ability to understand and apply agricultural innovations. Similarly, Nakasone, Torero, and Minten (2014, p. 11) found that literacy improves a farmer’s likelihood of using mobile-based platforms effectively. Thus, the relatively high literacy rate among respondents suggests a favourable environment for Esoko’s continued expansion in rural Nkoranza.

Figure 4.4: Type of Phone Owned by Respondents



As indicated in Figure 4.4, 69.6% of respondents used smartphones, while 30.4% relied on feature phones. This result demonstrates strong digital readiness among farmers in Nkoranza. The dominance of smartphones implies that most farmers can access multiple Esoko features including SMS alerts, mobile internet, and application-based tools. This finding is consistent with GSMA's (2020, p. 56) report that smartphone penetration among rural populations in sub-Saharan Africa has steadily risen, improving access to mobile extension platforms. Consequently, Esoko's integration into farmers' communication routines is supported by the increasing prevalence of smartphone ownership, which strengthens the potential for scaling digital agriculture initiatives.

4.1.2 Familiarity and Access to Esoko

Table 4.2: Familiarity and Access to Esoko Services

VARIABLE	CATEGORY	FREQUENCY	PERCENTAGE (%)
Familiar with Esoko E-extension services	Yes	23	100.0
	No	0	0.0
Currently registered on Esoko	Yes	17	73.9
	No	6	26.1
Duration of Use (among registered users)	Less than 6 months	2	11.8
	6 months - 1 year	13	76.5
	1-2 years	2	11.8
How respondents first heard about Esoko	SMS/Call	13	56.5
	Community meeting	5	21.7
	Another farmer	2	8.7
	Radio/TV	1	4.3
	Other/Not specified	2	8.7

The findings in Table 4.2 indicate that all respondents (100%) were familiar with Esoko’s e-extension services, demonstrating that awareness of the platform among rural farmers in Nkoranza is universal. This reflects the growing visibility of Esoko as a digital agricultural tool in Bono East, likely facilitated by both peer networks and community sensitization campaigns. According to Fabregas, Kremer, and Schilbach (2023, p. 13), widespread awareness is the first

and most crucial stage in the technology adoption process, as it influences farmers' readiness to engage with new agricultural innovations.

In terms of registration, approximately 74% of respondents were registered users of Esoko, while 26% had not yet registered. This level of uptake is relatively high for a rural setting and suggests strong interest and trust in digital agricultural information sources. Baumüller (2018, p. 143) notes that sustained use of digital agricultural platforms often depends on perceived credibility and the degree to which farmers feel the information addresses their immediate farming needs.

The duration of use among registered users further shows that the majority (76.5%) had used Esoko services for six months to one year, while smaller proportions (11.8% each) had used it for less than six months or one to two years. This pattern indicates that most users are relatively new to the platform, reflecting ongoing efforts to expand Esoko's reach in Nkoranza's rural communities. Consistent with the Diffusion of Innovations Theory, this represents the "early majority" stage of adoption, where awareness and interest are high, but long-term commitment is still consolidating (Rogers, 2003, p. 23).

When asked how they first heard about Esoko, the majority (56.5%) cited SMS or call notifications, followed by community meetings (21.7%), other farmers (8.7%), and radio/TV (4.3%). This shows that direct mobile communication remains the most effective outreach channel for Esoko in rural Ghana. As Aker (2011, p. 1049) argues, leveraging mobile phones to deliver agricultural information directly to farmers overcomes many of the geographic and logistical barriers associated with traditional extension systems. The influence of community meetings and peer referrals further highlights the importance of social networks and interpersonal trust in driving technology diffusion among smallholder farmers (Rogers, 2003, p. 24).

These findings suggest that Esoko’s awareness and registration levels are high among farmers in Nkoranza, with most users actively engaging through mobile channels. However, the relatively short duration of use implies that sustained engagement and user retention strategies remain important for maximizing the platform’s long-term impact.

Figure 4.5 Channels Through Which Respondents First Heard About Esoko

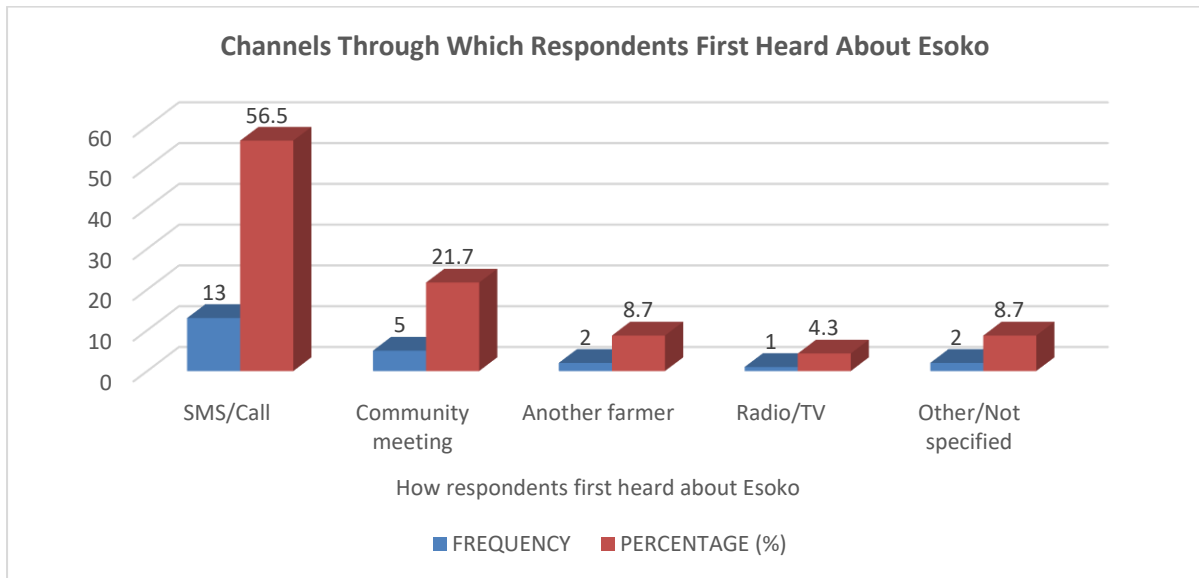


Figure 4.5 illustrates that the majority of respondents (56.5%) first heard about Esoko through SMS or phone calls, followed by 21.7% through community meetings, 8.7% through other farmers, and 4.3% via radio or television. This distribution indicates that direct mobile communication remains the most effective outreach channel for disseminating agricultural information in rural settings.

The finding supports Aker’s (2011, p. 1049) argument that mobile-based interventions reduce the distance barrier in agricultural communication by allowing information to reach farmers without the need for physical contact. Moreover, the role of community meetings (21.7%) shows that interpersonal communication and social learning remain essential components of technology diffusion, consistent with Rogers’ (2003, p. 22) Diffusion of Innovations Theory.

In this context, peer-to-peer learning through farmer networks reinforces adoption behaviour by building trust and shared understanding of the technology.

Figure 4.6 Familiarity, Registration, and Duration of Esoko Usage Among Respondents

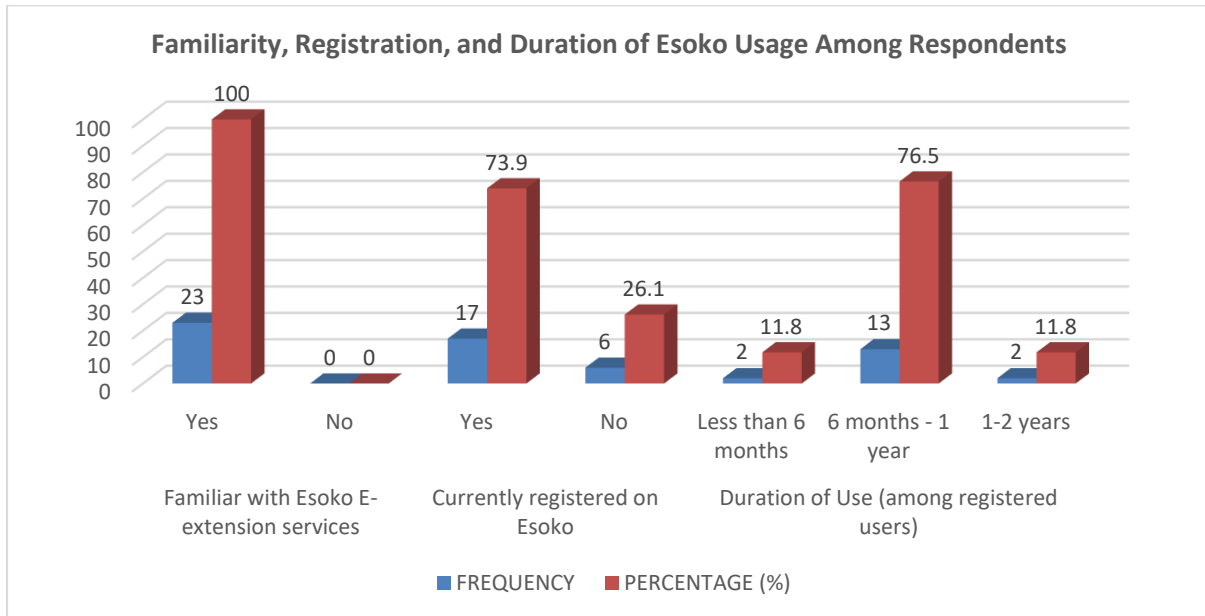


Figure 4.6 provides a comparative view of respondents’ familiarity with Esoko, their registration status, and the duration of use. The data show that while all respondents (100%) were familiar with the platform, only 73.9% had formally registered. This indicates that awareness does not automatically translate into adoption, a trend commonly observed in digital extension studies (Fabregas et al., 2023, p. 14).

Among registered users, most (76.5%) had used Esoko for six months to one year, suggesting that a large portion of farmers are recent adopters, reflecting the early majority stage of technology diffusion described by Rogers (2003, p. 23). The limited number of long-term users (11.8%) implies that while Esoko’s outreach has expanded rapidly, sustained engagement remains a challenge.

This pattern highlights the dynamic relationship between awareness, registration, and continued use where awareness serves as the entry point, registration reflects initial adoption, and duration represents ongoing commitment. Consistent with the Technology Acceptance Model (Davis, 1989, p. 320), these results suggest that continuous engagement may depend on users perceived usefulness and ease of use of Esoko’s services.

4.1.3 Usage Patterns and Services Accessed

Table 4.3: Farmers’ Perceptions and Constraints Toward the Use of Esoko

Statement	Frequency (f)	Mean (M)	Standard Deviation (SD)	Interpretation
Esoko is easy to use.	23	3.74	0.96	Agree
I find Esoko services useful for farming decisions.	23	3.91	0.88	Agree
The information I receive from Esoko is reliable.	23	3.96	0.87	Agree
Esoko fits well with my way of farming.	23	3.83	0.84	Agree
I trust Esoko services.	23	4.13	0.78	Agree /Strongly Agree
I would recommend Esoko to other farmers.	23	4.43	0.69	Strongly Agree
I struggle to understand the information provided.	23	1.61	0.73	Disagree
I have mobile network challenges in my area.	23	1.83	0.79	Disagree
I cannot afford a smartphone or data credit	23	1.83	0.88	Disagree

I do not receive enough training on how to use Esoko services	23	2.09	0.92	Neutral-Disagree
---	----	------	------	------------------

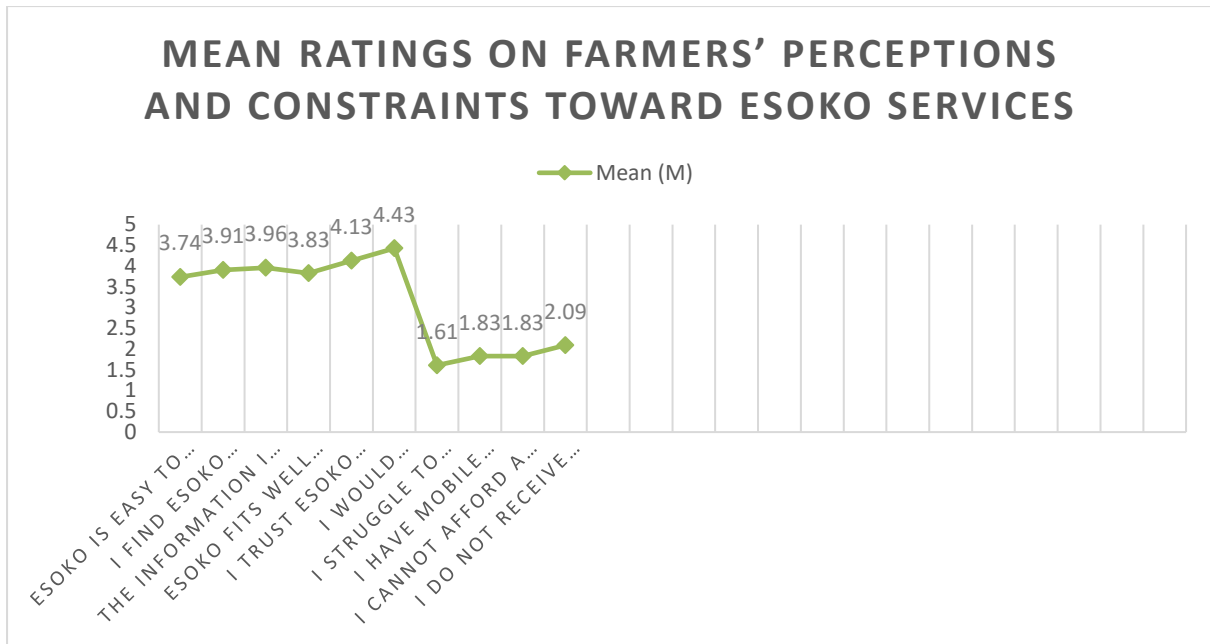
The findings in Table 4.3 indicate that respondents generally hold positive attitudes toward the Esoko platform. Farmers agreed that Esoko is easy to use ($M = 3.74$, $SD = 0.96$) and that the services are useful for farming decisions ($M = 3.91$, $SD = 0.88$). Similarly, they perceived the information from Esoko as reliable ($M = 3.96$, $SD = 0.87$) and well-integrated into their existing farming practices ($M = 3.83$, $SD = 0.84$).

