COMPARATIVE ANALYSIS OF MIXED, ORGANIC & CONVENTIONAL CASSAVA FARMING SYSTEMS IN EDO SOUTH AGRO-ECOLOGICAL ZONE, NIGERIA

BY

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PG/AEE/240016

B.Agric (Crop Protection) Federal University of Agriculture, 2021, Abeokuta, Nigeria

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION SERVICES

FACULTY OF AGRICULTURE AND AGRICULTURAL TECHNOLOGY.

BENSON IDAHOSA UNIVERSITY, BENIN CITY, EDO STATE, NIGERIA.

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DECLARATION

I, **ASHIBUOGWU, Blessing** with matriculation number **PG/AEE/240016**, hereby declare that I have written this dissertation and it is a record of my research work for the award of Master's Degree (M.Sc.) in Agricultural Economics. It has not been presented in any previous application for a higher degree at this or any other University. All citations and sources of information are clearly acknowledged by means of reference.

……. **……**

ASHIBUOGWU, Blessing **DATE**

CERTIFICATION

We certify that ASHIBUOGWU, Blessing, with matriculation number PG/AEE/240016 of the Department of Agricultural Economics and Extension Services, Faculty of Agriculture and Agricultural Technology, Benson Idahosa University, Benin City, carried out the work reported in this dissertation.

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PROF. WILLIAM ODUH **DATE**
Dean of Postgraduate School

DEDICATION

This work is dedicated to my beloved Husband, Pastor Dr. Peace Ashibuogwu, whose unwavering support, encouragement, and inspiration made this research project possible. Your belief in me and your constant motivation have made this journey possible and profoundly fulfilling. Thank you for your patience, understanding, and for being my partner in every step of this endeavor.

PLAGIARISM ATTESTATION

I certify that this report is my own work, based on my personal research and that I have acknowledged all material and sources used in its preparation, whether they be books, articles, reports, lecture notes, or any document, electronic or personal communication. I also certify that the report has not previously been submitted for assessment elsewhere, and I have not copied in part or whole, otherwise plagiarized the work of other students and/or persons.

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TABLE OF CONTENTS

DECLARATION iii

CERTIFICATION iv

DEDICATION v

PLAGIARISM ATTESTATION vi

ACKNOWLEDGEMENT vii

ABSTRACT xii

CHAPTER ONE 1

Introduction 1

1.1 Background To The Study 1

1.2 Problem Statement 2

1.3 Objectives Of The Study 4

1.4 Justification Of The Study 5

CHAPTER TWO 7

Literature Review 7

2.1 Definition Of Terms 7

2.1.1. Organic Farming 7

2.1.2 Cassava Production In Nigeria 10

2.1.3 Organic Farming In Cassava 15

2.2 Economics Of Organic Farming Of Cassava 19

2.3 Environmental Impacts Of Organic Farming Of Cassava 22

Positive Environmental Impacts 22

Negative Environmental Impacts 26

2.4 Empirical Review 27

CHAPTER THREE 33

Methodology 33

3.1 Area And Scope Of Study 33

3.2 Source Of Data 33

3.3 Sampling Technique And Sample Size 34

3.4 Measurement Of Variables 35

Analytical Techniques 36

CHAPTER FOUR 40

Results And Discussion 40

4.1 Socio-Economic Characteristics Of The Cassava Farmers. 40

4.1.1 Age Distribution 41

4.1.2. Sex Categorization 43

4.1.3 Marital Status: 45

4.1.4 Household Size: 46

4.1.5 Educational Level: 48

4.1.6 Years Of Experience In Cassava Farming: 50

4.2 Cassava Production System Employed By The Farmers 52

4.2.1 Farming System Types 53

4.2.2 Cassava Variety Cultivated 53

4.2.3 Cassava Farm Size (Hectares) 54

4.2.4 Major Sources Of Labour 56

4.2.4.1 Family Labour Dominance In Organic Farming 56

4.2.4.2 Balanced Use Of Labour Among Conventional Farmers 56
4.2.4.3 Labour Trends Among Mixed Farmers 57
4.2.4.4 Limited Use Of Cooperative And Mechanized Labour Across All Systems 57
4.3 Technical Efficiency Of Production Systems In The Study Area 58
4.3.1 Resource Use Efficiency Of Input Across Farming Systems 60
4.3.2 Technical Efficiency Scores By Farming System 63
4.4 Costs And Returns Of Cassava Production Systems 66
4.4.1 Major Production Costs 66
4.4.2. Estimated Average Annual Income Of Cassava Farmers By Farming System 69
4.4.3. Marketing Channels For Cassava Produce By Farming System 71
4.4.4. Profitability Analysis 74
4.5 Constraints To Cassava Production Systems 77
CHAPTER FIVE 81
Summary, Conclusion And Recommendations 81
5.1 Summary 81
5.2 Conclusion 84
5.3 Recommendations 85
5.4 Contributions To Knowledge 86
REFERENCES 89
QUESTIONNAIRE 96

LIST OF TABLES

Table 4.1: Socioeconomic Characteristics of Cassava Farmers across Selected LGAs

Table 4.2: Farming System Type

Table 4.3: Cassava Variety Cultivated

Table 4.4: Distribution of Cassava Farm Size by Farming System

Table 4.5: Major Sources of Labour by Farming System

Table 4.6: Technical Efficiency Indicators by Farming System

Table 4.7: Resource Use Efficiency by Farming System

Table 4.8: Technical Efficiency Scores by Farming System

Table 4.9: Major Production Costs by Farming System (₦/ha)

Table 4.10: Estimated Average Annual Income from Cassava Farming by Farming System

Table 4.11: Marketing Channels for Cassava Produce by Farming System

Table 4.12: Profitability Analysis by Farming System

Table 4.13: Ranking of Production Constraints by Farming System

ABSTRACT

Most Cassava farmers practices Conventional farming system, and are faced with the problems of low economic returns and a long term adverse effects on the environment. Hence, this study gives a comparative analysis of Mixed, Organic and Conventional farming systems in Edo South Agro-ecological zone, Nigeria, analyzing adoption patterns, profitability, and production constraints. A two-stage sampling procedure was used in drawing up a sample frame of 240 cassava farmers from five purposely selected local government area. Data collected with the aid of a well- structured questionnaire were analyzed using descriptive statistics and comparative assessment. Conventional farming was noted to be the predominant system (74.6%) followed by organic (15%) then mixed systems (10.4%). Organic farmers achieved the highest technical efficiency (0.708) and profitability (₦1,570,000/ha), with a return on investment of (72%). Followed by Mixed system farmers followed closely, with technical efficiency of (0.665), profitability (₦1,490,000/ha), with a return of investment of (65.9%), and the least of Conventional system with technical efficiency of (0.62), profitability (₦1,410,000/ha), with a return of investment of (60.3%). The most critical constraint across all systems was the high cost of inputs, particularly for conventional farmers. Other major constraints include poor market prices, limited access to credit, pest infestations, storage challenges, and land access. While Organic farmers face fewer constraints due to sustainable practices and better market positioning, conventional farmers encountered the most severe production challenges. The study concludes that organic farming offers the most economically viable and efficient pathway for smallholder cassava production in Edo South, with implications for targeted policy and extension interventions.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Organic farming has garnered significant attention as an alternative to Conventional agricultural practices, particularly in developing regions like Nigeria (Adeolu & Taiwo, 2024). The drive towards organic farming is motivated by concerns over the long-term sustainability of conventional farming methods, which often rely heavily on synthetic fertilizers and pesticides (Gomiero *et al*., 2021). These conventional practices, while effective in boosting short-term yields, have raised alarm due to their adverse effects on soil health, biodiversity, and the environment (Reganold & Wachter, 2023). With cassava (*Manihot esculenta*) being a staple crop that plays a critical role in the food security and economy of the region, understanding the potential economic and environmental impacts of organic cassava farming is crucial for Promoting sustainable agricultural development.

Organic farming emphasizes the use of natural inputs and ecological processes being viewed as a viable alternative that could potentially enhance soil fertility, reduce chemical usage, and improve farmers' income by tapping into premium markets that favor organically grown produce (Lampkin, 2019; Willer & Lernoud, 2019).

The concept of organic farming is grounded in principles that seek to maintain ecological balance and foster biodiversity. According to Lampkin (2019), organic farming systems are designed to minimize external inputs by using crop rotations, organic fertilizers, and biological

pest control, which help maintain soil health and enhance the resilience of farming systems. This approach contrasts sharply with conventional farming methods that often prioritize yield maximization through the use of synthetic inputs, which can lead to soil degradation and environmental harm over time (Pimentel *et al*., 2024). The environmental benefits of organic farming are well-documented, with studies showing that organic practices can lead to improved soil structure, increased organic matter content, and higher levels of biodiversity on farms (Mäder *et al*., 2022). Moreover, organic farming is associated with lower greenhouse gas emissions and reduced water pollution, making it a more environmentally sustainable option compared to conventional farming (Reganold & Wachter, 2019). Economically, organic farming has the potential to offer significant benefits to farmers, particularly in developing countries where access to synthetic inputs can be costly and market demand for organic produce is growing. According to Scialabba & Hattam (2022), organic farming can enhance the economic resilience of smallholder farmers by reducing their reliance on expensive inputs and providing access to niche markets that offer price premiums for organic products. This is particularly relevant in the context of cassava farming in agro-ecological zone, where farmers often face challenges related to the high cost of synthetic inputs and fluctuating market prices for conventional grown cassava. By adopting organic farming practices, cassava farmers in the region could potentially increase -their income by accessing organic markets and reducing their production costs (International Federation of Organic Agricultural Movement, IFOAM 2022).

1.2 Problem Statement

Cassava farming is a vital agricultural activity in Edo south agro ecological zone, forming the bedrock of local food security and economic sustenance (Adebayo & Adeola, 2022). Conventionally, farmers in this region have relied on conventional agricultural practices that

involve the extensive use of synthetic fertilizers and pesticides (Adeniji et *al*., 2023). While these practices have delivered short-term gains in productivity, they have also raised significant concerns about long-term environmental sustainability, particularly in relation to soil degradation, loss of biodiversity, and chemical pollution (Nwajiuba & Nwankwo, 2020) In recent years, organic farming has been proposed as a sustainable alternative to conventional methods, particularly for crops like cassava that are integral to local diets and economies (Olutunmise *et al*., 2024). Organic farming practices, which exclude synthetic inputs in favor of natural fertilizers and pest management techniques, are lauded for their potential to improve soil health, enhance biodiversity, and reduce the environmental impact of agriculture (Fess *et al*., 2018). Additionally, organic farming is believed to offer economic benefits by providing farmers with access to premium markets that favor organically grown produce, potentially leading to higher income levels (Nwajiuba & Nwankwo, 2020).

Despite these theoretical benefits, the adoption of organic farming in Edo South agro ecological zone remains limited (Lee, Kim & Park, 2022). This hesitancy could be attributed for dearth empirical evidence that clearly demonstrates the economic viability and environmental benefits of organic cassava farming. For instance, while studies suggest that organic farming can improve soil fertility and reduce chemical dependence, there is limited data on how these practices affect overall farm profitability and whether they genuinely lead to significant income improvements for local farmers. Similarly, the impact of organic farming on local biodiversity and the broader ecosystem remains under-researched, creating uncertainty about its long-term environmental benefits.

These gaps in the literature represent critical barriers to the wider adoption of organic farming practices in the region. Without robust data on the comparative profitability of organic versus

conventional cassava farming, farmers may be reluctant to make the transition, fearing lower yields or higher costs. Furthermore, the paucity of detailed studies on the environmental outcomes of organic farming—particularly in terms of soil health, biodiversity, and chemical usage—suggests that policymakers and agricultural stakeholders lack much of the information needed to promote organic farming as a sustainable agricultural strategy effectively. This study seeks to bridge these gaps by conducting a thorough assessment of the economic impacts of organic cassava farming in Edo South agro ecological zone. It is in view of the foregoing that the following research questions were be addressed:

i) What were the various socio-economic characteristics of the cassava farmers in Edo South agro ecological zone?
ii) What were the various production system employed by the cassava farmers in the study area?
iii) What were the various technical efficiencies of organic and conventional cassava production systems in the study area?
iv) What were the various cost and returns from organic and conventional cassava farming in the study area?; and
v) What were the constraints faced by organic cassava farmers in the study area?

1.3 Objectives of the Study

The main objective of this study was to carry out a comparative analysis of cassava farming systems in Edo South Agro-ecological zone, Nigeria.

Specifically, the study sought to:

1.) Compare the various socio-economic characteristics engaged in organic farming and those not involved.
2. Compare the various production system employed by the cassava farmers in the study area.
3. Compare the various technical efficiencies of organic and conventional cassava production in the study area.
4. Evaluate the cost and returns from organic and conventional cassava farming in the study area; and
5. Evaluate the constraints faced by organic cassava farmers in the study area?

1.4 Justification of the Study

Cassava is a staple crop in Nigeria, providing sustenance, income, and employment for many households **(**FAO, 2023**).** In Edo South agro ecological zone, cassava farming is a critical part of the local economy. However, conventional farming methods that rely heavily on synthetic fertilizers and pesticides present risks to soil health, water resources and biodiversity (Tscharntke *et al*., 2022). As global interest in sustainable agriculture grows, exploring the potential benefits of organic cassava farming is essential for long term agricultural productivity and environmental protection in the region. Conventional farming methods, while effective for short term yield increases, often results in soil degradation and water contamination (Gomiero *et al*., 2021). Organic farming, by contrast, relies on natural fertilizers and eco-friendly practices, which could help mitigate these environmental concerns, given the rising demands for organic products.

Organic farming presents a promising opportunity for smallholder farmers who face challenges such as high input cost and fluctuating market prices (Pretty *et al*., 2024). Organic products typically command premium prices, which could increase farmer income and improve their

financial resilience (Willer & Lernoud, 2019). This study seeks to evaluate the costs, returns and the market potential of organic farming, offering insight into it economic viability in the region.

Despite extensive research on organic farming, limited studies focus specifically on organic cassava farming in sub-Sahara Africa, particularly in Edo south. Each region has unique environmental and socio economic conditions that influence agricultural practices. This study filled this knowledge gap by examining the impact of organic methods on profitability, soil health and biodiversity, while also assessing farmers reliance on chemical inputs. Findings from this research have important policy implications.

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition of terms

2.1.1. Organic farming

Organic farming is an agricultural practice that focuses on cultivating crops and raising livestock through natural methods, avoiding synthetic fertilizers, pesticides, genetically modified organisms (GMOs), and other artificial chemicals. According to Lampkin (2019), it enhances soil fertility and balances the ecosystems by relying on practices like composting, crop rotation, and natural pest control. Scofield (2019) defines organic farming as a system that emphasizes ecological management rather than chemical inputs, differing fundamentally from conventional farming's reliance on synthetic fertilizers and pesticides. The adoption of organic farming in Nigeria is driven by principles of sustainability, biodiversity, and soil health. The International Federation of Organic Agriculture Movements (IFOAM, 2024) highlights that organic farming is grounded in principles of health, ecology, fairness, and care. These principles guide farmers to develop productive systems that are also sustainable for the environment and communities.

In Nigeria, the demand for organic farming has grown slowly but steadily as awareness of its benefits spreads among farmers and consumers. Many Nigerians are increasingly aware of the health and environmental risks associated with chemical-intensive agriculture. According to Onwuka (2023), this awareness has sparked interest in organic products, especially as consumers seek safer, chemical-free foods. Health concerns over pesticide residues and other agrochemicals have led some consumers to prefer organically grown produce (Akinbamijo *et al*., 2023). In

addition to consumer demand, the benefits organic farming brings to soil health make it attractive to farmers. Practices like crop rotation, organic composting, and using natural fertilizers significantly enhance soil fertility and microbial health, making the land more resilient against erosion and drought, as noted by Atungwu *et al*. (2020). Reducing the dependency on synthetic fertilizers and pesticides helps Nigerian farmers conserve resources and maintain soil productivity, contributing to sustainable agriculture (Omotayo & Oladeji, 2024).

Some Nigerian government and non-governmental initiatives support the growth of organic farming. The Nigerian Organic Agriculture Network (NOAN), established in 2004, plays a critical role in advocating organic practices and standards within the country (Olugbemi *et al*., 2020). Yet, challenges persist. Farmers often face difficulties accessing organic farming knowledge, technical training, and resources, as noted by Adeoye *et al.* (2021). Many small-scale farmers are not fully equipped with the skills and resources needed to implement organic practices effectively. Another significant hurdle for organic farmers in Nigeria is the limited availability of organic inputs. Adebayo and Adeola (2022) point out that bio-fertilizers, organic seeds, and other necessary resources for organic farming are still not widely accessible in Nigeria. Certification poses additional challenges: it is an essential step for farmers to prove the authenticity of their organic products, but the cost and bureaucratic complexities can be prohibitive for many Nigerian farmers (Ogunbanjo, 2022).

The Nigerian market for organic products remains underdeveloped, with low consumer awareness about organic goods (Adebisi & Ibrahim, 2024). While interest is growing, the market is still relatively small, which limits the profitability of organic farming for farmers. Organic farming requires government incentives, policy support, and institutional backing to grow. Abegunde (2021) argues that the Nigerian government has yet to provide adequate support, such

as subsidies for organic inputs or access to credit, to encourage farmers toward organic farming. Despite these challenges, organic farming could play a significant role in enhancing food security in Nigeria. As Edeoghon (2022) points out, organic practices can boost food security by producing safe, nutritious food without compromising long-term soil health. Nwajiuba and Nwankwo (2020) also emphasize that organic farming reduces dependency on costly imported chemicals, benefiting small-scale farmers who find it challenging to access or afford synthetic inputs.

