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SMALLHOLDER VEGETABLE FARMERS' PERCEPTIONS AND WILLINGNESS TO ACCEPT AGRIBUSINESS MODEL INNOVATION: A STUDY IN THE CENTRAL REGION OF GHANA

OPOKU-AGYEMANG WILLIAMS

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BY

OPOKU-AGYEMANG WILLIAMS

THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION, UNIVERSITY OF CAPE COAST

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PHILOSOPHY IN AGRICULTURAL ECONOMICS

MAY 2023

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree at this university or elsewhere.

Candidate's Signature: ..... Date: .....

Name: Opoku-Agyemang Williams

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of the thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature: ..... Date: .....

Name: Prof. Henry DeGraft-Acquah

Co-Supervisor's Signature: ..... Date: .....

Name: Dr. Alexander Tetteh Kwasi Nuer

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ABSTRACT

An agribusiness model provides farmers with a significant production and marketing edge, which helps them enjoy better livelihoods. The main objective of the research was to analyse Smallholder Vegetable Farmers' Perceptions and Willingness to accept an Agribusiness Model Innovation (AMI). The study was carried out in two communities in the central region of Ghana namely; Ayensudo and Dehia. The study was guided by four objectives which were analysed using descriptive and inferential statistics. 250 farmers were selected for the study through purposive sampling. Primary data was utilised through a questionnaire. Results from the study revealed that farmers in Ayensudo were more likely to be aware of contract farming and out-grower schemes while farmers in Dehia were more aware of supply chain management. Farmers perceived sustainable agribusiness innovation to be an effective means of achieving optimum productivity. However, these model innovations were not compatible with most farmers' socio-cultural beliefs and values. Also, landholding status, access to finance, householding status, and perception were significant predictors of farmers' willingness to accept AMI. In conclusion, vegetable farmers in the Central Region showed a high level of acceptance of the agribusiness model innovations but financial services had difficulty in accessing them. The study recommends that the Ministry of Agriculture through the Government of Ghana should help provide financial support to smallholder farmers through microloans and credit facilities designed to facilitate their investment in AMI.

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KEYWORDS

Agribusiness Model Innovation

Vegetable Farmers

Smallholder

Perception

Willingness to accept

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DEDICATION

To my grandmother, Dora Achiaa

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TABLE OF CONTENTS

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

LIST OF TABLES

Digitized by Sam Jonah Library

University of Cape Coast https://ir.ucc.edu.gh/xmlui

LIST OF FIGURES

Digitized by Sam Jonah Library

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LIST OF ABBREVIATIONS

UCC	University of Cape Coast
AMI	Agribusiness Model Innovation
MoFA	Ministry of Food and Agriculture
UN	United Nations
B2C	Business to Customer
FAO	Food and Agriculture Organization
ICT	Information and Communication Technology
SCM	Supply Chain Management
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance and Use of Technology
CCN	Cape Coast North
KEEA	Komenda Edina Eguafo Abirem Municipality

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CHAPTER ONE

INTRODUCTION

Background to the Study

The Central Region of Ghana, characterized by its unique geographical and socio-economic context, serves as an ideal location for examining the perceptions and willingness of smallholder vegetable farmers to accept agribusiness model innovation. Within this regional setting, the significance of agriculture as a primary driver of economic growth remains unmistakable, mirroring the global recognition of agriculture's pivotal role in sustainable development (Pattanayak, 2017). This region, like other parts of Ghana, heavily relies on agriculture for both sustenance and livelihoods, particularly in rural areas.

Smallholder vegetable farmers in the Central Region constitute a critical component of the agricultural landscape often operating on small plots of land, less than two hectares, and employing traditional farming practices (International Fund for Agricultural Development, 2019; World Bank, 2019). These farmers encounter challenges that are prevalent in many parts of Ghana, such as limited access to markets, credit, inputs, and inadequate infrastructure and extension services (Jayne, Matther, and Mghenyi, 2010; FAO, 2015). Their experiences mirror those of smallholder farmers in other regions but are particularly relevant in the Central Region due to the region's agricultural significance.

Given the agricultural importance of the Central Region, the introduction of agribusiness model innovations (AMIs) holds immense

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potential to address these challenges. AMIs, such as contract farming and value chain development, offer an opportunity to establish stronger linkages between smallholder farmers and markets, thereby improving production, post-harvest handling, processing, and marketing (Pera, Bavagnoli, and Benni, 2019). These models have taken various forms, including contract farming, out-grower schemes, e-commerce agriculture, greenhouse farming, and value chain development programs.

In the context of global debates on sustainability and inclusive development (Pouw *et al*., 2019), the Central Region of Ghana is seen as representative of broader agricultural dynamics in the country. Here, innovative business models are recognized as pivotal in improving smallholder farmers' access to markets and profitability, as the region's agricultural landscape reflects the need for such innovative solutions (Likoko and Kini, 2017).

The concept of a business model has been approached with various interpretations by scholars and academics, often relating it to firm performance, value creation, revenue generation, and delivery. Among these interpretations, Zott and Amit (2010) succinctly define a business model as a framework that clarifies how a company generates and delivers value to consumers, effectively converting customer revenue into firm profits. Richardson (2005) contributes by highlighting that a business model outlines the cohesive functioning of a company's activities, while Osterwalder *et al*. (2005) elaborate that a business model formalizes a set of elements, concepts, and their interconnections to convey the internal workings of a company.

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Given this array of definitions, this study adopts the comprehensive definition by Zott and Amit (2010), emphasizing that a business model serves as a strategic tool for analyzing operations in the context of agricultural businesses.

Existing research on business models within literature has focused on three key areas: viewing value creation as a networked process, examining the impact of business models on company success, and establishing the uniqueness of business models compared to other strategic frameworks. Consequently, the business model emerges as a potential source of competitiveness in the market. It signifies a novel factor that can influence the connection between strategy and performance, warranting careful consideration (Zott and Amit, 2010).

Additionally, as per earlier studies (Kibet, Kipkoech and Nzui, 2017; Ochieng, Mose, and Iravo, 2018), a farmer's willingness to accept agricultural innovations is influenced by various factors, including their perception of innovation, access to information, age, and level of education. Farmers exhibit varying openness to adopting new agricultural innovations, with adoption rates differing across different age groups, education levels, and ideological perspectives (Baudron and Jaleta, 2014).

The success of agribusiness models in enhancing smallholder farmers' access to markets and profitability hinges on the farmers' perceptions and their willingness to embrace these innovations. Unfortunately, smallholder farmers may exhibit hesitancy toward new agricultural technologies and practices, especially if they perceive them as risky or incompatible with their traditional farming methods. Consequently, comprehending the perceptions and

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willingness of smallholder farmers to accept agribusiness model innovations is pivotal in fostering their adoption and improving their standards of living.

Research on smallholder farmers' perceptions and their readiness to embrace agribusiness model innovations has been conducted in various contexts and regions (Rusike and Jideani, 2017). Nevertheless, there is an evident gap in the literature, particularly in the domain of vegetable farming, which constitutes a significant sub-sector in many developing nations like Ghana. This study aims to bridge this gap by contributing to our understanding of smallholder vegetable farmers' perceptions and their willingness to accept agribusiness model innovations, offering valuable insights for policy and practice in promoting adoption.

Furthermore, the willingness of farmers to accept and utilize innovative technologies hinges primarily on factors like value creation, value addition, profitability, usability, ease of operation, and affordability of the innovation (Wang *et al*., 2006). The existing literature demonstrates that not all new farmers opt for agricultural innovation as their business model, while some seasoned farmers are eager to break free from the constraints of conventional approaches to crop production in order to expand their horizons (Mark *et al*., 2016; Pivoto *et al*., 2018). A notable theoretical gap exists regarding how smallholder farmer acceptance perceptions impact the success of policies promoting agricultural innovation (Protopop and Shanoyan, 2016). It is within this gap that the current study endeavours to shed light.

Moreover, the study's focus on the Central Region offers a unique opportunity to contribute to the understanding of smallholder vegetable

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farmers' perceptions and their readiness to adopt AMIs in this specific context. Vegetable farming is a crucial sub-sector of agriculture in many parts of Ghana, and the Central Region is no exception. Therefore, research in this region can directly inform local policies and practices related to agricultural innovation.

With its particular agribusiness model innovations, including contract farming, value chain development, and organic greenhouse vegetable farming, the study aims to address the needs and opportunities specific to the Central Region. It seeks to answer questions like whether smallholder vegetable farmers in this region are aware of these models, what their perceptions are, and which models they prefer. Additionally, it explores the factors that predict their willingness to accept AMIs, tailored to the Central Region's unique agricultural context.

Statement of the Problem

The agricultural sector in the Central Region of Ghana holds promise for sustainable livelihoods through innovations in agribusiness models, a concept supported by Meijer *et al*. (2015). However, the region faces the substantial obstacle of climate change, as indicated by Dayanandan and Dayanandan (2018), Lombamo (2021), and Peng *et al.*, (2022). Climate change compounds the challenges faced by smallholder vegetable farmers, affecting their ability to achieve sustainable livelihoods. A key aspect of this challenge lies in the perceptions of farmers regarding agricultural innovations, which can significantly impact their willingness to accept new models, as

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highlighted in previous research by Masere (2023) and Raghav and Sen (2014).

In this context, risk and uncertainty emerge as significant influencers in how smallholder vegetable farmers perceive and approach agribusiness models, as documented by Ahmed *et al.*, (2020), Lemessa *et al.*, (2019), and Li *et al.*, (2018). These factors are likely to play a pivotal role in shaping farmers' attitudes of agribusiness models and determining their acceptance. Such acceptance is of paramount importance as it directly impacts their ability to accept innovation, a concept resonating with the notion of techno-optimism (Gardezi and Arbuckle, 2020), the perceived significance (Vijayasarathy and Ashok, 2015), and the influence of farmers' perceptions on their actions and decisions (Aspe and Jacqué, 2017), all of which are key factors influencing technology and innovation acceptance.

Moreover, the acceptance of agribusiness model innovations can hold the potential to empower smallholder farmers in the Central Region, enhancing their livelihoods, increasing food availability, and contributing to the overall sustainability of agriculture. This notion is corroborated by Makate *et al.*, (2017), Hatzenbuehler and Peña-Lévano (2022), and Hrustek (2020). Notably, farmers' expectations of increased revenue (Dhingra and Tenreyro, 2020) and cost-saving benefits (Hayat *et al.*, 2020) are likely to shape their perceptions of these models and their potential to offer sustainable livelihoods.

However, despite the clear importance of this issue, there exists a research gap where no empirical study has systematically examined smallholder farmers in Ghana based on their acceptance patterns of

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agribusiness innovations. Also, despite numerous studies on agricultural innovations in other parts, literature in Africa on agribusiness model innovation acceptance is less to be desired. In Ghana, for instance, there has been no report of vegetable farmers' willingness to agribusiness model innovation. It is within this context that this study focuses on understanding the perceptions and willingness of smallholder vegetable farmers regarding the acceptance of agricultural innovations within the Central Region of Ghana. By delving into these factors, the research aims to shed light on the complex dynamics that influence the willingness to accept agribusiness innovations in this region and contribute to the broader discourse on sustainable and innovative agricultural practices in Africa.

Purpose of the Study

The purpose of this study is to contribute to the enhancement of agricultural productivity, and economic well-being in the Central Region of Ghana by exploring the intricacies of agribusiness model innovation adoption among smallholder vegetable farmers.

Specific Objectives

Specifically, the study seeks to:

1. examine smallholder vegetable farmers' awareness of agribusiness model innovation in the study area;
2. examine smallholder vegetable farmers' perception of agribusiness model innovation in the study area;

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3. determine the agribusiness model innovation that is preferable to smallholder farmers in the study area;
4. identify factors that best predict smallholder vegetable farmers' willingness to accept the agribusiness model innovation in the study area.

Research Questions

The current study sought to find answers to the following research question.

1. Are smallholder vegetable farmers aware of the agribusiness business model?
2. What is the smallholder vegetable farmers' perception of the agriculture business model?
3. What agribusiness model innovation is preferable to smallholder vegetable farmers in the study area?
4. What factor(s) best predict smallholder vegetable farmers' willingness to accept the agribusiness model innovation in the study area?

Significance of the Study

Foremost, it has the potential to substantially enhance agricultural productivity in the Central Region, consequently boosting food production and food security. Moreover, it promises to be a catalyst for economic empowerment, as it delves into innovative practices that can augment the income and overall economic well-being of smallholder farmers.

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In an era where sustainable agriculture is paramount, this study is poised to promote the adoption of environmentally conscious and sustainable practices within the agricultural sector. It is not only a significant step toward sustainable agriculture but also a vital driver of policy formulation. The research findings can serve as evidence-based insights for policymakers in Ghana, guiding the development of policies and programs designed to bolster smallholder farmers and stimulate the adoption of innovation, thereby aligning with national agricultural and development aspirations.

Equally noteworthy is the contribution this study makes in closing critical knowledge gaps. By providing context-specific insights into the adoption of agribusiness model innovations in the Central Region of Ghana, it fills a research void and provides a foundation for future academic and research endeavors in the fields of agriculture, rural development, and sustainable practices

At its core, this study aims to empower smallholder farmers by unraveling the factors that influence their willingness to embrace innovation. This, in turn, leads to more informed decision-making among these farmers regarding their agricultural practices, ultimately fostering sustainability and profitability in their farming endeavours.

In conclusion, this study provides researchers and academics with a rich source of data, a basis for comparative analyses, and a real-world case study for policy research. It contributes to the academic community by addressing critical knowledge gaps, promoting cross-context learning, and offering insights that can guide future research endeavours and academic

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discussions in fields related to agriculture, rural development, and sustainability.

Delimitations of the Study

This study was carried out in two selected communities in the central region of Ghana where vegetable farmers were introduced to agribusiness model innovations. The study focused on the set objectives. With data collection, only questionnaires were used.

Limitation of the Study

The study focused on only vegetable farmers. Inadequate record-keeping practices resulted in farmers having to rely on their memory recall for responses. This posed challenges in obtaining accurate data regarding farmers' previous year's outputs, necessitating the study to rely on farmers' recollections. Additionally, constraints related to time and financial resources impacted the research, leading to a limited selection of vegetable farmers and preventing the study's expansion to other ecological zones. Adherence to project protocols at times constrained the study's flexibility in deviating from the project framework. Language differences further complicated matters, as the study had to depend on enumerators who were proficient in the local language for question interpretation. This language barrier posed a risk of misinterpretation and potentially skewed the study's results.

Definition of Terms

The operational definition of terms used in the study is presented in this section.

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Innovation: An introduction of a new method or idea.

Business model: The business model is an organisation or company's plan or unique way of attracting higher profit.

Willingness: Being prepared or eager to do or take or accept something.

Smallholder farmers: These are farmers who relatively cultivate on or own small-scale land for cultivation of subsistence crops and few cash crops that depend mostly on family labour.

Contract farming: Contract farming is a form of an agricultural production agreement between a farmer and a buyer based on stated or specified conditions for the production and marketing of the farmers' farm produce or products.

Direct farming is a modified agribusiness model widely employed by individual farmers with limited capital, land, or hesitation about entering into a contract or other arrangement to form a corporation.

Corporate farming: Organizations that already own or manage farms and agricultural techniques on a large scale.

E-commerce agriculture: This information communication technology model is used in producing and marketing agricultural produce.

Supply chain management farming: It is a collection of techniques for integrating producers, suppliers, warehousing, and customers effectively.

Agribusiness model innovation: refers to the development and implementation of new or improved business models within the agricultural sector.

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Perception: refers to the process by which individuals interpret and make sense of the sensory information they receive from their environment

The Organisation of the Study

The research was divided into five sections. The background of the study, the statement of the problem, the study's objective, the research questions, the significance of the study, delimitations, the study's limitations, and the study's organisation are all covered in Chapter One. The study of relevant literature was the subject of the second chapter. Both theoretical and empirical literature were examined in this chapter. The method was discussed in the third chapter. The chapter covered study design, population, sample and sampling techniques, research instrument, data collection method, and data analysis procedure are among the topics covered in this chapter. The results and discussion of the analysis was examined in Chapter Four. Finally, Chapter Five presented the summary, conclusion, and recommendations of the study.

Chapter Summary

The introductory chapter of the study encompassed several key elements. It began by providing a background to the study, followed by the problem under investigation. The chapter went on to outline the research objectives, articulate the research questions, and propose hypotheses that guided the entire research endeavour. Additionally, the significance of the study, the study's limitations and delimitation were presented. The chapter concluded with an overview of how the study was organized.

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CHAPTER TWO

REVIEW OF RELATED LITERATURE

General Overview

The literature review looks into various theoretical and conceptual frameworks underpinning the study. It also looks at existing works relevant to agribusiness model innovations.