Importantly, the highest-rated item was “I would recommend Esoko to other farmers” ($M = 4.43$, $SD = 0.69$), followed closely by “I trust Esoko services” ($M = 4.13$, $SD = 0.78$), reflecting strong confidence and user satisfaction. These findings align with Baumüller’s (2018, p. 145) assertion that trust and peer recommendation are critical factors in sustaining the adoption of digital agricultural platforms among smallholder farmers.

On the other hand, farmers largely disagreed with statements indicating barriers such as difficulty understanding information ($M = 1.61$), network problems ($M = 1.83$), or affordability issues ($M = 1.83$). This suggests that infrastructural and cognitive constraints are minimal among users in Nkoranza. However, the relatively lower rating for training adequacy ($M = 2.09$) reveals a gap in capacity-building efforts, confirming Aker’s (2011, p. 1051) observation that ongoing user support is essential for effective technology use in rural contexts.

Overall, the results portray Esoko as a user-friendly, trusted, and reliable platform that aligns well with local farming systems. The few challenges, mainly limited training, highlight the need for continued extension support to enhance farmers’ digital competencies and optimize the benefits of Esoko.

Figure 4.7: Mean Ratings on Farmers' Perceptions and Constraints Toward Esoko Services



As illustrated in Figure 4.7, the mean ratings vividly show that farmers in Nkoranza generally held strongly positive perceptions of Esoko’s usability, reliability, and value for agricultural decision-making. The visual trend reveals consistently high bars for all the favourable statements, with mean scores clustering between 3.7 and 4.4, which corresponds to the agree to strongly agree range on the five-point Likert scale. This pattern indicates a broad consensus among respondents that Esoko is both useful and user-friendly, confirming that digital extension tools can be effectively integrated into rural farming systems when designed with local contexts in mind.

The two highest-scoring items “I would recommend Esoko to other farmers” and “I trust Esoko services” stand out prominently in the figure. These peaks demonstrate the platform’s credibility and farmers’ willingness to act as peer advocates, a key driver of sustained adoption noted by Baumüller (2018, p. 145). The slightly lower but still positive bars for “Esoko is easy to use” and “Esoko fits well with my way of farming” further suggest that the platform aligns well with farmers’ existing practices and does not impose excessive technological barriers.

In contrast, the much shorter bars representing negative or constraint-related statements such as “I struggle to understand the information provided” and “I cannot afford a smartphone or data credit” visually confirm that challenges are minimal among the current user base. However, the moderately low score for “I do not receive enough training on how to use Esoko services” highlights an area for improvement: the need for continuous digital-literacy support and refresher orientation sessions. This observation echoes Aker’s (2011, p. 1051) argument that effective user training remains vital to maximizing the benefits of ICT-based agricultural extension.

The visual evidence from Figure 4.6 underscores that Esoko enjoys strong acceptance, trust, and perceived utility among rural farmers in Nkoranza. The figure reinforces the notion that positive user experience and interpersonal trust are central to the sustained diffusion of innovation in digital agriculture, as emphasized by Rogers (2003, p. 23) within the Diffusion of Innovations Theory.

Table 4.4: Summary of Outcomes of Esoko Usage

Table 4.4: Summary of Outcomes of Esoko Usage

Statement	Response Category	Frequency (f)	Percentage (%)
Has Esoko helped improve your yield?	Yes	21	91.3
	No	1	4.3
	Not Sure	1	4.3
Has it helped you get better market prices for your produce?	Yes	20	87.0
	No	1	4.3
	Not sure	2	8.7
Do you feel more confident in farming decisions after using Esoko services?	Yes	22	95.7

	No	0	0.0
	Not sure	1	4.3

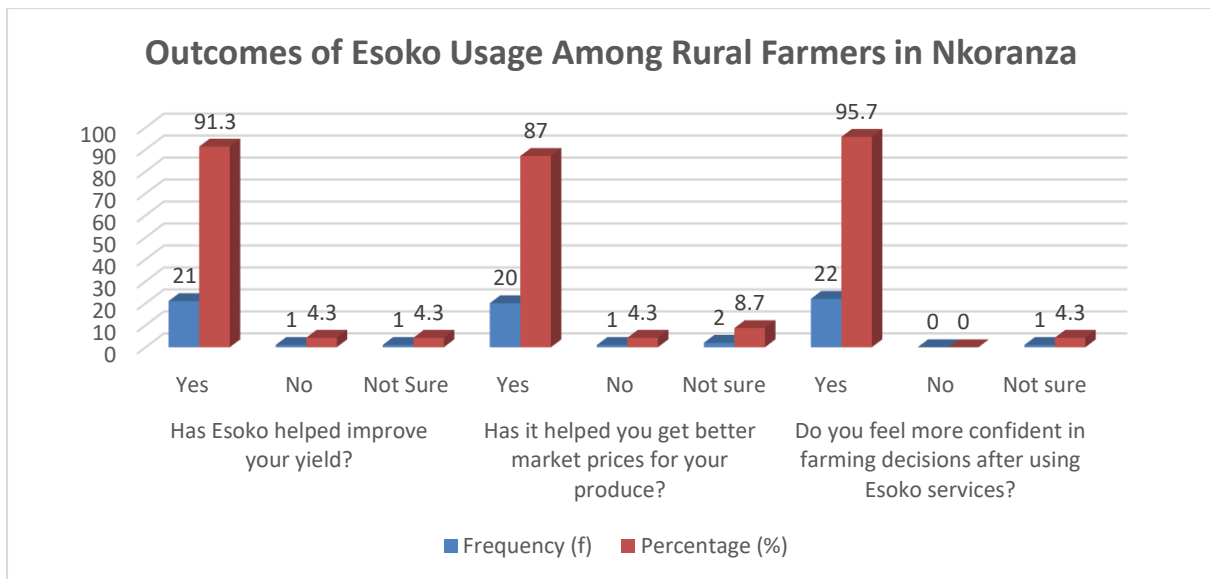
The data in Table 4.4 show that the majority of respondents reported positive outcomes from using Esoko. A striking 91.3% indicated that Esoko had helped improve their crop yields, confirming the platform’s role in enhancing productivity through timely agronomic and weather information. These findings reinforce the assertions of Subervie and Galtier (2014, p. 19) that mobile-based agricultural advisory services enable farmers to make better-informed decisions, thereby improving yields and reducing risk.

Similarly, 87% of the farmers reported that Esoko helped them obtain better market prices, suggesting that the market price alerts and buyer linkage features are effectively narrowing information asymmetry. According to Aker (2011, p. 1049), access to accurate market information allows smallholders to negotiate better terms, plan sales strategically, and avoid exploitation by middlemen.

Furthermore, an overwhelming 95.7% expressed greater confidence in their farming decisions after using Esoko, indicating that the platform not only serves as an information tool but also enhances psychological assurance and planning capacity. As Baumüller (2018, p. 146) notes, confidence and trust in digital tools are vital behavioural outcomes that sustain long-term adoption and participation.

These results therefore provide empirical evidence of Esoko’s contribution to improved agricultural performance among rural farmers in Nkoranza. The high levels of reported yield improvement, better marketing outcomes, and decision-making confidence demonstrate that digital extension services can have tangible impacts on rural livelihoods when effectively adopted and supported.

Figure 4.8: Reported Outcomes of Esoko Usage Among Rural Farmers in Nkoranza



he results presented in Figure 4.8 demonstrate that the vast majority of rural farmers in Nkoranza reported positive outcomes following their adoption of the Esoko digital agricultural extension platform. Specifically, 91.3% of respondents indicated that Esoko had helped improve their crop yields, while 87.0% affirmed that it assisted them in obtaining better market prices for their produce. In addition, an overwhelming 95.7% stated that they felt more confident in their farming decisions after using Esoko services. These findings underscore the significant role that digital agricultural platforms can play in enhancing both the economic and cognitive dimensions of smallholder farming.

The high rate of yield improvement corroborates earlier empirical evidence by Subervie and Galtier (2014, p. 19), who found that access to timely, location-specific agricultural information improves farmers' productivity and resilience against weather uncertainties. Similarly, the improvement in market pricing outcomes reflects Esoko's effectiveness in addressing information asymmetry, a challenge that has long disadvantaged smallholder farmers in negotiating fair prices (Aker, 2011, p. 1049). By providing up-to-date market and buyer information, Esoko enables farmers to plan sales strategically, thereby contributing to improved income stability.

Moreover, the fact that nearly all respondents expressed increased confidence in their farming decisions reveals the psychological and behavioural dimensions of technology adoption. As Rogers (2003, p. 23) asserts in his Diffusion of Innovations Theory, the perceived benefits and trustworthiness of a new technology significantly shape sustained adoption behaviour. The findings in Figure 4.7 suggest that Esoko not only delivers practical agronomic and market value but also fosters a sense of empowerment among rural farmers.

The visual data affirm that Esoko's digital extension services have had tangible and positive effects on farming performance and decision-making among users in the Nkoranza area. The platform's ability to simultaneously enhance yields, market outcomes, and user confidence highlights its potential as a transformative tool for rural agricultural development in the Bono East Region.

4.2 Qualitative Findings and Thematic Analysis

This section presents the qualitative findings of the study, which were derived from open-ended responses and in-depth interviews conducted with rural farmers in Nkoranza and surrounding communities within the Bono East Region. The qualitative strand was designed to complement the quantitative results by providing deeper, context-specific insights into how farmers perceive, adopt, and utilise the Esoko digital agricultural extension platform in their everyday farming activities. While the quantitative analysis offered numerical patterns on adoption levels, perceived usefulness, and outcomes, this section delves into the underlying motivations, experiences, and challenges that shape these patterns, thus providing a more holistic understanding of Esoko's impact on rural farming systems.

The data were analysed thematically, following the six-step framework developed by Braun and Clarke (2006, p. 79). This involved an iterative process of familiarising with the responses, generating initial codes, searching for and reviewing emerging themes, and refining them into

coherent narratives that reflect the participants lived experiences. Through this process, several interconnected themes emerged, capturing the complex realities of Esoko adoption among rural farmers.

The qualitative findings revolve around four broad but interrelated areas: the experiences and motivations that drive farmers to adopt Esoko, the perceived benefits and practical contributions of the platform to agricultural productivity, the challenges and constraints encountered in its use, and the ways in which farmers compare digital extension platforms with traditional agricultural extension systems. These thematic dimensions provide valuable insights into how Esoko has been assimilated into rural livelihood practices and the contextual factors influencing its perceived effectiveness.

By situating farmers' voices at the centre of the analysis, this section goes beyond numerical summaries to highlight the social and behavioural processes underlying technology use in agriculture. As Creswell and Plano Clark (2018, p. 73) observe, qualitative evidence in mixed-methods research enriches interpretation by uncovering the reasoning and perceptions behind statistical trends. In this regard, the qualitative findings presented here not only validate the quantitative results but also offer deeper explanatory depth, revealing how Esoko is reshaping farmers' access to agricultural information, decision-making practices, and overall confidence in farming operations across Nkoranza's rural communities.

4.2.1 Coding Process and Development of Themes

The qualitative strand of the study employed a thematic analysis approach to interpret open-ended responses and interview data obtained from rural farmers in Nkoranza. This analytical process followed Braun and Clarke's (2006, p. 79) six-phase framework, which involves familiarisation with the data, generating initial codes, searching for patterns, reviewing and defining themes, and finally presenting the thematic narrative. The purpose of this approach

was to uncover the underlying meanings, experiences, and perceptions surrounding farmers’ interaction with the Esoko digital agricultural extension platform.

A total of 23 qualitative interviews were conducted for the study. The interviews were carried out over a four-week period, specifically from June to July 2024, allowing sufficient time for recruitment, scheduling, and follow-up conversations where necessary. Each interview lasted an average of 25 - 35 minutes, depending on the respondent’s availability, level of engagement, and the depth of explanations provided. All interviews were conducted face-to-face in the respondents’ homes or farms, recorded with consent, and transcribed verbatim to ensure accuracy during coding.

Table 4.5: Codebook for Thematic Analysis of Farmers’ Experiences with Esoko

Theme	Code	Description of Code	Example Quote from Respondents.
Awareness and First Encounters with Esoko.	First contact through mobile communication.	Farmers first learned about Esoko through SMS, calls, or voice messages.	“It was through call.” / “I had an SMS from Esoko.” / “It was a voice call on weather advisories.”
	Community sensitization and peer networks.	Farmers were introduced to Esoko through workshops, meetings, or other farmers.	“Community meeting.” / “Other farmers spoke about how good their service is.”
Motivation for Adoption	Need for timely agricultural advice.	Farmers adopted Esoko for access to weather, market, and agronomic information.	“As a farmer, I need the weather and their agronomic advisories.” / “Their weather and market services.”
	Peer influence and trust.	armers were motivated by the positive feedback from fellow farmers.	“Comments from other farmers.” / “Other farmers spoke about how good their service is.”

