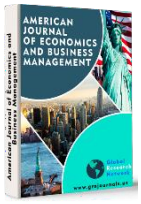

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Supply Chain Management and Income of Cooperative Farmers in Anambra State, Nigeria

Akwaekwe, Christian Ikechukwu [1], Mbah, Stella Ifeyinwa. PhD [2] Akam, Godwin Uche PhD [3]

[1] Department of Cooperative Economics and Management, Nnamdi Azikiwe University, Awka, Nigeria
[2,3] Department of Business Administration, Chukwuemeka Odumegwu Ojukwu University, Igbariam Campus, Anambra state, Nigeria

Abstract:
This study investigates the impact of supply chain management practices on the income levels of cooperative farmers in Anambra State, Nigeria. The research was conducted on a population of 13,484 individuals, with a carefully selected sample size of 524 respondents obtained through a multi-staged sampling technique, ensuring representativeness and reliability of the findings. The primary aim was to evaluate how various supply chain management variables influence farmers' income, thereby providing insights for policy formulation and strategic interventions. Using regression analysis, the study examined the relationship between supply chain management components - operational efficiency, cost management, quality control, inventory management, market access, and technological adoption - and farmers' income. The results indicate that all variables positively influence income levels, with quality control exerting the most significant effect (coefficient = 0.420, $p < 0.001$), followed by operational efficiency (0.350) and market access (0.310). The high t-statistics and significance levels ($p < 0.001$ for all variables) confirm the robustness of these relationships. The model demonstrates a strong explanatory power, with an R-squared value of 0.765, indicating that approximately 76.5% of the variation in farmers' income can be explained by the supply chain management variables included. The adjusted R-squared value of 0.754 further validates the model's suitability. The overall model is statistically significant ($F(6, 517) = 73.195$, $p < 0.001$), confirming that the supply chain management practices collectively have a substantial impact on the income of cooperative farmers. These findings highlight the importance of comprehensive supply chain management strategies in enhancing farmers' income and livelihoods. Improving operational efficiency, ensuring quality control, expanding market access, adopting suitable technologies, managing costs effectively, and optimizing inventory management are critical areas for intervention. Policymakers and cooperative leaders should prioritize these aspects to foster sustainable agricultural development and economic empowerment among farmers in Anambra State among others.

Keywords: Operational Efficiency, Cost Management, Quality Control, Inventory Management, Market Access, Technological Adoption, Farmers' Income.

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1. INTRODUCTION

Membership in agricultural cooperatives has been shown to significantly enhance farmers' incomes by providing better access to markets, resources, and collective bargaining power. A study focusing on rural China found that cooperative membership positively impacts household income by facilitating access to essential resources and services, thereby improving productivity and profitability (Ma & Abdulai, 2022; Ifechukwu-Jacobs, Ezeokafor & Ekwere, 2021; Ifechukwu-Jacobs, 2022). Similarly, in Burundi, the formation of cooperatives among avocado farmers has led to fairer pricing and increased earnings, with prices rising from approximately 10 cents to 70 cents per kilogram due to organized collective action (AP News, 2024). In the United States, agricultural cooperatives achieved a record gross business volume of over $300 billion in 2022, attributed to high commodity prices, underscoring the financial benefits that cooperatives can offer to their members (American Farm Bureau Federation, 2023). These examples illustrate how cooperative structures can enhance income by improving market access, reducing transaction costs, and increasing bargaining power for farmers. Effective supply chain management (SCM) is pivotal in enhancing the income of cooperative farmers by streamlining operations, reducing intermediaries, and improving market access. A study by Israel and Simtowe (2022) highlights that cooperative society's play a crucial role in strengthening agricultural supply chains by minimizing operational costs and maximizing profits through efficient distribution channels. By participating in supply chain integration, cooperatives can achieve high economic performance, as evidenced by research indicating that such integration leads to better resource utilization and increased profitability (Liu et al., 2021). Furthermore, cooperative interventions have been shown to improve bargaining power and optimize profit distribution within the agricultural supply chain, thereby enhancing farmers' livelihoods. These findings underscore the importance of robust SCM practices in elevating the economic outcomes for cooperative farmers.