Theoretical Review

The study was underpinned by two (2) theoretical frameworks. Thus, the Unified Theory of Acceptance and Use of Technology 2 (UTAUT 2) and Theory of Planned Behaviour (TPB).

Unified Theory of Acceptance and Use of Technology 2 (UTAUT 2)

Based on a literature survey, Venkatesh *et al*. (2003) constructed UTAUT as a thorough synthesis of previous technology acceptance studies for intake Davis (1989).

The Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) is a comprehensive and influential framework in the realm of technology adoption, designed to provide a deeper understanding of the factors that influence the acceptance and use of technology in various contexts (Venkatesh, Thong, and Xu, 2012; Venkatesh, Morris, Davis, and Davis, 2003). UTAUT2 builds upon the Technological Acceptance Model (TAM), the original UTAUT model, by incorporating additional constructs and moderators such as age, experience and gender making it a more robust and versatile tool for investigating technology adoption. In the context of this

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study, the UTAUT2 framework can be of significant relevance as it offers valuable insights into the attitudes and intentions of smallholder farmers regarding the adoption of agribusiness model innovations.

The UTAUT2 model introduces several key constructs and moderators that can be directly applicable to the study. Performance Expectancy, for instance, pertains to the extent to which individuals believe that using a particular technology will result in improved performance. In the context of smallholder farmers in the Central Region, the acceptance of agribusiness model innovations can be strongly influenced by their expectations of enhanced agricultural productivity and improved economic well-being through these innovations. Additionally, Effort Expectancy, a construct from UTAUT2, reflects the perceived ease of using technology. For smallholder farmers, this can relate to how user-friendly and accessible they find agribusiness model innovations, especially when compared to their traditional farming practices.

Social Influence is another construct within UTAUT2, acknowledging the impact of social factors and the opinions of peers and social networks on technology adoption. In the study's context, the perceptions and willingness of smallholder farmers to accept agribusiness model innovations can be significantly shaped by the views and experiences of fellow farmers and community members. The support or resistance from their social environment could play a decisive role in their decision-making process.

Moreover, UTAUT2 includes the construct of Facilitating Conditions, which considers the external factors that can either support or hinder

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technology adoption. In the study, these external factors could encompass the availability of necessary resources, infrastructure, and training, which are crucial elements for smallholder farmers when considering the adoption of agribusiness innovations.

Additionally, UTAUT2 recognizes demographic factors such as age and gender as moderators that can influence the relationships between the core constructs. It would be essential for the researchers to delve into how the age and gender of smallholder farmers impact their perceptions and acceptance of agribusiness model innovations.

In conclusion, the UTAUT2 framework provides a comprehensive and well-established structure for understanding the dynamics of technology adoption. When applied to the study in the Central Region of Ghana, it can serve as a powerful lens through which researchers can analyze the factors that influence the perceptions and willingness of smallholder vegetable farmers to adopt agribusiness model innovations, shedding light on the complex interplay of technology acceptance in an agricultural context.

Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour, as frequently utilized in the literature, has been a valuable tool for examining various behaviours, encompassing pro-environmental actions, travel mode choices, energy consumption, water conservation, dietary preferences, and ethical investments (Stern, 2000). According to Ajzen (1988), when predicting an individual's behaviour, a fundamental question to ask is whether they intend to engage in a specific manner. In the context of smallholder vegetable farmers in the Central

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Region of Ghana, understanding their intentions and behavioural tendencies regarding the acceptance of agribusiness model innovations is crucial. Individuals are likely to behave differently when faced with obstacles that impede their ability to take a particular action.

To address this challenge, Ajzen (1988) introduced three determinants that shed light on behavioural intentions:

1. Attitude (personal opinions about the behaviour)
2. Subjective norm (the influence of others' opinions on the behaviour)
3. Perceived behavioural control (one's self-efficacy regarding the behaviour)

According to this theory, the individual's attitude, subjective norms, and perceived behavioural control collectively influence their intentions, which, in turn, predict acceptance. This implies that the unique characteristics of individual farmers will shape their intentions through their attitudes, the influence of their social networks, and their perception of control over their behaviour before they decide to adopt a particular innovation.

The model suggests that farmers make decisions by weighing the costs and benefits of various actions and selecting the option that maximizes their expected net benefit. Thus, the study is expected to reveal why a farmer might choose between different agribusiness model innovations, such as contract and out-grower schemes, e-commerce agriculture, corporate farming and supply chain management, based on the expected net benefits they anticipate.

Nonetheless, it is important to acknowledge that the theory has faced criticism for oversimplifying individual behaviour. Human behaviour is a complex process influenced by various factors, not just the three determinants

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mentioned. Social, moral, and altruistic values, as well as self-seeking attributes, also come into play (Stallen, 2013). In the study of smallholder vegetable farmers in the Central Region of Ghana, it is essential to consider these multifaceted influences when exploring their perceptions and willingness to accept agribusiness model innovations, recognizing that the decision-making process is intricate and multifaceted.

Ghana Vegetable Production

Vegetables play a vital role in the agricultural sector in Ghana, serving as a source of livelihood and income for a significant portion of both rural and urban communities (Williams *et al.*, 2018). They are known for their year-round availability, quick growth, and ease of preparation. Nevertheless, (Williams *et al.*, 2018) indicated that the increasing impact of climate change poses a significant threat to smallholder farmers, potentially increasing their vulnerability and hampering their opportunities for growth and progress (Williams *et al.*, 2018).

Similarly, Bhardwaj, (2012) cited in (Fadairo, Williams, and Nalwanga, 2020) added that vegetables hold a crucial place in human diets, particularly as they are increasingly acknowledged worldwide for their role in ensuring nutritional security. Their high micronutrient content aligns with the growing awareness of healthy eating practices among the global population. Cultivating vegetables not only contributes to improved nutrition but also offers a potential avenue for enhanced income for farmers. Notably, global vegetable production has witnessed significant growth over the past two and a

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half centuries, with the trade value of vegetables now surpassing that of cereals (Bhardwaj, 2012 cited in Fadairo, Williams, and Nalwanga, 2020).

Approximately 30% of households engaged in crop production in Ghana depend on vegetable cultivation as a source of income, contributing to roughly 32% of total crop sales for these households (Ghana Statistical Service [GSS], 2012). Ghana's favourable agricultural conditions for growing vegetables, along with its geographic proximity to the European Union (EU) and established trade relations, position the country to benefit from exporting vegetables. Despite these advantages, Ghana has not fully leveraged this potential, primarily due to low productivity. Official data indicates that EU imports of vegetables from Ghana averaged about $9 million annually from 2008 to 2013.

However, during the same period, report from (FAO, 2019 cited in Tsiboe, Asravor, and Osei, 2019). Indicated that the value of pepper (*Capsicum sp*.) and eggplant (*Solanum melongena*) exports to the EU experienced annual declines of 10% and 11%, respectively, while all vegetable exports dropped by 10.5%. Notably, a significant proportion of Ghanaian vegetables remains for domestic consumption (only 2.3% are exported). Nevertheless, statistics reveal that domestic production consistently falls short of meeting consumption needs, with a deficit of 23% from 2002 to 2013 (FAO, 2019 cited in Tsiboe, Asravor, and Osei, 2019). This production-consumption gap has been widening by 22% annually, resulting in the importation of 4,000 tons of vegetables to bridge the consumption deficit in Ghana (FAO, 2019). This disparity between production and consumption can

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be attributed to low crop yields, as discussed in this study, as well as rising food demand driven by population growth, urbanization, and changing consumer preferences (Ministry of Food and Agriculture [MOFA], 2009).

Sociodemographics and Vegetable

The findings from various studies on vegetable farming reveal a consistent pattern. Ajulo (2004) observed that women constituted a minority, accounting for 31.9% of the sampled individuals involved in vegetable farming in the Ifedore Local Government Area of Ondo State. Olowa and Olowa (2015) provided further insight by reporting that a substantial 87.50% of female vegetable farmers fell within the age range of 20-50 years. Conversely, Mittal and Kaur (2021) indicated that men had a more significant presence in various aspects of vegetable cultivation, such as input procurement and land preparation. Fartyal and Rathore (2015) shed light on the fact that women play a substantial role in labour-intensive activities associated with vegetable farming, yet they still face limited access and control over property. In summary, these studies consistently underscore that women constitute a smaller proportion of individuals engaged in vegetable farming compared to men. Adeoti, Cofie and Oladele, (2012b) and Adeoti, Oladele and Cofie (2012a) conducted studies on the sustainability of livelihoods through urban agriculture in Accra, Ghana. Their findings revealed that both male and female vegetable producers actively engaged in urban agriculture and regarded it as a significant contributor to their livelihoods.

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Verma, Singh, Singh, Singh and Singh (2019) findings in the Meerut and Hapur districts of Western Uttar Pradesh, India, revealed that a significant majority of vegetable growers were native to the study area, emphasizing the strong presence of indigenous farmers in the local agricultural landscape. Also, in Torimiro, Ayinde, Koledoye and Oyedele (2014) study, it was noted that women played a dominant role in the cultivation of under-utilized indigenous vegetables in the southwestern region of Nigeria. This observation underscores the significant contribution of women in preserving and promoting these traditional and locally adapted crops, which are often crucial for food security and nutrition.

Oluwasola (2015) research in Oyo State, Nigeria, revealed that the farmers in that area were relatively highly educated, with only 11% having no formal education. Rahayu and Harahan (2015) reported that vegetable farmers in Medan Marelan, Indonesia, had an average educational level equivalent to 8 years of middle school education. Mohammad, Sharad and Gaurav (2020) examination of vegetable farmers in Balaghat, India, discovered that 53.337% of them had a high school education. In summary, these findings collectively suggest that vegetable farmers have varying levels of education, with a significant proportion having at least completed middle school education.

The prevalent marital status among vegetable farmers in the study regions points to the significance of the family unit in agricultural production. Singh, Kumar and Thakur (2022) in Varanasi district, Uttar Pradesh, highlighted that the majority of farmers belonged to nuclear family systems. Arsene *et al.,* (2016) further emphasized that both male and female heads of

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households participate in vegetable production for subsistence and family sharing, underscoring the collaborative effort within the family structure in this agricultural context.

The combined findings from the mentioned papers underscore the noteworthy challenge of land access for vegetable farmers in their respective study areas. A study conducted by Carolan, Mayerfeld, Bell and Exner, (2004) brought attention to the obstacles associated with rented land, where the instability of land tenure and conflicting interests between landlords and tenants can impede long-term investments in sustainable agricultural practices. Dwumfour-Asare, Nyarko, and Adams (2018) identified that a majority of urban vegetable farmers in Ghana rely on rented farmland, and the high rental costs create insecurity and limit investment in farm improvement. Carolan (2005) research emphasizes the importance of further investigation into the dynamics between landlords and tenants in the context of sustainable agriculture on rented land. Tia, Deaton, Hailu and Nazli (2022) empirical evidence from rural Pakistan reveals that households with limited initial land holdings turn to the rental market to achieve scale in food production. In summary, these findings collectively indicate that a significant portion of vegetable farmers in the study areas grapple with land access challenges, primarily relying on rented land, which acts as a substantial barrier to their agricultural production efforts (Carolan, Mayerfeld, Bell and Exner, (2004); Dwumfour-Asare, Nyarko, and Adams (2018); Carolan (2005); and Tia, Deaton, Hailu and Nazli (2022)).

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According to Rawal and Ansari (2019) study it wasreveals that vegetable growers expressed substantial extension needs. Conversely, Tamimi and Alataweneh (2019) research in the southern West Bank, Palestine, indicated that farmers were dissatisfied with the level of extension services provided in that region, suggesting potential gaps in service delivery. Fatty, Ode and Ogbe (2018) work emphasized the pivotal role of agricultural extension services in enhancing vegetable production and underlined the necessity to reduce input costs and better marketing opportunities. In summary, these findings collectively shed light on the diverse extension needs and preferences of vegetable farmers, indicating that extension services play a crucial role in addressing these needs and supporting farmers in their agricultural endeavours (Rawal and Ansri (2019); Tamimi and Alataweneh (2019); and Fatty, Ode and Ogbe (2018)

Furthermore, Premalatha and Sonu (2018), conducted a study in the Vellore district, Tamil Nadu, which emphasized that farmers' preferences for accessing agricultural finance were influenced by factors such as age, gender, education level, income, and household size. Cooperative banks were a favoured borrowing source for many of these farmers. Similarly, Agbo, Iroh and Ihemezie, (2015), focusing on vegetable farmers in Nigeria, highlighted that most of them resorted to informal sources for credit, with only a small percentage accessing formal financial institutions. Key factors affecting access to credit included education, land tenure, household size, off-farm income, and farming experience. Aside from the above, Besar (2009) underscored the challenges faced by farmers when attempting to access formal financial

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institutions due to issues like the lack of collateral, bureaucratic processes, high administrative charges, and elevated interest rates. Consequently, many farmers turned to informal financial sources.

Abu (2021), focused on the Tamale metropolitan area, pointing out that a significant majority of vegetable farmers in this region were between 26 and 36 years old, indicating a younger demographic involved in vegetable farming. Similar trends were observed in the capital city, Accra Ghana, as reported by Adeoti, Oladele and Cofie, (2011) and Adeoti, Cofie and Oladele (2012a), where male vegetable producers had a mean age of approximately 39 years, and female producers were slightly older, with a mean age of around 50 years. Bortey and Osuman, (2016) study focused on tomato farming and further supported these findings by showing that a substantial portion of tomato farmers in Ghana fell within the age brackets of 30-39 and 40 years and above. These studies suggest that the landscape of vegetable farming in Ghana encompasses a diverse range of age groups, with a notable presence of both younger and middle-aged farmers, signifying a promising and multifaceted future for vegetable agriculture in the country.

Dwumfour-Asare, Nyarko, and Adams (2018) revealed that the majority of urban vegetable farmers in Asante-Mampong, Ghana, operate on relatively small parcels of land, typically ranging from 1 to 2 acres. Danso, Drechsel, Obuobie, Forkuor and Kranjac-Berisavljevic, (2014) work provides a comprehensive overview of urban vegetable farming sites in Ghana, albeit without a specific focus on farm size. In contrast, Ohene-Yankyera (2005) research delves into the determinants of farm size in land-rich agrarian

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communities in Northern Ghana, emphasizing the pivotal role of access to labour and well-functioning markets for both agricultural inputs and outputs.

General Overview of the Business Model

The business model is a multi-faceted abstract idea. It describes the implementation of a business strategy and is used by various users for various purposes. For example, some believe a company's success or failure is determined by its business model. The word "business model" is used by business consultants and academics to define an entity's operations and business principles, and "despite its ambiguity, the business model concept has become an important notion in the managerial vernacular" (Tikkanen, Lamberg *et al*. 2005).

A business model also describes an organisation and how it functions in attaining its goals (e.g., profitability, expansion, social impact, etc.) at a comprehensive and intuitive level. Beyond this intuitive level, however, researchers have differing views on more practical business models (Zott *et al*., 2011; Klang *et al*., 2014; Wirtz *et al*., 2016). Nevertheless, over the last two decades, the business model has grown in importance, particularly in the fields of technology and innovation management (Massa & Tucci, 2014; Tripsas and Gavetti, 2000), strategy (Casadesus-Masanell and Zhu, 2013; Teece, 2013), and marketing (Casadesus-Masanell and Zhu, 2013; Teece, 2013).

Some academics have criticized the idea of the business model as a whole (Doganova & Eyquem-Renault, 2009; Porter, 2001; Shafer *et al*.,

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2005). "The notion of a business model is unclear at best," according to Porter (2001). Most of the time, it appears to allude to a hazy idea of how a corporation operates and earns income as an "invitation to erroneous thinking and self-deception" (Porter, 2001). Nevertheless, despite such vehement criticisms, a consensus has formed on the value of business models in management practice, philosophy, and policy (Klang *et al*., 2014; Demil, Lecoq, Ricart and Zott, 2015; Wirtz *et al*., 2016).

First, business models appear to have become a strategic focus for managers in a variety of industries, and they may be a source of above-average profits (Chesbrough, 2007a, 2007b; IBM, 2006; Ireland, Hitt, Camp, & Sexton, 2001; Johnson, Christensen, & Kagermann, 2008). Also, there are anecdotal examples of extraordinary people. These successful methods for achieving organisational goals drew the attention of both managers and academics.

Second, business models may represent a new dimension of innovation that complements standard dimensions such as product, process, and organisational innovation, broadening the scope of innovation-related events and, by extension, innovation theories (Casadesus-Masanell and Zhu, 2013; Massa & Tucci, 2014). Platform firms and associated business models, for example, aren't always focused on creating a real product that can be sold through a conventional sales channel (i.e., a more "traditional" business model) (Cennamo and Santalo, 2013). Rather, they enable value by curating and managing social and economic relationships (Choudary, 2015). This new

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perspective on what can be created has piqued the interest of practitioners and academics alike.