Ease of Use and Accessibility	Easy to use and understand.	Respondents found the platform straightforward, especially when messages were clear and in local languages.	“Very easy to use and understand.” / “Not that difficult since it was a voice advisory.”
	Neutral or initial learning curve.	A few farmers initially struggled to understand but later adapted.	“Initially didn’t understand what they were doing.” / “Neutral.”
Perceived Benefits and Contributions to Farming.	Timely weather and market updates.	Farmers rely on Esoko for daily and seasonal farming decisions.	“Weather updates help in spraying and planting time.” / “During drought, their advisories helped a lot.”
	Increased yields and productivity.	Esoko improved yields and decision-making.	“Increased yield.” / “Timely spraying of crops.” / “Yes, during drought they gave us types of crops to plant.”
	Improved marketing and income.	Farmers received better market prices and timely sales.	“Yes, timely sales.” / “I get good market prices.”
Challenges and Barriers to Usage	Network and connectivity issues	Farmers face difficulty receiving updates due to poor mobile networks.	“Network challenges by the time the messages come, my phone might have no network.”
	Language and literacy barriers.	Farmers prefer local language (Twi) communication to understand advisories.	“Yes... I prefer Twi.”
	Limited or irregular updates.	Some respondents complained about the timing and irregularity of advisories.	“The time of the advisories.” / “The time they send their advisories.”
Comparison with Traditional Extension Systems	Esoko perceived as faster and more reliable	Respondents found Esoko more efficient than face-to-face extension officers.	“Esoko is far better.” / “Esoko is fast and reliable.”
	Preference for blended approach	Some still value physical visits by extension officers.	“They are the same; the only difference is no farm visit.”

Suggestions for Improvement	Expand coverage and training	Farmers desire wider reach and training for others.	“Services should be extended to every farmer.” / “Add more farmers.”
	Improve timing and buyer access	Farmers want timely updates and market linkages.	“Timely delivery of messages.” / “We need buyers for our produce.”

The coding process reveals clear themes that reflect farmers’ engagement with Esoko. Most farmers were introduced to the platform through direct communication (calls/SMS) or peer influence, and they primarily use it for weather and market updates. Thematic patterns show that ease of use, trust, and information relevance drive adoption, while network limitations and language barriers occasionally hinder effective use. Importantly, respondents acknowledged improved yields, better market timing, and greater confidence in decision-making showing Esoko’s tangible contribution to farming outcomes in Nkoranza.

The emergence of these seven themes provided a structured framework for interpreting the farmers’ narratives. Each theme reflects a distinct yet interrelated dimension of how rural farmers in Nkoranza engage with Esoko from their initial exposure to their perceptions of its impact on agricultural decision-making and productivity. The following sections present these themes in detail, supported by illustrative quotes and contextual analysis that bring the farmers’ voices to the forefront of the discussion.

4.2.2 Farmers’ Experiences and Motivations for Using Esoko

The experiences and motivations of farmers toward using Esoko varied widely, yet a consistent theme emerged around the desire for timely agricultural information, improved productivity, and better market access. Many respondents explained that their initial interaction with Esoko came through mobile messages, community meetings, or peer recommendations from fellow farmers. For most, this first exposure sparked curiosity and gradually led to adoption,

particularly when they realised that the platform could address long-standing challenges such as unpredictable weather, pest outbreaks, and fluctuating market prices.

One farmer, for instance, remarked that “it was through a call from Esoko that I first got weather advice, and since then, I have been following their updates every week.” Another respondent added that “as a farmer, I need the weather and their agronomic advisories because they help me plan my planting and spraying periods.” These testimonies reflect the farmers’ practical motivations rooted in improving productivity and reducing uncertainty in farming operations. The accounts align with the Technology Acceptance Model (Davis, 1989, p. 320), which posits that users’ intention to adopt a technology is strongly influenced by their perception of its usefulness and ease of use. Farmers who found Esoko’s services reliable and beneficial were more inclined to integrate the platform into their regular agricultural practices.

Beyond mere utility, farmers’ motivation to adopt Esoko was also linked to trust and credibility in the information received. Many participants indicated that they valued Esoko’s updates because they were “accurate and consistent,” particularly regarding rainfall forecasts and pest alerts. This sense of reliability enhanced farmers’ confidence in decision-making. One respondent noted that “their weather and market information come at the right time, and when I follow it, it works well.” Such trust-based adoption behaviour is consistent with Rogers’ (2003, p. 23) Diffusion of Innovations Theory, which highlights the importance of perceived reliability and social validation in the diffusion process. As farmers share positive experiences within their communities, Esoko’s credibility grows, encouraging further adoption through peer influence.

Interestingly, several farmers also associated Esoko with a form of empowerment, as the service gave them direct access to agricultural information without depending solely on extension officers. For example, a female farmer explained that “before Esoko, we waited for

officers who came once in a while, but now I get messages directly to my phone.” This demonstrates how digital platforms can reduce dependency on traditional, resource-constrained extension systems and foster a sense of autonomy among rural farmers. Such empowerment resonates with Baumüller’s (2018, p. 142) observation that mobile-based agricultural platforms democratise access to information and reduce geographic inequalities in service delivery.

For some farmers, the motivation to use Esoko also stemmed from observable benefits in their communities. Respondents reported that they became interested in the platform after seeing neighbours achieve improved yields or successfully adjust their planting schedules based on Esoko’s advisories. As one farmer stated, “I joined because other farmers talked about how good the service is and how it helps them avoid losses during droughts.” This demonstrates how observability, one of Rogers’ innovation attributes, plays a vital role in influencing adoption decisions. When the positive effects of a technology become visible within a social system, more members are encouraged to experiment and eventually adopt it.

Furthermore, the flexibility and accessibility of Esoko services delivered through SMS, voice messages, and call centres also served as strong motivators. Farmers who had limited literacy particularly appreciated the voice-based advisories, which allowed them to understand weather forecasts and market information without difficulty. One respondent remarked that “it was not difficult since it was a voice advisory, and even those who cannot read can understand it.” This highlights Esoko’s inclusivity and adaptability to varying levels of education and digital literacy, reinforcing its user-friendly design and alignment with rural realities.

The qualitative findings show that the motivation to adopt Esoko among farmers in Nkoranza is multidimensional, combining both instrumental factors (such as usefulness, reliability, and accessibility) and social-psychological influences (such as trust, empowerment, and peer validation). These drivers not only confirm the relevance of TAM and DOI theories but also

demonstrate that effective digital agricultural platforms must address both functional needs and community dynamics. Farmers' experiences reveal that Esoko's adoption is not merely a technological act but a social process shaped by credibility, perceived benefits, and the gradual embedding of digital tools into local farming cultures across the Bono East Region.

4.2.3 Perceived Benefits and Practical Contributions to Farming

The thematic analysis revealed that rural farmers in Nkoranza perceived Esoko as an indispensable tool for enhancing their productivity, improving decision-making, and reducing agricultural risks. Across the interviews, participants consistently emphasized that Esoko's digital advisories provided them with timely, relevant, and actionable information that directly influenced their farming practices and outcomes. This finding echoes Aker's (2011, p. 1049) argument that mobile-based agricultural platforms significantly enhance farmers' access to market and extension information, thereby improving production efficiency and economic returns.

Most respondents cited weather updates as the most valuable service Esoko offered. Farmers described how regular forecasts helped them plan the timing of planting, spraying, and harvesting, thereby avoiding losses caused by unpredictable rainfall or drought. One farmer explained, "Their weather services are good; they help me know when to apply fertiliser or when to spray." Another stated, "During the 2024 cropping season, when drought was severe, their advisories helped me know how to keep the crops alive." Such accounts demonstrate that Esoko's weather alerts enhance climate resilience by equipping farmers with the knowledge to adapt proactively to changing conditions. This aligns with the International Fund for Agricultural Development's (IFAD, 2020, p. 34) assertion that timely access to meteorological information can reduce farmers' vulnerability to climate risks in sub-Saharan Africa.

In addition to weather information, many participants highlighted market price updates as a key benefit that improved their income and negotiation power. One farmer noted, “With the market price messages, I can tell when and where to sell my produce.” Others shared that Esoko’s market data enabled them to avoid exploitation by traders and identify profitable times to sell, which directly translated into higher returns. This finding supports Subervie and Galtier’s (2014, p. 19) conclusion that access to real-time market prices through digital platforms reduces information asymmetry and enhances farmers’ bargaining capacity.

Another major benefit expressed by respondents was agronomic and technical guidance. Esoko’s tailored messages on crop management, pest control, and fertiliser application were reported to improve yields and reduce losses. One participant stated, “The farming advice and weather updates help me know when to weed, spray, and harvest.” Another added, “During the fall armyworm outbreak, Esoko messages helped me control the pests before they spread.” These experiences affirm that Esoko’s advisories function as virtual extension services, bridging the long-standing gap left by inadequate field-based extension officers in rural Ghana. As MoFA (2019, p. 12) highlights, limited human resources and logistical challenges have historically constrained agricultural extension delivery, making digital alternatives essential.

Furthermore, respondents reported increased confidence in farming decisions as a psychological and practical outcome of using Esoko. Several farmers remarked that receiving frequent advisories reinforced their sense of control and professionalism. For instance, one explained, “It gives me confidence to trust my own decisions; I feel like I know what to do and when.” Another said, “It feels good to know I can confirm information through Esoko before acting.” This increased self-efficacy reflects the perceived behavioural control component of the Technology Acceptance Model, where confidence in technology use enhances adoption and continued use (Davis, 1989, p. 322).

In terms of tangible impact, many respondents attributed increased crop yields and income gains to the use of Esoko. One participant said, “Yes, I harvested more despite the pest infestation, because Esoko advised on what to spray.” Another shared, “Esoko is better than the old way because now I sell at the right time and make more profit.” These narratives illustrate that Esoko not only enhances technical knowledge but also contributes to economic empowerment among smallholder farmers. This observation aligns with Baumüller’s (2018, p. 145) findings that digital agricultural platforms foster productivity growth by providing farmers with the tools to make informed and market-responsive decisions.

Beyond individual gains, Esoko’s services also fostered community-level collaboration and knowledge sharing. Some farmers reported discussing advisories with neighbours or confirming messages together, which strengthened collective decision-making. For example, one farmer remarked, “When I miss a message, I ask others who got it, so we all follow the same advice.” This cooperative behaviour demonstrates how digital information can reinforce social learning and diffusion within rural networks, accelerating adoption across the community (Rogers, 2003, p. 27).

Farmers’ testimonies confirm that Esoko has significantly contributed to improving agricultural efficiency, yield outcomes, and income stability in Nkoranza. The platform’s ability to provide timely, relevant, and trustworthy information has positioned it as an essential component of rural livelihood enhancement. By merging local farming practices with digital innovation, Esoko exemplifies how technology can extend the reach of agricultural extension, empowering farmers to transition from subsistence to market-oriented production.

4.2.4 Challenges and Constraints in Using Esoko Services

Despite the notable benefits associated with Esoko, the study revealed that rural farmers in Nkoranza still face a variety of challenges that hinder optimal utilization of the platform. These

constraints, which emerged from both individual and structural factors, include technological barriers, limited training, language constraints, poor network connectivity, and timing issues related to the delivery of messages. While the overall perception of Esoko remains positive, these barriers highlight persistent gaps between technological innovation and the realities of rural digital inclusion.

A dominant challenge reported by respondents was poor network connectivity in farming communities. Several farmers lamented that messages and calls from Esoko sometimes failed to deliver on time due to weak signals in their localities. One farmer stated, “By the time the messages come, my phone might have no network.” Another added, “Sometimes, I don’t get the message until late, so I miss the spraying time.” Such experiences confirm findings by GSMA (2020, p. 56), which reported that network coverage gaps remain one of the most significant obstacles to digital service delivery in rural Africa. This challenge is particularly acute in the Bono East Region, where many farming settlements are distant from telecommunications infrastructure. The delay or inconsistency in message delivery often reduces the timeliness and practical relevance of Esoko’s advisories, especially during critical periods like planting or pest outbreaks.

Another major issue identified was limited access to smartphones and data credit among some farmers. While the majority of respondents owned mobile phones, several indicated that they struggled to maintain adequate data or battery life. One farmer explained, “Sometimes I cannot afford data or charging, so I miss some of the advisories.” This constraint echoes observations by Fabregas, Kremer, and Schilbach (2023, p. 11), who note that the affordability of mobile technology remains a limiting factor for full participation in digital agricultural ecosystems. For farmers living in low-income rural areas, sustaining consistent access to digital communication tools represents a continuing challenge that undermines equal access to information.

Language and literacy barriers also emerged as subtle but important constraints. Although Esoko uses simple English and voice advisories, some farmers expressed difficulty understanding technical terms or messages not delivered in their native language. One respondent admitted, “Sometimes I don’t understand the message well; I prefer if they use Twi.” This concern reflects a broader issue in ICT-based agricultural communication: the dominance of national or foreign languages can exclude low-literacy users from fully benefiting from digital tools (Baumüller, 2018, p. 146). For inclusivity, language localization and culturally adaptive messaging remain essential design considerations for rural-based platforms like Esoko.

A few participants also mentioned timing inconsistencies in the delivery of Esoko messages. Some complained that advisories were sent too close to or after the recommended farming activity. One farmer remarked, “The time of the advisories is sometimes late.” In agricultural decision-making, timeliness is crucial; delayed information can result in missed opportunities or ineffective interventions, particularly for activities such as spraying or harvesting. This issue reflects operational limitations on Esoko’s side and underscores the need for improved synchronization between data dissemination and local farming calendars.

Another recurring challenge was inadequate training and sensitization on how to fully navigate the platform. Although many farmers could receive and interpret messages, some indicated that they had not received formal orientation on the range of Esoko’s services or how to access advanced features. A respondent noted, “I did not get enough training; I only use the messages they send.” This finding aligns with MoFA’s (2019, p. 17) observation that digital literacy remains a critical barrier to scaling ICT solutions in rural Ghana. Without systematic training, farmers may limit their use of Esoko to basic functions, thereby underutilizing its potential.