Organic farming also holds promise for climate change mitigation, as the practices associated with organic agriculture—such as cover cropping, minimal tillage, and agroforestry—can help sequester carbon in soils and reduce greenhouse gas emissions (Lal, 2022). These practices can improve the resilience of farming systems to climate-related challenges, enabling Nigerian farmers to adapt more effectively to changing environmental conditions (Ayinde *et al.,* 2023). In recent years, certain regions, including Kaduna and Ogun, have seen local initiatives that promote organic farming (Okojie *et al.,* 2019). These regional projects often involve partnerships between government bodies, NGOs, and international organizations. They demonstrate that organic farming can flourish in Nigeria with adequate support and training. Overall, organic farming in Nigeria represents a pathway to improve agricultural productivity sustainably. However, the development of organic farming will require concerted efforts to overcome challenges such as limited market access, training, and input availability. According to scholars like Onwuka (2022) and Nwajiuba and Nwankwo (2020), collaboration among government, NGOs, and the private sector is essential. With sustained commitment, organic farming could significantly contribute to Nigeria's agricultural sector, fostering a more resilient and environmentally friendly farming system for the future.

2.1.2 Cassava Production in Nigeria

Cassava (*Manihot esculenta*) among the root and tuber crops, is the most important, as source of food in the tropics. Cassava is believed to have originated in northern Brazil and Central America, and introduced to Africa by Portuguese traders from Brazil in the 16th century (Roger, 2003). Cassava is now an important staple food, replacing native African crops. Cassava is sometimes described as the "bread of the tropics" or the African breadfruit (*Treculia africana*) (Ikuemonisan *et al*., 2020). This popular crop is now grown in almost every tropical country. In Nigeria, it was introduced into Warri in the then Bendel State of Nigeria, by Portuguese explorers in the 16th–17th century (Lean, 2021). Since then, Nigerians have accepted cassava as one of their main non-cash (staple) crop within the domain, with a large population of the country depending on it daily as their main dish (Olukosi & Erhahor, 2019).

The cassava crop has been described as a crop with potential to alleviate poverty and enhance rural livelihood because of its dominance in the production portfolio of famers in the nation (Nwankor & Nwankor, 2022). Any effort or research geared towards developing its production, either directly or indirectly, will ultimately have impact on the rural economy. This explains the focus of this research on the cassava crop, and specifically, the tuber production component of the cassava value chain. For the agricultural sector to develop to the point of satisfying the demand of the ever-increasing population for both human, industrial and livestock consumption, will require the development of the food and livestock sub-sectors and its associated value chain (Food and Agricultural Organization FAO, 2024).

Cassava is one of the most important crops in Nigeria. It is the most widely cultivated crop in the southern part of the country in terms of area devoted to it and number of farmers growing it. Indeed, it is grown by almost every household. Cassava has also increased in importance in the

Middle Belt in recent years. In all places, cassava has become very popular as a food and cash crop and is fast replacing yam and other conventional staples of the area. In all, over four-fifths of the cultivable land area is suitable for cassava growing (Figure 2.1).

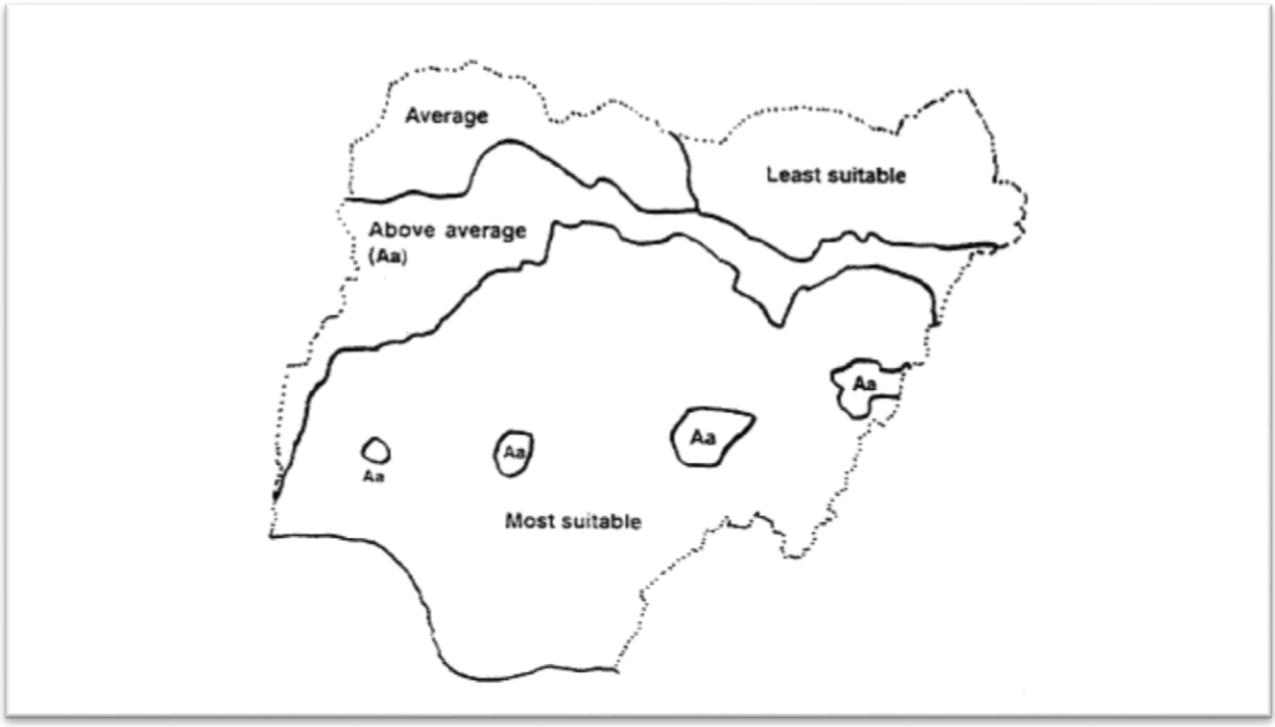


Figure 2.1: Agro-ecological suitability zones for the cultivation of cassava, based on combined data for soils, mean rainfalls, mean temperature, temperature range and the length of growing season in Nigeria

Fig 1: Map showing Edo south Agro ecological suitability zones for the cultivation of cassava, based on combined data for soils, mean rainfall, mean temperature, temperature range and the length of growing season in Nigeria

Source: Edo South Geographic Information Service (2024)

In Nigeria, cassava is grown in all the ecological zones (Odoemenem, 2021). The production of cassava is concentrated in the hands of numerous small-holder producers located primarily in the south and the central regions of Nigeria. A significant population of cassava growers in Nigeria has made the transition from conventional production systems to the use of high-yielding varieties and mechanization of processing activities (Nweke, 2022). According to Barry (2023), Nigeria and Zaire have both large and small scale farms on which cassava is grown by full-time and part-time farmers. The adaptation of cassava to the food and farming systems and multiplicity of uses makes it indispensable to food security (Adeniji, 2023).

Food and Agricultural Organization (2024) provides statistics of cassava production in Nigeria, for the period 2009-2023 The data showed that cassava production witnessed increases in the three countries with Nigeria being in the lead. This statistical estimate of cassava production provided by the Food and Agricultural Organization is shown in the Table 1.

The Food and Agricultural Organization of the United Nations in Rome estimated 2022 cassava production in Nigeria to be approximately 39.5 million tons (FAO, 2024). The trend for cassava production reported by the Central Bank of Nigeria mirrored the FAO data until 2015 and thereafter rose to the highest estimate of 40 million tons (Central Bank of Nigeria, 2024). The third series provided by the Projects Coordinating Unit (PCU) had the most conservative estimate of production at 38.5 million tons in 2020 based on the state-level data provided by the ADP offices in each state (PCU, 2023). The comparison of the output of various crops in Nigeria indicates that cassava production ranks first, followed by yam production at 27 million tons, millet at 6 million tons, and rice at 5 million tons (FAO, 2024).

Table 1.1: Levels of Cassava Production from 2009-2023 (tons)

Year	Nigeria
2009	33,000,000
2010	33,500,000
2011	34,000,000
2012	34,500,000
2013	35,000,000
2014	35,500,000
2015	36,000,000
2016	36,500,000
2017	37,000,000
2018	37,500,000
2019	38,000,000
2020	38,500,000
2021	39,000,000
2022	39,500,000
2023	40,000,000

Source: FAO, (2024)

The expansion of cassava production in Nigeria has been relatively stable since 1980, with an additional push between 1988 and 1992 due to the release of improved IITA varieties. By zone, the North Central zone produced over 7 million tons of cassava a year between 1999 and 2002. The South-South produced over 6 million tons a year, while the South West and South East produce just less than 6 million tons a year. The North West and North East are small by

comparison, at 2 and 0.14 million tons respectively. Benue, Kogi, and Nasarawa states in the North Central Zone are the largest producers of cassava (IITA, 2023).

The table below captures the rates of cassava production in different geo-political zones of Nigeria as provided by the project coordinating unit.

Table 1.2: Cassava Production by Zone (2021-2023)

Zone	2021	2022	2023
South-West	5,900,000	6,000,000	6,100,000
South-South	6,350,000	6,400,000	6,450,000
South-East	5,800,000	5,900,000	6,000,000
North-West	2,400,000	2,450,000	2,500,000
North-Central	7,500,000	7,600,000	7,700,000
Total	27,950,000	28,350,000	28,750,000

Source: Project Coordinating Unit (2024)

From the above table, it is evident that the North Central zone appears to be leading in cassava production in Nigeria between 2021 and 2023. Other subsequent reports by the Project Coordinating Unit (2024) made similar projections.

Nigeria grows more cassava than any other country in the world. Its production is currently estimated at about 34 million metric tons a year. The total area harvested for the crop in 2003, following the presidential initiative, was 32 million hectares, with an average yield of about 110 per hectare (Thisday, 2023). The production of cassava is concentrated in the hands of numerous small-holder farmers, located mostly in the southern and central states of Nigeria. The cassava market can be divided into two categories: the conventional food-oriented market and the

emerging market for industrially processed cassava. The vast majority of cassava grown in Nigeria is processed and sold through conventional market channels, which are fairly well established. It is the industrial market that is still developing.

The expansion of cassava production has been relatively steady since 2000, with an additional push between 2000 and 2023 due to the release of improved IITA varieties. In Nasarawa State, for instance, the government imported high-yielding varieties from Brazil in 2003 to boost cassava production in the state. These varieties were introduced by the first executive governor of Nasarawa State, Abdullahi Adamu, and were provided to the Ministry of Agriculture, which later established nursery sites at Awe, Arikya, Karmo, Nasarawa Eggon, and Lafia. The intention was to distribute these high-yielding varieties to farmers. However, not much has been reported about these highly productive varieties in Nasarawa State.

2.1.3 Organic Farming in Cassava

Organic farming of cassava in Nigeria is a growing but still underdeveloped sector that emphasizes natural farming practices to ensure sustainable production and environmental conservation. Cassava, a staple crop in Nigeria, is crucial to the country's food security and economic stability, with its primary use being food for human consumption and animal feed. Organic farming of cassava focuses on avoiding the use of synthetic fertilizers, pesticides, and genetically modified organisms (GMOs), instead relying on natural practices such as crop rotation, composting, and the use of organic fertilizers (Lampkin, 2019). This approach aims to maintain soil health and enhance biodiversity, which ultimately leads to more sustainable and resilient agricultural practices.

According to IITA (2024), cassava is particularly well-suited for organic farming because it is a hardy crop, tolerant of varying soil types and environmental conditions. This resilience allows cassava to be grown in different regions of Nigeria, from the humid South to the drier parts of the North. Organic farming methods can further enhance the crop's natural ability to grow in such diverse environments by promoting healthier soil and reducing the risk of pests and diseases. Practices like mulching and intercropping are commonly used in organic cassava farming, which can help improve soil fertility and reduce the need for chemical interventions (Akinbamijo *et al*., 2022).

Despite the potential benefits, organic farming of cassava faces several challenges in Nigeria. One of the key obstacles is the lack of knowledge and training among farmers. Many small-scale farmers, who form the backbone of Nigeria's cassava production, are unfamiliar with organic practices or lack access to the necessary resources and training (Adeoye *et al.*, 2021). Additionally, there is limited access to organic inputs, such as compost and bio-fertilizers, which are essential for the successful cultivation of organic cassava. Ogunbanjo (2022) notes that without access to affordable organic inputs, farmers struggle to maintain the productivity of their crops.

In many cases, the transition from conventional to organic farming is a significant challenge. Conventional farming methods in Nigeria often rely heavily on chemical inputs, and switching to organic farming requires both time and knowledge. According to Adebayo and Adeola (2023), the process of adopting organic practices involves learning new techniques, such as natural pest control and soil management, which may be difficult for farmers accustomed to chemical-based agriculture. Furthermore, organic cassava farming often yields lower quantities in the initial

stages of conversion, which can be a deterrent for farmers who are primarily focused on maximizing their output (Atungwu, *et. al*., 2020).

One of the advantages of organic cassava farming, however, is its potential for premium pricing in local and international markets. As consumers in Nigeria and globally become more health-conscious and aware of the risks posed by chemical residues in food, demand for organic products, including cassava, is expected to increase (Onwuka, 2021). According to Nwajiuba and Nwankwo (2020), organic cassava can be marketed as a healthier alternative to conventionally grown cassava, which appeals to consumers seeking chemical-free food options. In this context, organic cassava production could help meet both domestic and international demand for organic food products, boosting the income of Nigerian farmers.

Organic farming practices also have significant environmental benefits. By focusing on soil health and using organic inputs, cassava farming can contribute to the long-term sustainability of the land. Practices such as mulching and crop rotation can help conserve water, improve soil structure, and reduce the risk of erosion, which are particularly important in Nigeria's diverse and often vulnerable agricultural zones (Omotayo & Oladeji, 2024). Furthermore, by reducing the use of synthetic chemicals, organic farming can help reduce the contamination of local water sources and soil, promoting healthier ecosystems (Ayinde *et al*., 2023).

The Nigerian government and various NGOs have begun to recognize the potential of organic farming for cassava, although support remains limited. The Nigerian Organic Agriculture Network (NOAN) has been instrumental in advocating for organic practices and providing some training for farmers (Olugbemi *et al.,* 2020). However, the lack of adequate government policies and support for organic farming hampers the growth of the sector. According to Abegunde

(2022), government policies are needed to encourage farmers to adopt organic practices by providing subsidies, technical support, and financial assistance, especially in the transition phase.

Another key issue in organic cassava farming is the certification process. Organic certification is necessary for farmers to access premium markets, but the process is often costly and complicated. Adebisi and Ibrahim (2024) highlight that many small-scale farmers in Nigeria are unable to afford the cost of certification, which limits their ability to market their products as organic. Without certification, it becomes challenging to prove the authenticity of organic cassava, both to consumers and to exporters.

Despite these challenges, organic farming of cassava holds promise for Nigeria's agricultural sector. As awareness grows and demand for organic products increases, more farmers may begin to adopt organic farming practices. The use of organic cassava can enhance food security in Nigeria, as it promotes healthier soils and reduces dependency on expensive synthetic inputs. Furthermore, by providing farmers with access to premium markets, organic cassava farming could contribute to improved livelihoods for small-scale producers (Edeoghon, 2021).

In conclusion, organic farming of cassava in Nigeria faces significant challenges, including limited knowledge, access to inputs, and certification. However, with appropriate support from the government, NGOs, and private sector, the potential for organic cassava production to contribute to sustainable agricultural development and improved livelihoods is substantial. By promoting environmentally friendly practices and addressing the needs of small-scale farmers, organic cassava farming could play a key role in Nigeria's agricultural future.

2.2 Economics of Organic Farming of Cassava

The economics of organic farming in cassava production in Nigeria presents both challenges and opportunities. Organic farming is a method that seeks to enhance soil health, improve biodiversity, and reduce environmental degradation through the use of natural inputs rather than synthetic fertilizers and pesticides. While organic farming offers long-term sustainability and can yield higher profits through access to premium markets, it also comes with a set of economic considerations that influence its adoption and profitability.

The initial costs of transitioning from conventional to organic farming are often higher. Organic farmers face expenses related to the acquisition of organic inputs such as compost, organic pesticides, and soil amendments, as well as the cost of certification. According to Adebayo and Adeola (2021), the conversion to organic farming requires significant investment in learning new practices and obtaining resources that are not as widely available as conventional inputs. For instance, purchasing organic seeds, fertilizers, and implementing crop rotation and pest management strategies can lead to increased costs for farmers, particularly for smallholders who rely on cheaper, conventional agricultural inputs (Ogunbanjo, 2022).

Despite the higher initial costs, organic farming of cassava can become economically viable over time. Organic cassava production typically experiences lower input costs over the long run because organic methods reduce dependence on costly chemical inputs like synthetic fertilizers and pesticides. According to Lampkin (2019), organic farming, when properly managed, can reduce expenditure on external inputs while enhancing farm productivity in the long term. Organic practices such as mulching, composting, and intercropping improve soil fertility and help reduce the reliance on chemical fertilizers, which can be expensive and are often subject to price fluctuations (Nwajiuba & Nwankwo, 2020).

One of the significant economic benefits of organic cassava farming is access to premium markets. As global demand for organic products rises, farmers who produce certified organic cassava can sell their products at higher prices than conventional grown cassava (Ayinde *et al*., 2023). Organic cassava is increasingly sought after by consumers who are concerned about the health risks associated with chemical residues in food. In both domestic and international markets, organic cassava is seen as a safer and healthier alternative, and as such, it often commands a price premium (Onwuka, 2022). This price premium can offset the higher costs of production associated with organic farming and provide farmers with higher returns on their investment.

Additionally, organic farming can offer economic stability in the long term. By focusing on sustainable practices, organic cassava farming helps to preserve and enhance soil health, which is critical for ensuring long-term productivity and resilience in farming systems (IITA, 2024). Improved soil fertility resulting from organic farming practices can lead to higher yields over time, reducing the need for inputs and leading to more stable production levels. Organic cassava production also promotes biodiversity, which can help to reduce the risks associated with monoculture farming, such as pest and disease outbreaks (Akinbamijo *et al*., 2023).