Third, macro-level influences like Internet technology and globalisation are blurring industry divisions, lowering entry barriers, and potentially leading to more heated competition (Gambardella and Torrisi, 1998; Gambardella and McGahan, 2010; Hacklin, Marxt and Fahrni, 2009); businesses are being forced to rethink and revamp how they achieve their goals (Gambardella and Torrisi, 1998; Gambardella and McGahan, 2010 (profitability, growth, social impact). This convergence phenomenon makes it even more critical for incumbent firm managers to comprehend business model reconfiguration and entrepreneurs to understand how to create new business models to capitalise on fresh opportunities (Kim and Min, 2015; Massa and Tucci, 2014; Osiyevskyy and Dewald, 2015).

Fourth, academics and business leaders interested in generating social and environmental value (Dohrmann, Raith, and Siebold, 2015; Jenkins *et al*., 2011; Michelini & Fiorentino, 2012) in addition to economic value creation are increasingly utilising the business model concept. There is potential to build business models that realign the profit-seeking behaviour of firms with innovations that benefit the environment and society, including initiatives in deep poverty and low-income markets (Lovins, Lovins and Hawkens, 1999; Seelos and Mair, 2007; Lüdeke-Freund, Bocken, Brent, Massa and Musango, 2016). Many academics have taken notice of the arguments presented above. In their study of the evolution of the word "business model," beginning in the mid-1990s, Zott, Amit and Massa (2011) observed a surge of articles about

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business models, including scholarly works published in peer-reviewed journals.

Vegetable Farming

Technology Adoption in the Vegetable Farming

An idea, strategy, or object that is new to the farmer is referred to as an innovation (technology), according to Van den Ban and Hawkins (1992). They said that every breakthrough is a combination of hardware and software. Farmers' perceptions of it largely determine the acceptance of technology. What matters is the concomitant adjustments in farm management that this technology will need. Adoption will be made more difficult or easier depending on how the technology evolves. Farmers consider the technology's relative advantage, compatibility, complexity, trialability, and observability.

According to Leeuwis and Van den Ban (2004), the acceptance of innovations is the culminating stage in a series of stages. Awareness, interest, appraisal, trial, and the stage where the innovation is implemented on a big scale are all part of the traditional adoption process (adoption). When people seek diverse types of information at various stages, they are more likely to take advantage of new technology.

Early on, farmers are frequently made aware of agricultural developments through the media. In addition, these farmers seek interpersonal interaction with someone they can confide in as they progress through the stages. Rogers (1983) also proposed five steps for adoption, according to Leeuwis and Van den Ban (2004). They are the stages of understanding,

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persuasion, choice, implementation, and confirmation. One significant difference between the five stages is that the technology's rejection probability is taken into account (Van den Ban and Hawkins, 1992). Rogers (1983) divided innovators (technology adopters) into five categories since various people accept technologies at different periods. The five categories include; innovators, early adopters, early majority, late majority, and laggards. Rogers (1983) also stated that adoption distribution over time is natural.

Such categorization allows for a more nuanced understanding of how farmers embrace new technologies over time. Kella *et al.* (2022) emphasizes that for this classification to be effective, it is crucial to consider the regular distribution of technology adoption over time and to assess the degree of overall group adoption. By identifying the patterns of technology adoption within the farming community, researchers and extension agents can better tailor their strategies and interventions to meet the specific needs of different farmer groups, whether they are innovators who quickly embrace new methods or late adopters who require more time and convincing.

Furthermore, Kella *et al.* (2022) highlights the pivotal role of innovative agricultural extension methods and the trust that many farmers place in extension agents. Extension agents, being knowledgeable and respected figures within the community, hold the power to influence farmers' decisions to adopt new agricultural technologies. Given the trust that farmers place in these agents, they are more likely to follow their recommendations regarding agricultural innovations. Extension agents not only introduce new technologies but also provide crucial training, support, and guidance, making

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the adoption process smoother and more effective. This trust, combined with the right extension strategies, can significantly accelerate the spread of agricultural technologies, leading to positive socio-economic changes in farming communities (Kella *et al.* 2022).

Types of Agribusiness Models Innovations in Vegetable Farming

In the realm of agribusiness, understanding and exploring various business models is crucial to grasp the diverse strategies and approaches that can impact the agricultural sector. In this study, the focus will be on several noteworthy Agribusiness Models Innovation (AMI), each offering distinct advantages and challenges. These models include Contract Farming and Out-Growers Schemes, Corporate Farming, E-commerce Agriculture, Greenhouse vegetable farming, and Supply Chain Management.

Contract Farming and Out-growers Scheme Model

Contract farming is a type of vertical coordination in agricultural production. Processors, exporters, distributors, and retailers increasingly rely on it to ensure the quality and quantity of their inputs (Ragasa *et al.*, 2018). Contract farming (CF) is a system in which farmers produce and supply land-based and related products under advance contracts, the essential of which is an agreement to offer an agricultural output of a given sort at a specified time, price, and quantity to a known client (Singh, 2007). Contract farming would be much more likely to emerge when a market failure occurs when commodity specificity and uncertainty are high, just as in the trading of perishable as well as difficult-to-store and transport crops (Soullier & Moustier, 2018).

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Since the 1970s, the benefits of contract farming have been a source of discussion and debate, particularly in developing and transitional countries (Miyata *et al.*, 2009). Several scholars including, Abebe *et al.*, (2013); Bellemare and Novak, (2017); Ton *et al.*, (2018) have had their share of the comments by stating that contract farming is widely regarded as a crucial initiative to promote social welfare, increasing employment and production, and enhancing global food security. According to Barrett *et al.*, (2012), this innovation aids farmers in overcoming financial and insurance constraints, a lack of adequate inputs, and a lack of managerial and technical expertise. Furthermore, Bijman, (2008); Soullier and Moustier, (2018); Wang *et al.*, (2011) contract farming is critical for managing risk, the macroeconomic balance, improving farmers' livelihood opportunities, and combating market imperfections.

Conversely, contract farming is frequently condemned as a way for businesses to take advantage of farmers' unfair power dynamics and extract rents (Warning and Key, 2002). Contracts allow large agribusiness companies to use cheap labour while transferring risk to farmers. Smallholder farmers could be overlooked since large farmers are preferred by businesses, causing inequity for small and marginalised smallholder farmers in rural areas (Singh, 2002).

In agricultural economics and practice, there are several definitions of contract farming. A pioneer, Roy, (1963) defines the concept as "those contractual agreements among farmers and other organisations, either verbally or in writing, detailing several conditions of service. In practice, as found in

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Hoang, (2021), contract farming must be described as an agreement reached in advance between farmers (sellers) and firms (buyers) on the contractual terms of agro-food production and marketing. These terms define the price, quantity, quality, delivery time, transportation, inputs such as seeds, insecticides, fertilisers, and the firm's professional guidance.

Corporate Farming Model

In the cultivation of crops with few cycles, farmers cannot specialise in any one task, according to Allen and Lueck (1998). As an organisational form, crop farming favours the owner-operated farm above the corporate farm. On the contrary, Deininger and Byerlee (2012) argue that numerous land-rich countries have seen a rise in investments in large-scale agriculture characterized by non-family business models. Meanwhile, Lipton (2009) observes that developed countries with limited land resources have maintained a stable farming system. To illustrate their standpoint, Deininger and Byerlee (2012) provide examples of large corporate farms in emerging and transitional nations. Notably, three out of every five of Latin America's largest commercial farms focus on producing long-life cycle commodities. This aligns with Allen & Lueck's (1998) prediction that in agricultural output with multiple cycles and extensions, corporate or partnership ownership structures become more likely as specialization becomes increasingly crucial on the farm.

On an irrigation farm, however, the principal would be able to reduce the moral hazard between itself and the agent by specialising in a task, in this case, irrigation scheduling. The capacity of the principle to lower part of the

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uncertainty would therefore increase the ability to monitor stages, allowing for the detection of moral behaviour by the agent. Allen and Lueck (1998) argue that irrigation farms will tend to corporatise or create partnerships. These farms appear to have worked very effectively in some cases; nevertheless, this has not been the case in Africa to a considerable extent (Eicher and Baker, 1992). According to Deininger and Byerlee (2012), this is most likely due to a lack of well-defined property rights.

According to Deininger and Byerlee (2012), property rights that are well specified facilitate contracting, which fosters the establishment of large-scale farming corporations. The ability to freely transact with the market is one of the advantages of these organisational forms; they will be able to hire specialist labour at lower costs, as well as lower production costs due to the size of the organisation, enjoying all of the benefits of "economies of scale" (Deininger and Byerlee, 2012). It is expected that there would be feedback between producers and customers as a result of this ease of access to the market. Because of this feedback, James *et al.* (2011) suggest that agriculture has reached a tipping point, which has spurred contracts and organisational restructuring within the industry. These contracts, which can be either marketing or production contract (Allen & Lueck, 2000), are thought to stimulate organisational reform in agriculture (James, Klein, and Sykuta, 2011). Before production begins, the producer and customer discuss prices and volumes under a marketing contract. The manager/producer is in charge of the production process details, such as planting dates (James, Klein, and Sykuta, 2011). On the other hand, a production contract is a more tightly coordinated

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arrangement in which the producer has significantly less control over the production process, and the parent business specifies the manufacturing processes in much greater detail (James, Klein, and Sykuta, 2011).

The challenge appears to be in defining a corporate farm, which is thought to be related to organisational structure and direct primary production engagement rather than size and indirect involvement. As a result, marketing contracts are not considered corporate farming because the farmer employs their own labour and managers and is engaged by a company that invests in either upstream (intermediate input companies) or downstream markets (processing, value-adding).

A flour milling company, as an example, may extend marketing contracts to wheat farmers, who have the choice to either accept the contract or participate in open market trading, which involves some level of risk. When a farmer agrees to the contract, they are bound to fulfil it, and there are consequences if the contract is not honoured. By using price as both an incentive and a means of enforcement, the corporation structures the contract in a way that ensures the delivery of the specified quality and quantity of the product at the end of the season. Since the corporation cannot manage or commit too far into the future due to inherent risks, farmers have the flexibility to change contracts from year to year. Given that the farmer retains full control over production, they can be seen as an independent entity. Consequently, the flour mill cannot be categorized as a corporate farmer under a marketing contract, as it is not directly engaged in primary agriculture but relies heavily on its product (Allen and Lueck, 1998).

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On the other hand, corporate organisations often use one of two production contracts: cash-rent or crop-share (Allen and Lueck, 2000). According to Allen and Lueck (2000), farmers with cash rent contracts have the incentive to overuse the land and produce in an unsustainable manner. Still, farmers with crop-share contracts have a motivation and a chance to shirk while having less of an incentive to overuse the land. Owners would have to invest in measuring and monitoring costs, sometimes agency costs, to ensure that agents execute acts that maximise ownership interests (Elliott and James, 2013).

E-commerce Agriculture

E-agriculture is a new word in the field of information and communication technologies (ICT) that refers to a worldwide community activity in which individuals from all corners of the globe share resources, philosophies, and information linked to the use of ICT for sustainable agriculture and rural development. Epstein (2008) points out that a significant number of Kenyan farmers, primarily due to their limited access to information, are unable to sell their agricultural produce at market prices. As a result, they are forced to sell their products at low prices, resulting in losses and food insecurity. Farmers have been given access to information and communication technology (ICT) tools to produce and sell their crops at competitive prices. This is because the success of agriculture is determined by how quickly and accurately information is delivered to end consumers.

Information Communication Technology (ICT), as described by Pretty, Ball, Xiaoyun, and Ravindranath (2002), comprises a range of tools and

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resources employed for the collection, dissemination, storage, and broadcasting of information to facilitate decision-making. ICT represents a holistic framework that encompasses hardware, software, telecommunications networks, individuals, data, and processes, all of which play vital roles in the gathering, processing, storage, and distribution of data (Dewan and Kraemer, 2000).

Many individuals, academic institutions, professional groups, and funding organizations use e-agriculture. E-agricultural has much potential for augmenting traditional service delivery and communication channels in ways that help agriculture organisations better fulfil the demands of their farmers. Improved access to information and resources, farmer empowerment to make informed agricultural decisions, better organizational procedures and transactions, and improved quality, value, and happiness with agricultural productivity are just a few benefits.

E-agriculture is now commonly acknowledged as a technique for empowering farmers to make educated decisions about agricultural output and commercialisation. According to (Meera and Jhamtani, 2004), E-agriculture aims to boost agricultural and rural development by enhancing information and communication systems. E-agricultural, in particular, entails the conception, design, development, assessment, and deployment of novel ways to employ information and communication technologies (ICTs) in the rural domain, with a primary focus on agriculture.

Aside from the above, in the contemporary landscape, e-commerce has become a pivotal element in consumer product procurement, with online

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trading streamlining the entire process. Two predominant e-commerce models, Business to Business (B2B) and business-to-consumer (B2C), are widely adopted. Creating awareness about online marketing within the farming community can bring substantial benefits to farmers, including the ability for consumers to directly evaluate the product quality (Dharanidharan, Kumar, and Abishek, 2018).

Several studies, including those by Dharanidharan, Kumar, and Abishek, (2018) and Gopinath, Kalpana, and Shibu (2016), indicate that e-commerce can serve as a valuable tool for farmers in various aspects such as marketing, customer support, and collaboration with suppliers. For instance, it can help streamline marketing efforts and improve the interaction with customers, ultimately enhancing customer loyalty and satisfaction, as evidenced by Bhanupratap, Sheikh, Sohail, Tushar and Kunal, (2017).

Additionally, Bradić-Martinović and Tomić, (2014) emphasizes the role of web technology in offering transaction cost savings and other benefits to farmers, which can lead to increased efficiency. The collective findings of these papers suggest that the integration of e-commerce and web technology into vegetable farming practices can be instrumental in enhancing marketing strategies and improving communication with customers. This, in turn, has the potential to result in increased profitability and overall efficiency within the vegetable farming industry.

In their 2013 paper, Aditya, Khanal and Ashok K. Mishra reference a study conducted by Briggeman and Whitacre in 2010, which delved into the barriers preventing broader adoption of the Internet within farm households.

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They identify three primary factors, namely, the absence of a computer in the household, concerns about Internet security, and insufficient Internet service, to elucidate the reasons behind the limited Internet usage among farm households. Notably, two significant shortcomings of these earlier studies include: 1) the failure to explore the impact of Internet usage on farm household income and financial performance; and 2) the limited scope of data employed, as most studies relied on local or regional data from larger farms (Briggeman and Whitacre, (2010) cited in Khanal and Mishra, (2016).

Supply Chain Management Model

Supply chain management (SCM) has its foundations in logistical literature and was not previously thought to be distinct from the logistics management (Lambert *et al*., 1998). SCM was once considered as outside-the-company logistics for reaching buyers and producers. However, the concept of SCM has been expanded to include the integration and management of business processes throughout the supply chain.

The notion of supply chain management is progressively being used in agribusiness. Conventional marketing methods have been phased out in favour of farmer-to-market supply chains. According to Woods, (2003), this trend is mainly driven by competition for a larger share of consumer spending. Other significant determinants of supply chain management in agribusiness include growing demands for as well as availability of differentiated products (Nitschke and O'Keefe, 1997; Woods, 2003), technological advancements (Ortmann, 2001; Woods, 2004), consumer sensitivity to food quality, safety, and non-food values (Nitschke and O'Keefe, 1997; Woods, 2003), and more

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competitive markets as a result of globalisation and trade liberalisation (Nitschke and O'Keefe, 1997; Ortmann, 2001).

A study conducted by (Deloitte, 2013) expressed the food value chain as the linkages and networking among stakeholders. They defined the supply chain as "the interaction of stakeholders involved in producing, processing, and selling the products or commodity that consumers prefer. This is from the farm gate to the market final table. However, supply chain management manages the movement of food commodities along the supply chain to maximise consumer value. Supply chain management (SCM), according to Christopher, (2012), is the management of downstream and upstream relationships with suppliers and customers in an attempt to provide higher customer value at a lower cost to the supply chain as a whole.

Mena and Stevens, (2010) also found seasonality, health and safety concerns, limited shelf-life, unstable demand, and environmental repercussions are all important points of variance between food and industrial product supply chains as essential to supply chain management. Seasonality affects both supply and demand. Agricultural products have a limited shelf-life and are subject to fluctuating markets due to various causes. Therefore, seasonality affects both supply and demand. As a result, it necessitates a higher level of reactivity and quickness than industrial stock management. Other essential aspects to address are quality, traceability, safety, and food risk management (Jin and Liu 2018).

Pagell and Shevchenko, (2014) presented that SCM is the process of creating, organising, coordinating, and controlling supply chains to make them

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effectively sustainable, with the basic expectation of a truly sustainable supply chain being that it will retain economic viability while causing no harm to environmental or social systems.