Finally, although most farmers expressed satisfaction with Esoko, a small number mentioned issues of message repetition and lack of personalization. They felt that some advisories were too general and did not always correspond to the specific crops or conditions in their locality. One participant commented, “Sometimes, the advice is not for my kind of crops.” This points to a need for enhanced content customization, which would ensure that farmers receive context-specific and crop-relevant messages. According to Aker (2011, p. 1050), the effectiveness of digital agricultural services depends heavily on their ability to deliver precise, localized, and actionable information.

These challenges suggest that while Esoko is widely appreciated and adopted among farmers in Nkoranza, its impact could be significantly improved through structural and operational refinements. Strengthening network coverage, enhancing user training, expanding language localization, and improving message timing are all crucial steps toward optimizing user experience and maximizing the platform’s contribution to agricultural productivity. As Tambo et al. (2019, p. 64) assert, the sustainability of digital agricultural innovations in Africa depends not only on technological functionality but also on the system’s capacity to adapt to the socio-economic and infrastructural realities of its users. Addressing these constraints will ensure that Esoko’s benefits reach all farmers equitably, reinforcing its role as a transformative tool for rural development in Ghana.

4.2.5 Comparison Between Esoko and Traditional Agricultural Extension Systems

One of the most prominent themes that emerged from the qualitative data was the way farmers compared Esoko’s digital extension services to the traditional, face-to-face agricultural extension system. The majority of respondents expressed a strong preference for Esoko, emphasizing its timeliness, accessibility, and consistency compared to the conventional methods, which they often described as limited, irregular, and inaccessible. This perception

demonstrates a significant transformation in the communication dynamics of agricultural extension, from human intermediaries to digital, farmer-controlled platforms.

Several participants described Esoko as more efficient and responsive than traditional extension officers. One farmer commented, “Esoko is far better because they send the messages at the right time and we don’t have to wait for officers.” Another added, “Their weather and market messages come faster than waiting for someone to visit.” These narratives reflect the farmers’ appreciation for the immediacy and autonomy offered by digital systems. In contrast, traditional extension visits were often irregular and dependent on limited manpower. As the World Bank (2020, p. 78) notes, the ratio of extension officers to farmers in Ghana remains approximately 1:1500, far below the FAO’s recommendation of 1:500. Consequently, many rural farmers, especially in remote parts of Bono East, receive little to no personal extension support, which has weakened the reach of conventional agricultural communication systems.

Moreover, the farmers emphasized that Esoko provided equal access to agricultural information, regardless of location or gender. Several women farmers reported that, through Esoko, they now receive the same quality of agronomic and market updates as their male counterparts, something not always guaranteed under traditional extension services. One respondent noted, “Now we all get the same information from Esoko, not only those who the officer visits.” This finding supports the view of Asenso-Okyere and Mekonnen (2012, p. 10), who argue that digital tools democratize access to agricultural knowledge by removing geographical and social barriers that have historically marginalized rural women and smallholders.

In addition, Esoko’s ability to deliver continuous and customized updates was seen as a major advantage over traditional systems. Farmers highlighted that they could receive weather forecasts, market prices, and farming advice several times a week without leaving their farms.

This was particularly valuable during critical agricultural cycles such as planting, weeding, and harvesting. One farmer explained, “With Esoko, I can know what to do even when I’m on the farm the advice comes directly to my phone.” This reflects a shift toward real-time agricultural decision-making, which is vital for improving productivity and reducing risks. According to Baumüller (2018, p. 142), such real-time advisory systems enable farmers to respond quickly to dynamic environmental and market changes, thus enhancing their competitiveness and resilience.

However, a few participants noted that traditional extension officers still have an irreplaceable role, especially when it comes to field demonstrations and practical training. One farmer remarked, “Esoko is good, but the officers show us how to do things that the phone cannot do.” This sentiment points to a complementary rather than purely substitutive relationship between digital and traditional systems. As Aker (2011, p. 1051) observes, while ICT-based platforms provide scalable and rapid information delivery, physical extension officers remain critical for facilitating farmer learning through demonstration, feedback, and interpersonal communication.

Interestingly, some farmers suggested that the combination of both systems produces the best results. As one participant stated, “The messages from Esoko prepare us, and when the officers come, they just explain more.” This complementarity underscores the idea that digital tools should not completely replace human extension services but rather strengthen and expand their reach. The integration of Esoko into Ghana’s broader agricultural extension framework could therefore serve as a cost-effective model for hybrid information dissemination, where digital platforms provide continuous guidance, and field officers offer follow-up verification and technical support.

The comparative insights also reveal that farmers perceive Esoko as a trusted and empowering innovation that gives them more control over their farming decisions. Unlike the top-down nature of traditional extension, where information flows from officers to farmers, Esoko facilitates a bottom-up, participatory flow of information. Farmers can access updates anytime, discuss them within their communities, and even cross-check advice with peers. This interactive element fosters collective knowledge building, which aligns with Rogers' (2003, p. 27) Diffusion of Innovations theory, where peer interaction and mutual reinforcement accelerate technology acceptance.

While farmers in Nkoranza acknowledge the continued relevance of traditional extension services, Esoko is overwhelmingly viewed as a superior and more convenient communication channel for agricultural information. Its ability to deliver real-time, inclusive, and reliable information has not only enhanced farmers' productivity but also transformed the way agricultural knowledge is disseminated and used. Integrating digital platforms like Esoko into Ghana's agricultural extension system could therefore represent a strategic step toward modernizing rural communication networks and achieving sustainable agricultural growth.

4.2.6 Suggestions for Improvement and Future Expectations

While most respondents expressed deep appreciation for Esoko's role in improving their access to agricultural information, they also offered practical suggestions for enhancing the platform's effectiveness and inclusiveness. These suggestions reflected their lived experiences and expectations of a more user-friendly, reliable, and locally responsive digital agricultural service. The key recommendations revolved around improving message timing, expanding farmer coverage, enhancing training and sensitization, localizing content, and linking farmers more directly to markets and buyers.

A recurring suggestion among respondents was the need to improve the timing of advisories. Several farmers mentioned that, at times, messages arrived too late to be actionable. One farmer observed, “They should send the messages earlier because sometimes it comes when we have already planted or sprayed.” This sentiment was echoed by others who emphasized that early and well-coordinated communication would help them prepare adequately for changing weather or market conditions. As Rogers (2003, p. 28) argues, the effectiveness of an innovation depends not only on its content but also on the timing of its diffusion; in agriculture, delayed information can directly translate into reduced productivity or missed opportunities.

Farmers also recommended that Esoko expand its outreach to include more members of their communities, particularly those who are not yet registered on the platform. One participant stated, “They should extend the service to every farmer so that all of us can benefit.” This call for inclusivity reflects the social diffusion process, where early adopters see the need for a broader community uptake to maximize the benefits of collective information use. As noted by Fabregas, Kremer, and Schilbach (2023, p. 14), scaling up digital agricultural services is essential for achieving systemic transformation rather than isolated improvements among a few users.

Another strong theme from participants was the need for more training and user support. While most respondents reported that Esoko was easy to use, many also admitted that they lacked comprehensive knowledge about all its functions. A farmer remarked, “I did not receive enough training; I only use the messages they send.” Others suggested organizing community workshops to explain new features or updates. This aligns with Aker’s (2011, p. 1050) observation that digital literacy training significantly enhances adoption and sustained engagement, particularly among smallholder farmers with limited formal education. Providing refresher training sessions could deepen users’ understanding and encourage broader use of Esoko’s advanced tools, such as crop advisory dashboards or interactive voice services.

Language localization also featured prominently in the suggestions. Several farmers expressed a preference for receiving advisories in Twi, the local language spoken widely in Nkoranza and surrounding villages. One participant stated, “Sometimes I don’t understand everything; I prefer if they use Twi.” Localizing messages would make Esoko’s services more inclusive and accessible, especially for older farmers and those with limited literacy. As Baumüller (2018, p. 147) emphasizes, cultural and linguistic adaptation is a cornerstone of successful ICT interventions in rural Africa. When farmers receive information in a language they fully understand, the likelihood of comprehension and application increases significantly.

Additionally, farmers recommended stronger linkages between Esoko and market actors, including aggregators, buyers, and input suppliers. While they appreciated the market price information, several expressed a desire for more actionable connections to actual buyers. As one respondent put it, “We need buyers for our produce not only the price information.” This suggestion highlights a critical next step in digital agriculture: transitioning from information dissemination to market facilitation and transaction support. Such integration would not only enhance Esoko’s value proposition but also address one of the most persistent challenges facing smallholder farmers' limited access to reliable markets (World Bank, 2020, p. 83).

Finally, some respondents proposed that Esoko introduce feedback channels that allow farmers to ask questions or request clarifications on specific advisories. A participant suggested, “They should let us reply or call back when we need more explanation.” This recommendation resonates with Tambo et al. (2019, p. 68), who argue that participatory and two-way communication systems enhance the relevance, trust, and long-term sustainability of digital agricultural platforms. By creating a more interactive interface, Esoko could foster greater farmer engagement and strengthen its role as a trusted partner in agricultural decision-making.

Suggestions provided by farmers reveal a shared vision for a more responsive, inclusive, and interactive Esoko platform. Farmers in Nkoranza do not simply view themselves as passive recipients of digital information but as active participants seeking continuous improvement of the system. They envision an Esoko that not only provides timely advisories but also connects them to broader agricultural value chains, empowers them through training, and communicates in their own language. Addressing these suggestions would not only enhance Esoko's operational effectiveness but also consolidate its role as a sustainable and farmer-centered digital extension platform for Ghana's rural development.

4.3 Integration of Quantitative and Qualitative Findings

This section integrates the quantitative and qualitative findings to provide a comprehensive understanding of how farmers in Nkoranza adopt and use the Esoko digital agricultural extension platform, as well as how this adoption contributes to improved crop yields and farming outcomes. Following the convergent parallel mixed-methods design discussed in Chapter Three, both datasets were collected and analysed independently and then brought together for interpretation. As Creswell and Plano Clark (2018, p. 71) emphasize, integration in mixed-methods research enhances the robustness of findings by validating and enriching quantitative patterns with qualitative depth.

Overall, the integration of results revealed a strong convergence between the two strands: both sets of data confirmed that Esoko has achieved a high level of awareness and adoption among rural farmers in Nkoranza and that its use has led to measurable improvements in productivity, decision-making confidence, and access to agricultural information. However, both strands also identified persistent challenges related to network connectivity, training, and language barriers, indicating that while the platform is effective, its full potential is yet to be realized.

The quantitative findings established that 100% of respondents were familiar with Esoko, and 73.9% were registered users, reflecting significant penetration of the platform among rural farmers. The data also showed that the majority (76.5%) had used Esoko for between six months and one year, suggesting that the platform is relatively new but rapidly expanding. In parallel, the qualitative data corroborated these results, as many farmers recalled their first encounters through calls, SMS messages, or community sensitization programs. The consistency between these findings underscores the effectiveness of Esoko's communication strategies and aligns with Rogers' (2003, p. 23) Diffusion of Innovations theory, which posits that interpersonal and mediated communication accelerate early-stage adoption.

A similar convergence was observed in the perceived benefits of Esoko. Quantitative results indicated that 91.3% of farmers reported yield improvements, 87% achieved better market prices, and 95.7% felt more confident in making farming decisions after using Esoko. These numerical patterns were vividly supported by qualitative narratives. Farmers described specific ways in which Esoko advisories influenced their practices such as adjusting planting times based on weather updates, improving pest control, and selling produce at profitable market periods. Statements like "Their weather messages helped me avoid spraying when it was about to rain" and "Now I sell at the right time because I know the market price" clearly illustrate the causal link between Esoko usage and improved agricultural outcomes. This complementarity validates the Technology Acceptance Model (Davis, 1989, p. 320), which suggests that perceived usefulness and ease of use are key drivers of adoption and sustained engagement.

In addition, the qualitative findings enriched the quantitative data by revealing emotional and behavioural dimensions not captured in survey numbers. Farmers repeatedly mentioned increased confidence, trust, and pride in their decision-making a psychological transformation that cannot be easily quantified but is crucial for long-term empowerment. For instance, one participant said, "It gives me confidence to trust my own decisions; I feel like I know what to

do and when.” This qualitative insight complements the high quantitative scores for perceived usefulness and satisfaction, confirming that Esoko’s impact extends beyond technical efficiency to include psychological empowerment and social inclusion.

On the other hand, both data strands identified recurring challenges that constrain optimal use of Esoko. Quantitative responses highlighted difficulties such as limited training, affordability issues, and network problems. Similarly, qualitative narratives elaborated on these challenges, with farmers expressing frustration about late message delivery, poor connectivity, and language barriers. One respondent remarked, “By the time the messages come, my phone might have no network,” while another stated, “Sometimes I don’t understand the message well; I prefer if they use Twi.” These overlapping findings indicate strong convergence between the datasets and emphasize the need for Esoko to improve local language integration, infrastructural reliability, and farmer capacity-building findings consistent with Baumüller (2018, p. 146).

A notable point of complementarity emerged when comparing Esoko to traditional agricultural extension systems. Quantitative data showed that most respondents viewed Esoko as easier to use and more reliable than conventional extension officers. The qualitative data deepened this observation by explaining why highlighting timeliness, equal access, and flexibility as key differentiators. One farmer noted, “Esoko is far better because they send the messages at the right time, and we don’t have to wait for officers.” This integration underscores how Esoko complements rather than replaces traditional extension, creating a hybrid model where digital tools enhance the reach and efficiency of human agents.

Both strands converge on the forward-looking insight that farmers view Esoko as a transformative but improvable system. Quantitative evidence of high satisfaction levels is complemented by qualitative suggestions for improvement including earlier delivery of

advisories, more training, and stronger market linkages. As Fabregas, Kremer, and Schilbach (2023, p. 15) note, such feedback-driven evolution is crucial for sustaining user engagement and ensuring that digital platforms continue to meet farmers' needs in dynamic agricultural environments.