Supply chain management (SCM) is a holistic approach to managing the flow of goods, services, and information from suppliers to end customers. At its core, SCM is characterized by integration, coordination, optimization, customer focus, and adaptability. Integration involves aligning and integrating various functions and processes across the supply chain network. This includes collaborating closely with suppliers to ensure timely delivery of raw materials, coordinating production schedules to meet demand forecasts, and synchronizing distribution and logistics activities to ensure efficient delivery to customers. Integrated SCM facilitates seamless communication and information sharing, enabling stakeholders to make informed decisions and respond quickly to changes in market conditions (Christopher, 2022). Coordination is essential in SCM to ensure that all activities within the supply chain are harmonized and working towards common goals. This involves aligning resources such as inventory levels, production capacities, and transportation logistics to meet customer demand effectively. Effective coordination helps in reducing lead times, minimizing inventory holding costs, and optimizing overall operational efficiency. It also ensures that the right products are available at the right time and place, thereby enhancing customer satisfaction and loyalty.

Optimization is a characteristic of SCM focused on maximizing efficiency and minimizing costs throughout the supply chain. This includes optimizing inventory levels to balance between holding costs and service levels, optimizing transportation routes to reduce fuel consumption and emissions, and optimizing sourcing strategies to achieve cost savings without compromising quality. Optimization efforts leverage technology, data analytics, and continuous improvement practices to streamline processes and enhance supply chain performance. Customer focus is paramount in SCM, emphasizing the importance of understanding and meeting customer needs and expectations. Customer-centric SCM

involves gathering insights into customer preferences, behaviours, and buying patterns to tailor supply chain strategies accordingly (Chopra & Meindl, 2020). This includes offering personalized services, ensuring product availability, and providing responsive customer support (Heizer et al., 2020). By aligning supply chain activities with customer requirements, organizations can enhance customer satisfaction, build strong relationships, and differentiate themselves in competitive markets (Bowersox et al., 2020). Adaptability and resilience are critical characteristics of SCM that enable organizations to respond effectively to disruptions, uncertainties, and changes in market dynamics. This involves building flexibility into supply chain strategies, processes, and operations to quickly adapt to unexpected events such as natural disasters, supply chain disruptions, or shifts in consumer demand (Craighead et al., 2020). Resilient SCM practices include developing contingency plans, diversifying sourcing options, and enhancing supply chain visibility to mitigate risks and maintain operational continuity (Sheffi, 2021). Supply chain management embodies a set of fundamental characteristics that collectively enable organizations to achieve operational excellence, reduce costs, enhance customer satisfaction, and drive sustainable growth (Coyle et al., 2020).

The link between SCM and the income of cooperative farmers in Anambra State is profound and direct. Effective SCM practices can significantly enhance farmers' income by optimizing various aspects of the supply chain that directly impact profitability (Abdulrahman et al., 2021). SCM improves market access and opportunities for cooperative farmers. By establishing efficient distribution channels and market linkages, SCM helps farmers reach broader markets where demand and prices may be higher. This reduces dependency on local middlemen and enables farmers to negotiate better prices for their produce, thereby increasing their income (Nwankwo et al., 2020; Ifechukwu-Jacobs, Ezeokafor & Ekwere, 2021; Ifechukwu-Jacobs, 2022). SCM enhances operational efficiency and reduces costs throughout the supply chain. Efficient inventory management, transportation logistics, and storage facilities minimize wastage and post-harvest losses, ensuring that more of the harvested produce reaches the market in optimal condition. Reduced operational costs translate into higher profitability for farmers. Moreover, SCM fosters transparency and accountability in transactions, reducing the risk of exploitation and ensuring that farmers receive fair compensation for their efforts (Eze et al., 2021). Overall, by improving market access, reducing costs, and enhancing operational efficiency, SCM plays a crucial role in boosting the income of cooperative farmers in Anambra State and promoting sustainable agricultural development (Okeke et al., 2021). Enhancing the income of cooperative farmers in Anambra State, Nigeria, is significantly hampered by poor supply chain management, which exacerbates existing challenges within the agricultural sector (Okechukwu et al., 2020). The inefficiencies and gaps in SCM contribute to several interconnected problems that affect farmers' ability to maximize their income and overall productivity. Poor SCM leads to fragmented and inefficient market linkages for cooperative farmers. Without well-established channels and networks connecting farmers to end consumers or markets, cooperative farmers struggle to sell their produce at competitive prices (Adamu & Hassan, 2020). They often rely on middlemen or local traders who offer lower prices, reducing the income that farmers can generate from their crops. Limited access to markets also restricts cooperative farmers' opportunities for market diversification and access to higher-value markets where demand and prices may be more favorable (Adekoya et al., 2021; Ifechukwu-Jacobs, 2022; Jacobs, 2019; Ifechukwu-Jacobs, Ezeokafor & Ekwere, 2021).