Greenhouse Vegetable Farming Model

Over the past three decades, greenhouse vegetable farming has experienced rapid expansion worldwide to meet the increasing food demands of the world's rapidly expanding population. This is necessary to produce sufficient quantities of out-of-season vegetables. However, compared to other agricultural innovations, greenhouse farming has gotten very little attention in the academic literature, despite its use expanding and assuming an increasingly significant role in providing healthy foods.

McCartney and Lefsrud (2018) indicated that the ability of greenhouses to maintain their productive capacity throughout the year and to have a minor influence on the environment is one of the most significant benefits of greenhouse production. This is because greenhouses reduce their reliance on natural factors and cycles, such as humidity and temperature, water and rain, diseases and pests, and so on.

Also, according to (Forkuor *et al*., 2022), One of the most significant benefits of greenhouse farming is that it lessens reliance on natural seasonal patterns and enables production to continue throughout the year. Additionally, Meemken and Bellemare (2020) state that stable and high-value production can generate interconnections among farms and downstream businesses, such

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as those in the processing or retail industries, resulting in more stable output demand, which can increase production as well as labour demand.

Aside from the above Codron *et al*., (2014) and Forkuor *et al*., (2022), Greenhouse farms often concentrate on producing flowers and other forms of horticulture that have a higher added value and, depending on the circumstances, on delivering their goods to the international market per stricter food standards of quality and safety.

Contrasting View of the Various Models

The field of agribusiness encompasses a variety of models, each with its unique characteristics and applications in vegetable farming. Contract farming and out-grower schemes involve formal agreements between farmers and agribusiness firms, with the former committing to produce specific quantities and qualities of vegetables, while the latter includes small-scale farmers who receive support and market access. These models are relevant to vegetable farming as they empower small-scale producers by providing resources, technical assistance, and improved market opportunities (Key *et al.*, 2017).

Also, corporate farming, on the other hand, involves large agribusinesses owning and managing extensive vegetable farms, controlling the entire production and distribution process. This approach can lead to economies of scale, ensuring a consistent and efficient vegetable supply (Ishfaq and Haque, 2019).

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In the digital age, e-commerce agriculture is gaining prominence, allowing farmers to directly connect with consumers through online platforms, bypassing intermediaries. This model benefits vegetable farming by expanding market reach, enabling direct sales, and increasing profitability (Lakew *et al.*, 2019).

Furthermore, greenhouse vegetable farming is characterized by controlled environments that optimize vegetable growth, irrespective of external conditions. This method ensures year-round cultivation, reduces weather-related risks, and enhances vegetable quality (Liu *et al.*, 2019).

Lastly, supply chain management plays a crucial role in vegetable farming by optimizing the flow of produce from the farm to the consumer. It involves efficient logistics, distribution, and quality control, ensuring timely delivery of fresh vegetables, reducing losses, and maintaining product quality (Xu *et al.*, 2018).

In summary, these diverse agribusiness models offer distinct approaches to vegetable farming, catering to the needs of different stakeholders, whether small-scale farmers, large agribusinesses, or tech-savvy entrepreneurs, each contributing to the overall efficiency and success of vegetable cultivation in today's dynamic agricultural landscape.

Socioeconomic and Institutional Characteristics of Agricultural Innovations

The socioeconomic and institutional profiles of smallholder farmers in Ghana's central region are influenced by various factors. These include farm

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size, proximity to markets, access to information, the frequency of extension officer visits, labour practices, familiarity with traditional norms, organic standards, and land tenure systems, as identified in the study by Badu-Gyan *et al.*, (2018). Additionally, the educational level, household size, farming experience, engagement in off-farm activities, social capital, and income derived from farming play a crucial role in shaping the characteristics of these smallholder farmers (Badu-Gyan *et al.*, 2018).

Mwangi and Kariuki (2015) categorized the determinants of smallholder farmers' characteristics in developing countries into two main groups: economic and institutional factors. The former encompasses aspects like farm size, labour and input costs, off-farm earnings, age, gender, and household size, while the latter includes social capital, information acquisition, access to extension services, and credit availability. In the context of Ghana, a developing nation, these factors hold particular significance, especially within the central region, where smallholder farmers face specific socioeconomic and institutional challenges.

Katie and Ricketts' (2019) study sheds light on the distinctive dynamics affecting smallholder farmers in Ghana. Their research findings highlight both positive and challenging aspects of these farmers' socioeconomic and institutional characteristics. Specifically, the study underscores the beneficial impacts of improved access to income, market information, and extension services on these farmers. However, a significant impediment identified in the research is the limited availability of farm credit,

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which poses a considerable constraint for smallholder farmers in the region (Alidu, Man, Ramli, Haris, and Alhassan, 2022).

Moreover, the agricultural landscape in Ghana is characterized by the predominance of smallholder farmers, who constitute over 70% of the workforce in the sector. These individuals predominantly reside in less developed communities and are primarily engaged in traditional and rudimentary agricultural practices.

The socioeconomic and institutional characteristics of smallholder of farmers in Cameroon very identical to those of Ghana (Djoumessi *et al*., 2018). In terms of the land tenure system and rain pattern, agricultural activities, there are many similarities between Cameroon and Ghana. In Ghana, smallholder farmers across the country have similar characteristics. Djoumessi *et al*., (2018) found that family size, education and extension service were significant determinants of socioeconomic and institutional characteristics of smallholder farmers. They also found that credit service was also a determinant of socioeconomic and institutional characteristics of smallholder farmers (Djoumessi *et al*., 2018).

Tizale, (2007) concluded that older farmers have shorter planning horizons and are more reluctant to invest in modern agriculture technologies, which take a long time before farmers realise the benefits. As a result, farmers will be sluggish to accept innovations, according to (Amos, 2007), who discovered that young farmers are more responsive than older farmers, as elderly farmers are not always willing to abandon old technologies in favour of new ones. Conversely, Kassie *et al*., (2009) and Teklewold *et al*., (2013)

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indicated that older farmers are perceived to be more experienced than younger farmers and thus are more likely to adopt new agricultural technologies. The findings are similar to those of Asfaw *et al*., (2012), who found that older and experienced farmers were likelier to adopt improved innovation in Tanzania. Kanyenji *et al*., (2020) advocated that older farmers were less likely to adopt the use of innovation compared to younger farmers starting farming. The study suggested that younger farmers are willing to invest in farming enterprises with a higher turnover rate. Therefore, older farmers are willing to invest in long-term farm enterprises and wait for the anticipated benefits.

Capital and financial endowments, such as income, savings, and access to finance and insurance, will likely impact small-scale farmers' adoption of innovation. This is because they serve as a "security net" for farmers during times of crisis, allowing them to experiment and take risks to ensure long-term sustainability (Jones *et al*., (2010). However, in other circumstances, innovation adoption necessitates a significant capital commitment, which is typically out of reach for the majority of rural farmers. This means that farmers with more resources are much more likely to accept innovation than farmers with fewer resources (Deressa *et al*., 2009).

According to Field, farmers with access to extension services are more likely to accept agricultural innovation (Maina *et al*., 2020). Their findings corroborated with those of (Ali and Abdulai, 2010), who claimed that extension visits make adoption easier. Alternatively, (Kassie *et al*., 2015) discovered that access to high-quality extension services improved the

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adoption of new technology across East and Southern Africa. Farmers are becoming increasingly aware of emerging technology because of extension programs promoting knowledge flow. Extension services also allow farmers to see possible benefits firsthand through demonstrations or connecting them with early adopters.

A study made by Kanyenji *et al*., (2020); Kassie *et al*., (2011, 2015) and Marwa *et al*., (2020) revealed that membership in an agricultural group increased the likelihood of adopting a farming technology. Social capital is measured by membership in a group. These social networks improve the flow of knowledge and allow farmers to learn from one another. Quisumbing, (2003) specifies that social groups also act as informal insurance in crisis periods. This suggests that disseminating new technologies can reach more farmers when channelled through agricultural groups such as cooperatives.

Acceptance of the Agribusiness Model Innovations.

Several research studies have looked into the aspects that influence farmers' adoption decisions. Age, farm size, household size, experience, gender, farm income, off-farm income, and the cost of agricultural technology are all considered socio-economic factors influencing adoption. Access to extension services and credit are also among the institutional considerations. However, the direction of effect is mainly determined by the study in question.

Barungi *et al.* (2013) conducted a study to investigate the factors that influence the adoption of agricultural technologies. The authors proposed that farm size had a favourable or unfavourable impact on adoption. Farmers with

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larger farms are more inclined to adopt and intensify agricultural technologies at a faster rate to benefit from economies of scale. However, in other cases, technological risk causes a negative association between farm size and agricultural technology adoption and intensity. The size of a farm can influence and be influenced by the other elements that influence acceptance (Lavison 2013). Farmers with larger farms are more likely to accept new technology because they can afford to dedicate a portion of their land to experimenting with new technologies, unlike those with smaller farms (Uaiene *et al*., 2009).

In most research, the impact of household size on the adoption of agricultural technology has been positive. According to Mignouna *et al.*, (2011), family size benefits adoption since farmers with big households have more labour to devote to innovation. They also claimed that the size of the family has a positive effect on technology adoption rates. This is because workforce availability ensures the development of farm operations and, as a result, more technological investment. Gebremichael and Gebremedhin (2014) investigated the uptake and intensity of enhanced agriculture technology. Their studies revealed that household size had a favourable but insignificant effect on both the adoption and power of the use of technology.

Land tenure or landholding status has a significant impact on a farmer's willingness to accept an agricultural innovation. Kassie *et al*., (2013) concentrated on rural Tanzanian smallholders' acceptance of innovative farming practices. The findings demonstrated that land ownership impacted the adoption of agricultural innovation. In Ghana, Abdulai *et al*., (2011)

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investigated the association between land tenure and several farming practices and innovations. It was concluded that for households that cultivate on their owned land with full property rights, land tenure was rated as secure, which can be easily used for an innovative purpose without restriction. Insecure land tenure, on the other hand, included landowners with limited property rights, set rent, and sharecropping contracts in which tenants pay a portion of their produce to the landowner. The results show that securing land tenure positively impacts the possibility of accepting an innovation.

Farmers' experience is another crucial factor that influences their adoption decisions. Typically, years of farming or the biological age of the farmer are utilised as proxy variables. The years of farming were used by Fernandez-Cornejo *et al.*, (2001) and Tiamiyu *et al.*, (2009) to measure farming experience. More experience is commonly thought to improve the possibility of adoption, according to Fernandez-Cornejo *et al*. (2001). This was linked to the fact that more seasoned farmers were more likely to perceive those early adopters benefit the most from technological advancements. In their study, Tiamiyu *et al*. (2009) proposed that farming experience could have an equivocal effect on adoption depending on the length of time. However, they discovered that prior farming experience had a beneficial and significant impact on adopting improved rice technology.

The adoption and intensity of the use of agricultural technologies are influenced by gender. According to Ayuya *et al*. (2012), male farmers are less risk-averse and have better access to resources and information than female farmers. Gender was found to be positively associated with adopting

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agricultural production technologies by Akudugu *et al*. (2012). They also point out that male farmers are more likely to adopt agricultural innovations since they have more control over productive resources, which are crucial for adoption and intensity of use.

Martey *et al*. (2013) found that off-farm income benefits adoption and adoption intensity. This is because farmers who generate money outside the farm are better equipped to meet the financial requirements of adopting modern agricultural technologies. In their study, Hanschuch and Wollni (2013) concluded that off-farm income benefits agricultural technology adoption. This is because wealthy farmers have more access to finance and are more likely to adopt new technologies. In their study of technology adoption, Nnadi and Nnadi (2009) discovered that farm income has a beneficial impact on adoption. They noticed farmers had more capital and were thus able to expand their usage of agricultural technology as annual farm income improved. However, according to Zhou *et al*. (2010), farm income has a mixed effect on farmer adoption behaviour.

Access to extension services, according to Mignouna *et al*. (2011), improves farmers' exposure to and familiarity with agricultural technologies. As a result, it is predicted to have a favourable impact on agricultural technology uptake and intensity. Extension services raise awareness of agricultural technologies by providing the required information and unique skills to assist farmers in implementing the advancements. According to Beshir (2014), access to extension services influences acceptance rather than the intensity of usage of improved forage technology. He also stated that

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farmers' access to extension services is the most important source of knowledge for them to become familiar with new agricultural technologies.

According to Olagunju and Salimonu (2010), the level of formal education has a favourable impact on the adoption and intensity of agricultural technologies. Formal education refers to classroom-based instruction delivered by qualified teachers. They added that farmers with a higher level of formal education have a better understanding of how to use and apply inputs. In their study, Chiputwa *et al*. (2011) discovered that education level positively links agricultural innovation adoption and intensity. The explanation is that farmers with a greater level of education are better equipped to utilise data and identify appropriate technology. Ndamani and Watanabe, (2016) recommended that better-educated farmers are much more knowledgeable about innovation since they have access to more information.

Credit has also been demonstrated to impact the adoption of agricultural technologies. According to Beshir *et al*. (2012), access to financing has a beneficial impact on adoption. This is because farmers with access to finance can invest in more advanced agricultural technologies. According to Gebremichael and Gebremedhin (2014), access to financing favours the intensity of agricultural technology adoption since liquidity limitations are reduced. In their analysis of technology adoption, Scholz *et al*. (2014) concluded that higher costs to purchase or apply the technology would discourage uptake and intensity of use. The high price of agricultural technology has always been a deterrent to adoption and has a negative impact on it.

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To strengthen agricultural technology adoption, social networks and involvement in farmer groups have been widely advocated in the literature. According to several research (Cavanagh *et al*., 2017; Liverpool-Tasie & Winter-Nelson, 2012; Ramirez, 2013) from literature, these groups are significant in promoting the acceptance of agricultural innovations among farmers of similar or related networks. Social networks have been demonstrated to be critical in strengthening professional and non-professional networks in the initial investigations. The findings also show that both professional and non-professional networks aided the adoption of agricultural technologies.

Attitude and Perception of Smallholder Farmers

Intrinsic and extrinsic factors influence the acceptance of new technologies and practices in the decision-making process for innovation acceptance. The present study on the smallholder vegetable farmers' perceptions and willingness to accept agribusiness model innovation tends to focus on external factors like economic concerns (Meijer *et al*., 2015). Meijer *et al*., (2015) further explained that intrinsic factors, on the other hand, could have an equal, if not greater, impact on the acceptance of agricultural innovations by smallholder farmers in Ghana. A mix of intrinsic and external qualities could provide a better comprehensive understanding of farmers' attitudes toward technology acceptance.

Farmers' attitudes regarding innovations may be the most critical factor in determining whether or not they accept new agricultural methods. In social

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psychology, attitude is a central, intrinsic construct broadly utilised in explaining human behaviour (Edison and Geissler, 2003). As a principle, attitude is used to determine whether an object or practice is beneficial or detrimental.

Smallholder farmers in agricultural production have been realised to evaluate agricultural innovations like other technologies in terms of their utility (Edison and Geissler, 2003). In the research, (Nyanga, 2012) socio-demographic parameters such as age, gender, income, and education level have been indicated as critical predictors of agricultural technology acceptance. Specific research has determined that gender roles inside households cannot be adequately described, particularly regarding the influence of gender on technology adoption among African women (Doss, 2001). Palacios-Lopez *et al*., (2017) posited that although women contribute a significant amount of effort to crop production, a clear pattern of agricultural adoption has yet to be identified for them compared to their male counterparts.

Several smallholder farmers have been shown to behave differently depending on their production requirements or household conditions. The intention to embrace agricultural innovations was significantly influenced by confidence in applying the innovations, perceptions of net advantages, and farm size (Adrian *et al*., 2005). According to these findings, economic benefits may not motivate farmers to use agricultural innovations. The results, however, did not conclude that they are generalizable across several innovations.

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Ntshangase *et al*., (2018) investigated farmers' perceptions toward agriculture innovation. It was concluded that farmers' positive perceptions were found to be associated with increased crop yields. Morton *et al*., (2017) stipulated that when farmers are uncertain about accepting a new innovative technology owing to a lack of information or proper training, access to extension services can help them change their perceptions about their farming practices.

Conceptual Framework

The study's underlying conceptual framework is visually represented in Figure 1. Within this framework, the researcher posits that the willingness of smallholder vegetable farmers to accept Agribusiness Model Innovation (the dependent variable) hinges on four primary factors (independent variables), namely:

1. Socio-economic and institutional characteristics;
2. Awareness or knowledge level of the farmers;
3. Perceived innovation characteristics of the AMI; and
4. Preferred AMI.

Based on the research objectives, Figure 1 explains the concept of the study.