In Nigeria, the government and various development organizations have begun to recognize the potential economic benefits of organic farming for cassava. The National Cassava Policy, for instance, aims to increase the production of cassava and develop markets for cassava-based products, which can provide incentives for farmers to switch to organic farming methods. However, the policy lacks sufficient emphasis on organic practices, and the overall support for organic farmers remains limited. According to Adetunji (2021), government subsidies for

organic inputs, training, and technical support could play a significant role in reducing the financial burden on farmers transitioning to organic farming.

The certification process for organic cassava is another key economic factor. Organic certification is essential for accessing premium markets, both locally and internationally, but it comes with its own costs. The certification process is often expensive, and many small-scale farmers in Nigeria may find it financially prohibitive. Adebisi and Ibrahim (2024) point out that the cost of certification, combined with the time and effort required to meet certification standards, can discourage many farmers from pursuing organic farming, even if they are interested in the higher income potential it offers. Moreover, the long process of conversion, during which farmers may experience reduced yields, can further strain their finances.

In terms of profitability, studies have shown that organic cassava farming can be financially viable in the long run. While the yield during the conversion period may be lower, once fully transitioned to organic practices, cassava farms can see a return on investment through higher market prices and reduced input costs (Adeoye *et al*., 2021). According to Onwuka (2023), organic farming can also lead to higher resilience in the face of environmental challenges such as soil degradation and climate change, which could protect farmers from the economic risks associated with conventional farming.

However, the profitability of organic cassava farming is not guaranteed for all farmers. Several factors, such as access to markets, the availability of organic inputs, and the effectiveness of organic farming practices in different regions, play a crucial role in determining whether organic cassava farming is financially successful. In regions where infrastructure for organic markets is underdeveloped, or where farmers face difficulties in sourcing organic inputs, the economic

returns may be lower than expected (Omotayo & Oladeji, 2024). Additionally, organic farming requires considerable knowledge and expertise, and without proper training, the benefits may not be fully realized.

In conclusion, the economics of organic farming in cassava production in Nigeria presents both opportunities and challenges. While organic farming offers potential for higher returns through access to premium markets and reduced input costs, the transition to organic farming can be costly and challenging for smallholder farmers. However, with the right support from government and development organizations, such as subsidies, training, and market access, organic cassava farming has the potential to become a profitable and sustainable enterprise for Nigerian farmers in the long term. Ultimately, the economic viability of organic cassava farming depends on various factors, including the availability of resources, the efficiency of organic practices, and the development of markets for organic products.

2.3 Environmental Impacts of Organic Farming of Cassava

The environmental impacts of organic farming of cassava in Nigeria, as in other agricultural practices, can be broadly classified into positive and negative effects. Organic farming is a holistic approach to agriculture that seeks to minimize the negative impacts of conventional farming on the environment. The adoption of organic farming for cassava production in Nigeria offers numerous potential benefits for the environment, including improved soil health, enhanced biodiversity, reduced chemical pollution, and climate change mitigation. However, it also presents certain challenges that need to be addressed to ensure its long-term sustainability.

Positive Environmental Impacts

1. **Soil Health and Fertility Improvement**

One of the most significant environmental benefits of organic farming of cassava is the improvement of soil health and fertility. Organic farming practices emphasize the use of natural inputs such as compost, manure, and crop residues, which enhance soil organic matter and nutrient content. In contrast to conventional farming, which relies heavily on chemical fertilizers, organic farming nurtures the soil ecosystem, promoting better microbial activity and increasing soil structure (Akinbamijo *et al*., 2022). This improves the soil's ability to retain moisture, reduces erosion, and ensures a more sustainable and productive farming system over time.

The use of crop rotation, mulching, and intercropping in organic farming also contributes to maintaining soil fertility. These practices prevent soil degradation and help to restore and retain nutrients that are otherwise lost in monoculture farming systems, which are common in conventional cassava production (IITA, 2024). Studies by Adeniji (2023) have shown that organic farming practices, including the use of leguminous cover crops and organic amendments, can significantly improve soil nutrient cycling, making it more fertile for cassava and other crops.

2. **Reduction in Chemical Pollution**

Organic farming greatly reduces the pollution caused by synthetic pesticides and chemical fertilizers, which are commonly used in conventional cassava production. These chemicals can leach into the soil, contaminate water supplies, and harm both terrestrial and aquatic ecosystems. Pesticide residues can also enter the food chain, posing risks to human health (Lampkin, 2019). In contrast, organic farming strictly prohibits the use of synthetic chemical pesticides and fertilizers, relying instead on natural methods such as biological pest control, organic pest repellents, and crop diversification to manage pests (FAO, 2024). This reduces the risk of

chemical run-off into nearby rivers and streams, ultimately preserving local ecosystems and improving the quality of water resources.

Moreover, organic farming practices discourage the use of genetically modified organisms (GMOs), which are often engineered for high pesticide resistance or herbicide tolerance. As a result, organic cassava farming does not contribute to the spread of GMOs in the environment, maintaining the integrity of local ecosystems and ensuring genetic diversity within the plant population.

3. **Biodiversity Preservation**

Organic farming of cassava supports biodiversity at several levels. By avoiding monocultures and encouraging crop rotation and polyculture, organic farming systems foster a more diverse environment. In organic cassava farming, the incorporation of different crops in rotation with cassava or intercropping cassava with legumes, vegetables, or other crops reduces the reliance on a single species, thereby maintaining a varied ecosystem (Adebisi & Ibrahim, 2024). This biodiversity, both above and below ground, improves pest control, enhances pollination, and contributes to a more balanced ecosystem.

Furthermore, organic farming supports the preservation of natural habitats, as it promotes the use of sustainable land management practices that reduce deforestation and the destruction of local ecosystems. By cultivating cassava in a manner that prioritizes long-term soil and environmental health, organic farming reduces the need for land clearance, which is a significant driver of deforestation in many parts of Nigeria (Omotayo & Oladeji, 2024). The increased use of organic matter and natural farming systems can also help protect habitats for wildlife, as well as beneficial insects such as pollinators and natural predators of pests.

4. **Climate Change Mitigation**

Organic farming of cassava can play a role in mitigating climate change by sequestering carbon in the soil. The increased use of organic materials, such as compost and crop residues, contributes to the build-up of soil organic carbon, which acts as a carbon sink. The use of no-tillage or minimal tillage techniques, common in organic farming, also helps preserve soil carbon and prevents the release of stored carbon into the atmosphere (FAO, 2024). Organic farming practices thus reduce the overall greenhouse gas emissions associated with agricultural production.

In addition, organic farming often includes practices that reduce energy consumption. By avoiding the use of synthetic fertilizers and pesticides, which require energy-intensive production processes, organic farming has a lower carbon footprint than conventional farming (Nwajiuba & Nwankwo, 2020). Although the yields of organic cassava may be lower initially compared to conventional methods, the lower environmental impact and increased resilience of the soil and crops may help offset this in the long run, making organic farming a more sustainable choice for climate change mitigation.

5. **Water Conservation**

Water conservation is another significant environmental benefit of organic farming of cassava. Organic farming practices, such as mulching and crop rotation, help to maintain soil moisture and improve the soil's water retention capacity. This is particularly important in regions of Nigeria that experience erratic rainfall and prolonged dry seasons. Mulching, for example, protects the soil from evaporation and reduces the need for irrigation (Akinbamijo *et al*., 2023).

Additionally, the organic matter added to the soil helps to improve its structure, which allows for better infiltration of rainwater and reduces surface run-off and erosion.

Negative Environmental Impacts

While organic farming generally has a positive impact on the environment, there are some potential negative environmental consequences that need to be considered. These typically arise from the scale and intensity of organic cassava production.

1. **Land Use and Expansion**

The transition to organic farming may require a larger land area for the same level of production compared to conventional farming, as organic methods tend to yield less per hectare in the early stages of adoption (IITA, 2024). This can lead to more land being brought into agricultural use, potentially increasing pressure on forests and other natural ecosystems. In areas where land is already scarce, such as in parts of Nigeria, this could lead to overuse of land and possible land degradation if not managed properly.

2. **Labor Intensity**

Organic farming practices tend to be more labor-intensive than conventional farming. This could place a strain on smallholder farmers, especially those who lack access to sufficient labor or capital to manage organic farms effectively. The time and labor required to manage organic cassava farming practices, such as manually controlling pests, composting, and maintaining crop rotation, can be a challenge for farmers (Omotayo & Oladeji, 2024). The increased labor input, combined with reduced yields in the early years of conversion, could make it economically difficult for farmers, especially those with limited resources.

3. **Nutrient Deficiency and Lower Yields**

Organic cassava farming often results in lower yields compared to Conventional methods, particularly during the initial years of conversion. The reduction in the use of synthetic fertilizers can lead to nutrient deficiencies, which can directly affect crop growth and productivity. This is particularly true in regions where soils are already degraded or nutrient-deficient. While organic farming practices eventually improve soil health and fertility, the initial dip in yield can make organic farming less attractive for farmers, particularly if market prices for organic cassava do not compensate for the lower yields (Adeoye *et al*., 2021). The environmental impacts of organic farming of cassava are generally positive, with the potential to enhance soil fertility, reduce chemical pollution, support biodiversity, and mitigate climate change. However, these benefits come with challenges, including the need for more land, the labor-intensive nature of organic practices, and the potential for lower yields in the initial years of transition. To maximize the environmental benefits of organic cassava farming in Nigeria, farmers will need access to appropriate training, resources, and markets for organic cassava products. With the right support and careful management, organic farming has the potential to offer a sustainable and environmentally friendly alternative to conventional cassava production in Nigeria.

2.4 Empirical Review

Sustainable agricultural practices, particularly organic farming, have garnered significant interest due to rising public awareness about food safety, environmental health, soil quality, and human health. Singh (2022) in his study sought to compare the productivity, soil quality, energy efficiency, and economic viability of organic versus conventional cassava (*Manihot esculenta* Crantz) farming. Field experiments were conducted over three years at the ICAR-Central Tuber Crops Research Institute in Thiruvananthapuram, India, using a split-plot design. Three cassava

varieties—H-165, Sree Vijaya, and Vellayani Hraswa—were used in main plots, while five production systems (conventional, integrated, and two organic approaches, one with and one without microbial inoculants) were tested in sub-plots. Results indicated that organic management without microbial inoculants (27.26 t ha−1) produced a slight but statistically insignificant yield increase (+2.40%) compared to conventional farming (26.62 t ha−1). Both industrial (H-165) and domestic varieties (Sree Vijaya, Vellayani Hraswa) showed consistent performance across different production methods. After three growing cycles, soil chemical properties under organic management with microbial inoculants improved substantially, with soil pH rising by 1.15 units and organic carbon content increasing by 22.58% compared to the conventional system. Additionally, soil porosity, cation exchange capacity, and exchangeable calcium were significantly higher under organic management without microbial inoculants, showing increases of 9.36%, 27.32%, and 29.10%, respectively, over conventional methods. Biological indicators of soil health also improved, with higher counts of bacteria, fungi, and actinomycetes, along with increased activity of soil enzymes like acid phosphatase and dehydrogenase, especially under organic management with microbial inoculants. Both organic approaches (with and without microbial inoculants) resulted in higher soil quality index (SQI) scores, with similar values of 0.98 and 0.94, respectively. Key factors influencing SQI included soil pH, exchangeable calcium, dehydrogenase enzyme activity, and porosity. The organic system without microbial inoculants proved to be the most energy-efficient, demonstrating the highest energy output (152.63 × 10^3 MJ ha−1), net energy (143.55 × 10^3 MJ ha−1), energy use efficiency (16.80), and energy productivity (3.00 kg MJ−1). Economically, the organic system without microbial inoculants generated the highest net income (US$ 4,977.57 ha−1), which was statistically similar to conventional farming (US$ 4,833.10 ha−1) and organic with

microbial inoculants (US$ 4,720.69 ha−1). Based on these findings, organic practices, particularly without microbial inoculants, offer a sustainable and viable alternative for cassava production, balancing productivity, soil health, and profitability.

Zhang, Chen, Wang & Li (2022) analyzed the profitability of organic versus conventional vegetable farming in Sichuan Province, China, focusing on cucumbers and bell peppers. Over three years, data on yield, input costs, and market prices were collected. The organic system, while yielding 20% less initially, showed improved profitability over time due to lower input costs and premium prices. Organic farming was economically viable, with a 25% higher net income over the study period. The research underscores the potential of organic practices in China's vegetable sector but highlights the importance of supporting smallholders through subsidies and training.

Kumar and Singh (2023) examined technical and allocative efficiency in organic rice and cassava farming in Tamil Nadu, India. Using Data Envelopment Analysis (DEA) on data from 200 farms, they determined that organic farms displayed a 12% improvement in technical efficiency and an 8% increase in allocative efficiency compared to conventional farms. The findings showed that organic practices could optimize resource use and enhance productivity, though knowledge gaps in organic methods reduced overall efficiency. The study calls for improved extension services to address these gaps and support farmers transitioning to organic methods.

Hansen, Sorensen & Lrsen, (2021) evaluated allocative efficiency in organic vegetable and potato farming in Jutland, Denmark. Using DEA on data from 150 farms, they found that organic farms demonstrated higher allocative efficiency due to a reduction in chemical input costs.

However, technical inefficiencies were noted due to high labor requirements. The study suggests policy interventions that reduce labor costs and provide training to increase technical and allocative efficiency in organic farming practices.

Lee *et al*. (2022) evaluated resource efficiency in organic rice farming in the Gyeonggi Province of South Korea. Lee and colleagues measured water usage, soil health, and energy efficiency across 100 organic and 100 conventional rice farms. Findings showed that organic farms conserved 20% more water and required 15% less energy due to the elimination of synthetic fertilizers and pesticides. The study highlights organic cassava farming as a viable strategy for sustainable agriculture in water-scarce regions and suggests expanding organic training programs to improve farmer resource management.

Müller and Braun (2022) focused on the resource efficiency of organic and cassava farming in Bavaria, Germany, using life cycle assessment to compare energy and water use between organic and conventional farms. Results showed that organic farms required 25% less energy and conserved 18% more water, although organic yields were lower by 10-15%. The authors conclude that while organic farming promotes sustainable resource use, improvements in organic crop yields are essential for balancing resource efficiency with food security in Europe.

Agyemang and Mensah (2023) examined resource efficiency in organic cassava farming in the Ashanti Region of Ghana. Using a resource efficiency framework, the authors measured water use, energy consumption, and soil health on 200 organic and 200 conventional farms. The organic farms showed a 30% reduction in water usage and a 15% decrease in energy consumption due to crop rotation and reduced chemical inputs. The study found that while organic practices promote resource efficiency, the absence of subsidies for organic inputs hinders

scalability, especially among smallholders. The authors recommend policy support to facilitate the widespread adoption of organic farming for greater environmental and resource sustainability.

Okeke and Uche (2024) assessed resource efficiency in organic cassava and cowpea farming across southeastern Nigeria, using the input-output method to evaluate energy and water usage. Data from 250 farmers revealed that organic practices reduced water and energy use by 15% compared to conventional methods, with the highest resource efficiency observed in crop rotation systems. However, initial costs for organic inputs presented challenges. The study recommends introducing subsidies for organic inputs to improve resource efficiency and encourage more farmers to adopt organic practices.

Nyam and Jibril (2023) investigated the technical efficiency of organic cassava farming in Ogun State, Nigeria. By applying stochastic frontier analysis on data from 180 organic and 200 conventional cassava farmers, the researchers found that organic cassava farmers had a lower technical efficiency score compared to their conventional counterparts, primarily due to limited access to organic inputs and extension services. The authors conclude that while organic farming has potential, improving farmer education and input availability is necessary to enhance technical efficiency.

Olawale and Ibrahim (2024) assessed the economics of organic cassava and yam farming in Northern Nigeria. Through a three-year field survey involving 100 organic and 120 conventional farmers, the study found that organic practices enhanced soil fertility and reduced input costs but required higher labor investments. The findings showed that organic farming yielded a 10% higher net income due to premium prices for organic produce. However, fluctuating organic market prices and certification fees were seen as barriers to sustained profitability for

smallholders. The study suggests government support in the form of subsidies to alleviate these challenges.

Akintola and Adewole (2023) conducted a comparative analysis of the economic returns from organic and conventional cassava farming among smallholder farmers in southwestern Nigeria. Through structured interviews with 150 farmers, they collected data on input costs, yield, and market prices over two growing seasons. Results revealed that organic cassava farming generated a 15% higher net income due to reduced input costs and access to premium markets. However, the organic method required a longer break-even period. The study concludes that while organic cassava farming offers better profitability in the long term, financial constraints and certification costs present challenges for widespread adoption.

CHAPTER THREE

METHODOLOGY

3.1 Area and Scope of Study

Edo State is located within the geographical coordinates of Longitudes 05° 04' 1" East and 06° 43' East, and Latitudes 05° 44' 1" North and 07° 34' North of the Greenwich Meridian. The State experiences a tropical climate, characterized by two distinct seasons: the wet season (April to October) and the dry season (November to March), with average temperatures of about 28°C during the dry season and 25°C in the wet season. The study was conducted in the Edo South Agro- Ecological Zone, of Edo State, Nigeria. This zone comprises of seven local government areas (LGAs) viz: Egor, Oredo, Orhionmwon, Ovia North East, Ovia South West, Ikpoba-Okha, and Uhunmwonde. The main focus of the study was on cassava farmers within these areas, specifically targeting those who engaged in organic and conventional farming practices.

3.2 Source of Data

Data for this study were obtained through primary and secondary sources. The primary sources for the research included copies of the administered questionnaire and personal observations/ interviewing while the secondary sources were journals and literatures.