Inadequate transportation infrastructure exacerbates the challenges of SCM in Anambra State. Poor road networks and limited transportation options make it difficult for farmers to transport their produce from rural areas to urban markets or processing facilities efficiently (Uche et al., 2020). Delays in transportation contribute to post-harvest losses and reduce the freshness and quality of agricultural products, impacting farmers' profitability. Lack of reliable and affordable transportation further isolates cooperative farmers from economic

opportunities beyond their immediate vicinity (Chukwuemeka et al., 2020; Ifechukwu-Jacobs & Arinze, 2021; Ilechukwu, Ifechukwu-Jacobs, & Okeke, 2023). Moreover, poor SCM practices contribute to inefficiencies in inventory management and storage facilities. Many cooperative farmers lack access to proper storage facilities such as cold storage or warehouses equipped with adequate facilities for preserving perishable goods (Okoro et al., 2021). This results in higher post-harvest losses due to spoilage or damage, further diminishing farmers' income. Inefficient inventory management also leads to overstocking or stockouts, affecting farmers' ability to meet market demand and optimize sales opportunities (Osuji et al., 2021). Additionally, the absence of effective information and communication systems within SCM poses significant challenges for cooperative farmers. Limited access to real-time market information, pricing trends, and demand forecasts hinders farmers' decision-making processes. Without timely and accurate information, farmers may struggle to plan production cycles, adjust planting schedules, or negotiate fair prices for their produce. This information gap leaves farmers vulnerable to exploitation by intermediaries and limits their ability to maximize income through informed market strategies. The complexities of SCM are compounded by a lack of technological adoption and innovation in agricultural practices. Many cooperative farmers rely on traditional farming methods and have limited access to modern technologies and tools that could improve productivity and reduce production costs (Umeh et al., 2021; Ezeokafor, Ifechukwu-Jacobs & Ekwere, 2021; Ifechukwu-Jacobs, 2022). The high cost of technology acquisition and maintenance further limits farmers' ability to adopt sustainable and efficient farming practices that could enhance their income (Chukwu et al., 2021). Addressing the challenges of enhancing income for cooperative farmers in Anambra State requires addressing the systemic issues within supply chain management. Improving market linkages, enhancing transportation infrastructure, investing in storage facilities, strengthening information systems, and promoting technological innovation are essential steps to mitigate the challenges of poor SCM. Collaborative efforts involving government support, private sector investment, and community participation are crucial to developing sustainable solutions that empower cooperative farmers and improve their livelihoods in Nigeria (Eze & Nwakobi, 2021).