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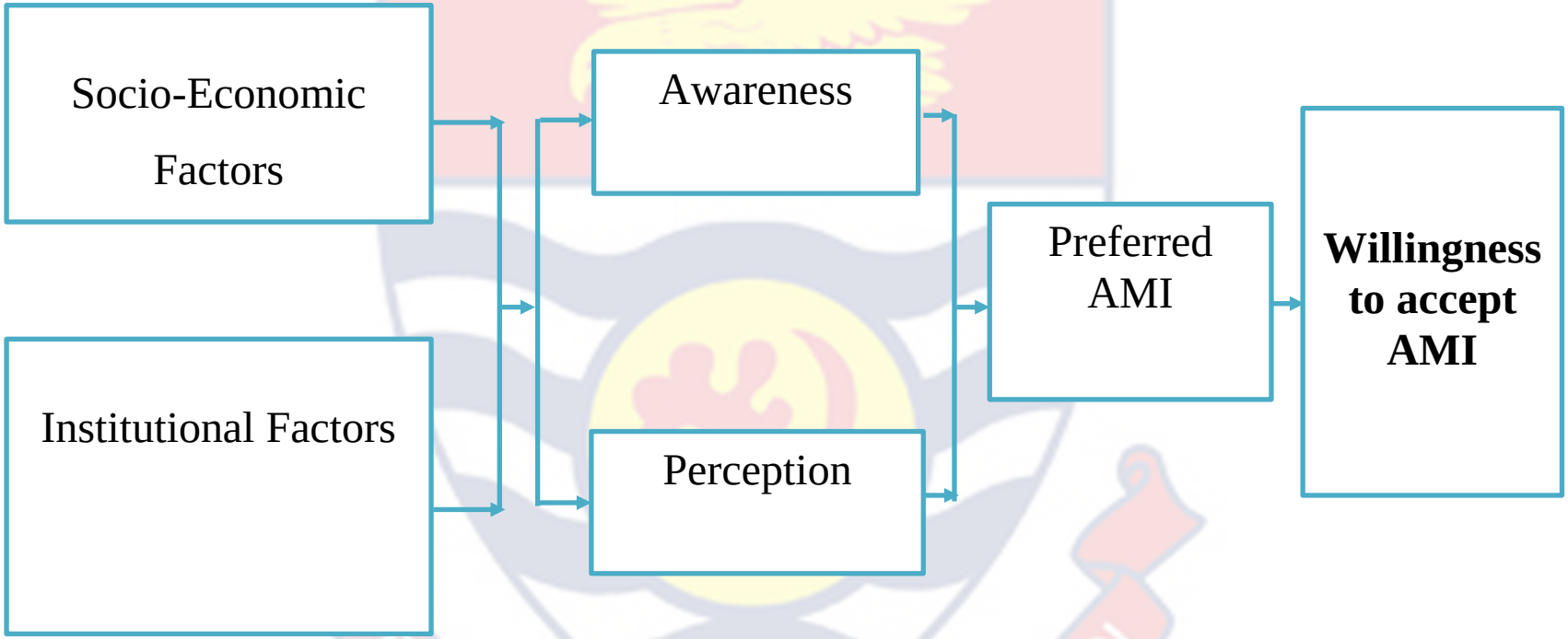

Figure 1: Conceptual Framework of the Study

Source: Field data **(**Opoku-Agyemang, 2023)

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The Socio-economic and Institutional-related Characteristics

In this study, a comprehensive analysis of socio-economic and institutional characteristics is conducted to assess their potential impact on smallholder vegetable farmers' willingness to embrace Agribusiness Model Innovation (AMI) when it becomes available. These factors encompass age, native region, education level, landholding status, household composition, labour sources, farm size, household income, household size, farming experience, access to extension and financial services, as well as involvement in farmer-based organizations. Younger farmers (Amos, 2007), those from the same native region, and individuals with higher education levels (Chiputwa *et al.*, 2011) may exhibit greater openness to AMI. Larger landholdings, diverse household structures, reliable labour sources, bigger farms, higher income, and access to support services may also positively influence acceptance. The impact of these characteristics can be context-specific, and further empirical research is needed to determine the precise direction and magnitude of these relationships.

Preferred Agribusiness Model Innovation

The study presented several Agribusiness Model Innovations (AMIs) for farmers to choose from, which included options like contract farming and out-grower schemes, direct farming, corporate farming, organic greenhouse vegetable farming, E-commerce agriculture (Business-to-customer) B2C, and supply chain management farming. The underlying premise was to investigate how the farmers' willingness to accept these different AMIs related to their choices. By selecting the most preferred AMI, the farmers were essentially

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indicating their willingness to embrace a specific innovative approach, which they believed would offer them the best opportunity to enhance their livelihoods. This choice reflected their level of acceptance and enthusiasm for the particular AMI they deemed most suitable for their circumstances and goals.

Awareness of AMI

The awareness focused on whether the smallholder vegetable farmers knew the AMIs. Awareness of something or innovation substantially impacts one's willingness to accept or not to accept. However, the conceptual framework focused also on the farmers' knowledge level of the perceived benefits of the AMI. Moreover, the research poised that the smallholder vegetable farmers' perceived awareness level of the AMI would have a significant association with their willingness to accept the innovation when accessible.

Perception of AMI

The study's emphasis on awareness was rooted in understanding whether smallholder vegetable farmers were informed about the Agribusiness Model Innovations (AMIs) available to them. This awareness was recognized as a critical factor influencing their willingness to accept or reject these innovations. Furthermore, the conceptual framework delved into the farmers' knowledge levels regarding the perceived benefits of the AMIs. The research posited that farmers who were not only aware of the innovations but also had a good understanding of their potential benefits would be more inclined to accept the innovation when it became accessible. In essence, the study

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highlighted the integral role of both awareness and knowledge in shaping smallholder vegetable farmers' willingness to accept AMIs, underlining that informed and aware farmers were more likely to embrace these innovations as they recognized the potential benefits and opportunities they could offer.

Interrelationships among the Independent Variables

In addition to the associations observed between the dependent variable (Willingness to accept AMI) and the independent factors discussed, Figure 1 illustrates interconnections among some of the independent variables. Notably, farmers' levels of awareness and knowledge are intertwined with socio-economic and institutional factors like age, work experience, and educational background in the realm of vegetable production. This awareness and knowledge level significantly impacts the perceived willingness to embrace Agribusiness Model Innovation. Consequently, the greater the understanding and awareness farmers possess about these innovations, the more likely they are to accept them. This, in turn, enables them to identify the potential challenges and opportunities associated with these innovations, ultimately contributing to their ability to improve their livelihoods.

Chapter Summary

This chapter reviewed relevant literature on the theories underpinning the research like the Unified Theory of Acceptance and Use of Technology 2 (UTAUT-2), Theory Planned Behaviour (TPB). The chapter also reviewed the literature on some of the agribusiness models, preferred agribusiness model, perceptions, factors affecting AMI acceptance.

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CHAPTER THREE

RESEARCH METHOD

General Overview

A research methodology offers a solid basis for how the research is carried out. The research techniques used have a significant impact on the validity, reliability, as well as generalisation of the findings. This chapter explains the techniques and methods used in collecting and analysing the data for the study. It considered the research design, study population, sample and sampling techniques, research instrument used, pilot study, data collection procedure, data processing and analysis.

Research Design

A cross-sectional survey design was employed in this research to investigate the current state of the study's variables and the connections between them. The study was carried out in the Central Region of Ghana which was chosen deliberately due to their significant vegetable production capabilities. Data was collected at a single time point to assess farmers' perception and willingness to accept Agribusiness Model Innovation (AMI) to achieve sustainable livelihood.

According to Babbie (2004), a cross-sectional survey is a research method that involves collecting data from a diverse and representative sample of individuals or entities at a single point in time. The objective of a cross-sectional survey is to gain insights into the characteristics, behaviours, attitudes, or conditions of a specific population at that particular moment. This

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type of survey does not involve following the same participants over time; instead, it focuses on a snapshot of the population's attributes or circumstances at a specific time point.

Cross-sectional surveys possess several strengths in research. They are efficient in terms of time and resources since data is collected at a single point in time, making them suitable for investigating a wide array of topics quickly (Babbie, 2016). When a random and well-structured sample is employed, these surveys can provide a snapshot of a population's characteristics, allowing findings to be generalized to the broader population. Additionally, cross-sectional surveys tend to be cost-effective, making them a favourable research method in terms of budget constraints. They also provide timely information about a population, which is crucial for tracking trends or addressing immediate concerns. Furthermore, researchers can use cross-sectional data to compare different groups or subpopulations, offering insights into disparities or variations in attitudes and behaviours.

However, cross-sectional surveys come with notable weaknesses. They are temporally limited, offering only a snapshot at one specific point in time, which hinders the ability to assess changes or trends over time. Causality is challenging to establish with cross-sectional surveys, as they do not track variable changes over time. Respondents may introduce response bias, misrepresenting their true attitudes or behaviours, which can undermine the findings' validity (Sudman and Bradburn, 1983). Cross-sectional surveys cannot effectively capture developmental processes or changes that occur within individuals over time. Additionally, they may not adequately address

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rare events or conditions because they might not occur during the specific time of data collection (Fowler and Cosenza 2009). In conclusion, while cross-sectional surveys offer efficiency and representativeness, they are limited in their ability to study changes over time and establish causal relationships.

Study Area

One of the sixteen regions of Ghana is the Central Region. The Central Region was a part of the Western Region until 1970 when it was carved off as a separate regional body soon before the 1970 Census. It covers 9,826 km² or 4.1 % of Ghana's geographical area, and it is the third smallest after Greater Accra and Upper East in terms of area. It is bordered on the west by Western Region, on the north by the Ashanti and Eastern Regions, and on the east by Greater Accra Region. The Atlantic Ocean (Gulf of Guinea) coastline stretches for 168 kilometers to the south.

Moreover, the temperature of the region is normally warm, ranging from 24 and 34 degrees Celsius. Rainfall in the region is bi-modal, ranging from 800 to 1500 mm on average, with the coast receiving the fewest. The primary season runs from April to July, while the minor season runs from September to November. The relative humidity in the area ranges from 50 to 85 per cent.

The region's land area is 9,830 km^2, accounting for 4.1 per cent of Ghana's total land area. The total cultivable land area in the region is estimated to be 7,864 km^2 (approximately 80 per cent) of the region's total land area). However, about 3,932 km^2 (40 per cent of the Region's land area) is cultivated.

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High production costs, high pesticide and fertiliser costs, low farm produce prices, undependable rainfall patterns, marketing flex, insufficient access to credit facilities for production, marketing, and processing, and inaccessibility of certain groups during the rainy season are all constraints in the region's agricultural activities.

The region is located in a semi-equatorial climate with a bi-modal rainfall pattern. The average yearly rainfall is between 700 and 1200 millimetres. The primary rainy season is from March to mid-July, with moderate rain from September to mid-November. During the rainy season, humidity is at an all-time high, peaking at 90 per cent between late May, early June, and early July. The district experiences a minimum temperature of 30˚C around March/April whilst the mean monthly temperature is 27˚C.

The selection of the Central region was chosen based on the fact that they among the leading region in vegetable production. This was supported by (Ministry of Food and Agriculture, 2023). The majority of farmers in the municipality are subsistence farmers who depend mostly on traditional production methods. The average size of a farm ranges from 0.3 to 1 hectare. Few commercial farmers and groups practice restricted large-scale agriculture. Also, the study area indicates that most of the farmers are inclined to the traditional farming method. This calls for a more innovative way of vegetable production and marketing. Hence the smallholder vegetable farmers' perceptions and willingness to accept agribusiness model innovation: a study in the Central Region of Ghana.

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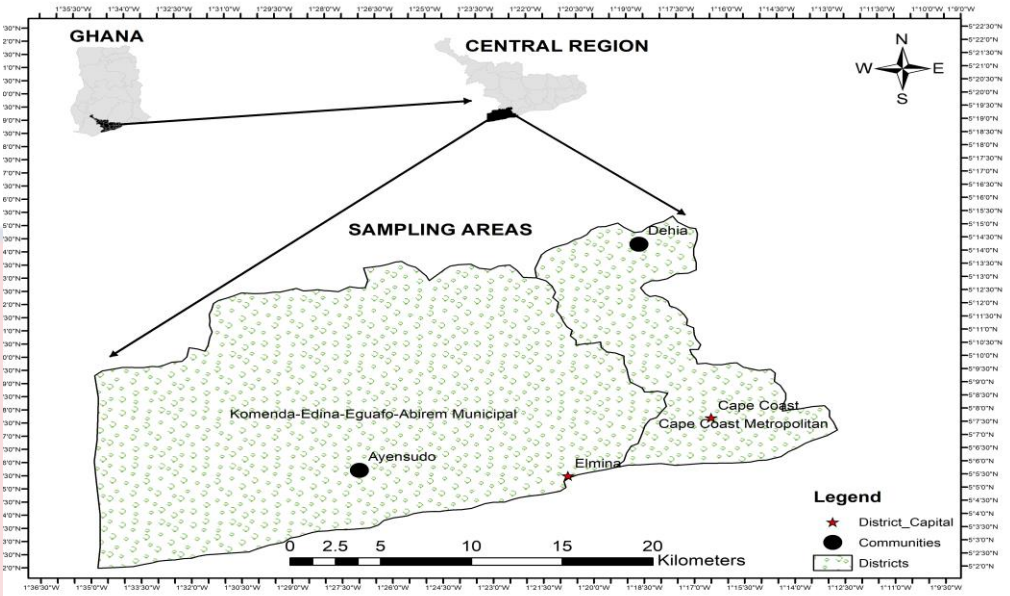

Figure 2: Map of the Study Areas in the Central Region

Source: Department of Geography and Regional Planning, UCC (2023)

Types of Data and Methods of Data Collection

Primary and secondary data were used to execute this study. The primary data was obtained from the information gathered from the selected farmers in the study area. A cross-sectional survey of smallholder vegetable farmers in the selected study areas in the Central Region of Ghana was used to gather the primary data.

Through a personal interview with the vegetable farmers, a questionnaire was employed to solicit the information. Socio-economic and institutional characteristics data of the farmers from each study area were captured using the questionnaire instrument. Again, the farmers'; awareness, perception, and preferred agribusiness model.

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Secondary data on demographic issues, including population size and other statistics, were obtained from journals, books, publications, the Ministry of Food and Agriculture (MoFA), the Ghana Statistical Service, and the Internet. All these data were acquired from Publish or Perish, Sage, Research Gate, student thesis, and Google Scholar database.

Study Population

In a broader context, a target population exhibits various characteristics and is also referred to as the theoretical population. The population being studied in a research project encompasses the complete collection of units that will be utilized to derive conclusions for that specific study, as described by (Cox, 2019). The population for the study was vegetable farmers in the Central region from two selected communities. According to (Ministry of Food and Agriculture, 2023) the Central region of Ghana is among the highest producers of vegetables. The study population used were vegetable farmers from the two communities (Ayensudo and Dehia) who were registered with MoFA. The study focused on vegetable farmers who resided and operated within the selected study areas, Ayensudo and Dehia in the Central Region. In order to accurately represent the study's population and sampling frame, a total of 400 registered vegetable farmers were included from these communities. The sampling frame indicated that Ayensudo had 250 registered vegetable farmers, while Dehia had 150. To do so, two hundred and fifty (250) vegetable farmers were used as a sample size as stated by the (Yamane, 1973) formula.

$$n = \frac{N}{1 + Ne^2}$$

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Where n=sample size

N=population size

e=error (0.05) term

Sample size calculation for Dehia

$n = \frac{150}{1+150(0.05)^2} = 109.09$

$n \approx 109$

Sample size calculation for Ayensudo

$n = \frac{250}{1+250(0.05)^2} = 153.85$

$n \approx 154$

Sampling Procedure and Sample Size

Sampling is a method used in research to select a subset of individuals or items from a larger population for the purpose of conducting a study or analysis. Sampling allows researchers to make inferences about a population without having to study every individual or element within that population. It is a crucial technique in research as it enhances efficiency, reduces costs, and often makes data collection more manageable (Creswell and Creswell 2017).

The research employed a two-stage sampling method to achieve the desired sample size for the study. This two-stage sampling approach was chosen because it involved just two distinct phases. These phases encompassed the use of purposive and simple random sampling techniques. In the initial phase, the researcher deliberately selected two areas from among the 22 administrative districts in the region, with a specific focus on their significant vegetable production capacity. These include; Komenda Edina

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Eguafo Abirem Municipality (KEEAM) and Cape Coast North Metro (CCN) In the second phase, a random sampling process was conducted to select a total of 250 farmers, consisting of 150 farmers from Ayensudo and 100 from Dehia.