The integration of quantitative and qualitative findings demonstrates a coherent and mutually reinforcing narrative: Esoko is a highly valued, widely adopted, and impactful digital extension tool among rural farmers in Nkoranza. It enhances productivity, strengthens market participation, and empowers farmers with timely and reliable information. However, its continued success depends on addressing structural constraints such as network access, training, and localization. The complementarity of numerical evidence and narrative insight not only validates the study's findings but also illustrates the power of mixed-methods research in capturing both the measurable outcomes and lived experiences of digital agricultural transformation in Ghana.

4.5 Summary of Key Findings

This chapter presented and discussed the findings of the study on “Assessing the Adoption of Digital Agricultural Extension Platforms and Their Contribution to Crop Yields Among Rural Farmers in Nkoranza, Bono East Region: A Study of Esoko.” Guided by the convergent parallel mixed-methods design, both quantitative and qualitative data were integrated to provide a holistic understanding of how rural farmers engage with the Esoko platform and how its use influences their agricultural outcomes.

The quantitative results revealed strong levels of awareness and adoption of Esoko among farmers in Nkoranza. All respondents (100%) indicated familiarity with the platform, and a significant proportion (73.9%) were registered users. Most users (76.5%) had engaged with Esoko for a period between six months and one year, reflecting a growing but still maturing

adoption trend. In terms of service access, weather updates and market price information were the most frequently used services, confirming Esoko's core role in providing timely agricultural intelligence to rural farmers.

The demographic data provided important context for interpreting these patterns. The majority of respondents were middle-aged farmers between 40 and 59 years old, moderately educated, and predominantly engaged in crop farming. Smartphone ownership (69.6%) was relatively high, creating an enabling environment for digital extension service delivery. This demographic profile supports the argument by Aker (2011, p. 1048) that digital agricultural tools are most effective where there are basic literacy, moderate technological exposure, and high motivation to access information.

The findings further revealed that Esoko's use significantly contributed to improved farming outcomes. Approximately 91.3% of respondents reported that the platform helped improve their yields, while 87% stated that it enabled them to secure better market prices for their produce. Moreover, 95.7% of farmers expressed increased confidence in making farming decisions after using Esoko. These results underscore the platform's practical impact on enhancing productivity, income, and decision-making among rural farmers.

Qualitative findings provided deeper insights into these statistical patterns. Farmers described Esoko as a "helpful" and "easy-to-use" service that provided real-time updates, particularly on weather and market conditions. Many farmers recounted experiences where Esoko's advisories helped them avoid losses during droughts, pest infestations, or inappropriate planting times. Respondents emphasized that the platform's reliability, timely delivery, and ease of access were major motivators for continued use. In contrast, the few challenges reported—such as language barriers, network issues, and limited training illustrate contextual constraints that, while significant, do not diminish the overall value of the platform.

The integration of both data strands reinforced these insights, revealing a consistent narrative across methods. Quantitative patterns of adoption and perceived usefulness were mirrored in qualitative accounts of satisfaction and improved yields. Together, these findings confirm that Esoko serves as both an informational and empowerment tool for rural farmers, bridging gaps in traditional agricultural extension systems. This dual validation highlights the strength of using a mixed-methods design in communication and technology adoption research (Creswell & Plano Clark, 2018, p. 73).

The theoretical discussion, grounded in the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) Theory, illuminated the behavioural and social mechanisms driving Esoko's uptake. Farmers adopted Esoko because they perceived it as both useful and easy to use core constructs of TAM (Davis, 1989, p. 322). Simultaneously, the process of adoption and diffusion was reinforced through observable benefits, peer influence, and compatibility with existing agricultural practices attributes emphasized in DOI (Rogers, 2003, p. 24). Thus, Esoko's growing adoption in Nkoranza can be understood as a product of both individual-level acceptance and community-level diffusion.

The findings demonstrated that Esoko is making a measurable contribution to improving access to agricultural information, strengthening farmers' decision-making capacities, and increasing crop yields in the Bono East Region. The study also identified critical areas for enhancement, including improved language localization, stronger mobile network infrastructure, and more frequent user training. These insights not only validate Esoko's relevance within Ghana's agricultural innovation ecosystem but also provide direction for scaling digital agricultural platforms more inclusively and sustainably across rural communities.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary, conclusions, and recommendations derived from the study titled “Assessing the Adoption of Digital Agricultural Extension Platforms and Their Contribution to Crop Yields Among Rural Farmers in Nkoranza, Bono East Region: A Study of Esoko.” The purpose of this chapter is to synthesize the major findings from both the quantitative and qualitative analyses, draw conclusions based on the study’s objectives and theoretical underpinnings, and propose actionable recommendations for policy, practice, and future research.

The study sought to investigate the extent to which rural farmers in Nkoranza have adopted Esoko’s digital agricultural extension services and the perceived contribution of the platform to their farming productivity and yields. Using a convergent parallel mixed-methods design, both quantitative and qualitative data were collected and analysed concurrently to provide a comprehensive understanding of adoption patterns, user experiences, and the broader implications of Esoko for rural agricultural development.

The chapter is structured into three main sections. Section 5.1 provides a summary of the study, presenting an overview of the research objectives, methods, and key findings. Section 5.2 draws conclusions based on the empirical results and their connection to the study’s theoretical framework, particularly the Technology Acceptance Model (TAM) and the Diffusion of Innovations (DOI) theory. Finally, Section 5.3 offers recommendations directed at policymakers, agricultural extension agencies, Esoko management, and other stakeholders to improve the adoption and sustainability of digital agricultural platforms in rural Ghana.

5.1 Summary of the Study

The study examined the adoption of Esoko, a digital agricultural extension platform, among rural farmers in Nkoranza, Bono East Region, and assessed how its use contributes to crop yield improvement and market access. The study was guided by four specific objectives:

1. To determine the level of awareness and adoption of the Esoko platform among rural farmers in Nkoranza.
2. To examine the types of Esoko services accessed and their perceived usefulness to farmers.
3. To identify the challenges and barriers farmers encounter in using the Esoko platform.
4. To assess the perceived contribution of Esoko to crop yields and agricultural productivity among rural farmers.

The study adopted a convergent parallel mixed-methods design, combining quantitative data from structured questionnaires with qualitative data from semi-structured interviews and open-ended responses. The quantitative data were analysed using descriptive statistics, while the qualitative data were thematically analysed using Braun and Clarke's (2006, p. 79) framework.

The demographic results revealed that the majority of respondents were middle-aged (40–59 years), moderately educated, and predominantly engaged in crop farming. Males constituted 56.5% of the sample, while females made up 43.5%, indicating a fairly balanced gender distribution. Most respondents (69.6%) owned smartphones, suggesting a favourable technological environment for the adoption of digital agricultural services.

Findings from the quantitative analysis indicated a high level of familiarity and adoption of Esoko's services among respondents. All farmers (100%) were aware of the platform, and 73.9% were registered users. The majority (76.5%) had used Esoko for between six months and one year, suggesting growing integration of digital advisory tools into local farming

practices. The most frequently used services included weather updates, market price information, and agronomic tips, which farmers found highly useful for planning planting, fertiliser application, and harvesting.

Qualitative insights reinforced these statistical trends, showing that farmers perceived Esoko as an accurate, reliable, and easy-to-use platform that complements traditional extension systems. Participants described the service as particularly helpful in improving timing of planting, pest control, and market decisions, leading to increased productivity. Some farmers noted that during droughts and pest outbreaks, Esoko's real-time advisories were instrumental in mitigating losses.

However, the study also identified several challenges limiting full utilisation of the platform. These included poor mobile network connectivity, language barriers, limited training, and high data costs. Despite these barriers, farmers overwhelmingly expressed trust in Esoko's information and a willingness to recommend it to others, highlighting its perceived value as a modern agricultural support system.

The study demonstrated that Esoko significantly contributes to enhancing rural farmers' access to relevant agricultural information, improving decision-making, and increasing yields and income. These findings affirm the potential of digital agricultural platforms to complement traditional extension services and promote sustainable rural development in Ghana.

5.2 Conclusions

The findings of this study provide important insights into how rural farmers in Nkoranza have adopted and integrated Esoko's digital agricultural extension services into their farming practices. Drawing from the Technology Acceptance Model (TAM) by Davis (1989, p. 320) and the Diffusion of Innovations (DOI) Theory by Rogers (2003, p. 21), this section synthesizes the conclusions under the major objectives of the study.

The study concludes that awareness and adoption of Esoko among rural farmers are high, with 100% of respondents indicating familiarity and over 70% registered as users. This widespread awareness confirms Esoko's effective visibility through communication channels such as SMS, calls, and community sensitization. According to the knowledge stage in the Diffusion of Innovations Theory, awareness is a critical step in triggering adoption. Esoko's success in this regard demonstrates that digital platforms can penetrate rural farming communities when information is disseminated through accessible and trusted media.

Secondly, the study concludes that perceived usefulness and perceived ease of use the two central constructs of TAM strongly influence the adoption of Esoko. The majority of farmers reported that the platform was easy to use, reliable, and beneficial in providing timely weather updates, agronomic advice, and market prices. These perceptions enhanced users' confidence and willingness to rely on Esoko's advisories for decision-making. As Davis (1989, p. 322) posits, users are more likely to adopt a technology when they believe it will improve their task performance and is effortless to use. The findings affirm that Esoko's user-friendly design and relevant agricultural information are key enablers of sustained adoption among rural farmers.

Thirdly, the study establishes that Esoko significantly contributes to improved agricultural productivity. Over 90% of respondents indicated that the platform helped improve their yields, while 87% reported better access to market prices and 96% felt more confident in their farming decisions. This aligns with earlier studies (Aker, 2011, p. 1050; Baumüller, 2018, p. 145) which found that digital extension tools reduce information gaps, enhance market participation, and improve overall farm efficiency. These outcomes demonstrate that Esoko serves not only as an information platform but also as a catalyst for evidence-based decision-making that enhances productivity and resilience among rural farmers.

Despite these positive outcomes, the study concludes that several structural and contextual barriers continue to constrain optimal use of Esoko. Challenges such as poor network coverage, high cost of data, limited digital literacy, and inadequate training were identified as major deterrents. From the perspective of DOI theory, these constitute the “implementation barriers” that slow down the transition from early adoption to full institutionalization. Without addressing these limitations, Esoko’s potential for large-scale impact may remain underutilized.

The study also concludes that social influence and interpersonal trust play a pivotal role in Esoko’s adoption. Farmers often learned about the platform through peers, community meetings, or group demonstrations, reinforcing Rogers’ (2003, p. 23) argument that interpersonal networks are crucial in diffusing innovations, especially in rural settings where word-of-mouth credibility shapes attitudes toward new technologies.

Finally, it can be concluded that digital agricultural platforms such as Esoko complement rather than replace traditional extension services. Many farmers still value personal interactions with extension officers, but Esoko provides a cost-effective and timely channel for continuous advisory support. This hybrid model reflects the growing integration of ICTs in agricultural communication and highlights a transformative shift toward digitalized extension systems in Ghana.

The study concludes that the adoption of Esoko among rural farmers in Nkoranza is driven by its perceived usefulness, ease of use, and relevance to local farming needs. The platform has positively influenced yields, market access, and confidence in decision-making. However, addressing infrastructural and educational barriers remains essential for maximizing its impact and ensuring equitable participation across all farmer groups.

5.3 Recommendations

Based on the findings and conclusions of this study, the following recommendations are proposed for policymakers, agricultural extension institutions, Esoko implementers, and future researchers to enhance the adoption and effectiveness of digital agricultural platforms among rural farmers in the Bono East Region and beyond.

The study established that awareness and accessibility significantly influenced Esoko adoption among farmers. Therefore, it is recommended that the Ministry of Food and Agriculture (MoFA), Esoko, and local assemblies intensify awareness creation and sensitization programmes targeting rural farmers. Community radio stations, mobile campaigns, and farmer-based organizations should be strategically used to disseminate information on the benefits and features of Esoko. Consistent with the knowledge and persuasion stages of the Diffusion of Innovations Theory (Rogers, 2003, p. 23), this would accelerate the rate of adoption by exposing non-users to credible and relatable success stories from early adopters.

Secondly, the study revealed that perceived ease of use and perceived usefulness, as outlined in the Technology Acceptance Model (Davis, 1989, p. 322), are vital determinants of farmers' adoption decisions. To sustain these perceptions, it is recommended that Esoko should continuously simplify its user interface and diversify content delivery through voice-based advisories and local language translations. Since not all rural farmers possess advanced literacy skills, integrating local languages and voice messaging will ensure inclusivity and enhance usability. Moreover, Esoko should collaborate with rural telecommunication providers to develop farmer-friendly mobile bundles that reduce the cost of data usage for accessing agricultural services.

Thirdly, in response to the identified infrastructural and network challenges, it is recommended that telecommunication companies, in partnership with MoFA and Esoko, improve mobile

connectivity and digital infrastructure in farming communities. Poor network reception remains a critical barrier to real-time access to agricultural information. Government-led initiatives such as the Ghana Rural Telephony Project should prioritize agricultural zones like Nkoranza, where the potential impact of digital extension on productivity is high.

Furthermore, since the study found that training and technical support were inadequate, it is recommended that capacity-building programmes and regular refresher workshops be instituted for farmers. MoFA extension officers, Esoko field representatives, and local farmer cooperatives should work collaboratively to train farmers on navigating digital tools, interpreting information, and applying advisories in their day-to-day farming activities. As argued by Aker (2011, p. 1049), digital tools are only as effective as the user's ability to interpret and apply the information they provide.

Another important recommendation concerns the integration of Esoko into Ghana's formal agricultural extension system. While the platform effectively complements traditional extension, the study found that it functions largely as a parallel service. Therefore, it is recommended that MoFA officially mainstream Esoko into its extension policy framework to enhance coordination, ensure message consistency, and avoid duplication of advisory content. By doing so, Esoko can serve as a vital digital support mechanism for state extension officers, promoting a hybrid model of in-person and remote advisory delivery.