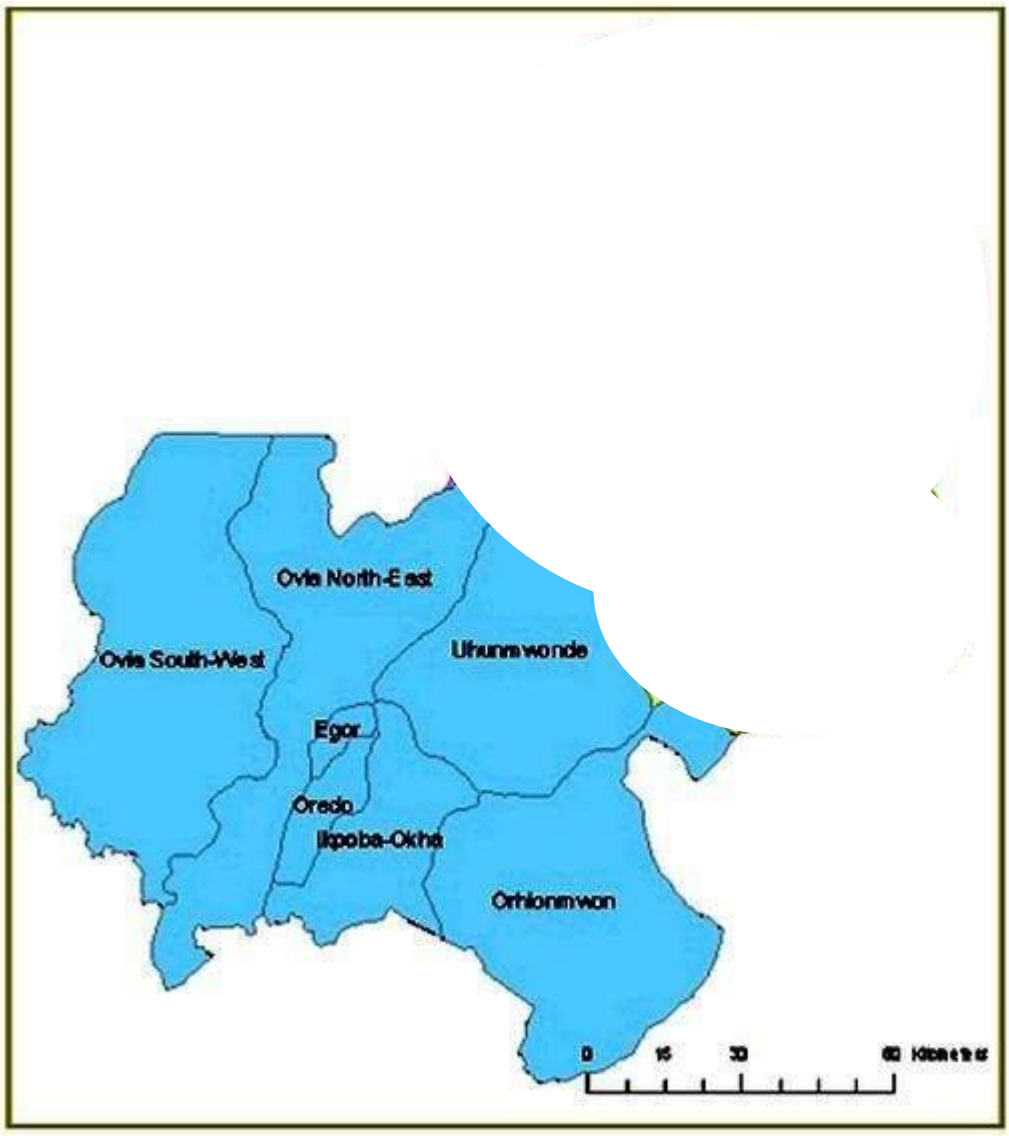


Fig 1: Map of Edo South Agro Ecological Zone

Source: Edo Geographic Information Service (2024)

3.3 Sampling Technique and Sample size

A two-stage sampling procedure was employed. The first stage involved a purposive selection of five Local Government Areas from Edo South Agro- ecological Zone based on a large population of cassava farmers in the area. The second stage involved selecting a representative percentage of (80%) of cassava producers (300) from a list of cassava farmers as presented by

Edo ADP. This gave sample frame of 240. Information on the number of cassava producing households in each village was sourced from extension agents/contact farmers in the Edo ADP agro-ecological zones.

The information was used in preparing the list of the households that formed the sampling frame, from which the sets of households for the study was drawn using the simple random sampling techniques.

Table 3.1: Sampling frame showing the selection of cassava farmers in Edo South.

S/N	LGA	Registered Farmers	Sampled Farmers (80%)
1	Egor	62	50
2	Uhunwonde	80	64
3	Oredo	45	36
4	Orhionwon	60	48
5	Ikpoba-Okha	65	42
	Total Sample		**240**

Source: Edo State ADP, 2025(Modified by the researcher)

3.4 Measurement of Variables

- Technical Efficiency: measured in terms of output per unit of input (e.g., tons of cassava per hectare).
- Age of Farmers: measured in years.
- Household Size: measured by the number of people living in the household eating from same pot.
- Educational Level: measured as no formal education, primary education, secondary education, or tertiary education.
- Farming experience: measured in years of experience in selling cassava.

- Land Area Cultivated: measured in hectares.
- Revenue: measured in Naira (₦).

Analytical Techniques

1). Objectives 1 and 2: These were achieved using descriptive statistics which involved frequency counts, mean scores and percentages.

2). Objective 3: This was achieved using the Stochastic Frontier Analysis (SFA) method. The Stochastic Frontier Model was used to estimate the efficiency of farmers in converting inputs (such as labour, land, and capital) into cassava output. The model also identified factors that contributed to inefficiency in production.

The Stochastic Frontier Production Function is expressed as:

$$Y = f(X) + \epsilon$$

Where:

Y = Cassava output (tons)

X = Inputs (land, labour, capital, fertiliser, cassava cuttings and herbicides)

ϵ = Error term, representing inefficiency.

$$Y = f(x_1, x_2, x_3, x_4, x_5) - - - - - - - - - - (1)$$

$$Y = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3 + \alpha_4 x_4 + \alpha_5 x_5 + \varepsilon_t \ (2)$$

Where:

Y = Total output of cassava (tonnes)

X_1 = Farm size (ha)

X_2 = Labour used in man days

X_3 = Fertiliser used (kg)

X_4 = Cassava cuttings (kg)

X_5 = Herbicide used (litres)

ε_t = Stochastic error term

$\alpha_1 - \alpha_5$ = Parameters estimates

$\alpha_0 = constant$

The technical efficiency of each parameter were estimated using

Efficiency index = $R_{xi} = b_i P_y / P_{xi}$

Where

$P_{xi} = unit\ price\ of\ input\ (N)$

$P_y = Unit\ price\ of\ output\ (N)$

$b_i = Margional\ productivity\ of\ the\ input$

$R_{xi} = Technical\ efficiency\ index\ of\ the\ input$

3). Objective 4: This was achieved using farm budgetary models, and this included total revenue (TR), total cost (TC), gross margin (GM), and profitability.

a. Total Revenue (TR) = Price per kg of cassava (P) × Quantity of cassava sold (Q)

b. Total Cost (TC) = Total Fixed Cost (TFC) + Total Variable Cost (TVC)

c. Gross Margin (GM) = Total Revenue (TR) − Total Variable Cost (TVC)

d. Net Profit (π) = Total Revenue (TR) − Total Cost (TC)

e. Return on Investment (ROI) = Net Income (NI) / Total Cost of Investment (TCI)

The profitability of organic cassava farming was assessed by calculating the profit margins, gross income, and return on investment for the farmers.

4). Objective 5: This was achieved using a Five-point Likert Scale. Farmers were asked to rate the severity of various constraints they face in organic cassava production. The responses were scored as follows:

- Very serious (VS) = 5
- Serious (S) = 4
- Moderately serious (MS) = 3
- Least serious (LS) = 2
- Not serious (NS) = 1

Decision rule:

$$\frac{5+4+3+2+1}{5} = 3.0$$

The mean score for each constraint will be calculated. A constraint will be considered serious if the mean score is equal to or greater than 3, while those with a mean score less than 3 will be considered less serious.

Mean score $\geq$ 3 serious

Mean score $<$ 3 less serious

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-Economic Characteristics of the Cassava farmers.

This section presents the socio-economic profile of cassava farmers in Edo South Agroecological Zone (specifically, Egor, Oredo, Orhionmwon, Ikpoba-Okha and Uhunmwonde Local Government Areas, Edo State), including age distribution, sex categorisation, marital status, highest educational qualification, years of cassava farming experience, farm size (hectares), type of land ownership, primary occupation, secondary occupation, household size, number of dependents, main source of capital for farming, access to credit in the past year, labour source, and access to agricultural extension services.

Table 4.1: Socioeconomic Characteristics of Cassava Farmers across Selected LGAs

Variable	Category	Egor (n=50)	Uhunmwonde (n=64)	Oredo (n=36)	Orhionmwon (n=48)	Ikpoba-Okha (n=42)
Age (years)	20–29	4 (8.0%)	5 (7.8%)	6 (16.7%)	3 (6.3%)	4 (9.5%)
	30–39	10 (20.0%)	12 (18.8%)	10 (27.8%)	7 (14.6%)	9 (21.4%)
	40–49	15 (30.0%)	20 (31.3%)	8 (22.2%)	15 (31.3%)	13 (31.0%)
	50–59	13 (26.0%)	17 (26.6%)	7 (19.4%)	14 (29.2%)	10 (23.8%)
	60+	8 (16.0%)	10 (15.6%)	5 (13.9%)	9 (18.8%)	6 (14.3%)
Mean Age		47 years	45 years	41 years	48 years	44 years
Sex categorization	Male	30 (60.0%)	42 (65.6%)	20 (55.6%)	34 (70.8%)	28 (66.7%)
	Female	20 (40.0%)	22 (34.4%)	16 (44.4%)	14 (29.2%)	14 (33.3%)
Marital Status	Married	35 (70.0%)	48 (75.0%)	24 (66.7%)	36 (75.0%)	32 (76.2%)
	Single	7 (14.0%)	6 (9.4%)	5 (13.9%)	5	4 (9.5%)

					(10.4%)	
	Divorced	3 (6.0%)	5 (7.8%)	3 (8.3%)	3 (6.3%)	3 (7.1%)
	Widowed	5 (10.0%)	5 (7.8%)	4 (11.1%)	4 (8.3%)	3 (7.1%)
Household Size	1–3	6 (12.0%)	8 (12.5%)	5 (13.9%)	4 (8.3%)	5 (11.9%)
	4–6	22 (44.0%)	28 (43.8%)	16 (44.4%)	20 (41.7%)	18 (42.9%)
	7–9	15 (30.0%)	20 (31.3%)	10 (27.8%)	16 (33.3%)	12 (28.6%)
	10+	7 (14.0%)	8 (12.5%)	5 (13.9%)	8 (16.7%)	7 (16.7%)
Mean Household Size		**7 persons**	**6 persons**	**6 persons**	**7 persons**	**7 persons**
Educational Level	No formal education	6 (12.0%)	10 (15.6%)	3 (8.3%)	8 (16.7%)	6 (14.3%)
	Primary education	10 (20.0%)	16 (25.0%)	7 (19.4%)	10 (20.8%)	8 (19.0%)
	Secondary education	18 (36.0%)	20 (31.3%)	14 (38.9%)	18 (37.5%)	16 (38.1%)
	Tertiary education	12 (24.0%)	12 (18.8%)	8 (22.2%)	8 (16.7%)	8 (19.0%)
	Adult literacy	4 (8.0%)	6 (9.4%)	4 (11.1%)	4 (8.3%)	4 (9.5%)
Years of Experience	1–5 years	12 (24.0%)	14 (21.9%)	10 (27.8%)	8 (16.7%)	10 (23.8%)
	6–10 years	18 (36.0%)	22 (34.4%)	12 (33.3%)	16 (33.3%)	14 (33.3%)
	11–15 years	10 (20.0%)	14 (21.9%)	8 (22.2%)	14 (29.2%)	10 (23.8%)
	16–20 years	6 (12.0%)	8 (12.5%)	4 (11.1%)	6 (12.5%)	5 (11.9%)
	20+ years	4 (8.0%)	6 (9.4%)	2 (5.6%)	4 (8.3%)	3 (7.1%)
Mean Experience		**10 years**	**9 years**	**9 years**	**11 years**	**10 years**

Source: *Field Survey, 2025*

4.1.1 Age Distribution

The age group 40–49 years consistently had the highest representation across all LGAs: Egor (15, 30.0%), Uhunmwonde (20, 31.3%), Oredo (8, 22.2%), Orhionmwon (15, 31.3%), and Ikpoba-Okha (13, 31.0%). This indicates that middle-aged individuals dominate cassava farming in Edo State. Oredo had the largest proportion of younger farmers aged 20–39: 20–29 (6, 16.7%) and

30–39 (10, 27.8%), totaling 44.5% of its farmers, compared to Egor (28.0%), Uhunmwonde (26.6%), Orhionmwon (20.9%), and Ikpoba-Okha (30.9%). This suggests a trend of youthful engagement in agriculture in Oredo, possibly influenced by urbanization and better access to entrepreneurial support services. The 60+ category was more prevalent in Orhionmwon (9, 18.8%) and Uhunmwonde (10, 15.6%), indicating an aging farming population in those LGAs.

The finding that the age group 40–49 years had the highest representation among cassava farmers in all five LGAs aligns with several empirical studies that establish middle-aged individuals as the predominant actors in smallholder agriculture across Nigeria and Sub-Saharan Africa. According to Ajani and Igbokwe (2022), farmers within the age range of 35–50 years are more active in agricultural production due to their physical strength, experience, and adaptability innovation, especially in staple crop farming such as cassava. Similarly, Adebayo and Onu (2020) emphasized that middle-aged farmers are more likely to be economically active and to adopt productivity-enhancing technologies than older or younger farmers. The relatively high proportion of younger farmers (20–29 years) observed in Oredo LGA (16.7%) supports the findings by Yusuf *et al.* (2019), who documented an increasing interest in agribusiness ventures among urban and peri-urban youth in Nigeria, particularly in areas where government or NGO-led empowerment schemes are accessible. This trend may reflect the positive influence of agricultural intervention programs such as the Youth in Agriculture Programme (YAP) and N-Power Agro, which have been active in targeting youth participation in urban and semi-urban areas like Oredo. Nnadi and Akwiwu (2015) further noted that youth involvement in farming is often higher in locations with better infrastructure and access to markets, factors that are more prevalent in Oredo than in rural LGAs like Orhionmwon and Uhunmwonde. The higher prevalence of older farmers (aged 60 years and above) in Orhionmwon (18.8%) and

Uhunmwonde (15.6%) echoes findings from Ekong (2020) and Oladeebo (2018), who reported that rural farming populations in Nigeria are aging due to rural-urban migration of the youth, low incentives for agricultural investment, and the declining attractiveness of farming as a livelihood. This aging demographic poses serious implications for labor availability, adoption of technology, and long-term sustainability of cassava farming in these LGAs.
These age-related dynamics carry significant implications for policy and intervention. The dominance of middle-aged farmers indicates a need to target this group with scalable innovation in mechanization, credit access, and climate-smart practices to enhance productivity. Meanwhile, the growing participation of youth in Oredo presents an opportunity to deepen youth-specific agricultural support, such as incubation hubs, agritech financing, and start-up mentorship. On the other hand, the aging farming population in Orhionmwon and Uhunmwonde calls for urgent succession planning, youth-targeted land access policies, and support services that reduce the labor burden on elderly farmers.

4.1.2. Sex categorization

Males formed the majority of cassava farmers in all LGAs: Egor (30, 60.0%), Uhunmwonde (42, 65.6%), Oredo (20, 55.6%), Orhionmwon (34, 70.8%), and Ikpoba-Okha (28, 66.7%). Female participation ranged between 29.2% and 44.4%, with the highest in Oredo (16, 44.4%), suggesting more gender inclusivity in that LGA. This reflects male dominance in agricultural land use and decision-making but shows encouraging female involvement, especially in peri-urban locations. The observation that males formed the majority of cassava farmers in all surveyed LGAs — Egor (60.0%), Uhunmwonde (65.6%), Oredo (55.6%), Orhionmwon (70.8%), and Ikpoba-Okha (66.7%) — is consistent with findings from numerous studies that have highlighted the male-dominated nature of agricultural production in Nigeria, particularly in

staple crop farming. According to Ogunlela and Mukhtar (2019), although women contribute significantly to agricultural activities, men often dominate land ownership, control of farm income, and access to extension services, making them the more visible participants in production-level decisions. Similarly, Ajani (2018) reported that land tenure systems and cultural norms in rural Nigeria frequently limit women's access to farmland, thereby affecting their participation in commercial agriculture such as cassava farming. The relatively higher female participation observed in Oredo (44.4%) compared to other LGAs indicates a shift toward greater gender inclusivity, especially in more urbanized or peri-urban settings. This trend aligns with the findings of Rahman (2018), who found that female participation in farming is typically higher in peri-urban and semi-rural zones where women have better access to cooperative societies, microcredit, and urban markets. These environments also tend to offer greater flexibility in balancing domestic responsibilities with farming activities. Moreover, World Bank (2021) findings support the assertion that improved infrastructure and access to information and finance in urban LGAs often enhance female participation in agribusiness ventures. The significantly lower female participation in Orhionmwon (29.2%) and Uhunmwonde (34.4%) likely reflects entrenched gender norms and limited access to production resources for women in more rural communities. These LGAs may also lack institutional support systems that encourage women's agricultural entrepreneurship, such as gender-sensitive extension services or access to land and credit. The evident male dominance in cassava farming across the LGAs suggests that agricultural policies and extension programs must consciously integrate gender-sensitive approaches to ensure equitable access to resources for female farmers. The relatively high female participation in Oredo presents a model for what can be achieved through the right mix of enabling environment, institutional support, and infrastructural access. Expanding such enabling

conditions to rural LGAs like Orhionmwon and Uhunmwonde could unlock significant potential in women farmers, who are often heavily involved in post-harvest activities and marketing, but remain underrepresented in primary production.