To establish the appropriate sample size from the total study population, the Yamane formula, as outlined in (Yamane 1973), was employed. This formula was instrumental in determining the sample size required to represent the entire population adequately. According to the calculations using the Yamane formula, it was determined that a sample size of 109 farmers from Dehia was equivalent to representing 150, while a sample size of 154 farmers from Ayensudo corresponded to 250. Therefore, the total number of vegetable farmers needed for the study was found to be 263. However, the researcher was not able to get all 263 farmers necessary for the study. The researcher was able to get 250 vegetable farmers which represents a 95.1 % response rate. As per Holbrook, Krosnick, and Pfent (2007), research with a response rate exceeding 50% is more likely to result in accurate extrapolation from the sample size to the overall study population.

Table 1: Selected Sample Size based on the Communities

Selected communities	**Sample size**
Ayensudo	150
Dehia	100
Total	**250**

Source: Field data (Opoku-Agyemang, 2023)

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Data Collection Instruments

A questionnaire was adopted as the research instrument for the data collection from the respondents. The primary data was gathered from the responses of the vegetable farmers from the study areas using the questionnaire. The instrument was made up of open-ended and closed-ended questions. The instrument comprised six (6) parts.

1. Part 1: Socio-economic characteristics of farmers in the study areas. This dealt with the farmers' socioeconomic characteristics in the likes of; gender, age, whether the farmer is a native of the community or not, the highest level of education, marital status, religious background, landholding status, farm size, household income, status in the household, household size, years of vegetable farming experience, and a major source of labour.
2. Part 2: Institutional Characteristics. The farmers were asked about their access to extension services, source of extension services, access to financial services, and farmer-based groups/organisations/associations.
3. Part 3: Farmers' Awareness about Agribusiness Model Innovation (AMI). This part looked at farmers' awareness or knowledge of AMIs, whether a farmer is aware of the list of AMIs (thus, contract farming and out-grower scheme, corporate farming, direct farming, organic greenhouse vegetable farming, e-commerce agriculture, and supply chain management).
4. Part 4: Farmers' Perception of AMI. This area sought to resolve how farmers perceive the various AMIs.

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5. Part 5: Willingness to accept AMI. Farmers were asked questions to determine their willingness to accept the AMI.
6. Part 6: Preferred AMI Option by Farmers: Having determined farmers' willingness to accept AMI, farmers were introduced to different AMIs to choose from as the most preferred choice.

Recruitment and Training of Field Assistants

Three student researchers, all possessing substantial educational backgrounds in agriculture, economics, community development, and social sciences, were carefully chosen and enlisted for the data collection. These students were drawn from the University of Cape Coast in the Central Region of Ghana. Each of the enumerators possessed extensive experience in data collection and had a strong familiarity with the study areas and local languages. A thorough training program spanning three days was conducted to ensure their comprehension of the study's concepts and the data collection instrument. Pretesting took place in the chosen pilot study area, Kofiridua in the Cape Coast North Municipality, on the second day of training. The final day was dedicated to debriefing and reflecting on the outcomes of the pretesting. Adjustments to the questionnaire were made based on the feedback from the pretesting, and strategies were developed to approach the farmers more effectively for data collection.

Data Collection Procedure

A consent form was sent to the Agricultural Extension Agents in the two selected communities for the study. Also, the student researcher sought

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consent from the farmers from the study areas two weeks before the main data collection commenced. This was done through sensitisation and awareness programs. Although, the farmers showed positive interest in the study, the researcher returned to the community two weeks after the consent form has been approved for the main data collection exercise. The form provided information on the relevance of the study and issues regarding the safety of the data which was to be collected from the farmers. Data for the study were collected by the student researcher and three trained student researchers. They were trained in English yet, on the field, the local dialect of the farmers was used for easy understanding and accurate responses. The data collection commenced on March 1st, 2023 starting from Ayensudo which took two weeks to complete the exercise. On 16th March 2023, the next batch of the exercise commenced in the Dehia community, completed on 30th March 2023. In totality, it took the researcher a month to complete the two hundred-and-fifty data collection exercise.

Pilot Study

Pre-testing of the research instrument was done on vegetable farmers in Koforidua in the Cape Coast Municipality to ensure its reliability and validity on 15th February 2023. This was done on vegetable farmers in Koforidua in the Cape Coast North Metro in the Central Region. The area was chosen due to their significant involvement in vegetable farming; however, it has similar features to the study participants. The validity of an instrument concerns the extent to which the research measures what it purported to

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measure without bias or distortion. A copy of the questionnaire was sent to the research supervisor for validity testing to see if the quantity and kind of items in the questionnaire assess the concept or construct of interest (content validity). The student researcher made the necessary modifications based on the supervisor's remarks, such as rewording, adding, or removing some components as required.

Cronbach Alpha (=0.7) was utilised to assess the instrument's internal consistency in order to verify its reliability. As a result, the instrument's overall reliability was predicted to be 0.70 or higher. Pallant (2005) states that an instrument with a reliability coefficient of 0.70 or higher is more reliable and suitable.

The pilot study utilised Cronbach's alpha to test for the internal reliability of the variables used. A total of 7, 11, and 5 items were used to test for reliability. It was found that the alpha value for all the variables for the knowledge or awareness, perception, and preferred agribusiness model was equal to or greater than 0.934, 0.853, and 0.946, respectively. According to the rule of thumb, a reliability coefficient of 0.70 or above is good. This shows all the respondents' answers were considered reliable, indicating good internal consistency.

Table 2: Reliability Statistics

Variables	Cronbach Alpha	No: of Items
Awareness	0.934	7
Perception	0.853	11
Preferred Agribusiness Model	0.946	5

Source: Field data (Opoku-Agyemang, 2023)

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Data Processing Procedure

IBM-Statistical Package for Social Sciences (SPSS) version 26.0 software was used to analyse the data for the study. Descriptive and inferential statistics were performed to find solutions to the study's objectives. The data analyses were based on the purposes of the study.

Descriptive statistics such as; percentages, frequencies, mean and standard deviations were used to analyze the farmers'; socio-economic and institutional characteristics and awareness.

Farmers' preferred AMI was analyzed using Kendall's coefficient of concordance (Kendall W). Again, an independent sample t-test was used to analyse the perception of vegetable farmers on the AMI. Again, factor(s) that best predict farmers' willingness to accept AMI was analysed using the binary probit regression model.

Data Management

The collected data was password-protected on the computer to prevent someone else from accessing it. After the research, the data will be erased from the computer. Both the online and hard copies of the data will be deleted and discarded (burning) after five years of having taken relevant parts for publication. The hard copy will be locked in the supervisor's office to prevent external persons aside from the researcher and the supervision team from access.

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Ethical Considerations

Ethical clearance was obtained from the University of Cape Coast Institution Review Board to commence the study. Approval was also obtained from the various communities before conducting the research. Issues about the informed consent of study participants, anonymity and confidentiality were given much attention.

Participants were approached individually to seek their consent to participate in the study. The researcher explained the purpose of the study, confidentiality procedures, risks involved, benefits and the freedom to opt out of the study at any time. A participant who opt-out of the study was excluded and was not persuaded or forced in any form to participate in the study. All study participants were assured that their responses will be recognized or identified with unique codes.

An Empirical Model for Farmers' Acceptance of an Innovation

Estimation Techniques for Farmers' Willingness to Accept AMI

The study adopted binary probit regression to identify factors that best predict the smallholder vegetable farmers' willingness to accept the agribusiness model innovation in the study area. The probit model is said to be a statistical probability model of binary variables in the dependent variable (Liao and Liao, 1994)

The cumulative normal probability distribution is used in probit analysis. The binary response variable, *y*, has two possible values: 0 and 1 (Aldrich and Nelson, 1984). The probit model analysis provides statistically

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significant findings of which socioeconomic and institutional factors decrease or increase the farmers' probability of acceptance.

According to several studies conducted by researchers, (Bryan *et al*., 2013; Fosu-Mensah *et al*., 2012) have examined factors that impact a farmer's decision to pick a technological strategy using a probit model. The response variable is a dichotomous variable that is 1 if the farmer is willing to accept any of the innovational choices in response to perceived increased livelihood, and 0 if they will not. A binary response model (1=Yes and 0=No) is needed for this response variable. The logit and probit models are two choices for this study.

The probit model was applied to analyze the farmers' survey data to estimate the factors that best predict their willingness to accept. The regressors included socio-economic characteristics of the farmers such as gender, age, whether the farmer is a native of the community or not, the highest level of education, marital status, religious background, landholding status, whether farming is their principal occupation or not, farm size, household income, status in the household, household size, years of vegetable farming experience, and a major source of labour. Again, variables related to institutional characteristics also included: access to extension services and the number of times extension agents visit, source of extension service, access to financial service, and farmer-based group/organisation/association. The probit model is generally expressed as:

$$Yi=X_i\beta_i+\varepsilon_i \quad \ldots\ldots (1)$$

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Given, Y_i as the dependent variable (willingness to accept). X_i is the vector of explanatory variables contributing to the farmers' willingness to accept the innovation, and the εi is the error term.

The empirical model which is the probit model used is defined as follows:

Willingness to Accept (Y) = β_0 + β_1(Gender) + β_2(Age) + β_3(Education) + β_4(Marital Status) + β_5(Landholding) + β_6(Income) + β_7(Access to Extension Services) + β_8(Access to Financial Service) + β_9(Native Status) + β_{10}(Years of Farming Experience) + β_{11}(Household Size) + β_{12}(Household Status) + β_{13}(Perception) + β_{14}(Awareness) + β_{15}(Farm Size) +…….(2)

The socio-economic and institutional variables of the farmers in the model are presented as follows. FarmExp denotes the farmers' vegetable farming experience expressed in years. Gen denotes the farmers' gender, which is a dichotomous variable 1 if a farmer is a male, 0 for female (1=Male, 0=Female), Age represents the age of the farmer in complete years, Native indicates whether the farmer is an indigene of the community or immigrant who was a dummy variable, where 1 is Yes if the farmer is an indigene and 0 is No if the farmer is an immigrant (1=Indigene, 0=Immigrant). Edu denotes the farmer's level of education, MaritalStatus represents whether the farmer is; married, single, separated/divorced, and widowed, FarmSize represents the size of the farmers' farm-in acreage, AnnualIncome represents the farmers' household annual income, ExtService denotes the farmers' access to extension services, where a dichotomous (1=Yes and 0=No) variable was employed to evaluate their response, AccessFin denotes farmers' access to financial service

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which is a dichotomous (1=Yes and 0=No) variable 1 when the farmer has access to financial service, and 0 is when the farmer does not, FBO denotes a dummy variable 1 when a farmer belongs to a farmer based group/organisation/association, 0 if the farmer do not, ßs represents the unknown parameter yet to be estimated εi is the assumed error term which is predicted to be normally distributed.

Model Specification for Independent Sample T-Test

The T-test widely utilized statistical methods for assessing the statistical significance of differences in means between two groups. The null hypothesis posits that both means are equivalent from a statistical perspective, while the alternative hypothesis suggests that both means are statistically distinct, indicating a significant difference between them (Sundaram, Dwivedi and Sreenivas, 2010; Whitley and Ball 2002). For the comparison of 2 independent group means, (Kim 2019) use a *t*-statistic to test the hypothesis of equal population means only if we know the population variances of 2 groups, S^2_1 and S^2_2, as follows;

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad \text{.....(1)}$$

Where:

- X_1 is the sample mean of group 1.
- X_2 is the sample mean of group 2.
- S_1^2 is the sample variance of group 1.
- S_2^2 is the sample variance of group 2.

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- n_1 is the sample size of group 1.
- n_2 is the sample size of group 2.

From the study, the researcher compared two communities where group 1 denotes Dehia, and group 2 denotes Ayensudo.

Estimation Technique for Farmer Preferred Choice of AMI using Kendall's Coefficient of Concordance

Kendall's coefficient of concordance (W) was used to rank the farmers' preferred choice AMI. According to (Steedle and Shavelson, 2009), Kendall's W is an estimate of the variance of the row sum of *rank* R_1 divided by the maximum possible value the variance can take. However, this occurs when all variables under consideration are in total agreement. Hence, $0 \leq W \leq 1$, where 1 represents perfect concordance.

The Kendall's W statistic, S is computed first from the row-marginal sums of ranks R_i values received by the objectives.

$$S = \sum_{i=1}^{n}(R_i - \mathrm{r})^2 \quad \ldots\ldots (1)$$

Given S is a sum of squares statistics over the row sums of ranks R_i, and r is the mean of the R_i *value.* Following that, Kendall's W statistics can be obtained from the following formula:

$$W = \frac{12s}{m^2(n^2-n)-mT} \quad \ldots\ldots (2)$$

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Table 3: Variables and their Measurement included in the Model

Variables	Measure	A prior Expectation
Dependent Variable		
Willingness to accept the agribusiness model innovation	1-willing to accept 0-Not willing to accept	
Independent Variables		
Gender	Gender of the farmers (1=male, 0=female)	+/-
Age	Years	+
Marital status	1=married, 0= others	+/-
Educational level	Years of acquired education	+
Landholding	1= Own 0= others	+/-
Farm size	Farm size in acreages	+
Household income	The annual amount in GHC	+
Years of farming experience	Years of being a vegetable farmer	+
Extension services	1=access to extension service, 0=no access.	+
Access to financial services	1=access to financial service, 0=no access	+
Native	1=Indigene,0=immigrant	+/-
Household status	1=head, 0=other	+/-
Household size	Number of people in the house	+/-
Perception	Continuous variable	+
Awareness	1=yes, 0=no	+

Chapter Summary

This chapter of the study looked at the research methods employed in the current study. The methos included the introduction, description of the study area, research design, types of data and methods of data collection, study population, sample size and sampling procedure, data collection instruments, data collection procedure, pilot study, and data processing procedure. The chapter also looked at the models used in the study. Specifically, the models were: binary probit regression model, independent sample t-test, and the Kendall's coefficient of concordance.

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CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presents the discussions of the research findings concerning the research questions and hypothesis.

Socioeconomic Characteristics of the Respondents

Table 4 provides basic descriptive statistics on various variables for smallholder farmers. These variables include socioeconomic and institutional information such as gender, age, native status, and marital status, as well as information on landholding status, farm size, household income, years of experience, access to extension services and financial services.

The gender distribution within the sample demonstrates that women constitute just 30% of the sample engaged in vegetable farming in the study area, whereas men make up the majority at 70%. This is supported by Ajulo (2004) observed that women constituted a minority, accounting for 31.9% of the sampled individuals involved in vegetable farming. Adeoti, Cofie and Oladele, (2012b) and Adeoti, Oladele and Cofie (2012a) conducted studies on the sustainability of livelihoods through urban agriculture in Accra, Ghana. Their findings revealed that both male and female vegetable producers actively engaged in urban agriculture and regarded it as a significant contributor to their livelihoods.

It was revealed that the majority (77.6%) of the vegetable farmers were indigenes of the study area. his majority status suggests a wealth of local knowledge and expertise in vegetable cultivation, emphasizing the importance

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of harnessing these insights for sustainable farming practices. A study by Verma, Singh, Singh, Singh and Singh (2019) to assess the socio-economic profile of vegetable farmers in Western Uttar Pradesh in India indicated that the majority of the farmers were indigenes.

The study uncovered that a significant portion of vegetable farmers in the research area possess limited formal education, with 13.7% having no formal schooling, and 72.6% having completed only primary or junior high school. This highlights the pressing need for increased investment in educational and training initiatives for farmers to enhance crop productivity, access new markets, and embrace sustainable farming techniques though most of the farmers have formal education, however, the level of formal education is quite low. This is in line with Oluwasola (2015); Rahayu and Harahan (2015) and Mohammad, Sharad and Gaurav (2020) who collectively suggest that vegetable farmers have varying levels of education, with a significant proportion having at least completed middle school education.

The study found that the majority of vegetable farmers in the study area are married (86.8%), suggesting that the family unit plays a central role in agricultural production. Married farmers may benefit from having additional labour and support, which could increase productivity and improve outcomes. This is in confirmation of Singh, Kumar and Thakur (2022) in Varanasi district, Uttar Pradesh, who highlighted that the majority of farmers belonged to nuclear family systems.

Furthermore, the majority of vegetable farmers in the study area (55.5%) rent their land, indicating that access to land may be a significant

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barrier to agricultural production. In support, the majority of vegetable farmers in the study areas rent their land, indicating that access to land is a significant barrier to agricultural production Carolan, Mayerfeld, Bell and Exner, (2004); Dwumfour-Asare, Nyarko, and Adams (2018); Carolan (2005); and Tia, Deaton, Hailu and Nazli (2022).

The majority of vegetable farmers in the study area (86.3%) have access to extension services. However, (13.7%) do not. Farmers who have access to extension services can benefit from expert advice, training, and information tailored to their specific agricultural needs, thereby helping them overcome challenges and make informed decisions about their farming practices. This study is supported by Fatty, Ode and Ogbe (2018) whose work emphasized the pivotal role of agricultural extension services in enhancing vegetable production, reduced input costs, and better marketing opportunities. Conversely, Tamimi and Alataweneh (2019) research in southern West Bank, Palestine, indicated that farmers were dissatisfied with the level of extension services provided in that region.