The study also recommends strengthening social learning and peer influence mechanisms. Given that many farmers adopted Esoko based on information from peers or community groups, it is important to encourage farmer-to-farmer training, peer demonstrations, and digital learning groups within local cooperatives. These informal learning networks align with the social system element of Rogers' Diffusion of Innovations Theory (2003, p. 25) and can

significantly enhance trust, adoption rates, and knowledge retention among smallholder farmers.

Lastly, for future research, it is recommended that scholars undertake longitudinal studies to assess the long-term impact of digital agricultural platforms like Esoko on productivity, income levels, and food security. Additionally, future studies should adopt comparative designs to evaluate Esoko's effectiveness alongside other digital platforms across different agro-ecological zones in Ghana. This will deepen the understanding of contextual variables such as literacy, gender, and infrastructure that influence adoption and sustained use.

The recommendations emphasize the need for a coordinated, inclusive, and sustainable approach to digital agricultural extension. Strengthening awareness, simplifying technology, improving infrastructure, and fostering human capacity will not only enhance Esoko's impact but also accelerate Ghana's broader digital transformation agenda in agriculture.

5.4 Suggestions for Further Research

While this study has provided valuable insights into the adoption and impact of Esoko among rural farmers in the Bono East Region, several areas remain open for further investigation. Future research should therefore explore these aspects to deepen the understanding of digital agricultural extension and its role in rural development.

First, it is suggested that future studies adopt a longitudinal design to track farmers' usage patterns and productivity outcomes over time. The current study provides a cross-sectional snapshot, but a longitudinal approach would enable researchers to assess how continuous exposure to Esoko services influences behavioural change, yield sustainability, and income growth in the long term. Such studies could also capture seasonal variations in farmers' engagement with the platform.

Secondly, comparative studies across different regions of Ghana are recommended to evaluate how contextual factors such as literacy levels, language diversity, network infrastructure, and socio-economic status affect adoption and sustained use of digital agricultural platforms. Comparing Esoko's performance in other agricultural regions, such as the Northern, Ashanti, or Volta Regions, would generate broader national insights and guide region-specific policy interventions.

Thirdly, it is recommended that future research focus on gender dynamics in digital agricultural adoption. Although this study included both male and female farmers, a more in-depth gendered analysis could reveal how social roles, access to resources, and decision-making power influence women's participation and benefits from platforms like Esoko. Such work would contribute to gender-inclusive agricultural development policies.

Furthermore, qualitative case studies focusing on non-users or dropouts could provide deeper insights into the barriers to sustained engagement. Understanding why some farmers discontinue using Esoko whether due to technological, economic, or social factors would help improve retention strategies and user experience design.

Additionally, impact assessment studies using experimental or quasi-experimental designs could be conducted to measure the causal relationship between Esoko usage and key agricultural outcomes, such as yield increases, market access, and income levels. This would strengthen the empirical evidence base for digital agricultural interventions in Ghana.

Finally, it is recommended that future researchers explore the integration of emerging technologies, such as artificial intelligence (AI), machine learning, and localized mobile applications, into existing platforms like Esoko. Investigating how these tools can personalize advisories, predict climate risks, and enhance user interaction would advance the digital transformation of agricultural extension systems in sub-Saharan Africa.

In conclusion, while this study has illuminated key dimensions of Esoko adoption and its contribution to rural agricultural productivity, future research should continue to build on these findings by addressing temporal, regional, and technological dimensions. Expanding the scope of inquiry will help policymakers and development practitioners design more adaptive, inclusive, and evidence-based digital extension systems that meet the evolving needs of Ghanaian farmers.

REFERENCE

- Aker, J. C. (2011). Dial “A” for agriculture: A review of information and communication technologies for agricultural extension in developing countries. *Agricultural Economics*, 42(6), 631–647.
- Aker, J. C., & Fafchamps, M. (2015). Mobile phone coverage and producer markets: Evidence from West Africa. *World Bank Economic Review*, 29(2), 262–292.
- Aker, J. C., & Mbiti, I. (2010). Mobile phones and economic development in Africa. *Journal of Economic Perspectives*, 24(3), 207–232.
- Amoako, J., & Asiedu, E. (2021). The influence of mobile-based agricultural platforms on smallholder farmers’ market access in Ghana. *Ghana Journal of Agricultural Science*, 55(2), 88–103.
- Amankwah, A., & Adjei, S. (2020). The adoption of digital innovation for agricultural development in Ghana. *International Journal of ICT Research*, 12(1), 44–59.
- Anderson, J. R., & Feder, G. (2007). Agricultural extension. In R. Evenson & P. Pingali (Eds.), *Handbook of agricultural economics* (Vol. 3, pp. 2343–2378). Elsevier.
- Asenso-Okyere, K., & Mekonnen, D. A. (2012). *The importance of ICTs in agricultural extension services*. International Food Policy Research Institute.
- Asfaw, S., et al. (2015). Agricultural extension and technology adoption in developing countries. *Applied Economic Perspectives and Policy*, 37(2), 305–331.
- Aubourg, R. (2022). Digital technology adoption among rural farmers: Barriers and opportunities. *World Development*, 150, 105–118.

- Awuor, J., & Nyamboga, E. (2020). ICTs for agricultural transformation in sub-Saharan Africa. *African Journal of Information and Communication*, 26, 1–15.
- Baumüller, H. (2018). The little we know: An exploratory literature review on the utility of mobile phone-enabled services for smallholder farmers. *Journal of International Development*, 30(1), 134–154.
- Benard, R., & Dulle, F. (2017). Usage of mobile phones in accessing agricultural information by farmers in Tanzania. *Information Development*, 33(3), 1–13.
- Birner, R., et al. (2009). *From best practice to best fit: A framework for analyzing agricultural advisory services worldwide*. IFPRI.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Budu, J., et al. (2018). Determinants of ICT adoption in Ghanaian agricultural extension. *Government Information Quarterly*, 35(3), 588–602.
- Chapman, R., & Slaymaker, T. (2002). *ICTs and rural development: Review of the literature, current interventions and opportunities for action*. ODI.
- Chong, A. (2018). Are mobile phones driving economic growth? *World Development*, 104, 213–221.
- Cole, S., & Fernando, A. (2012). *The value of advice: Evidence from mobile phone-based agricultural extension*. Harvard Business School Working Paper.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE.

- Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research* (3rd ed.). SAGE.
- CTCN. (2018). *Esoko: Mobile-based agricultural information services*. Climate Technology Centre and Network.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
- Donovan, K., & ITU. (2011). *Mobile applications in agriculture*. ICT for Development.
- Etwire, P. M., et al. (2017). Factors influencing farmer participation in agricultural value chain development. *Agriculture & Food Security*, 6(80), 75–89.
- Fabregas, R., Kremer, M., & Schilbach, F. (2023). Realizing the potential of digital development: The case of agriculture. *Annual Review of Economics*, 15, 1–27.
- FAO. (2019). *The state of food and agriculture 2019*. Food and Agriculture Organization.
- FAO. (2021). *Digital agriculture transformation: Evidence and trends*. FAO.
- FAO. (2023). *Digital agriculture: Challenges and opportunities*. FAO.
- Fuglie, K., & Rada, N. (2013). *Resources, policies, and agricultural productivity in sub-Saharan Africa*. USDA Economic Research Service.
- Galtier, F., et al. (2014). The impact of SMS price alerts on agricultural markets in West Africa. *Journal of African Economies*, 23(3), 238–259.
- Ghana Statistical Service. (2021). *Ghana annual economic report*.
- Greene, J. (2007). *Mixed methods in social inquiry*. Jossey-Bass.

- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? *Field Methods*, 18(1), 59–82.
- Higgins, D. (2019). Mobile-based extension services for smallholder farmers. *Information Technology for Development*, 25(4), 722–742.
- IFAD. (2020). *Rural development report 2020*. International Fund for Agricultural Development.
- IFC. (2018). *Scaling ICT innovation in agriculture: Lessons from Esoko*. International Finance Corporation.
- International Telecommunication Union. (2020). *Measuring digital development: ICT indicators*.
- Kante, A., et al. (2019). Adoption of mobile advisory services by smallholder farmers. *Information Technology for Development*, 26(1), 22–39.
- Labarta, R., et al. (2017). Impacts of the Rice Crop Manager in the Philippines. *Agricultural Economics*, 48(2), 233–245.
- McCormack, R., et al. (2022). Digital tools and farmer adoption in low-income settings. *Information Systems Journal*, 32(2), 1–15.
- Mensah, R., & Osei, L. (2021). Mobile phones and agricultural productivity among Ghanaian maize farmers. *Ghana Journal of Development Studies*, 18(1), 34–50.
- Ministry of Food and Agriculture. (2019). *Agricultural sector performance report*.
- Nteye, E., & Boateng, R. (2020). Digital platforms and farmer empowerment in Ghana. *Information Development*, 36(4), 564–575.

- Patton, M. Q. (2015). *Qualitative research and evaluation methods* (4th ed.). SAGE.
- Qiang, C. Z., et al. (2012). *Mobile applications for agriculture and rural development*. World Bank.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Sen, P., Choudhury, A., & Tripathy, A. (2025). ICT and farmers' knowledge acquisition. *Information Development*, 41(4), 3007–3015.
- Tambo, J. A., & Wünscher, T. (2017). Farmer participation in innovation platforms. *Food Policy*, 74(1), 9–19.
- Van Campenhout, B., et al. (2021). Farmer feedback and mobile extension. *World Development*, 144, 182–195.
- World Bank. (2017). *ICT in agriculture: Connecting smallholders to knowledge, networks, and institutions*.
- World Bank. (2020). *Agricultural extension and advisory services: A review*.
- Yin, R. K. (2018). *Case study research and applications* (6th ed.). SAGE.
- Zhou, G., & Bery, R. (2021). Ensuring methodological rigour in mixed-methods research. *International Journal of Social Research Methodology*, 24(1), 44–56.

APPENDIX A: SURVEY QUESTIONNAIRE (QUANTITATIVE INSTRUMENT)

Title: Assessing the Adoption of Digital Agricultural Extension Platforms and Their Contribution to Crop Yields Among Rural Farmers in Nkoranza, Bono East Region: A Study of Esoko

This questionnaire was designed to collect quantitative data on farmers' demographic characteristics, awareness, adoption, and perceived impact of the Esoko digital agricultural extension platform. Respondents were informed that participation was voluntary and confidentiality was assured.

Section A: Demographic Information

1. Age:

Below 20

20–29

30–39

40–49

50–59

60 and above

2. Gender:

Male

Female

3. Highest Educational Level:

No formal education

Primary

JHS

SHS

Tertiary

4. Type of Farming:

Crops

Livestock

Both

5. How many years have you been farming?

Less than 5

5–10

11–20

21–30

Above 30

6. Do you own a mobile phone?

Yes

No

7. If yes, what type of phone do you use?

Feature phone

Smartphone

Section B: Awareness and Adoption of Esoko

8. Are you familiar with the Esoko e-extension service?

Yes

No

9. How did you first hear about Esoko?

SMS/Call

Radio/TV

Community meeting

Another farmer

Other (specify): _____

10. Are you currently registered on Esoko?

Yes

No

11. If yes, how long have you been using Esoko?

Less than 6 months

6 months – 1 year

1–2 years

More than 2 years

Section C: Services Used and Perceptions (Likert Scale Section)

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

Please respond to the following statements:

12. Esoko is easy to use.

13. I find Esoko services useful for farming decisions.

14. The information I receive from Esoko is reliable.

15. Esoko fits well with my way of farming.

16. I trust Esoko services.

17. I would recommend Esoko to other farmers.

18. I struggle to understand the information provided.

19. I have mobile network challenges in my area.

20. I cannot afford a smartphone or data credit.

21. I do not receive enough training on how to use Esoko services.

Section D: Perceived Impact of Esoko

22. Has Esoko helped improve your yield?

Yes

No

Not sure

23. Has Esoko helped you get better market prices for your produce?

Yes

No

Not sure

24. Do you feel more confident in farming decisions after using Esoko?

Yes

No

Not sure

APPENDIX B: INTERVIEW GUIDE (QUALITATIVE INSTRUMENT)

Title: Qualitative Interview Guide for Exploring Farmers' Experiences with Esoko Digital Agricultural Extension Services in Nkoranza, Bono East Region

This semi-structured interview guide was used to collect qualitative data from selected rural farmers. The questions were designed to explore their experiences, motivations, challenges, and perceptions regarding the Esoko platform.

Section A: Introduction and Rapport Building

1. Can you briefly introduce yourself and tell me about your farming background?
2. What kinds of crops or livestock do you typically produce?

Section B: Awareness and First Encounter with Esoko

3. Can you tell me about your first encounter with the Esoko platform?
4. How did you first hear about Esoko?

Section C: Motivations for Adoption or Non-Adoption

5. What motivated you to start using (or not using) Esoko services?
6. What made you feel that Esoko could be useful to your farming activities?

Section D: Ease of Use and User Experience

7. How easy or difficult was it for you to use the Esoko platform at first?
8. Did anyone help you understand or use the platform initially?