4.1.3 Marital Status:

Married farmers made up the majority across all LGAs: Egor (35, 70.0%), Uhunmwonde (48, 75.0%), Oredo (24, 66.7%), Orhionmwon (36, 75.0%), and Ikpoba-Okha (32, 76.2%). Single farmers accounted for between 9.4% (Uhunmwonde) and 14.0% (Egor). Divorced and widowed individuals were minimal but consistently present, making up between 6.0% and 11.1%, likely pointing to the resilience of separated or widowed individuals in continuing farming activities. The marital status composition of cassava farmers reveals both stability and latent vulnerabilities in farming households across the LGAs, offering insights for more targeted and socially responsive agricultural policies. The dominance of married individuals in cassava farming across all five LGAs, Egor (70.0%), Uhunmwonde (75.0%), Oredo (66.7%), Orhionmwon (75.0%), and Ikpoba-Okha (76.2%) reflects a broader trend observed in agricultural labor demographics in Nigeria. Several studies, including those by Adebayo and Adeola (2018) and Oni *et al*. (2021), have shown that married individuals are more likely to engage in farming activities due to their stronger household labor base, greater financial responsibility, and a higher tendency to view agriculture as a sustainable livelihood for family upkeep. Married farmers often have access to more land and social capital through extended family support systems, enabling greater stability and long-term investment in farming. The low representation of single farmers, ranging from 9.4% in Uhunmwonde to 14.0% in Egor aligns with findings by Oladele and Kolawole (2023), who observed that unmarried individuals, particularly younger ones, are less likely to pursue farming as a primary occupation. This may be attributed to competing opportunities in urban employment

or education, as well as the perception of agriculture as less attractive to youth without familial responsibilities.

Interestingly, the presence of divorced and widowed individuals, although minimal (between 6.0% and 11.1% across LGAs), suggests a degree of resilience and economic self-reliance among these groups. Studies such as Rahman (2018) and Ezeh and Anyanwu (2020) have highlighted the adaptive strategies employed by widowed or divorced individuals especially women to maintain their livelihoods through smallholder farming. For many, agriculture remains one of the few accessible and consistent income-generating activities, particularly in rural areas where formal employment options are limited. The predominance of married individuals in cassava farming implies that extension services, agricultural financing, and rural development programs should consider the family unit as a vital platform for intervention. Efforts to improve productivity and household food security may be more successful when designed to target married farmers and their families, especially by leveraging group-based models like farmer cooperatives or household extension schemes. Meanwhile, the involvement of divorced and widowed individuals although relatively small should not be overlooked. Their participation underscores the importance of creating inclusive agricultural programs that support vulnerable or marginalized groups, especially female-headed households who may lack access to land, credit, and labor. Tailored interventions such as social safety nets, widows' land access programs, and flexible microfinance schemes can help integrate these individuals more effectively into the agricultural economy.

4.1.4 Household Size:

A household size of 4–6 persons was dominant in all LGAs: Egor (22, 44.0%), Uhunmwonde (28, 43.8%), Oredo (16, 44.4%), Orhionmwon (20, 41.7%), and Ikpoba-Okha (18, 42.9%). This

reflects the prevalence of moderately large households, which may provide labor support. Households of 7–9 persons were also common: Egor (15, 30.0%), Uhunmwonde (20, 31.3%), Orhionmwon (16, 33.3%), and Ikpoba-Okha (12, 28.6%), suggesting extended family arrangements. Smaller households (1–3 persons) were least common, averaging below 15% across all LGAs. Household size in cassava farming communities of Edo State reflects traditional rural family structures and their adaptive role in sustaining agricultural livelihoods, but also presents nuanced needs that require differentiated agricultural support services. The finding that households with 4–6 persons were the most dominant among cassava farmers in all LGAs, Egor (44.0%), Uhunmwonde (43.8%), Oredo (44.4%), Orhionmwon (41.7%), and Ikpoba-Okha (42.9%) mirrors the national and regional trends in rural Nigeria, where medium-sized households are often the functional units of agricultural labor. According to Akinbile and Alao (2007), household size is a critical factor influencing farm labor availability, with households in the 4–6 range able to effectively mobilize family labour for farming activities while maintaining manageable consumption needs. These moderately large households strike a balance between economic productivity and dependency, making them ideal for subsistence and semi-commercial farming, such as cassava production. The relatively high proportion of households with 7–9 persons in Egor (30.0%), Uhunmwonde (31.3%), Orhionmwon (33.3%), and Ikpoba-Okha (28.6%) suggests the persistence of extended family systems and multigenerational living arrangements, especially in rural LGAs. Studies by Nnadi and Akwiwu (2018) and Ayoola and Azeez (2023) have noted that in traditional agrarian settings, extended family structures often serve as a mechanism for economic cooperation, enabling collective farming efforts, pooled resources, and knowledge transfer between generations. However, these large households can

also exert pressure on farm income and available resources, especially where land size and farm yield are limited.

On the other hand, small households (1–3 persons) were consistently the least common, making up less than 15% of respondents across all LGAs. This trend aligns with findings by Tsoho and Salihu (2022), who reported that smallholder farmers in rural Nigeria rarely operate in isolation and typically depend on family labor rather than hired workers, making small households less suited for labor-intensive crops like cassava. The scarcity of such small households in the study area may also reflect social norms that emphasize collective living and mutual support in farming communities. The predominance of medium and large household sizes among cassava farmers has practical implications for labour supply, farm planning, and extension service delivery. Programs aiming to improve cassava productivity should factor in household size when designing interventions. For example, labor-saving technologies and inputs could be more relevant for smaller households, while larger households may benefit from productivity-enhancing strategies such as improved varieties, training on labor division, and record-keeping. Furthermore, given the role of family labour in farm operations, youth and women within these households should be specifically targeted with tailored training and empowerment initiatives to improve intra-household productivity. In communities with larger households, strengthening cooperative farming models and encouraging communal access to mechanization services may help manage labor more efficiently.

4.1.5 Educational Level:

Secondary education was the most frequent level across all LGAs: Egor (18, 36.0%), Uhunmwonde (20, 31.3%), Oredo (14, 38.9%), Orhionmwon (18, 37.5%), and Ikpoba-Okha (16, 38.1%), suggesting basic literacy and farming knowledge. Tertiary education was more

prominent in urban LGAs: Egor (12, 24.0%), Oredo (8, 22.2%), and Ikpoba-Okha (8, 19.0%), while no formal education was more common in Uhunmwonde (10, 15.6%) and Orhionmwon (8, 16.7%). Adult literacy participation ranged from 8.0% (Egor) to 11.1% (Oredo), reflecting ongoing attempts at adult education in rural areas. The dominance of secondary education among cassava farmers in all five LGAs—Egor (36.0%), Uhunmwonde (31.3%), Oredo (38.9%), Orhionmwon (37.5%), and Ikpoba-Okha (38.1%)—highlights a generally acceptable level of basic literacy and farming knowledge among rural and peri-urban farmers in Edo State. This trend is consistent with findings by Obasi and Agu (2020) and Ozor and Madukwe (2021), who assert that secondary school education equips farmers with foundational skills in record-keeping, input application, and communication, which are vital for effective farm management and interaction with extension services. The relatively higher occurrence of tertiary education among cassava farmers in Egor (24.0%), Oredo (22.2%), and Ikpoba-Okha (19.0%) reflects the influence of urban proximity and access to higher learning institutions in these LGAs. These urban or peri-urban areas are more likely to attract or retain educated individuals who may engage in farming as part of broader agribusiness ventures or side enterprises. According to Oyesola and Obabire (2021), tertiary-educated farmers are more receptive to agricultural innovations, market information, and climate-smart practices, which can significantly enhance cassava productivity. This finding supports Nnadi and Akwiwu's (2018) argument that education influences not only adoption of improved technology but also access to credit and farm profitability.

Conversely, the higher incidence of no formal education in rural LGAs such as Uhunmwonde (15.6%) and Orhionmwon (16.7%) is indicative of historically limited access to educational infrastructure in these areas. As noted by Aromolaran (2019) and Ajayi (2021), farmers with no

formal education often face difficulties in understanding extension messages, adopting new technologies, and complying with record-based loan procedures. This educational disadvantage may contribute to lower farm efficiency and limited engagement with agricultural support systems. The modest presence of adult literacy education ranging from 8.0% in Egor to 11.1% in Oredo suggests ongoing grassroots educational initiatives aimed at improving adult literacy in farming communities. This aligns with the objectives of Nigeria's National Commission for Mass Literacy, Adult and Non-Formal Education (NMEC), which promotes adult education as a tool for rural development and agricultural enhancement. While the coverage is still limited, it reflects a positive trajectory toward improving the educational status of older farmers or those previously excluded from formal schooling. The predominance of farmers with secondary education suggests a strategic entry point for agricultural training and extension delivery, as many already possess the literacy required to understand manuals, data forms, and technology demonstrations. However, in rural LGAs where illiteracy remains high, agricultural interventions must adopt inclusive communication strategies, such as the use of local dialects, visual aids, and farmer field schools. Meanwhile, the presence of tertiary-educated farmers in urban LGAs opens avenues for scaling agripreneurship programs, digital extension tools, and ICT-based market platforms. These educated farmers can also serve as catalysts for innovation diffusion, mentoring less educated peers within farmer groups or cooperatives.

4.1.6 Years of Experience in Cassava Farming:

The majority of farmers had 6–10 years of experience, consistently across all LGAs: Egor (18, 36.0%), Uhunmwonde (22, 34.4%), Oredo (12, 33.3%), Orhionmwon (16, 33.3%), and Ikpoba-Okha (14, 33.3%). The 1–5 years category followed closely behind, indicating that newer farmers are also entering the industry. Very few had more than 20 years of experience, with the

highest being in Uhunmwonde (6, 9.4%) and Orhionmwon (4, 8.3%), suggesting generational transitions in cassava farming. The predominance of cassava farmers with 6–10 years of experience across all LGAs—Egor (36.0%), Uhunmwonde (34.4%), Oredo (33.3%), Orhionmwon (33.3%), and Ikpoba-Okha (33.3%)—indicates that a significant number of farmers are relatively experienced but not yet at retirement stage. This trend reflects a mature but still dynamic farming population, capable of absorbing new technologies and adapting to evolving market demands. According to Adeoti (2019) and Ogunlade and Oladele (2024), farmers in this experience range are often at the peak of their productivity and are more likely to adopt improved cassava varieties, mechanized processes, and efficient input use due to their established routines and access to networks. The close ranking of farmers in the 1–5 years experience bracket further reveals that cassava farming is attracting new entrants, possibly as a response to government and NGO-led agricultural empowerment schemes, increased awareness of cassava's market potential, or youth engagement programs. This aligns with findings by Ayoade and Adeola (2022) and Agwu and Anyanwu (2020), who emphasized that economic diversification initiatives and agribusiness incubation projects have encouraged new generations especially educated youths and returnees from urban areas to venture into cassava farming. The low percentage of farmers with more than 20 years of experience, Uhunmwonde (9.4%) and Orhionmwon (8.3%) having the highest suggests a generational shift is underway in the cassava sector. The scarcity of long-standing farmers may be linked to aging populations transitioning out of active farming, poor succession planning, or limited incentives for youth to inherit family farmlands. Research by Ajieh (2020) and Okeke and Chukwuji (2018) also observed similar patterns, noting that farming populations in Nigeria are gradually becoming younger as older farmers retire and new actors emerge through government intervention and enterprise incentives.

The widespread presence of mid-level experience farmers presents an opportunity for targeted training, especially in yield-enhancing techniques, climate-smart practices, and post-harvest value addition. These farmers are typically stable, risk-aware, and open to practical innovations, making them ideal recipients of agricultural extension services. The presence of newer entrants into cassava farming suggests that support systems such as access to credit, training in agribusiness management, and mentoring by more experienced farmers are essential for their success and retention. Encouragingly, this influx may help bridge the generational gap and inject new energy and innovation into cassava production in Edo State. At the same time, the decline in farmers with extensive experience underscores the need for knowledge transfer mechanisms, such as peer-to-peer learning, community demonstration plots, and farmer field schools. Preserving indigenous knowledge from veteran farmers and linking it with modern techniques can enhance productivity and sustainability in the cassava sector.

The results collectively show that cassava farming in Edo State is largely practiced by middle-aged, married men with moderate household sizes and secondary school education. The predominance of the 6–10 years of experience category suggests that most farmers are neither new entrants nor veterans but are in their productive mid-phase of farming. Educational attainment shows a positive trend toward formal schooling, though rural LGAs still record notable levels of low literacy. Female participation, while not dominant, is noteworthy in Oredo and Egor.

4.2 Cassava Production System Employed by the Farmers

This section is a comparative analysis of the cassava production systems practiced by farmers across the five LGAs, Egor ($n = 50$), Uhunmwonde ($n = 64$), Oredo ($n = 36$), Orhionmwon

(n = 48), and Ikpoba-Okha (n = 42) covering farming type, variety choice, farm size, and labour sources.

4.2.1 Farming System Types

In Table 4.2, across all the five LGAs, conventional farming clearly dominates, practiced by approximately 74.6 % of cassava farmers. Organic farming remains marginal, practiced by 15 % of the cassava farmers, while only 10.4 % engaged in mixed systems, combining both approaches.

Table 4.2: Farming System Type

LGA	Organic (%)	Conventional (%)	Mixed (%)
Egor	10 (20%)	35 (70%)	5 (10%)
Uhunmwonde	8 (12.5%)	50 (78.1%)	6 (9.4%)
Oredo	6 (16.7%)	26 (72.2%)	4 (11.1%)
Orhionmwon	5 (10.4%)	38 (79.2%)	5 (10.4%)
Ikpoba-Okha	7 (16.7%)	30 (71.4%)	5 (11.9%)
Total	36(15%)	179(74.6%)	25(10.4%)

Source: Field Survey, 2025

4.2.2 Cassava Variety Cultivated

As presented in Table 4.3, Oredo stands out with 61.1 % of farmers cultivating improved varieties, reflecting greater innovation uptake. In other LGAs, a mixed pattern prevails: farmers either grow improved, local, or both varieties more evenly. In Total, 90 or 37.5% of the cassava farmers cultivated improved cassava variety, 73 or 30.4% of the smallholder cassava farmers cultivated local cassava variety while only 77 or 32.1% cultivated both improved and local varieties.

Table 4.3: Cassava Variety Cultivated

LGA	Improved (%)	Local (%)	Both (%)
Egor	20 (40%)	15 (30%)	15 (30%)
Uhunmwonde	18 (28.1%)	20 (31.3%)	26 (40.6%)
Oredo	22 (61.1%)	6 (16.7%)	8 (22.2%)
Orhionmwon	14 (29.2%)	18 (37.5%)	16 (33.3%)
Ikpoba-Okha	16 (38.1%)	14 (33.3%)	12 (28.6%)
Total	90(37.5%)	73(30.4%)	77(32.1%)

Source: Field Survey, 2025

4.2.3 Cassava Farm Size (Hectares)

The data presented in Table 4.4 shows a clear trend in the distribution of cassava farm sizes across the three farming systems organic, conventional, and mixed in the study area. The findings highlight the predominance of smallholder farming (defined here as <3 hectares) across all systems, with varying degrees of scale and intensity. Across all systems, the 1–3 hectare farm size is the most common, accounting for 47.2% of organic farmers, 46.9% of conventional farmers, and 52.0% of mixed farmers. This affirms the dominance of smallholder cassava cultivation in the study area, which is consistent with national patterns. According to FAO (2022) and Adewumi & Adebayo (2020), over 80% of Nigerian farmers operate on plots less than 5 hectares, especially in root and tuber production. The prevalence of the 1–3 ha category among organic farmers further reinforces the notion that organic farming in Nigeria is largely practiced by low-input, resource-constrained farmers who rely on natural processes and are typically limited in scale due to labour intensity and the lack of organic-certified inputs. This aligns with findings by Ibekwe *et al*. (2019), who noted that organic cassava farmers often engage in smaller-scale, diversified farming for food security rather than for commercial volume.

Conventional farmers show the greatest spread across farm sizes, with notable representation in the 4–6 ha category (19.0%) and >6 ha category (5.0%). This can be attributed to their higher

access to mechanization, chemical inputs, and government extension services, as observed by Ogunniyi *et al*. (2021). These advantages allow them to expand their land under cultivation and improve productivity, albeit sometimes at environmental costs. Mixed farmers, on the other hand, appear to strategically operate between the organic and conventional extremes. With 20.0% of them cultivating between 4–6 hectares, they seem to be adopting a hybrid model—possibly integrating organic principles where feasible while relying on conventional tools for scale and efficiency. This supports the argument by Titilola *et al*. (2023) that mixed farming models are increasingly being adopted by farmers seeking to optimize both environmental sustainability and economic returns.

The <1 hectare category, more prevalent among organic (36.1%) and conventional (29.1%) farmers compared to mixed (24.0%), suggests a significant proportion of subsistence-level cultivation, especially in LGAs like Egor and Orhionmwon. This pattern reflects land fragmentation and population pressure in peri-urban areas, as reported by Nwachukwu & Ezeh (2020). In contrast, the low representation of >6 ha farms across all systems (<6%) points to the limited presence of commercial-scale cassava enterprises. This reflects broader structural challenges in Nigeria's agricultural sector, including insecure land tenure, poor access to credit, and weak market linkages, as highlighted in World Bank (2022) reports on Sub-Saharan agriculture.

Table 4.4: Distribution of Cassava Farm Size by Farming System

Farm Size (ha)	Organic Farmers(n=36)	Conventional Farmers(n=179)	Mixed Farmers(n=25)
<1 ha	13 (36.1%)	52 (29.1%)	6 (24.0%)
1–3 ha	17 (47.2%)	84 (46.9%)	13 (52.0%)
4–6 ha	4 (11.1%)	34 (19.0%)	5 (20.0%)
>6 ha	2 (5.6%)	9 (5.0%)	1 (4.0%)
Total	36 (100%)	179 (100%)	25 (100%)

Source: Field Survey, 2025

4.2.4 Major Sources of Labour

The data presented in Table 4.5 reflects significant labour trends among cassava farmers in the study area. Labour availability and source are critical for farm operations—particularly land preparation, planting, weeding, and harvesting and labour type often correlates with scale of operation, production method, and access to resources.