The study's findings are indicative of a substantial divide in access to financial services among vegetable farmers in the study area. Specifically, just over half, or 54.6%, of the farmers have access to financial services. This suggests that a significant proportion of farmers are equipped with the necessary financial resources and access to credit to support their agricultural activities. However, it's concerning that 45.4% of the farmers do not have such access, highlighting notable barriers to obtaining credit and essential financial resources for their farming operations. This study is in line with Agbo, Iroh

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and Ihemezie, (2015) and Besar (2009) who indicated that although most vegetable farmers have access to financial services but informal means, however, due to difficulty in accessing formal financial services, most of the vegetable farmers sought to informal access.

The mean age of 44.956 for vegetable farmers in the study area reveals a demographic snapshot of the agricultural community in the region. With an average age of approximately 45, it suggests that the farming population is relatively mature. Bortey and Osuman, (2016) study supported these findings by showing that a substantial portion of vegetable farmers in Ghana fell within the age brackets of 30-39 and 40 years and above

The finding that the average farm size for vegetable farmers in the study area is 4.388 acres is a crucial piece of information for understanding the agricultural landscape in that region. In support, Dwumfour-Asare, Nyarko, and Adams (2018) revealed that the majority of urban vegetable farmers in Asante-Mampong, Ghana, operate on relatively small parcels of land, typically ranging from 1 to 2 acres.

The study's findings reveal that households engaged in vegetable farming in the study area have relatively modest income levels, with an average income of GHC6857.287. This statistic underscores the economic conditions within the community and suggests that, on average, vegetable farming might not be a high-income activity in the region.

Lastly, the study's results reveal that vegetable farmers in the study area have significant expertise in their agricultural pursuits, boasting an average of 13.955 years of farming experience. This statistic underscores the

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wealth of knowledge and hands-on proficiency within the farming community, suggesting that these farmers have accumulated nearly 14 years of practical wisdom and skills, which can be highly valuable in their farming operations.

Table 4: Socio-Economic Characteristics of the Respondents

Variable	Frequency	Percent
Gender		
Male	175	70
Female	75	30
Native		
Yes	194	77.6
No	56	22.4
Educational level		
No formal education	34	13.7
Primary	81	32.7
MSLC/JSS/JHS	99	39.9
SSS/SHS	27	10.9
Tertiary	7	2.8
Marital status		
Married	217	86.8
Single	20	8.0
Separated/Divorced	5	2.0
Widowed	8	3.2
Land holding status		
Owned	77	31.2
Family land	33	13.4
Rent	247	55.5
Extension service		
Yes	215	86.3
No	34	13.7
Access to financial service		
Yes	136	54.6
No	113	45.4

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	Mean	SD
Age	44.956	10.62
Farm size	4.388	1.82
Household income	6857.287	4388.23
Years of experience	13.955	9.22

%=Percentage, %=Frequency

Source: Field data (Opoku-Agyemang, 2023)

Smallholder Vegetable Farmers' Awareness of AMI

Awareness of agricultural innovations is pivotal for farmers as it keeps them abreast of evolving trends and contemporary methods for achieving sustainable livelihoods. Figure 4 illustrates the distribution of awareness among smallholder vegetable farmers regarding Agribusiness Model Innovation (AMI). The results unveiled that a significant proportion (83.0%) of farmers in Dehia were cognizant of supply chain management. In contrast, just over half (55.7%) of farmers in Ayensudo were aware of this concept. Moreover, 79.0% of farmers in Dehia and 50.0% in Ayensudo were aware of Agricultural E-commerce. On average, 74.0% of farmers in Ayensudo and 66.0% in Dehia were familiar with these practices. The awareness levels for contract farming and out-grower schemes stood at 74.0% in Dehia and 54.7% in Ayensudo, while for organic greenhouse vegetable farming and corporate farming, the figures were 71.3% and 27.0% in Ayensudo and Dehia, respectively. These findings collectively demonstrate that a significant majority of farmers are well-informed about various AMIs. Such awareness is of paramount importance as it paves the way for their willingness to embrace and adopt these innovations.

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The study agrees with a similar study by Sa'ari *et al.* (2018) on the deficiency in awareness and skills among Malaysian farmers when it came to sustainable farming technology. This deficiency was identified as a significant barrier that impeded both the acceptance and effective implementation of these sustainable agricultural technologies and innovations. Farmers who are aware of and implement these models tend to be better equipped to deal with changing weather patterns, droughts, and other climate-related challenges. Farmers who accept these technologies may experience higher productivity and profitability in the long run.

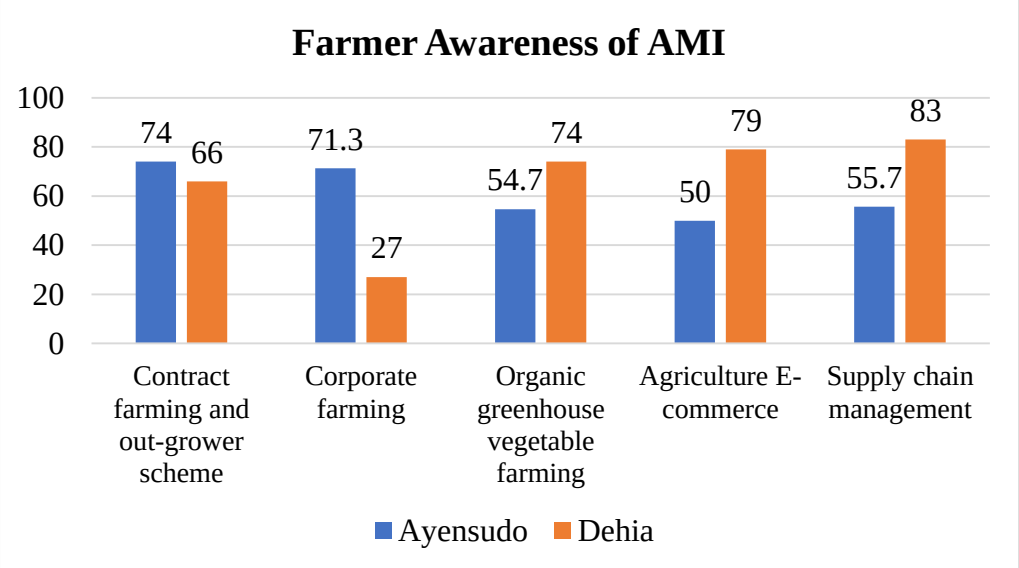

Figure 3: Smallholder Vegetable Farmers' Awareness of the AMI

Source: Field data (Opoku-Agyemang, 2023)

Perceived Characteristics of AMI in Vegetable Production

Table 5 below presents the perceived characteristics of AMI in vegetable production in the study area. The results indicated that there is a significant difference between several of the scores of the perceived characteristics of AMI. Between the two communities, it is evident that

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farmers in Dehia recorded a higher level of positive perception as compared to Ayensudo.

Favourable views regarding AMI encompass the belief that AMI innovations are effective in achieving optimal productivity (M=4.03, SD=0.90).

Additionally, it's perceived that AMI will harmonize with current farming practices (M=3.74, SD=1.07) and align with the current needs of the vegetable farming sector (M=3.72, SD=1.06), all while potentially reducing production costs (M=3.72, SD=1.05). Given the unpredictability of weather patterns and climate events, adaptability is paramount for sustaining agricultural productivity. AMI models often integrate innovative and climate-resilient techniques, serving as effective strategies to enhance productivity and mitigate the adverse impacts of climate variability. These AMI technologies offer flexible solutions that seamlessly integrate into farmers' routines, a critical factor for sustaining agricultural productivity amidst shifting weather patterns.

Furthermore, AMI practices, tailored to address climate challenges, such as improved pest and disease management through greenhouse vegetable farming, encourage the adoption of climate-smart agricultural strategies for long-term sustainability. These findings corroborate those of Ntshangase *et al.* (2018), which explored farmers' attitudes toward agricultural innovation, concluding that positive perceptions were associated with increased crop yields. Embracing agricultural innovations was significantly influenced by the

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confidence in applying these innovations and the perceived net benefits, as identified by Adrian *et al.*, (2005).

Table 5: Perceived Characteristics of AMI in Vegetable Production

Perceived attributes of AMI in vegetable production	**Ayensudo**		**Dehia**		**t-value**
	Mean	**SD**	**Mean**	**SD**	
AMI is an effective means of achieving optimum productivity	3.77	0.97	4.03	0.90	0.036**
There is a ready market for my produce	3.75	0.95	4.00	0.94	0.092
AMI is the best means of attaining a higher income	3.85	0.95	3.91	0.92	0.603
Post-harvest losses will be minimized	3.85	0.91	3.81	0.97	0.768
AMI will be compatible with the current practices of the farm	3.35	1.09	3.74	1.07	0.005***
AMI will be compatible with the current needs of the vegetable farming	3.41	0.96	3.72	1.06	0.019**
Reduce production cost	2.95	1.24	3.72	1.05	0.000***
Vegetable farmers will adopt AMI when mandated by law from the government	3.65	0.96	3.77	0.99	0.353
Implementing an AMI is most significant for farm business	3.66	1.00	3.79	1.07	0.339
AMI is a threat to farm business	3.48	0.92	3.65	1.07	0.180
AMI would be compatible with most socio-cultural beliefs and values	3.51	1.03	3.74	1.18	0.110
Compost	**3.57**	**1.00**	**3.81**	**1.02**	**0.22**

Significant at ***1% and **5%, 1-strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree
Source: Field data (Opoku-Agyemang, 2023)

Preferred AMI Smallholder Farmers

Results in Table 6 below present a summary of the findings from the preferred AMI by the smallholder farmer using Kendall's coefficient of concordance. Substantially, it was noted that the farmers preferred ($\bar{x} = 4.10$) contract farming and out-grower scheme as the most AMI innovation in

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achieving maximum livelihood. This may be of higher interest to the farmers already facing inputs, production, and finding markets for their production constraints. In support of this finding, (Schieffer and Vassalos 2015) indicated that contract farming has become a significant avenue in vegetable production. Averagely, the results indicated that most of the farmers preferred ($\bar{x} = 3.77$) corporate farming, therefore, farmers who may wish to lease out their lands to the various agribusiness firms as well as better access to credit facility (Mariyono, 2018) and marketing information (Shroff, *et al.,* 2015) would prefer to opt for this type of innovation.

Moreover, ($\bar{x} = 3.68$) organic greenhouse vegetable farming was preferred by smallholder farmers as an innovation for attaining higher returns. Farmers with relatively small land, and the promotion of organic production (Nakono, 2011); without compromising the health and well-being of the land (Sohail *et al.*, 2021) would vote to implement greenhouse vegetable farming as an alternative innovation for achieving maximum livelihood. It can also be seen from Table 3 above that some of the farmers from the study area preferably, choose ($\bar{x} = 3.25$) direct farming. This could be suggesting that farmers who wish to be sole owners have the necessary capital, training and knowledge, farm business assessment and planning (Thakur *et al.*, 2022) and ($\bar{x} = 3.20$) E-commerce agriculture (Business-to-customer) B2C as their best means of achieving better livelihood. Notably, perceived usefulness and perceived ease of use emerge as pivotal determinants in this context (Nguyen *et al.,* 2022). When farmers perceive e-commerce platforms as useful for their operations and find them easy to use, they are more inclined to consider

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incorporating them into their sales strategies. It was evident from the results that ($\bar{x} = 3.00$) supply chain management farming is the least preferred SAM as indicated in Table 3 above by the framers from the study area. Therefore, this may serve as a better way of achieving a greater livelihood for farmers who wants to be an actor along all aspects of the value chain. Serving as actors from the production, processing, marketing, and the final consumer (Ali, 2016).

Table 6: Preferred AMI by the Smallholder Farmers

Preferred AMI by the smallholder farmers	*n*	$\bar{x}$ Rank	SD	Min	Max
Contract farming and out-grower scheme	250	4.10	1.62	1.00	6.00
Direct Farming	250	3.25	2.03	1.00	6.00
Corporate Farming	250	3.77	1.37	1.00	6.00
Organic Greenhouse Vegetable Farming	250	3.68	1.53	1.00	6.00
E-commerce agriculture (Business-to-customer) B2C	250	3.20	1.72	1.00	6.00
Supply Chain Management Farming	250	3.00	1.64	1.00	6.00
Kendall's W[a]	.500				
Chi-Square	61.15				
df	5				
Asymp. Sig.	.000				

Ranked options: 1, 2, 3, 4, 5, 6. with six as the most preferred method and one as the least preferred

Source: Field data (Opoku-Agyemang, 2023)

Willingness to Accept

From the data provided, it's evident that smallholder vegetable farmers were surveyed about their willingness to embrace Agribusiness Model Innovations (AMI). The results indicate that the majority, comprising 94%, responded affirmatively with a "Yes," while a small minority, making up only 6%, responded negatively with a "No." This robust willingness to accept these

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innovations is an encouraging indicator for their success. Conversely, the limited reluctance to accept could suggest the possibility of resistance or opposition to these innovations.

Table 7: Summary Table on Vegetable Farmers Willingness to Accept

AMI	Frequency	Percentage
Willing to accept	235	94.0
Not willing to accept	15	6.0

n= 250

Source: Field data (Opoku-Agyemang, 2023)

Probit Model Estimation for Willingness to Accept AMI

To determine the best predictor influencing farmers' willingness to accept AMI, a probit model was employed, and the results are outlined in Table 14. The model, as a whole, demonstrates statistical significance, with a chi-squared value of 44.69 ($p = 0.0001$) and a pseudo-R-squared value of 0.4060. This pseudo-R-squared value signifies that the model effectively accounts for a considerable proportion of the variation in farmers' willingness to accept agribusiness models aimed at achieving sustainable livelihoods.

The study's revelation of a significant negative association between landownership and the willingness of smallholder farmers to accept agribusiness models for sustainable livelihoods holds crucial implications for agricultural development and rural well-being. It suggests that farmers who do not own their land might be less inclined to accept these innovative models due to resource constraints. This finding resonates with prior research, notably the works of Abdulai *et al*. (2011) and Kassie *et al*. (2015), emphasizing the consistent nature of this challenge across different contexts. To address this

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issue, there is a pressing need for strategies that alleviate resource limitations among landless farmers, such as providing access to credit, tailored extension services, and the development of agribusiness models adaptable to the realities of those without land. Additionally, these findings underscore broader discussions about equity and social inclusion in rural development, aiming to ensure that innovative and sustainable agriculture benefits all farmers, regardless of landownership, ultimately fostering more inclusive and equitable agricultural progress.

The research findings shed light on a significant negative impact of limited access to financial services on the acceptance of agribusiness models among smallholder farmers, with a p-value of 0.029. This emphasizes the indispensable role of financial inclusion in promoting the adoption of these models. These results resonate with the conclusions drawn by Beshir *et al.* (2012), who found that access to financing has a positive influence on adoption. This is primarily because farmers with financial access can invest in more advanced agricultural technologies, which can lead to increased productivity and sustainability. Furthermore, as noted by Gebremichael and Gebremedhin (2014), access to financing reduces liquidity constraints and enhances the intensity of agricultural technology adoption. In essence, the findings highlight the pivotal role of financial services in agricultural innovation adoption, making a strong case for policies and initiatives aimed at improving access to finance among smallholder farmers to facilitate their acceptance of agribusiness models and enhance their overall agricultural practices and outcomes.

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The research findings, which reveal the significant and negative impact of household status, particularly being the head of the household, on farmers' willingness to embrace agribusiness model innovations (with a p-value of 0.050), provide valuable insights into the dynamics of agricultural adoption within rural communities. These results underscore the multifaceted nature of the challenges faced by household heads in embracing new agricultural practices. As primary decision-makers and resource allocators, household heads often carry the weight of responsibilities that extend beyond the agricultural domain. This burden may lead to time constraints, risk aversion, and a conservative approach to adopting innovative models, as their choices have wide-ranging consequences for their entire family. Moreover, gender and sociocultural norms can further shape their roles and responsibilities. To address these barriers, tailored support programs, extension services, and educational initiatives are essential. By acknowledging the unique challenges faced by household heads and providing targeted solutions, agricultural policies and interventions can help bridge the gap between household dynamics and the successful adoption of sustainable and innovative agribusiness models, contributing to more resilient and productive rural communities.

The study's recognition of perception as a significant and positive factor influencing farmers' willingness to accept agribusiness models, with a p-value of 0.001, highlights the critical role of farmers' attitudes and beliefs in the adoption of innovative agricultural practices. A positive perception, driven by an understanding of the potential benefits, serves as a powerful motivator

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for smallholder farmers. This aligns with the notion that perception can be a catalyst for change, driving the adoption of sustainable and efficient agribusiness models. To foster this positive perception, multifaceted strategies can be employed. Education and awareness-raising campaigns can provide farmers with information and insights into the advantages of these innovations, dispelling uncertainties and building confidence in their effectiveness. Demonstrating the tangible benefits of agribusiness models through practical examples can further reinforce the positive perception. Additionally, employing targeted communication strategies ensures that information is conveyed effectively to the target audience, emphasizing the relevance and advantages of the innovations to their specific needs and circumstances.