Section E: Types and Usefulness of Information Received

9. What kinds of information do you usually get from Esoko?

10. How useful is the information you receive for your farming activities?

Section F: Real-Life Examples and Impact on Farming

11. Can you give an example of a time when Esoko helped you make an important farming decision?

12. Has Esoko contributed to any improvement in your crop yield or income? If yes, how?

Section G: Challenges and Constraints

13. What challenges have you faced in using Esoko (technical, cost, language, network, etc.)?

14. Are there times when the information comes too late or is difficult to understand?

Section H: Community Influence and Adoption

15. Do other farmers in your community use Esoko services?

16. How do they feel about the platform?

Section I: Comparison with Traditional Extension Services

17. How do you think Esoko compares with agricultural extension officers who visit farms physically?

18. Which of the two (Esoko vs. extension officers) do you trust more and why?

Section J: Recommendations for Improvement

19. What changes would you suggest to improve Esoko services for rural farmers like you?

20. Is there anything else you would like to share about your experience with Esoko?

APPENDIX C: INFORMED CONSENT FORM

Title: Participant Consent Form for Research on Digital Agricultural Extension Platforms
(Esoko)

Principal Researcher: Hannah Larten

Institution: University of Media, Art and communication- Institute of Journalism

Study Title: Assessing the Adoption of Digital Agricultural Extension Platforms and Their Contribution to Crop Yields Among Rural Farmers in Nkoranza, Bono East Region: A Study of Esoko.

Purpose of the Study

You are being invited to participate in a research study that seeks to examine the use of Esoko digital agricultural extension services among rural farmers in the Bono East Region.

Voluntary Participation

Your participation is voluntary. You may withdraw at any time without penalty.

Confidentiality

All information you provide will be kept strictly confidential. Your name will not appear in any report or publication.

Risks and Benefits

There are no known risks in participating. The benefit is contributing to research that may improve agricultural extension services.

Consent Statement

I have read and understood the purpose of this study. I voluntarily agree to participate.

Name of Participant: _____

Signature/Thumbprint: _____

Date: _____

Researcher's Signature: _____

APPENDIX D: DESCRIPTIVE STATISTICS OUTPUT

This appendix includes all statistical tables generated in Chapter Four.

Tables Included:

Table 4.1: Demographic Characteristics of Respondents

VARIABLE	CATEGORY	FREQUENCY	PERCENTAGE (%)
Age	30-39 years	4	17.4
	40-49 years	8	34.8
	50-59 years	7	30.4
	60 years and above	4	17.4
Gender	Male	13	56.5
	Female	10	43.5
Educational Level	No formal education	2	8.7
	Primary	6	26.1

	JHS	7	30.4
	SHS	8	34.8
Type of Farming	Crops only	13	56.5
	Crops and Livestock	10	43.5
Type of Phone	Smart phone	16	69.6
	Feature phone	7	30.4

Table 4.2: Awareness and Adoption of Esoko

VARIABLE	CATEGORY	FREQUENCY	PERCENTAGE (%)
Familiar with Esoko E-extension services	Yes	23	100.0
	No	0	0.0
Currently registered on Esoko	Yes	17	73.9
	No	6	26.1
Duration of Use (among registered users)	Less than 6 months	2	11.8
	6 months - 1 year	13	76.5
	1-2 years	2	11.8
How respondents first heard about Esoko	SMS/Call	13	56.5
	Community meeting	5	21.7
	Another farmer	2	8.7
	Radio/TV	1	4.3

	Other/Not specified	2	8.7
--	---------------------	---	-----

Table 4.3: Perceptions and Constraints (Frequencies & Means)

Statement	Frequency (f)	Mean (M)	Standard Deviation (SD)	Interpretation
Esoko is easy to use.	23	3.74	0.96	Agree
I find Esoko services useful for farming decisions.	23	3.91	0.88	Agree
The information I receive from Esoko is reliable.	23	3.96	0.87	Agree
Esoko fits well with my way of farming.	23	3.83	0.84	Agree
I trust Esoko services.	23	4.13	0.78	Agree /Strongly Agree
I would recommend Esoko to other farmers.	23	4.43	0.69	Strongly Agree
I struggle to understand the information provided.	23	1.61	0.73	Disagree
I have mobile network challenges in my area.	23	1.83	0.79	Disagree
I cannot afford a smartphone or data credit	23	1.83	0.88	Disagree
I do not receive enough training on how to use Esoko services	23	2.09	0.92	Neutral-Disagree

Table 4.4: Perceived Outcomes of Esoko Use

Statement	Response Category	Frequency (f)	Percentage (%)
Has Esoko helped improve your yield?	Yes	21	91.3
	No	1	4.3
	Not Sure	1	4.3
Has it helped you get better market prices for your produce?	Yes	20	87.0
	No	1	4.3
	Not sure	2	8.7
Do you feel more confident in farming decisions after using Esoko services?	Yes	22	95.7
	No	0	0.0
	Not sure	1	4.3

APPENDIX E: FIGURES AND CHARTS

This appendix contains all visualizations used in Chapter Four.

Figures Included:

Figure 4.1: Age Distribution of Respondents

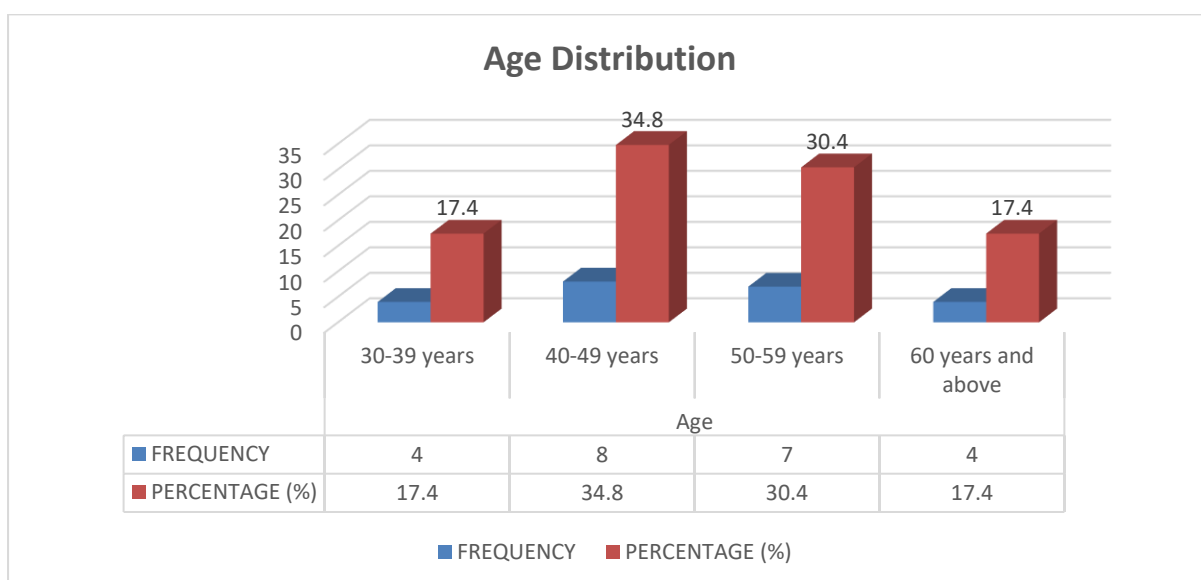


Figure 4.2: Highest Educational Level of Respondents

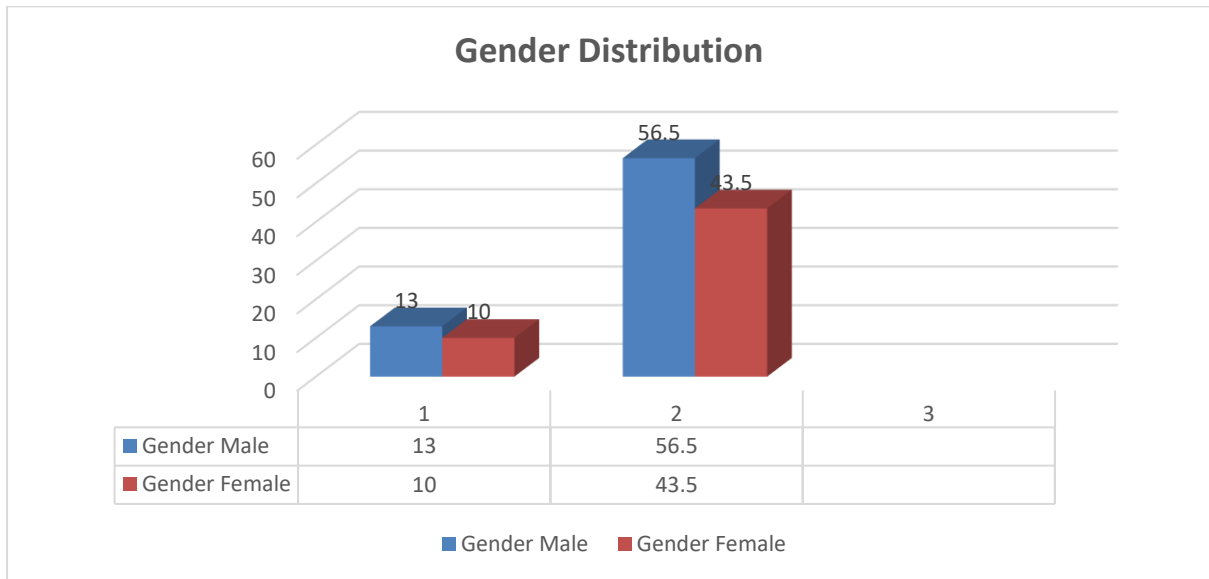


Figure 4.3 Educational Level Respondent

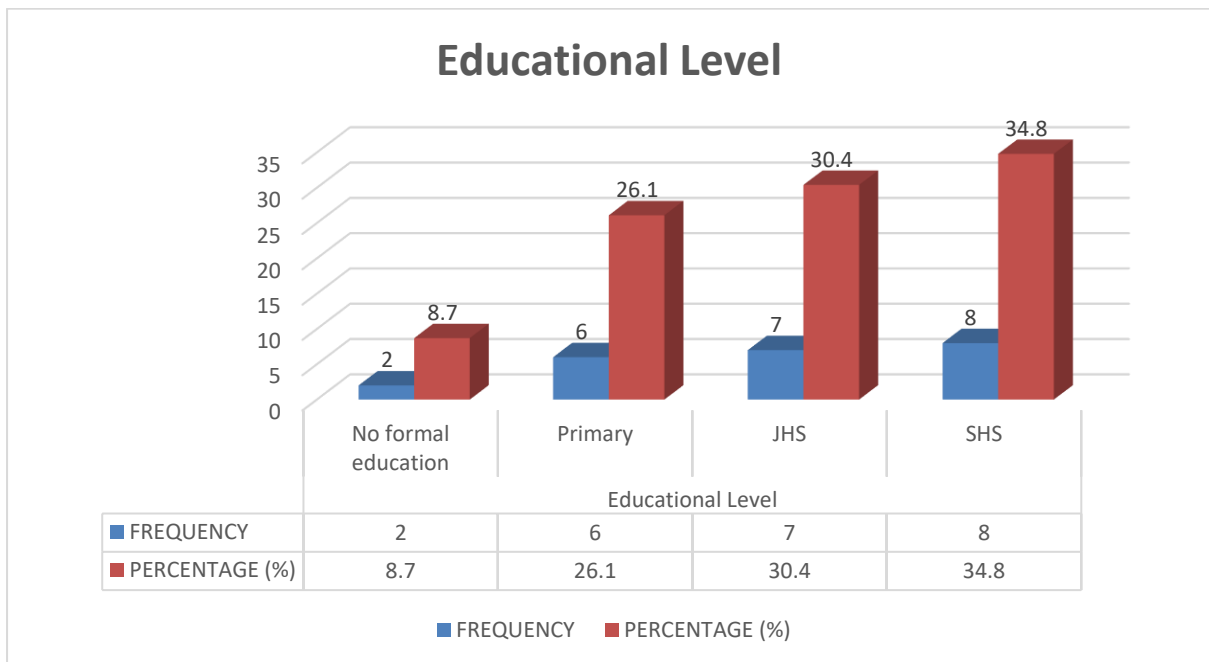


Figure 4.4: Type of Phone Ownership

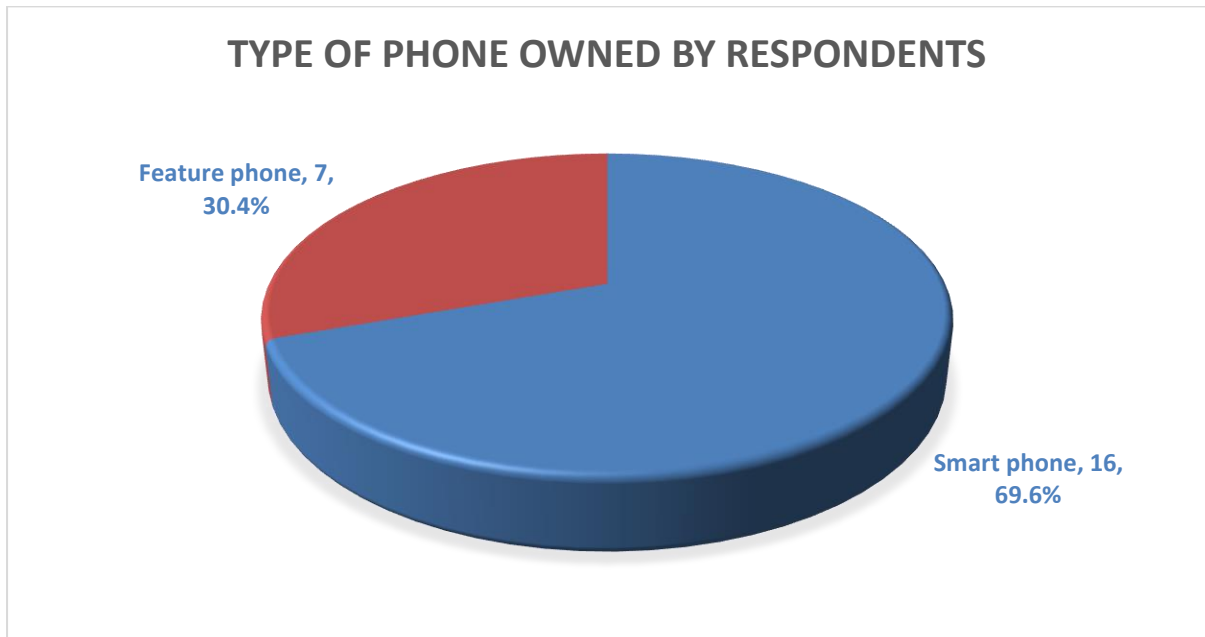


Figure 4.5: Channels Through Which Farmers First Heard About Esoko

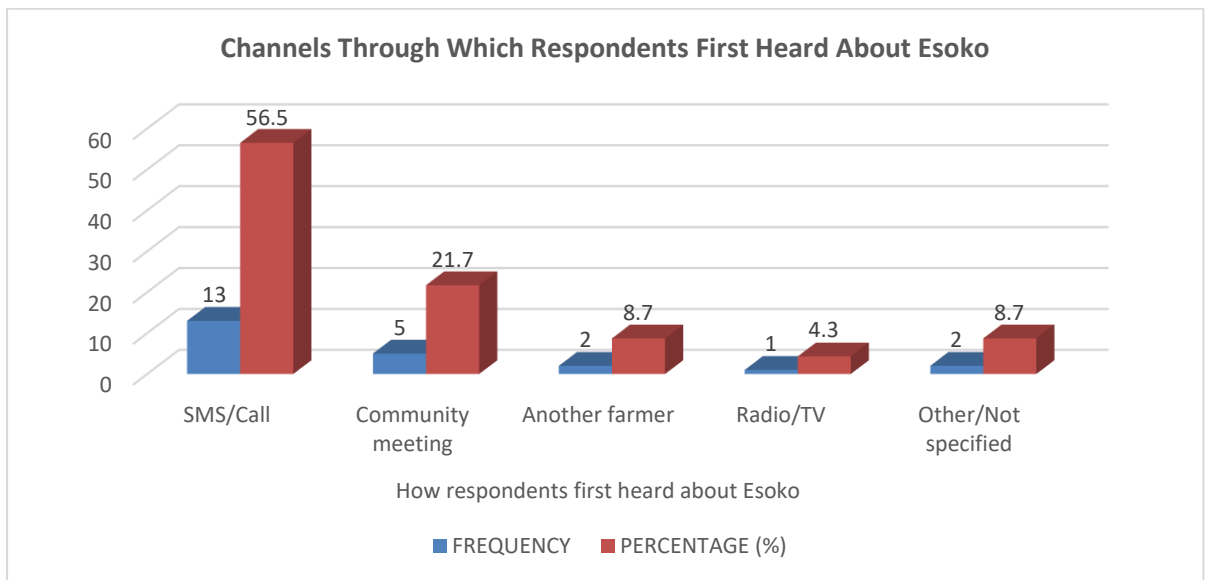


Figure 4.6: Esoko Registration and Duration of Use

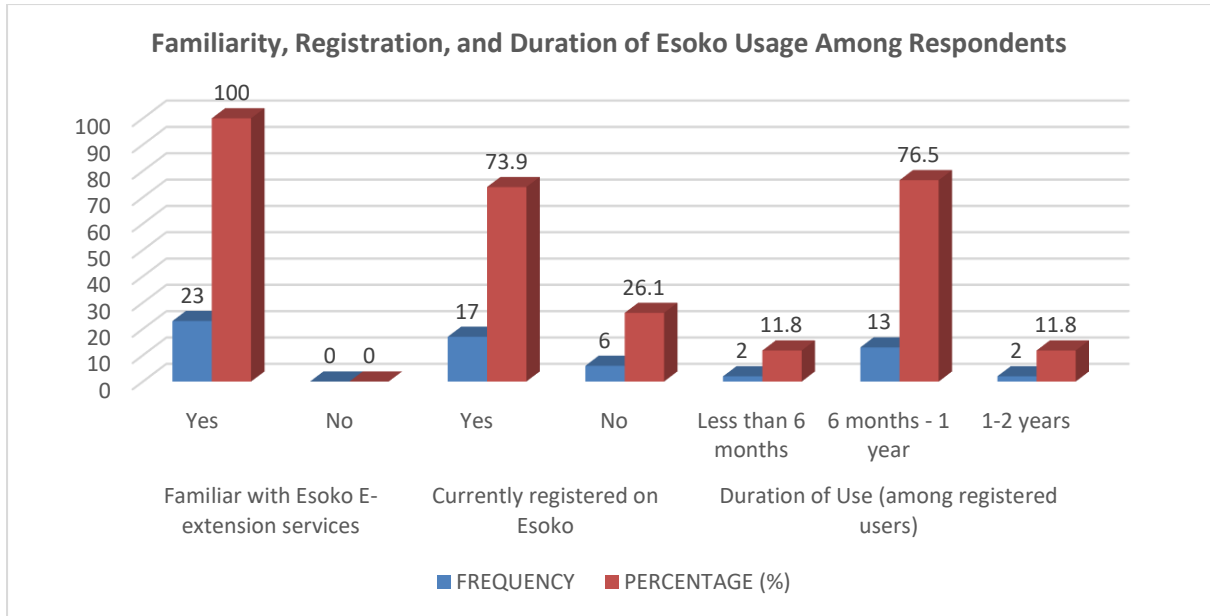


Figure 4.7: Mean Ratings of Perceptions and Constraints

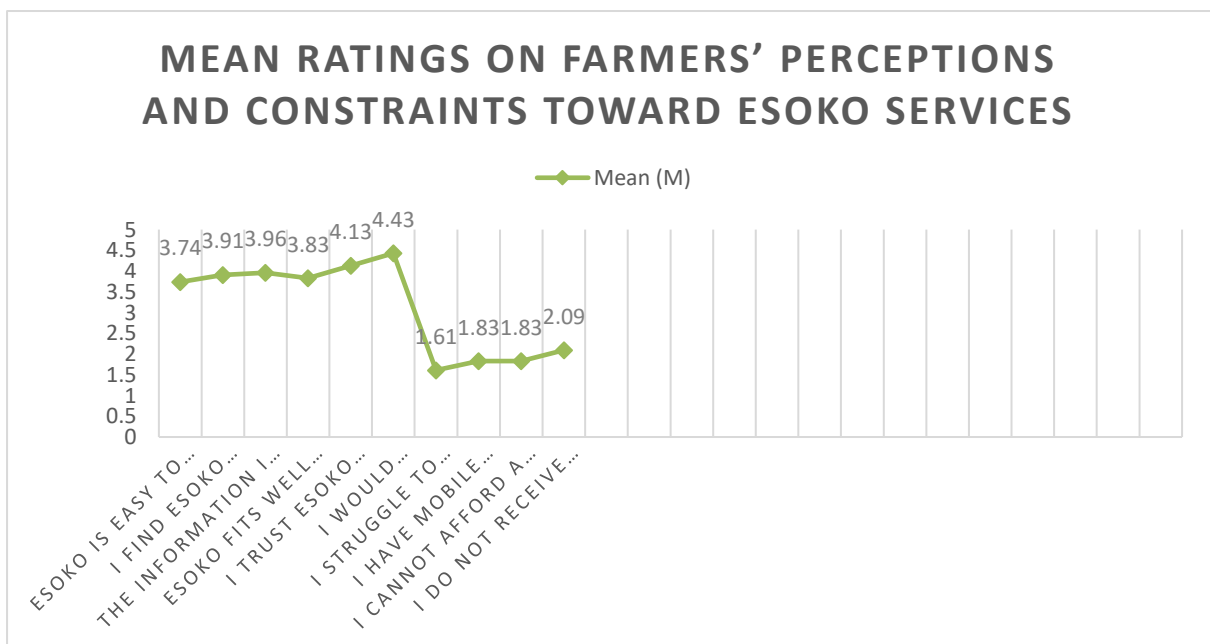
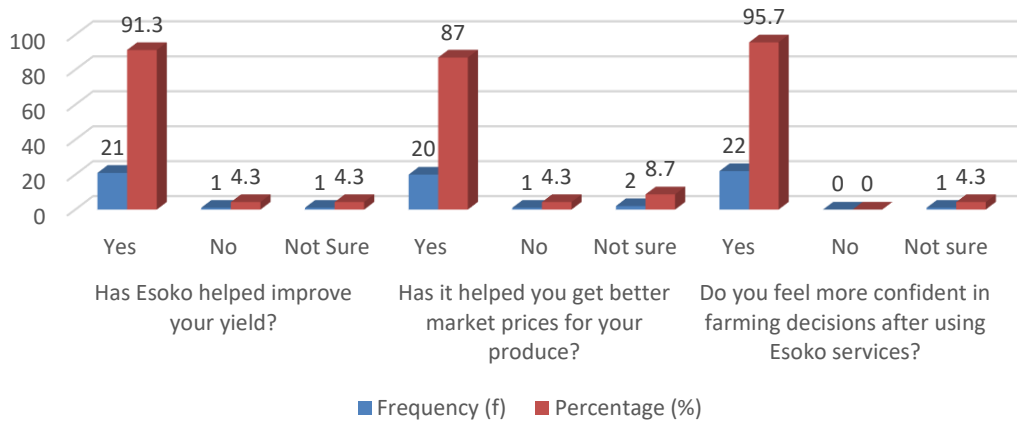


Figure 4.8: Perceived Outcomes of Esoko on Yields, Prices, and Decision-Making

Outcomes of Esoko Usage Among Rural Farmers in Nkoranza



APPENDIX F: QUALITATIVE CODEBOOK

This appendix presents the full codebook used during the thematic analysis.

Theme	Code	Description of Code	Example Quote from Respondents.
Awareness and First Encounters with Esoko.	First contact through mobile communication.	Farmers first learned about Esoko through SMS, calls, or voice messages.	“It was through call.” / “I had an SMS from Esoko.” / “It was a voice call on weather advisories.”
	Community sensitization and peer networks.	Farmers were introduced to Esoko through workshops, meetings, or other farmers.	“Community meeting.” / “Other farmers spoke about how good their service is.”
Motivation for Adoption	Need for timely agricultural advice.	Farmers adopted Esoko for access to weather, market, and	“As a farmer, I need the weather and their agronomic advisories.” / “Their

		agronomic information.	weather and market services.”
	Peer influence and trust.	farmers were motivated by the positive feedback from fellow farmers.	“Comments from other farmers.” / “Other farmers spoke about how good their service is.”
Ease of Use and Accessibility	Easy to use and understand.	Respondents found the platform straightforward, especially when messages were clear and in local languages.	“Very easy to use and understand.” / “Not that difficult since it was a voice advisory.”
	Neutral or initial learning curve.	A few farmers initially struggled to understand but later adapted.	“Initially didn’t understand what they were doing.” / “Neutral.”
Perceived Benefits and Contributions to Farming.	Timely weather and market updates.	Farmers rely on Esoko for daily and seasonal farming decisions.	“Weather updates help in spraying and planting time.” / “During drought, their advisories helped a lot.”
	Increased yields and productivity.	Esoko improved yields and decision-making.	“Increased yield.” / “Timely spraying of crops.” / “Yes, during drought they gave us types of crops to plant.”
	Improved marketing and income.	Farmers received better market prices and timely sales.	“Yes, timely sales.” / “I get good market prices.”
Challenges and Barriers to Usage	Network and connectivity issues	Farmers face difficulty receiving updates due to poor mobile networks.	“Network challenges by the time the messages come, my phone might have no network.”
	Language and literacy barriers.	Farmers prefer local language (Twi) communication to understand advisories.	“Yes... I prefer Twi.”
	Limited or irregular updates.	Some respondents complained about the timing and	“The time of the advisories.” / “The

		irregularity of advisories.	time they send their advisories.”
Comparison with Traditional Extension Systems	Esoko perceived as faster and more reliable	Respondents found Esoko more efficient than face-to-face extension officers.	“Esoko is far better.” / “Esoko is fast and reliable.”
	Preference for blended approach	Some still value physical visits by extension officers.	“They are the same; the only difference is no farm visit.”
Suggestions for Improvement	Expand coverage and training	Farmers desire wider reach and training for others.	“Services should be extended to every farmer.” / “Add more farmers.”
	Improve timing and buyer access	Farmers want timely updates and market linkages.	“Timely delivery of messages.” / “We need buyers for our produce.”

APPENDIX G: SAMPLE CODED EXTRACTS

Extract 1

“It was through a call.”

Code: First contact through mobile communication

Theme: Awareness and First Encounters with Esoko

Extract 2

“Community meeting.”

Code: Community sensitization and peer networks

Theme: Awareness and First Encounters with Esoko

Extract 3

“As a farmer, I need the weather and their agronomic advisories.”

Code: Need for timely agricultural advice

Theme: Motivation for Adoption

Extract 4

“Comments from other farmers.”

Code: Peer influence and trust

Theme: Motivation for Adoption

Extract 5

“Very easy to use and understand.”

Code: Easy to use and understand

Theme: Ease of Use and Accessibility

Extract 6

“Initially I didn’t understand what they were doing.”

Code: Initial learning curve

Theme: Ease of Use and Accessibility

Extract 7

“Weather updates help in spraying and planting time.”

Code: Timely weather and market updates

Theme: Perceived Benefits and Contributions to Farming

Extract 8

“Increased yield.”

Code: Increased yields and productivity

Theme: Perceived Benefits and Contributions to Farming

Extract 9

“Network challenges by the time the messages come my phone might have no network.”

Code: Network and connectivity issues

Theme: Challenges and Barriers to Usage

Extract 10

“Esoko is fast and reliable.”

Code: Esoko perceived as faster and more reliable

Theme: Comparison with Traditional Extension Systems

Extract 11

“Services should be extended to every farmer.”

Code: Expand coverage and training

Theme: Suggestions for Improvement

Extract 12

“We need buyers for our produce.”

Code: Improve timing and buyer access

Theme: Suggestions for Improvement