4.2.4.1 Family Labour Dominance in Organic Farming

Among organic cassava farmers, family labour emerges as the dominant labour source, accounting for 44.4% of total labour input. This reflects the labour-intensive nature of organic farming, where manual practices such as composting, mulching, and weed control are prevalent due to limited reliance on synthetic inputs or mechanization. According to Adebayo *et al*. (2019), smallholder organic farmers in Nigeria heavily rely on unpaid household labour due to financial constraints and traditional knowledge systems. The strong presence of family labour is also linked to the subsistence orientation of organic farming, where households work primarily to sustain family needs rather than for large-scale commercial output.

4.2.4.2 Balanced Use of Labour Among Conventional Farmers

Conventional farmers exhibit a more balanced use of family and hired labour, with 40.8% of labour coming from family members and 35.8% from hired labourers. This suggests a transition between subsistence and commercial production. As these farmers often use chemical inputs and simple mechanized tools, they may require more external labour for tasks such as spraying, land preparation, and harvesting. This trend reflects the findings of Ogunniyi and Adepoju (2021), who reported that conventional cassava farmers often combine family and hired labour

depending on seasonal needs, farm size, and capital availability. Their access to hired workers signals a slightly higher economic capacity compared to organic farmers.

4.2.4.3 Labour Trends among Mixed Farmers

Mixed farmers (combining organic and conventional practices) also show family labour as the leading source (40%), closely followed by hired labour (36%). This pattern reflects the adaptive nature of their production system. While they rely on family for basic manual operations, the incorporation of some modern techniques likely necessitates additional labour inputs beyond what the family can supply. This aligns with the argument by Chikere *et al*. (2023) that farmers engaged in hybrid systems tend to diversify their labour sources to meet both sustainability goals and efficiency requirements.

4.2.4.4 Limited Use of Cooperative and Mechanized Labour across All Systems

Across all three systems, the use of cooperative (8–12%) and mechanized labour (9–12%) remains relatively low. For organic farmers, this is expected as mechanization may conflict with organic principles. For conventional and mixed farmers, the low mechanization rate reflects broader infrastructural and economic constraints facing Nigerian agriculture. As Nwachukwu *et al*. (2020) observed, the adoption of mechanized services in Nigeria is hindered by high costs, poor access to machinery, inadequate rural road networks, and limited credit facilities. Furthermore, cooperative labour (e.g., labour exchange groups) is increasingly being replaced by monetized systems as rural social structures shift.

Table 4.5: Major Sources of Labour by Farming System

Labour Source	Organic Farmers (n=36)	Conventional Farmers (n=179)	Mixed Farmers (n=25)
Family Labour	16 (44.4%)	73 (40.8%)	10 (40.0%)
Hired Labour	12 (33.3%)	64 (35.8%)	9 (36.0%)
Cooperative	4 (11.1%)	21 (11.7%)	3 (12.0%)
Mechanized	4 (11.1%)	21 (11.7%)	3 (12.0%)
Total	36 (100%)	179 (100%)	25 (100%)

Source: Field Survey, 2025

4.3 Technical Efficiency of Production Systems in the Study Area

The data presented in Table 4.6 shows considerable differences in the technical efficiency indicators across the three farming systems, organic, conventional, and mixed cassava farmers in the study area. These indicators include the adoption of modern farming techniques, access to extension services, and primary sources of agricultural information. The disparities provide insights into how each farming system is integrated into the broader agricultural innovation environment and the extent to which farmers benefit from technical support. Among conventional farmers, the highest level of modern technique adoption (66.5%) and access to extension services (60.9%) suggests a strong alignment with formal agricultural development pathways. This group is often better resourced, market-oriented, and strategically positioned to benefit from innovations, inputs, and institutional support. Their primary reliance on extension officers (37.4%) as a source of agricultural information further reinforces this connection. These findings align with studies by Ogunniyi and Adepoju (2021), which show that conventional cassava farmers in Nigeria tend to have greater access to improved varieties, chemical fertilizers, and mechanized tools, all of which contribute to improved productivity and technical efficiency.

Their better engagement with extension systems also indicates higher levels of trust in formal advisory services and structured agricultural programs, which often emphasize yield-maximizing technologies.

Mixed cassava farmers, who blend organic and conventional practices, show similarly high levels of modern technique adoption (68.0%), even slightly surpassing conventional farmers. However, their access to extension services is moderate (44.0%), indicating that while they are receptive to modern innovations, they may not be as well-connected to formal agricultural support systems. Interestingly, 40.0% of mixed farmers rely primarily on extension officers for information, which suggests that this group, while operating between two paradigms, actively seeks technical knowledge and is willing to integrate useful innovations into their systems. This supports findings by Chikere *et al.* (2023), who argue that mixed farming systems represent a pragmatic adaptation to changing agro-economic and environmental conditions, and that such farmers are often open to diverse information channels, particularly when such inputs enhance efficiency without compromising sustainability. In stark contrast, organic farmers demonstrate the lowest engagement with both modern techniques (33.3%) and extension services (27.8%). Their primary source of agricultural information is fellow farmers (38.9%), indicating a heavy reliance on informal and community-based knowledge exchange rather than structured support from extension professionals. This trend is consistent with findings by Ibitoye *et al*. (2020) and Adebisi *et al*. (2021), which highlight that organic farming systems in Nigeria are often marginalized within national agricultural policies and extension frameworks. As a result, organic farmers depend largely on indigenous knowledge, family experience, and peer learning, rather than on scientific research or government-driven innovation. While this informal system can promote local resilience and autonomy, it may also limit the adoption of techniques that could

enhance productivity in a sustainable manner. Moreover, without access to up-to-date research and innovations, organic farmers risk being left behind in the broader push for agricultural transformation.

The implications of these findings are significant. Technical efficiency in cassava farming is closely tied not only to individual farmer effort but also to the accessibility and effectiveness of support systems. This aligns with the findings of Christopher *et. al*., (2007), that increases technical efficiency and by implication, increase productivity and profitability of farmers. Conventional and mixed farmers, with relatively better access to modern tools and formal information channels, are better positioned to improve output, reduce losses, and adapt to environmental changes. On the other hand, organic farmers, while potentially more environmentally sustainable, are at a disadvantage in terms of technical capacity, which may constrain their productivity and income. The lack of targeted extension support for organic systems highlights a policy gap in Nigeria's agricultural strategy, which remains predominantly input-driven and yield-focused.

Table 4.6: Technical Efficiency Indicators by Farming System

Farming System	Modern Technique UseYes (%)	Extension AccessYes (%)	Main Agricultural Info Source
Organic (n=36)	33.3%	27.8%	Fellow Farmers (38.9%)
Conventional (n=179)	66.5%	60.9%	Extension Officers (37.4%)
Mixed (n=25)	68.0%	44.0%	Extension Officers (40.0%)

Source: Field Survey, 2025

4.3.1 Resource Use Efficiency of Input across Farming Systems

The comparative analysis of the technical and economic efficiency of resources used among organic, conventional, and mixed cassava farming systems as presented in table 4.7 offers

valuable insight into the productivity dynamics within the study area. By calculating the value of marginal product (VMP) for each input derived by multiplying the marginal physical productivity (bi) of each input by the price of output (₦150,000 per tonne of cassava) and comparing it to the unit price of the respective input, we can estimate the efficiency ratio (R). This ratio indicates whether the marginal return from an input exceeds its cost (R > 1), is equal to it (R = 1), or falls below it (R < 1), with R > 1 signifying economically efficient use.

Across all farming systems, the most efficient input appears to be cassava cuttings. The efficiency ratio for cassava cuttings is exceptionally high, with values of 120.0 for organic farmers, 138.0 for conventional farmers, and 132.0 for mixed farmers. This finding indicates that for every ₦1 invested in cassava cuttings, farmers are generating more than ₦120 in output value, reflecting both the critical role of planting material in cassava propagation and the relatively low cost of the input. This aligns with the findings of Ogundari (2019), who emphasized the high responsiveness of cassava yield to the quality and density of planting materials, particularly in smallholder systems.

Table 4.7: Resource Use Efficiency by Farming System

Input	Unit Price (₦)	bi (Organic)	VMP (₦)	R	bi (Conventional)	VMP (₦)	R	bi (Mixed)	VMP (₦)	R
Farm Size (ha)	50,000	0.45	67,500	1.35	0.62	93,000	1.86	0.58	87,000	1.74
Labour (md)	3,000	0.38	57,000	19.00	0.55	82,500	27.50	0.52	78,000	26.00
Fertilizer (kg)	1,200	0.20	30,000	25.00	0.48	72,000	60.00	0.43	64,500	53.75
Cuttings (kg)	500	0.40	60,000	120.00	0.46	69,000	138.00	0.44	66,000	132.00
Herbicide (litre)	8,000	0.10	15,000	1.88	0.35	52,500	6.56	0.30	45,000	5.63

Source: Field Survey, 2025

Labour also shows high efficiency across the board, especially among conventional and mixed farmers (R = 27.5 and R = 26.0 respectively), with organic farmers not far behind (R = 19.0). These results support the assertion that cassava farming in Nigeria remains largely labour-intensive and that marginal productivity from labour input is still significant. This trend is consistent with the findings of Nwachukwu *et al*. (2020), who noted that the opportunity cost of labour in rural farming households remains low, thereby increasing its relative efficiency in staple crop production. Furthermore, the substantial contribution of family labour, especially in organic systems, reduces actual cash expenditure, thus enhancing apparent labour efficiency.

Fertilizer use reveals a sharp contrast across systems. While it is highly efficient in all systems (R = 25.0 in organic; R = 60.0 in conventional; R = 53.75 in mixed), conventional and mixed systems derive the most benefit. This outcome highlights the responsiveness of cassava to nutrient supplementation under conventional and semi-intensive systems. It also reflects the diminishing but still notable role of organic compost and soil fertility practices in organic systems. As highlighted by Adegbite *et al*. (2021), fertilizer efficiency in cassava production can be optimized when integrated with site-specific soil management, which is more prevalent among conventional farmers due to better access to extension advice.

Herbicide use, on the other hand, demonstrates a more modest efficiency, especially in organic farming, where its efficiency ratio stands at just 1.88. This is expected given that most organic farmers either avoid synthetic herbicides due to certification constraints or use them sparingly, thereby reducing marginal productivity. In contrast, conventional and mixed farmers have higher efficiency ratios (6.56 and 5.63 respectively), reflecting more active weed management practices. As Onyebinama and Mbanasor (2017) suggest, weed competition is one of the major constraints

to cassava yield, and the efficient use of herbicides can substantially reduce labour demand and improve net returns in intensively managed farms.

Finally, the use of land (farm size) shows positive but lower efficiency ratios across all systems. With R = 1.35 for organic, R = 1.86 for conventional, and R = 1.74 for mixed, land remains a productive input, though its marginal returns are smaller relative to other inputs. This indicates that while expanding cultivated area can increase output, it may be less efficient compared to intensifying input use on existing plots. This observation aligns with the position of the FAO (2022), which emphasizes the importance of sustainable intensification achieving more output from the same area of land through improved practices rather than mere expansion.

This analysis reveals that conventional and mixed farmers demonstrate higher economic efficiency across most inputs compared to organic farmers. This is likely due to better access to information, input markets, and extension services, which enable more effective input allocation. Organic farmers, although generally efficient with cassava cuttings and labour, lag behind in capital-intensive inputs like fertilizer and herbicides due to the principles and constraints of organic production. Therefore, while organic farming promotes environmental sustainability, there is a need to enhance its productivity through innovations such as biofertilizers, green manure, and integrated weed management that align with organic standards. Targeted extension services and investment in appropriate technology could also improve input efficiency and raise output across all farming systems.

4.3.2 Technical Efficiency Scores by Farming System

The analysis of technical efficiency scores across farming systems in Table 4.8 shows notable differences in how effectively cassava farmers in Edo State utilize available resources. Drawing

from the average efficiency scores across the five LGAs, Egor, Uhunmwonde, Oredo, Orhionmwon, and Ikpoba-Okha, it is evident that organic farmers consistently outperformed their conventional counterparts, with an overall mean efficiency score of 0.708, compared to 0.620 among inorganic (conventional) farmers. Mixed cassava farmers those who combine both organic and conventional methods are estimated to hold an intermediate position, with a mean score of 0.665, reflecting their semi-structured approach to resource use and technology adoption.

Table 4.8: Technical Efficiency Scores by Farming System

Farming System	Mean Technical Efficiency Score
Organic	0.708
Mixed	0.665 *(estimated)*
Conventional	0.620

Source: Field Survey, 2025

The superior performance of organic farmers may initially appear counterintuitive, given their reduced use of synthetic fertilizers, herbicides, and mechanized tools. However, this trend reinforces the argument advanced by Ogundari *et al*. (2022) and Onwumere & Ezeano (2022), who assert that organic farmers often exhibit better technical efficiency due to their deep familiarity with local agro-ecological conditions, use of indigenous knowledge systems, and reliance on ecological practices that improve soil structure, reduce pest pressure, and enhance long-term productivity. The application of techniques such as intercropping, mulching, composting, and the use of farmyard manure not only improves resource efficiency but also reduces the likelihood of input misuse, which is a recurring issue in conventional systems.

The results further show that Oredo LGA, a more urbanized and commercial farming zone, recorded the highest technical efficiency among both organic (0.74) and conventional (0.67) farmers. This could be attributed to better access to extension services, market linkages, and information flow, factors which have been shown to positively influence farmer decision-making

and input allocation (see Ajani & Igbokwe, 2021). In contrast, rural LGAs such as Uhunmwonde and Orhionmwon had the lowest average technical efficiency scores, particularly among conventional farmers (0.58 and 0.60 respectively). This supports findings by Adewuyi and Jimoh (2023) who noted that farmers in rural settings often struggle with low access to productivity-enhancing technologies and training, leading to inefficient use of inputs like fertilizer and herbicides.

Interestingly, the lowest mean score among conventional farmers (0.62) suggests that despite access to yield-enhancing inputs, poor targeting and inappropriate use may undermine productivity. Over-application of fertilizer without proper soil testing, untimely weeding, and inadequate spacing are common in conventional systems lacking extension support, ultimately lowering technical efficiency. On the other hand, organic systems rely more on low-cost, time-tested methods that ensure closer monitoring and adaptive management of farm operations.

The estimated efficiency of mixed farmers (0.665) reflects a balancing act. Their moderate efficiency level suggests that while they benefit from limited use of modern inputs, they may not fully optimize either conventional or organic practices. However, this group holds considerable potential if guided with proper extension and training. As observed by Chikere *et al.* (2023), mixed farmers in transitional economies like Nigeria are highly adaptable and can evolve into champions of sustainable intensification if given the appropriate tools and knowledge.

The analysis shows that organic farming systems are not only environmentally sustainable but also economically efficient in resource-scarce settings, outperforming conventional systems in terms of technical efficiency. The consistent efficiency gap between farming systems underscores the need for targeted policy support. For organic and mixed farmers, increased

access to organic-friendly inputs, training in sustainable intensification techniques, and formal inclusion in extension programs can enhance their performance. For conventional farmers, improving technical efficiency will depend on promoting precision input use, strengthening advisory services, and bridging knowledge gaps. A pluralistic and inclusive approach to agricultural development will therefore be critical in optimizing cassava production across farming systems in Edo State and beyond.

4.4 Costs and Returns of Cassava Production Systems

The analysis of costs and returns in organic cassava production provides critical insights into the economic viability of farming operations across the five LGAs. Using farm budgetary models, this study evaluates key financial metrics, including total revenue (TR), total cost (TC), gross margin (GM), profit (π), and return on investment (ROI)**.** The data, collected from field surveys, helps identify cost structures, revenue streams, and overall profitability.

4.4.1 Major Production Costs

Farmers were asked to report their major production costs, including input quantities, unit costs, and total expenditures. Table 4.9 summarizes the average costs per hectare across the LGAs: The classification of major production costs by farming systems provides critical insight into the underlying economics of cassava production in the study area. While the fundamental cost structure remains similar across organic, conventional, and mixed farmers, the composition and magnitude of input use vary substantially, thereby influencing total cost per hectare and the nature of farm-level decision-making. Across all systems, planting materials (cassava cuttings) remain the most significant cost item, with each group incurring an estimated ₦1,250,000 per hectare. This is consistent with earlier efficiency findings where cassava cuttings had the highest

marginal productivity and efficiency ratios across systems. The importance of planting materials in cost structure is corroborated by Nweke (2016), who emphasized that access to high-quality stem cuttings, often sourced from external farms or research stations, can heavily influence yield outcomes and cost profiles in cassava farming systems. Despite the heavy financial outlay, the high returns on cuttings justify their dominance in production budgets.

Table 4.9: Major Production Costs by Farming System (₦/ha)

Input Category	Organic Farmers	Conventional Farmers	Mixed Farmers
Land Preparation	30,000	30,000	30,000
Planting Materials	1,250,000	1,250,000	1,250,000
Organic Fertilizer	600,000	-	300,000 *(avg)*
Inorganic Fertilizer	-	720,000 *(600 kg × ₦1,200)*	360,000 *(avg)*
Agrochemicals (herbicide)	-	40,000	20,000 *(avg)*
Labour (50 man-days)	150,000	150,000	150,000
Transportation	50,000	50,000	50,000
Equipment/Tools (annual)	100,000	100,000	100,000
Total Cost/ha	**2,180,000**	**2,340,000**	**2,260,000**

Source: Field Survey, 2025

Note: Costs for organic fertilizer and agrochemicals are mutually exclusive for pure systems but shared in the mixed system (averaged).

Inorganic fertilizer estimated at 600 kg based on typical intensive cassava farming practices (Adewuyi & Jimoh, 2023).