These results resonate with previous research, including Morton *et al.,* (2017) and Ntshangase *et al.,* (2018), which also underlines the pivotal role of perception in influencing farmers' behaviour and adoption of agricultural innovations. In essence, the findings emphasize that understanding and positively shaping farmers' perceptions can be a linchpin in promoting the acceptance of agribusiness models. This, in turn, can lead to enhanced sustainability, productivity, and resilience in smallholder farming communities, ultimately contributing to the overall well-being and prosperity of rural areas.

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Table 8: Probit Regression Willingness to Accept AMI

Willingness to Accept	Coef.	Std. Err.	z	P>z	dy/dx
Gender (1=male)	0.82	0.62	1.32	0.187	0.07
Age (years)	-0.02	0.02	-0.70	0.484	-0.00
Marital status (1=married)	0.71	0.75	0.94	0.347	0.06
Educational level	0.36	0.26	1.39	0.164	0.03
Landholding (1=owner)	-0.56**	0.28	-2.02	0.044	-0.05
Farm size (acres)	-0.12	0.10	-1.15	0.249	-0.01
Household income (GHC)	0.00	0.00	0.28	0.783	0.00
Years of farming experience	0.02	0.03	0.70	0.482	0.00
Extension services (1=yes)	-0.18	0.87	-0.20	0.840	-0.01
Access to financial services (1=yes)	-1.56**	0.71	-2.18	0.029	-0.13
Native (1= indigene)	0.16	0.45	0.36	0.716	0.01
Household status (1=head)	-0.87*	0.45	-1.96	0.050	-0.07
Household size	0.16	0.13	1.24	0.215	0.01
Perception	0.12***	0.03	3.38	0.001	0.01
Awareness (1=yes)	-0.07	0.11	-0.64	0.519	-0.01
Constant	-0.82	2.14	-0.38	0.702	
Number of obs	=	250			
LR $chi^2(15)$	=	44.69			
Prob>chi^2	=	0.0001			
Pseudo R^2	=	0.406			
Log-likelihood	=	-32.693			

N=250, *p-value=0.1, **p-value=0.05, and ***p-value=0.01
Source: Field data (Opoku-Agyemang, 2023)

Chapter Summary

This chapter presented the results and discussed the findings of the study. The chapter was introduced to reflect the content of the chapter. The socioeconomic characteristics of vegetable farmers in the study areas were presented. The farmers' awareness of AMI, perception, and preferred AMI. The last part of the chapter then looked at the factors that best predict the farmers' willingness to accept agribusiness model innovation.

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CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

Introduction

This chapter presents the summary, conclusions and recommendations of the study. The summary of the study and conclusions have been organized based on specific objectives and the hypothesis of the study. This section also presents a suggested area for further research.

Summary

Overview of the Study

The issues of agricultural innovation acceptance have gained a lot of attention in recent vegetable production. This has become one of the topmost discussed issues by several farmers, agricultural experts, researchers and academics. By investigating the perceptions and willingness of farmers in the Central Region to accept agribusiness model innovations, the research contributes to understanding the potential for increased productivity and economic growth in the agricultural sector of the region. To improve smallholder farmers' productivity, perception, awareness and willingness to accept AMI is paramount. However, it is deemed expensive relative to traditional farming. Research findings suggest that the primary challenge is often linked to the acquisition of the innovation and the initial phase of its utilization. However, a farmer who employs these innovations stands to potentially reap profits exceeding double the initial investment made in its purchase or utilization. This study was designed to determine whether

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vegetable farmers are willing to accept agribusiness model innovation to help achieve sustainable livelihood thus, the following specific objectives were specified for the study; a) To examine smallholder vegetable farmers' awareness of agribusiness model innovation in the study area; b) To examine smallholder vegetable farmers' perception of agribusiness model innovation in the study area; c) To determine the agribusiness model innovation that is preferable to smallholder farmers in the study area; d) To identify factors that best predict smallholder vegetable farmers' willingness to accept the agribusiness model innovation in the study area.

The study was conducted in the Central Region of Ghana. The area selected is a vegetable farming area in the Central Region of Ghana. The location was Ayensudo and Dehia community. The research utilized a quantitative research method and structure by employing a cross-sectional survey approach. The study population comprised vegetable farmers residing in the specified study areas. The study made use of two-stage sampling technique to obtain the desired sample of 250 respondents from the sample frame of 400 farmers. The study used a questionnaire as the data collection tool for the study with different sections of the questionnaire soliciting for response based on the specific objectives of the study. The data was analysed using analytical tools such as descriptive statistics, Kendalls Coefficient of Concordance, Independent Sample T-test, and binary probit regression model. The summary of the findings of the study is as follows;

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Socio-Economic and Institutional Characteristics of the Respondents

The study revealed that (70.0%) of the respondents were males. This could only be true as a result of males being known for farming activities and their female counterparts being targets or champions of activities regarding trading. The average age indicated in the study was found to be approximately 45 years with about 14 years of farming experience. Regards to household income, the study revealed that on average the farmers' income is GHC6857. 29pesawas. Also, it was found that the average farm size of the vegetable farmers was 4.39 acres of land. Again, it was revealed that about (77.6%) of the respondents were natives of the communities. This suggests a probable low level of migration into migrants into vegetable farming in the study area. Moreover, the results suggested that even though a high proportion (72.6%) of the respondents had a formal education, the level of their education could be much higher. The study revealed that most (55.7%) of the farmers rent their farms. In the study, 86.3% indicated that they have access to extension services. With the access to financial services, (54.5%) of farmers were indicated that they have access.

Smallholder Vegetable Farmers' Awareness

The findings indicated that an overwhelming majority of the farmers were aware of the various AMI innovations. The awareness level of the farmers is essential since it will facilitate their willingness to accept the AMI.

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Perceived Characteristics of AMI in Vegetable Production

Almost all the farmers had a positive perception of the AMI. The perception level of the farmers about innovation is vital to deciding their acceptance level of the innovation. The farmers' response shows that AMI can serve as a tool for delivering farmers from poverty. In summary, the perception index on the various variables was encouraging. From this, the vegetable farmers showed a higher level of positive perception toward the innovations presented to them. Farmers' attitudes regarding new innovations may be the most important factor in determining whether or not they accept new agricultural methods.

Preferred AMI Smallholder Farmers

Substantially, it was noted that the farmers preferred ($\bar{x}$=4.10) contract farming and out-grower scheme as the most AMI innovation in achieving maximum and sustainable livelihood. This may be of higher interest to the farmers already facing inputs, production, and finding markets for their production constraints.

Probit Model Estimation for Willingness to Accept AMI

The findings on the summary on the farmers willingness to accept AMIs revealed that farmers in both communities were willing to accept as it was indicated by 94.0% of the farmers. The results of the binary probit regression model of 15 variables, only 4 variables thus, landholding, access to financial services, household status and farmers' perception were significant.

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Conclusion

The study's results successfully meet the study's objectives and hypotheses. Each objective was approached as an individual concept, and the relationships between them were examined by testing the hypotheses, ultimately leading to the establishment of relationships among the variables.

The socio-economic characteristics of the study were introduced into the study to find out the individual characteristics of the farmers for the study. The majority of the farmers are male, aligning with traditional gender roles in farming and trade. The average age is around 45 years, with an average of 14 years of farming experience. Household income and farm size were within an average and relatively small-scale farming respectively. A significant portion of the respondents were natives of the communities, indicating limited migration into vegetable farming. Furthermore, while many farmers have formal education, there is potential for further educational attainment. A substantial percentage of the farmers rented their farms, and there is a high level of access to extension services. Access to financial services is also significant, supporting their agricultural activities.

The study further concluded that the farmers demonstrated a strong awareness of various AMI innovations and had a positive perception of their potential to give them sustainable livelihood. They particularly favoured contract farming and out-grower schemes as effective means to address production challenges and market access.

Lastly, it was concluded that there was a strong willingness among farmers in accepting AMI, especially when considering factors like

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landholding, access to financial services, household status, and farmers' perception.

Recommendations

Based on the results of the study, it is recommended that:

Firstly, the Ministry of Food and Agriculture, in collaboration with agricultural-focused Non-Governmental Organizations (NGOs), should prioritize educational initiatives aimed at enlightening vegetable farmers in the Central Region on the significance of accepting agricultural innovations over adhering solely to traditional farming methods. Such a shift can lead to more sustainable livelihoods for farmers while concurrently promoting environmental sustainability.

Secondly, the Ministry of Agriculture and various Agribusiness firms should help expand and promote contract farming, support and extend out-grower schemes, improve input accessibility, enhance market access, and provide training and financial support. By capitalizing on these recommendations, farmers can thrive within the framework of contract farming and out-grower schemes, ultimately benefiting their economic well-being and contributing to the growth of the agricultural sector.

Thirdly, the Government of Ghana should focus on facilitating improved land access and allocation, strengthening land tenure security, and promoting efficient land use practices. Encouraging land allocation and leasing policies that support smallholder farmers and provide them with the necessary resources for AMI adoption can provide additional avenues for

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smallholders to maximize the potential of their landholdings, ultimately enhancing their livelihoods and contributing to agricultural development.

Fourthly, the Ministry of Agriculture through the Government of Ghana should help provide financial support to smallholder farmers through microloans and credit facilities designed to facilitate their investment in AMI. Also, the Ministry of Agriculture should encourage an enabling environment for these initiatives, recognizing the pivotal role of access to financial services in promoting AMI adoption among farmers.

Lastly, the Ministry of Agriculture should focus on providing training and awareness programs that emphasize the advantages of AMI to all household members. Encouraging shared decision-making and involvement in farm activities can empower every family member to participate in the adoption process.

Suggestions for Further Research

The research's focus on specific aspects of Agribusiness Model Innovations (AMI) in the Central Region of Ghana is valuable, but there is room for broader insights. Future studies should consider expanding their scope to encompass other regions in Ghana, such as the Northern Region, Ahafo Region, Bono East Region, and Eastern Region. This extension will help in understanding whether the findings and patterns observed in the Central Region are consistent across different geographical and socio-economic contexts. By conducting more comprehensive and diverse studies, researchers can provide a more holistic view of AMI adoption in Ghana,

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allowing for a better-informed policy and strategy development that caters to the diverse needs of farmers across the country.

The study employed several estimation methods, including Kendalls coefficient of concordance, probit regression, independent sample t-test, and descriptive statistics. To enhance the research, it is advisable to explore alternative estimation methods in future studies.

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APPENDICES

UNIVERSITY OF CAPE COAST

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

Questionnaire

Smallholder Vegetable Farmers' Perceptions and Willingness to Accept Agribusiness Model Innovation: A Study in the Central Region of Ghana

This study is designed to assess Smallholder Vegetable Farmers' Perceptions and Willingness to Accept Agribusiness Model Innovation: A Study in the Central Region of Ghana. You have been identified as an individual to provide information to achieve the objectives of the study. The interaction session is expected to last for about 30 minutes. Please respond honestly to the questions on this questionnaire/interview schedule. Be assured that all the information that will be provided will be used for the intended objectives and will be kept confidential. Your name and phone number have been requested to assist us in reaching you again for follow-up questions. Participation in this survey is voluntary, and you can choose not to answer any individual question or all of the questions. However, I hope you will participate in this study since your views are important.

Do you want to ask me anything about the survey now? 1. Yes [ ] 2. No [ ]

If yes, indicate your question ……..

May I ask you the survey questions? 1. Yes [ ] 2. No [ ]

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Part 1: Socioeconomic characteristics of farmers in the study areas.

1. Gender: 1. Male [ ] 2. Female [ ]
2. Age at last birthday: _____ years
3. Are you a native of this community? 1= Yes [ ] 0=No [ ]
8. Highest level of education? 1=Primary [ ] 2=MSLC/JSS/JHS [ ] 3=SSS/SHS [ ] 4=Tertiary [ ]
9. Marital Status: 1=Married [ ]2=Single [ ] 3=Separated/Divorced [ ] 4=Widowed [ ]
10. Religion: 1=Christian [ ] 2=Muslim [ ] 3=Traditionalist [ ] 4=I prefer not to say [ ]
11. What is your current land holding status?1=Own land [ ] 2=Renting [ ]
12. What is the size of your farm? ……(Acres)
13. What is your household annual income?.....(GHC)
14. Status in the household. 1=Head [ ] 2=Spouse [ ] 3=Child [ ] 4=Others, specify …….
15. Please indicate your household size……
16. How long have you been a vegetable farmer?.....
17. What is the major source of labour for your vegetable production activities? 1=Family [ ] 2=Hired [ ] 3=Others (Specify)……

Part 2: Institutional Characteristics

18. Do you have access to any extension services? 1=Yes [ ] 0=No [ ]
19. Do you have access to financial services? 1=Yes [ ] 0=No [ ]
20. Do you belong to any farmer-based group/organisation/association? 1=Yes [ ] 0=No [ ]

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Part 3: Farmers' Awareness about Agribusiness Model Innovation (AMI)

21. What type of business model are you aware of? Respond **Yes** or **No** to the table below.

Awareness of AMI	**Yes**	**No**
Contract farming and out-grower scheme		
Corporate Farming		
Organic Greenhouse Vegetable Farming		
E-commerce agriculture (Business-to-customer) B2C		
Supply Chain Management Farming		

Part 4: Farmers' Perception of AMI

22. Please tick the perception statements(s) that apply to you. Respond on a Likert scale 1=Strongly disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree.

Perceived characteristics of AMI in vegetable production	**1**	**2**	**3**	**4**	**5**
AMI innovation is an effective means of achieving optimum productivity					
AMI is the best means of achieving a higher income					
There is a ready market for my produce					
Post-harvest losses will be minimized					
AMI is a threat to farm business					
Implementing an AMI is most significant for farm business					
AMI will be compatible with most socio-cultural beliefs and values					
AMI will be compatible with the current needs of the vegetable farming					
AMI will be compatible with the current practices of the farm					
Vegetable farmers will Accept AMI when mandated by law from the government					
Reduce production cost					

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Part 5: Willingness to accept AMI

23. Will you be willing to accept a new method of farming and marketing your produce? 1=Yes [ ] 0= No=[ ]

24. I will like you to imagine the following scenario. A company is introducing an innovation in the production and marketing of your vegetables. Several scenarios will be introduced to you to choose one which is most preferable to give you a maximum expected livelihood. You are to indicate if you are willing to accept or not willing to accept.

Packages	**Yes**	**No**
Option 1: Contract farming and out-grower scheme		
		
Reduction of the risk of production, stable price and marketing costs, **Unequal bargaining power**		
Option 2: Corporate Farming	**Yes**	**No**
		
Reduction in post-harvest losses, access to new technologies, access to inputs, **Control over your operations**		

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Option 3: Organic Greenhouse Vegetable Farming	**Yes**	**No**
		
Provides greater protection against pollution, diseases, and pests, **high cost of inputs**		
Option 4: E-commerce agriculture (Business-to-customer) B2C	**Yes**	**No**
		
Reduction in inventory cost eliminates the requirement of a physical location, **Fraud cases**		
Option 5: Supply Chain Management Farming	**Yes**	**No**
		
Improved cash flow, employment generation, produce loss minimization, **Quality control and defect**		

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Part 6: Preferred AMI option by farmers

25. Which of the following AMIs is your preferred option for scaling up a farmer's income level? Rank all the options from 1, 2, 3, 4, 5, 6 etc. with 6 as the most preferred method and so on.

AMI	**Ranking**
Contract farming and out-grower scheme	
Direct Farming	
Corporate Farming	
Organic Greenhouse Vegetable Farming	
E-commerce agriculture (Business-to-customer) B2C	
Supply Chain Management Farming	

Thank You

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Ethical Clearance

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10TH FEBRUARY 2023

Mr Williams Opoku-Agyemang
Department of Agricultural Economics and Extension
University of Cape Coast

Dear Mr Opoku-Agyemang,

ETHICAL CLEARANCE – ID (UCCIRB/CANS/2022/47)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research on ***Smallholder Vegetable Farmers' Perceptions and Willingness to Accept Agribusiness Business Model: A Study in Central Region of Ghana.*** This approval is valid from 10th February 2023 to 9th February 2024. You may apply for a renewal subject to the submission of all the required documents that will be prescribed by the UCCIRB.

Please note that any modification to the project must be submitted to the UCCIRB for review and approval before its implementation. You are required to submit a periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Koli F. Amuquandoh

Ag. UCCIRB Administrator

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