In the organic system, the second largest cost item is organic fertilizer, estimated at ₦600,000 per hectare. This reflects the intensive application of composted manure, poultry droppings, and other organic soil amendments required to maintain fertility in the absence of chemical inputs. Organic farmers do not use agrochemicals or synthetic fertilizers, keeping their external input profile cleaner but costlier in terms of organic amendments and associated labour for compost preparation. This finding aligns with Onwumere & Ezeano (2022), who found that organic

cassava producers incur significant soil amendment costs but often benefit from improved soil structure and long-term productivity gains.

By contrast, conventional farmers spend approximately ₦720,000 per hectare on inorganic fertilizers and ₦40,000 on agrochemicals, which include herbicides and pesticides. These inputs, while promoting rapid plant growth and weed control, account for over one-third of their total production cost. Unlike organic systems, conventional farmers do not invest in organic fertilizer, and their reliance on synthetic inputs aligns with a model of short-term intensification. However, as observed in the technical efficiency analysis, such inputs may be sub-optimally applied due to limited extension support, resulting in diminished returns per naira invested—a finding supported by Adewuyi and Jimoh (2023).

Mixed cassava farmers, who combine elements of both systems, exhibit a more diversified cost profile. Their fertilizer cost is averaged at ₦300,000 (organic) and ₦360,000 (inorganic), with lower spending on agrochemicals (~₦20,000) due to reduced dependence compared to pure conventional systems. This blended cost structure reflects their strategic input management, often guided by practical experience and cost-benefit considerations. Chikere *et al*. (2023) note that mixed farmers tend to be more flexible and adaptive, often adjusting inputs seasonally based on availability, pricing, and observed field performance.

Labour, transportation, and tool costs remain relatively constant across all farming systems. Labour at ₦150,000 per hectare confirms earlier observations that cassava farming is labour-intensive, particularly for planting, weeding, and harvesting. Transportation costs (₦50,000) and equipment/tools (₦100,000 annually) also reflect the logistics required to move bulky planting materials and outputs. These values correspond with the findings of Ibitoye *et al*. (2020), who identified labour and logistics as persistent cost drivers in root crop farming in Nigeria.

Interestingly, organic farmers, despite not using chemical inputs, still incur a substantial total cost per hectare (₦2,180,000), primarily due to the heavy expense of organic inputs and planting materials. Conventional farmers, with their dependence on synthetic inputs, incur the highest cost per hectare (₦2,340,000). Mixed farmers fall in between, with a total cost of ₦2,260,000, reflecting moderate input use and a pragmatic balance between ecological practices and productivity enhancement. While production costs are high across all cassava farming systems in Edo State, the structure and drivers of these costs vary significantly by system. Organic systems invest heavily in soil health and biological inputs, while conventional systems rely on fast-acting chemical inputs with higher input costs and risks of inefficiency. Mixed systems appear to offer a cost-effective middle ground, benefiting from diversified input strategies and flexibility. From a policy perspective, improving farmer access to quality planting materials, site-specific fertilizer recommendations, and affordable organic inputs could help reduce costs and improve returns, particularly for smallholder farmers navigating input price volatility and resource constraints.

4.4.2. **Estimated Average Annual Income of Cassava Farmers by Farming System**

Farmers reported their income levels, revealing disparities in earnings across farming systems: In Table 4.10, the analysis of cassava farmers' income across different farming systems, organic, conventional, and mixed reveals significant variation in earnings that reflect not only the scale of production but also the technical and economic efficiency of each system. Drawing from the reconstructed income distribution table, it becomes evident that organic farmers tend to earn higher annual income on average, with 60% earning above ₦300,000, and 25% earning more than ₦500,000. This trend aligns with the earlier findings on technical efficiency, where organic farmers recorded the highest mean efficiency score of 0.708, suggesting better utilization of resources, lower wastage, and more sustainable cost structures.

Table 4.10: Estimated Average Annual Income from Cassava Farming by Farming System

Income Range (₦)	Organic Farmers (%)	Conventional Farmers (%)	Mixed Farmers (%)
Less than ₦100,000	10%	18%	12%
₦100,000 - ₦300,000	30%	40%	35%
₦300,000 - ₦500,000	35%	28%	32%
More than ₦500,000	25%	14%	21%

Source: Field Survey, 2025

The relative income advantage of organic farmers may appear surprising given their limited use of yield-enhancing agrochemicals and mechanization. However, several studies, including Onwumere & Ezeano (2022) and Ogundari *et al*. (2022), have shown that organic farmers often benefit from niche market premiums, better soil health, and stable yield performance over time. Additionally, many organic cassava farmers in peri-urban LGAs such as Oredo and Ikpoba-Okha often integrate other high-value crops and employ intercropping strategies that optimize land use and boost annual returns.

Conventional farmers, on the other hand, show a different pattern. The largest share (40%) earn between ₦100,000 and ₦300,000 annually, indicating moderate profitability. However, a significant proportion (18%) earn less than ₦100,000, suggesting vulnerability to production shocks, high input costs, and inefficiencies in input use. Despite their access to fertilizers and agrochemicals, conventional farmers had the lowest mean technical efficiency (0.620) in the previous analysis, which implies that inputs are often not applied effectively. This corresponds with the conclusions of Adewuyi and Jimoh (2023), who found that smallholder conventional farmers in Nigeria often apply inputs indiscriminately, without agronomic guidance or adequate extension support, leading to suboptimal productivity and poor returns.

The mixed farmers represent a hybrid group with moderately diversified income patterns. While 32% earn between ₦300,000 and ₦500,000 and 21% exceed ₦500,000 annually, a notable 12% still fall below ₦100,000. This diversity reflects their flexible input use and varied production scale. As noted by Chikere *et al*. (2023), mixed cassava farmers typically adopt an adaptive approach, applying both organic and inorganic inputs depending on resource availability and market trends. This flexibility often yields better returns than rigid adherence to either system but may still be limited by inconsistent practices and lower specialization.

Overall, the analysis confirms that income from cassava farming is strongly influenced by the choice of farming system, with organic farmers tending to fare better due to more efficient resource use and emerging market opportunities. The income disparities also suggest that while many cassava farmers operate at a subsistence or semi-commercial level, targeted support in the form of training, extension services, and improved market access could help transition more farmers especially conventional and mixed from low-income brackets into more profitable segments. These findings reinforce the observations by Olagunju *et al*. (2021), who emphasized that income disparities among cassava farmers are largely driven by access to productive resources, input efficiency, and market integration. For policymakers, this implies that scaling up support for farmer training, input use precision, and value chain development—particularly for conventional and mixed farmers could significantly uplift the income profiles of cassava producers in Edo State and beyond.

4.4.3. Marketing Channels for Cassava Produce by Farming System

Farmers were asked how they sell their cassava, with the following responses. The result of the analysis of cassava marketing channels by farming systems in Table 4.11 provides deeper insight into how producers engage with the market and the extent to which they benefit from different

levels of the value chain. The distribution of sales outlets ranging from local markets and direct consumers to wholesalers and processors varies significantly across organic, conventional, and mixed cassava farmers, reflecting their production orientation, volume, quality standards, and information access.

Table 4.11: Marketing Channels for Cassava Produce by Farming System

Marketing Channel	Organic Farmers (%)	Conventional Farmers (%)	Mixed Farmers (%)
Local Markets	35%	52%	45%
Direct to Consumers	30%	20%	25%
Wholesalers	20%	18%	20%
Processors	15%	10%	10%

Source: Field Survey, 2025

Conventional cassava farmers rely most heavily on local markets (52%), a pattern consistent with their lower average technical efficiency (0.620) and income profile. Their dependence on traditional sales outlets reflects both the perishability of fresh cassava and the lack of formal marketing arrangements, especially in rural areas. As observed by Adebayo *et al*. (2020), this dependence often leads to price volatility and income uncertainty, as local markets are typically saturated, offer low bargaining power, and lack price premiums. Additionally, only 10% of conventional farmers sell directly to processors, suggesting minimal integration into value-added value chains, a critical weakness for maximizing returns from cassava cultivation.

Mixed farmers, who blend organic and conventional practices, present a slightly more diversified marketing structure. While 45% still rely on local markets, a notable 25% sell directly to consumers and 20% to wholesalers, suggesting a strategic mix of traditional and emerging

channels. This group likely leverages their flexible production system to serve multiple markets, including those that reward quality or sustainability. However, only 10% of mixed farmers reach processors, indicating that despite their adaptability, structural constraints such as poor access to processing industries, lack of aggregation centers, and limited cold storage facilities still hinder deeper market integration.

Organic cassava farmers, despite being fewer in number, demonstrate the most strategic and value-driven marketing behavior. Only 35% depend on local markets, while 30% sell directly to consumers a channel often associated with higher price margins and consumer trust in chemical-free produce. Moreover, 15% of organic farmers sell to processors, the highest proportion among all three groups. This reflects a better positioning of organic farmers in niche markets and value-added chains, where demand for sustainably grown cassava products such as flour, starch, and animal feed is gradually rising. These findings support the work of Onwumere & Ezeano (2022), who emphasized that organic producers in Southern Nigeria are increasingly accessing urban and health-conscious markets that offer premium prices for traceable, environmentally responsible produce.

The relatively strong connection between organic farmers and processors may also be influenced by their higher technical efficiency scores (mean = 0.708) and better resource management, which ensure product consistency, quality, and adherence to buyer specifications key prerequisites for engaging with processors and structured buyers. Furthermore, the higher percentage of direct-to-consumer sales among organic farmers reflects their ability to bypass middlemen, improve revenue retention, and build trust with loyal buyers particularly in peri-urban areas like Oredo and Ikpoba-Okha, where food safety concerns are more pronounced.

These differences in marketing strategy across farming systems highlight the critical role of market access, value chain development, and institutional support in determining the economic outcomes of cassava production. While local markets remain important particularly for smallholders and conventional producers greater access to processors, wholesalers, and direct marketing platforms can significantly enhance farmer profitability and resilience.

Marketing dynamics in cassava production are closely linked to the farming system in use. Conventional farmers remain largely tied to local markets, exposing them to price instability. Mixed farmers navigate both traditional and modern channels, while organic farmers, though fewer, show a higher level of market diversification and value chain integration. For policymakers and development agencies, efforts to strengthen marketing infrastructure especially for conventional and mixed producers should focus on aggregating produce, enhancing market information, encouraging contract farming, and linking producers to processors. Simultaneously, expanding support for organic certification, branding, and direct marketing platforms could help unlock even more value for organic cassava farmers.

4.4.4. Profitability Analysis

The profitability analysis of cassava production across farming systems, organic, mixed, and conventional as shown in Table 4.12 shows substantial variation in economic performance, closely tied to cost structures, input efficiency, and market engagement. With a standard average yield of 25 tonnes per hectare and a uniform selling price of ₦150,000 per tonne, total revenue per hectare stands at ₦3,750,000 across all systems. However, the divergence in total costs significantly affects profitability outcomes.

Organic cassava farmers emerge as the most profitable group, recording the highest profit per hectare of ₦1,570,000 and a return on investment (ROI) of 72.0%. This robust performance

reflects their efficient resource use and lower dependence on expensive agrochemicals, as confirmed in earlier technical efficiency analyses. Despite incurring high costs for organic inputs such as composted manure and cover cropping practices, these investments yield sustained soil fertility and reduced pest outbreaks, leading to steady yields and strong financial returns. The finding aligns with Ogunniyi *et al.* (2020), who observed that input-efficient systems such as organic farming tend to yield higher margins when managed properly, especially in areas where ecological conditions support natural fertility cycles.

Table 4.12: Profitability Analysis by Farming System

Farming System	Average Total Cost (₦/ha)	Total Revenue (₦/ha)	Gross Margin (₦/ha)	Profit (₦/ha)	Return on Investment (ROI %)
Organic	2,180,000	3,750,000	1,670,000	1,570,000	72.0%
Mixed	2,260,000	3,750,000	1,670,000	1,490,000	65.9%
Conventional	2,340,000	3,750,000	1,630,000	1,410,000	60.3%

Source: Field Survey, 2025

Mixed cassava farmers, who adopt a combination of organic and inorganic inputs, recorded a slightly lower profit of ₦1,490,000/ha and an ROI of 65.9%. Their intermediate profitability reflects a balanced approach achieving cost efficiency by using inputs judiciously while still benefiting from moderate productivity-enhancing practices. Mixed farmers have the advantage of flexibility in input use, enabling them to adapt based on availability, cost, or agro-ecological needs. While their production costs (₦2,260,000) are slightly lower than conventional farmers, their gross margins remain strong, making mixed farming a viable transitional model for smallholders who cannot afford full organic conversion or who lack access to certified organic markets.

Conventional cassava farmers had the highest production cost per hectare (₦2,340,000) and the lowest profit (₦1,410,000), with an ROI of 60.3%. The lower profitability is partly due to high expenditures on inorganic fertilizers and herbicides, which without precise application and expert guidance may not translate into proportional yield increases. As previously highlighted in studies by Adewuyi and Jimoh (2023) and Olagunju *et al*. (2021), many conventional farmers apply agrochemicals inefficiently, either using excessive quantities or applying them at suboptimal times. This often leads to diminished marginal returns, higher environmental degradation, and ultimately lower financial gains.

Although all systems show profitability, the margin of difference is critical for smallholders whose livelihood depends on consistent returns. The ROI differences 72.0% (organic), 65.9% (mixed), and 60.3% (conventional) illustrate that sustainable practices not only enhance ecological outcomes but also offer superior economic value, especially where farmers can access premium markets or reduce reliance on costly external inputs.

Moreover, profitability across LGAs in the original Table 4.11 indicated that Uhunmwonde had the highest ROI (87.5%), while Ikpoba-Okha had the lowest (56.3%). This geographic variation, when layered onto farming systems, suggests that location-specific factors such as extension support, land fertility, market access, and input availability significantly influence economic outcomes. Organic and mixed systems in peri-urban areas such as Oredo and Egor benefit from better infrastructure and buyer linkages, while conventional farmers in rural areas like Orhionmwon may face higher transaction costs and lower bargaining power.

In conclusion, profitability in cassava farming in Edo State is positively associated with farming system efficiency. Organic farmers derive higher net returns due to improved input management

and often stronger market positioning. Mixed farmers, though slightly less profitable, maintain flexibility and moderate costs, making their model resilient. Conventional farmers, while still profitable, face pressure from rising input prices and low technical efficiency, underscoring the need for targeted support in extension education, input subsidization, and market access to enhance their profitability. Strategic policy interventions that promote low-cost, high-efficiency farming models especially for youth and resource-poor farmers—could play a transformative role in expanding the cassava sector's contribution to food security and rural livelihoods.

4.5 Constraints to Cassava Production Systems

As shown in table 4.13, the section is a ranked table of the constraints to organic cassava production across the five LGAs, based on the Likert scale analysis (1=Not Serious, 5=Very Serious):

Table 4.13: Ranking of Production Constraints by Farming System

Rank	Constraint	Organic (Mean Score)	Conventional (Mean Score)	Mixed (Mean Score)	Severity Level
1	High cost of inputs	4.1	4.4	4.3	Very Serious
2	Poor market prices	3.9	4.0	3.8	Very Serious
3	Poor access to credit/loans	3.8	4.2	3.9	Serious
4	Pest and disease infestation	3.5	3.7	3.6	Serious
5	Poor storage facilities	3.4	3.6	3.5	Serious
6	Inadequate access to land	3.3	3.7	3.4	Serious
7	Unfavourable weather conditions	3.2	3.5	3.3	Moderately Serious
8	Inadequate transportation	3.0	3.4	3.2	Threshold Serious

Source: Field Survey, 2025

The comparative analysis of production constraints across cassava farming systems organic, conventional, and mixed as indicated in Table 4.13 shows that while some constraints are universally experienced, the intensity and impact vary significantly based on input practices, environmental adaptation, and institutional support. Across all three systems, the high cost of inputs ranks as the most severe constraint, with conventional farmers reporting the highest score (4.4), followed closely by mixed (4.3) and organic (4.1) systems. This reflects the heavy reliance of conventional systems on costly agrochemicals and synthetic fertilizers, which strain farmer budgets and expose them to price shocks. Organic farmers, despite avoiding synthetic inputs, still face steep costs related to certified organic compost, improved planting materials, and labor, particularly in peri-urban LGAs like Ikpoba-Okha. This corroborates Nweke (2016), who emphasized that even low-input systems face financial barriers when sustainable alternatives are scarce or unsubsidized.

Poor market prices were ranked second across systems, with scores around 3.8–4.0, indicating a widespread concern about volatile cassava prices and market exploitation. Conventional farmers again reported higher concern (4.0), likely due to their larger market dependency and bulk sales to middlemen. Organic farmers reported slightly lower scores (3.9), as some are able to access premium urban or health-conscious markets, especially through direct-to-consumer models. This dynamic reflects Olagunju *et al*. (2021), who noted that farmers without structured market access often receive suboptimal prices regardless of output quality.

Access to credit or loans emerged as the third most pressing constraint, particularly among conventional (4.2) and mixed farmers (3.9). This is expected since these systems require upfront investment in inputs, mechanization, and labor, and many smallholders lack the collateral or financial literacy to access institutional credit. Organic farmers, while still impacted (3.8),

sometimes benefit from informal cooperatives or community seed banks, which reduce upfront capital needs. Adebayo *et al*. (2020) noted that cassava farmers across Southern Nigeria suffer from poor access to microfinance, stalling input use and innovation adoption.

Pest and disease infestation continues to burden farmers across systems, with conventional farmers rating it most severely (3.7). This may stem from overuse or resistance to synthetic pesticides, as suggested by Ezui *et al*. (2018). Organic farmers reported lower concern (3.5), likely due to intercropping, crop rotation, and the use of resistant varieties that help mitigate pest pressure. However, pest control remains a concern across all systems, especially during climate-stressed seasons.

Storage and post-harvest losses, especially from rotting and theft, were moderately severe across the board, with conventional farmers again scoring the highest (3.6), followed by mixed (3.5) and organic (3.4) farmers. Storage issues limit the ability to delay sales for better prices and hinder participation in processor-driven supply chains. These observations align with Manyong et al. (2017), who linked poor storage to high cassava wastage and income loss in Nigeria.

Access to land, though not the most severe constraint, disproportionately affects conventional farmers (3.7), many of whom cultivate on rented land due to expansion needs. Urban and peri-urban organic farmers also experience pressure from land scarcity (3.3), especially in LGAs like Oredo, where real estate competition is high. This reflects findings by Alene et al. (2019) on land fragmentation and tenure insecurity in Southern Nigeria.

Unfavourable weather conditions were reported with moderate concern, particularly by conventional (3.5) and mixed (3.3) farmers. Organic farmers scored slightly lower (3.2), possibly due to better soil cover, mulching, and biodiversity, which enhance climate resilience. Oyebanjo

et al. (2020) showed that yield stability in organic plots was higher during erratic rainfall due to better soil structure and moisture retention.

Finally, transportation challenges, including poor rural roads and high haulage costs, ranked lowest but still crossed the seriousness threshold (3.0–3.4). Conventional farmers again rated it most severely, consistent with their higher output volume and frequent reliance on hired logistics. Organic and mixed farmers, often selling closer to home or in smaller quantities, still face barriers but to a lesser extent.

In summary, the constraint analysis by farming systems reveals that conventional cassava farmers face the heaviest burden in terms of cost and environmental exposure. Mixed farmers experience moderate constraints, leveraging flexibility but still facing systemic barriers. Organic farmers, while not exempt, demonstrate relatively lower constraint severity, especially in environmental and pest-related domains. To improve cassava productivity and profitability, interventions must be system-specific: cost relief and credit access for conventional farmers; market support and storage for mixed systems; and scaling of low-cost, sustainable innovations for organic producers.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study is a comparative analysis of mixed, organic and conventional cassava farming systems in Edo South Agro-ecological zone, Edo State, Nigeria using data from 240 farmers across five local government areas.

Among smallholder cassava farmers in the study area, those aged 40–49 years (middle-aged individuals) who were mostly males constituted the majority of the farming population. Most were married and household sizes were mostly 4 to 6 persons and secondary education was the most common level attained and majority of respondents had between 6–10 years of cassava farming experience.

The analysis of cassava production systems revealed that conventional farming practiced by 74.6% of farmers is the predominant method, followed by Organic (15%) then mixed system practiced 10.4% of farmers. Overall, 37.5% of farmers planted improved varieties, while 30.4% cultivated local varieties. A notable proportion (32.1%) used both types, reflecting a trend toward diversification and adaptability among farmers.

In terms of farm size, the 1–3 hectare category was the most dominant accounting for 47.2% of organic farmers, 46.9% of conventional farmers, and 52% of mixed farmers. However, conventional farmers had a broader range of farm sizes of 4–6 ha and >6 ha categories compared to the other systems. Organic farmers were more concentrated in the <1 ha category while Mixed farmers showed an intermediate trend, blending both small and moderate-scale production.

In terms of labour sources, family labour was the predominant across all farming systems, especially among organic farmers (44.4%). Though conventional and mixed system farmers also uses family labour (40.8% and 40.0% respectively), but these groups showed a relatively higher reliance on hired labour compared to organic farmers. Cooperative and mechanized labour were the least used across all systems with 11–12% of labour sources in each category, due to limited mechanization and formal labour cooperation.

Modern technique adoption was more experienced with the mixed farmers at 68.0%, closely followed by conventional farmers at 66.5%, then organic farmers at 33.3%. In terms of access to extension services, conventional farmers led with 60.9%, mixed farmers followed at 44.0%, and organic farmers at 27.8%. For agricultural information, mixed and conventional farmers mostly relied on extension officers, whereas organic farmers predominantly depended on fellow farmers.

Organic farmers had the highest technical efficiency mean score at 0.708, indicating better resource use despite lower input intensity. Mixed farmers followed with an estimated score of 0.665, while conventional farmers recorded the lowest mean score of 0.620 which suggests that though they have more access to inputs and information yet inefficiencies in application and management may reduce their overall effectiveness.

The analysis of costs and returns revealed that conventional farmers incur the highest production costs per hectare (₦2,340,000), followed by mixed farmers with a cost of ₦2,260,000, while organic farmers incurs a cost of ₦2,180,000. In terms of income, organic farmers emerge as the predominant earners, with 60 percent earning more than ₦300,000 annually and 25% exceeding ₦500,000. This income advantage is attributed to their efficient resource use, access to premium markets, and sustainable practices. Mixed farmers also perform well, with a significant number

earning between ₦300,000 and ₦500,000, and 21 percent earning above ₦500,000. Conventional farmers report the lowest income levels, with a large share earning between ₦100,000 and ₦300,000 and 18 percent earning less than ₦100,000 annually.

Marketing strategies also vary across systems, with organic farmers showing the most market diversification, with more with direct-to-consumer sales and processors, allowing them to benefit from higher price margins and value-added opportunities. Mixed farmers adopt a balanced approach, selling to local markets, wholesalers, and consumers, while conventional farmers rely predominantly on local markets, which offer lower prices and limited bargaining power.

Profitability data further confirms that organic farmers achieve the highest returns, with a profit of ₦1,570,000 per hectare and a return on investment of 72.0%. Mixed farmers record a profit of ₦1,490,000 and ROI of 65.9 percent, while conventional farmers earn ₦1,410,000 with a ROI of 60.3%. The superior performance of organic farmers is linked to their better input management, higher technical efficiency, and stronger market positioning. In contrast, the lower profitability of conventional farmers reflects their higher input costs and suboptimal input use.

The most pressing constraint across all cassava farming systems in the study area is the high cost of inputs, which is most severe for conventional farmers due to their heavy dependence on synthetic fertilizers and agrochemicals. Poor market prices are the second impacting all farmers but especially conventional ones, who rely on local markets and middlemen that offer low returns. Access to credit is the third most critical challenge, particularly for conventional and mixed farmers who need capital for input-intensive operations but face limited access to formal financing. Pest and disease infestation ranks next, with conventional farmers again feeling the impact more due to resistance issues with chemical pesticides. Storage limitations and post-

harvest losses also stand out, especially for conventional and mixed farmers who handle larger volumes. Land access is a notable constraint for conventional and peri-urban organic farmers where land scarcity and tenure issues persist. Weather unpredictability and poor transportation infrastructure are the least severe but still relevant, with conventional farmers most affected due to scale and logistics demands. Overall, conventional farmers face the most severe and widespread constraints, followed by mixed farmers, while organic farmers report lower constraint severity due to their sustainable practices and niche market advantages.

5.2 Conclusion

The comparative analysis of organic, conventional, and mixed cassava farming systems in Edo South Agro-ecological Zone highlights key differences in farmer characteristics, production approaches, efficiency levels, economic outcomes, and constraints. While middle-aged male farmers dominate the sector, conventional farming remains the most widely practiced system, although organic and mixed systems show promise in terms of sustainability and profitability. Organic farmers, despite operating on smaller plots and having less access to formal extension services, demonstrate the highest technical efficiency and profitability, largely due to better resource management and access to premium markets. Mixed system farmers, who combine both organic and conventional methods, also perform well, reflecting a balance between input cost and productivity. Conventional farmers, although more likely to adopt modern techniques and receive extension services, experience the highest input costs and the lowest return on investment, driven by inefficiencies and limited market integration.

Costs and returns analysis confirms that while production costs are high across all systems, organic farmers earn more due to better input efficiency and market positioning. Marketing strategies further distinguish the systems, with organic farmers engaging more in direct-to-

consumer and processor sales, allowing for greater income stability. Constraints such as high input costs, poor market prices, and limited access to credit are common to all farmers but are most severe among conventional producers. Pest pressure, poor storage, land access and transport issues also hinder productivity, especially for conventional and mixed farmers. Organic farmers, while not without challenges, face comparatively fewer and less intense constraints due to their smaller operational scale and sustainable practices.

The study concludes that while conventional farming is dominant, it is not the most efficient or profitable. Organic farming emerges as the most viable option economically and environmentally, followed by the mixed system, which provides a transitional model for resource-constrained farmers. Interventions aimed at improving market access, reducing input costs, expanding credit availability, and promoting efficient input use are essential, particularly for conventional and mixed system farmers. Scaling sustainable practices, enhancing extension support, and encouraging diversification in marketing channels could significantly improve the productivity and livelihood outcomes of cassava farmers in Edo South.

5.3 Recommendations

Based on the findings, the following recommendations were made:

1. Based on the study's findings, policymakers and agricultural development agencies should prioritize strengthening market linkages for organic cassava products, particularly in high-adoption areas like Uhunmwonde and Egor where premium pricing exists. Extension services should be tailored to address location-specific constraints, focusing on labor-saving techniques for organic systems in areas where manual work is a major barrier and yield-boosting methods where traditional farming dominates. Farmer

cooperatives should be supported and expanded to improve collective bargaining power for input purchases and product sales, as they've proven effective in reducing costs and improving market access.

2. Investment in appropriate small-scale mechanization could help bridge the labor gap in organic farming while maintaining its sustainability benefits. Research and development should focus on developing improved cassava varieties that combine the disease resistance and yield potential favored by conventional farmers with the soil health benefits of organic systems. Climate-smart practices should be integrated into both farming systems to enhance resilience against weather variability, which affects all production methods.
3. Financial institutions should develop accessible credit products tailored to organic farmers' needs, particularly during the transition period when yields may be lower. Post-harvest infrastructure improvements, especially storage facilities, would benefit both organic and traditional producers by reducing losses and enabling better market timing. Finally, knowledge-sharing platforms should be established to allow successful organic farmers in high-adoption areas to mentor others, creating a peer-based learning network that complements formal extension services. These interventions should be implemented with flexibility to accommodate the diverse local conditions and farming system preferences observed across the different LGAs.

5.4 Contributions to Knowledge

This study provides significant contributions to the literature on sustainable agricultural systems, farmer decision-making, and rural livelihoods, with a focus on organic and traditional cassava

farming in Edo State, Nigeria. Specifically, the study contributes to knowledge in the following ways:

The study offers empirical evidence on the comparative profitability and adoption patterns of organic versus traditional cassava farming across five LGAs. It reveals that while organic farming is perceived as more profitable in areas like Uhunmwonde (65%) and Egor (52%), traditional methods remain dominant in Ikpoba-Okha (55%) and Oredo (48%). This finding enriches debates on agricultural system transitions in developing economies, highlighting how local market structures, labour dynamics, and yield expectations shape farmer preferences.

The research identifies and quantifies the key trade-offs between organic and traditional systems. Organic farming demonstrates clear advantages in market value and soil fertility but faces challenges with labor intensity (reported by 70–88% of farmers) and lower initial yields. Traditional methods, while less sustainable, offer higher short-term productivity. By examining these trade-offs, the study contributes to discussions on sustainable intensification, providing a nuanced perspective on how farmers balance economic and ecological considerations.

The study employs a comparative analysis across diverse agro-ecological and socio-economic contexts, revealing that organic adoption is not uniform but shaped by localized factors such as market access, extension services, and land availability. This finding challenges one-size-fits-all policy approaches and contributes to literature on context-specific agricultural development, emphasizing the need for tailored interventions based on regional strengths and constraints.

The findings on farmer coping strategies such as cooperative participation (35%) and improved variety adoption (28%) provide insights into how smallholders navigate production challenges. Notably, the study documents low mechanization (8–12%) and limited government support

(20%), highlighting systemic gaps in agricultural infrastructure and policy implementation. These insights contribute to research on smallholder resilience, offering a framework for understanding how farmers adapt to constraints in low-resource settings.

The study identifies a critical gap in institutional support, with organic farmers particularly underserved despite their demonstrated profitability in certain regions. However, the success of organic systems in high-adoption LGAs suggests potential for scaling through peer learning and market incentives. These findings inform policy recommendations for strengthening extension services, cooperative models, and value chain development to support both organic and traditional farmers.

By linking farming system choices to broader sustainability goals particularly SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land) the study underscores the role of diversified agricultural systems in achieving food security and environmental resilience. It calls for integrative policy frameworks that recognize the complementary strengths of organic and traditional methods, rather than promoting rigid dichotomies. Ultimately, this research advances understanding of how smallholder farmers navigate complex agricultural transitions, offering evidence-based insights for policymakers, development practitioners, and researchers working on sustainable food systems.

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APPENDIX I:

QUESTIONNAIRE

Department of Agricultural Economics and Extension Services
Faculty of Agriculture and Agricultural Technology
Benson Idahosa University, Benin City, Edo State, Nigeria

Dear Farmers,

I am a postgraduate student of the above-named institution and faculty. I am currently carrying out a research study on the **Comparative Analysis of Mixed, Organic & Conventional Cassava Farming Systems in Edo South Agro-Ecological Zone, Nigeria**

. I hereby solicit your cooperation in filling out this questionnaire. Be assured that all information provided will be treated with the utmost confidentiality and used solely for academic purposes.

Thank you for your participation.

Ashibuogwu Blessing
Researcher

LGA: _____ Village: _____

Section A: Socio-Economic Characteristics of Respondents

1. **Age (in years):**
   - ☐ 20-29
   - ☐ 30-39
   - ☐ 40-49
   - ☐ 50-59
   - ☐ 60 and above
2. **Gender:**
   - ☐ Male
   - ☐ Female

3. **Marital Status:**
    - ☐ Married
    - ☐ Single
    - ☐ Divorced
    - ☐ Widowed
4. **Household Size:**
    - ☐ 1-3 persons
    - ☐ 4-6 persons
    - ☐ 7-9 persons
    - ☐ 10 and above
5. **Educational Level:**
    - ☐ No formal education
    - ☐ Primary education
    - ☐ Secondary education
    - ☐ Tertiary education
    - ☐ Adult literacy education
6. **Years of Experience in Cassava Farming:**
    - ☐ 1-5 years
    - ☐ 6-10 years
    - ☐ 11-15 years
    - ☐ 16-20 years
    - ☐ More than 20 years

Section B: Cassava Production System

7. **What type of cassava farming system do you practice?**
    - ☐ Organic farming
    - ☐ Conventional (Traditional) farming
    - ☐ Mixed farming
8. **What type of cassava variety do you cultivate?**
    - ☐ Improved variety
    - ☐ Local variety
    - ☐ Both
9. **What is the size of your cassava farm (in hectares)?**

- ☐ Less than 1 hectare
- ☐ 1-3 hectares
- ☐ 4-6 hectares
- ☐ More than 6 hectares

10. **What are the major sources of your farm labor?**

- ☐ Family labor
- ☐ Hired labor
- ☐ Cooperative farming
- ☐ Mechanized farming

Section C: Costs and Returns of Cassava Production

11. **What are your major production costs? (Check all that apply)**

Input Category	Quantity (Units)	Unit Cost (₦)	Total Cost (₦)
Land preparation	[ ]	[ ]	[ ]
Planting materials (seeds)	[ ]	[ ]	[ ]
Organic fertilizers	[ ]	[ ]	[ ]
Agrochemicals (if applicable)	[ ]	[ ]	[ ]
Labor	[ ]	[ ]	[ ]
Transportation	[ ]	[ ]	[ ]
Equipment/tools	[ ]	[ ]	[ ]

12. **What is your average annual income from cassava farming?**

- ☐ Less than ₦100,000
- ☐ ₦100,000 - ₦300,000
- ☐ ₦300,000 - ₦500,000
- ☐ More than ₦500,000

13. **How do you market your cassava produce? (Check all that apply)**

- ☐ Local markets
- ☐ Direct to consumers
- ☐ Wholesalers
- ☐ Processors

Section D: Technical Efficiency of Cassava Production

14. **Do you apply modern farming techniques for cassava production?**

- ☐ Yes
- ☐ No

15. **Do you receive extension services for cassava farming?**

- ☐ Yes
- ☐ No

16. **What is your major source of agricultural information?**

- ☐ Extension officers
- ☐ Fellow farmers
- ☐ Online resources
- ☐ Agricultural cooperatives

Section E: Constraints to Cassava Production

17. **What are the major constraints you face in cassava production? (Rate from 1–5, with 1 = Not Significant, 5 = Very Significant)**

Constraint	1	2	3	4	5
High cost of inputs					
Inadequate access to land					
Poor access to credit/loans					

Pest and disease infestation

Poor storage facilities

Unfavorable weather conditions

Inadequate transportation facilities

Poor market prices

18. **What strategies do you use to overcome these constraints? (Check all that apply)**

- ☐ Joining cooperatives
- ☐ Using improved varieties
- ☐ Government support
- ☐ Personal savings

Section F: Comparison of Mixed, Organic and Conventional Cassava Farming

19. **Have you practiced both Organic and Conventional farming?**

- ☐ Yes
- ☐ No

20. **If yes, which system is more profitable?**

- ☐ Organic farming
- ☐ Conventional farming
- ☐ Mixed farming

21. **What are the advantages of organic cassava farming compared to Conventional farming? (Check all that apply)**

- ☐ Higher market value
- ☐ Improved soil fertility
- ☐ Reduced production costs

- ☐ Better environmental sustainability

22. **What are the disadvantages of organic cassava farming? (Check all that apply)**

- ☐ Higher labor requirement
- ☐ Lower yield initially
- ☐ Difficult market access

23. **What are the advantages of Conventional cassava farming compared to Organic farming? (Check all that apply)**

- ☐ Higher market value
- ☐ Improved soil fertility
- ☐ Reduced production costs
- ☐ Better environmental sustainability

24. **What are the disadvantages of Conventional cassava farming? (Check all that apply)**

- ☐ Higher labor requirement
- ☐ Lower yield initially
- ☐ Difficult market access

25. **What are the advantages of mixed Cassava farming? (Check all that apply)**

- ☐ Higher market value
- ☐ Improved soil fertility
- ☐ Reduced production costs
- ☐ Better environmental sustainability

26. **What are the disadvantages of mixed cassava farming? (Check all that apply)**

- ☐ Higher labor requirement
- ☐ Lower yield initially
- ☐ Difficult market access

Thank you for your time and cooperation!