Statement of the Problem

The agricultural sector in Nigeria is pivotal to the nation's economy, significantly contributing to employment, food security, and national income (Nwankwo, Chukwuemeka, & Ugwuanyi, 2020). However, cooperative farmers in regions like Anambra State face persistent challenges that impede their productivity and profitability. Key issues include operational inefficiencies (Adamu & Hassan, 2020), poor cost management (Osuji, Nwachukwu, & Chukwuma, 2021), inadequate quality control (Okeke, Eze, & Umeh, 2021), ineffective inventory management, limited market access, and low levels of technological adoption (Chukwu, Okoye, & Ume, 2021). These problems are exacerbated by outdated farming practices, insufficient infrastructure, and limited access to modern agricultural technologies, leading to increased production costs and reduced profitability (Adekoya, Adetola, & Ogundele, 2021; Ifechukwu-Jacobs, Ezeokafor & Ekwere, 2021; Ilechukwu, Ifechukwu-Jacobs, & Okeke, 2023). Addressing these multifaceted challenges through effective supply chain management (SCM) practices is crucial for enhancing the income and overall well-being of cooperative farmers in Anambra State. Despite various interventions by the government and stakeholders to improve the agricultural sector, many initiatives have not yielded the desired results (Federal Ministry of Agriculture and Rural Development [FMARD], 2016). For instance, the Nigerian government's Agriculture Promotion Policy (2016–2020) aimed to build an agribusiness economy capable of delivering sustained prosperity by meeting domestic food needs and creating export markets. However, challenges such as poor infrastructural development, inadequate storage facilities, and insecure markets for post-harvest products have persisted, particularly in

regions like Awka South Local Government Area of Anambra State. These ongoing issues highlight the need for more targeted and effective strategies to address the specific challenges faced by cooperative farmers in the region.

If these challenges remain unaddressed, the consequences could be dire. Cooperative farmers may continue to experience low productivity and profitability, leading to increased poverty levels and food insecurity in the region (Nwankwo et al., 2020; Ifechukwu-Jacobs, Ezeokafor & Ekwere, 2021; Ifechukwu-Jacobs, 2022). The inefficiencies in SCM could result in higher post-harvest losses, reduced marketability of agricultural produce, and an inability to compete in both domestic and international markets (Osuji et al., 2021). Therefore, this research is imperative to develop targeted strategies that can mitigate these inefficiencies and barriers within the supply chain. By focusing on enhancing operational efficiency, cost management, quality control, inventory management, market access, and technological adoption, the study aims to empower cooperative farmers to achieve sustainable income levels, improve their livelihoods, and contribute to the broader economic development of Anambra State.

Objectives of the Study

The main objective of the study is to measure the effect of supply chain management on the income of cooperative farmers in Anambra state, Nigeria**.** Specifically, the study intends to:

1. Investigate the effect of operational efficiency on income of cooperative farmers in anambra state, Nigeria

2. Determine the effect of cost management on income of cooperative farmers in anambra state, Nigeria

3. Access the effect of quality control on income of cooperative farmers in anambra state, Nigeria

Hypotheses for the Study

H_{o1}: Operational efficiency has no significant effect on income of cooperative farmers in Anambra state, Nigeria

H_{o2}: Cost management has no significant effect on income of cooperative farmers in Anambra state, Nigeria

H_{o3}: Quality control has no significant effect on income of cooperative farmers in Anambra state, Nigeria

2. THEORETICAL FRAMEWORK

This study is anchored on Theory: Resource-Based View (RBV). The Resource-Based View (RBV) is a strategic management theory that posits that a firm's sustainable competitive advantage is primarily derived from its internal resources and capabilities. These resources must be valuable, rare, inimitable, and non-substitutable (VRIN) to confer a competitive advantage that can lead to superior financial performance (Barney, 1991).

Tenets and Assumptions:

1. Resources and Capabilities: The RBV emphasizes that an organization's resources (physical, human, and organizational assets) and capabilities (the firm's ability to coordinate and use resources) are central to gaining and sustaining competitive advantage.
2. Valuable, Rare, Inimitable and Non-substitutable (VRIN) Criteria: For resources to provide a sustainable competitive advantage, they must be Valuable (improve efficiency and effectiveness), Rare (not widely possessed by competitors), Inimitable (cannot be easily replicated), and Non-substitutable (no equivalent resources or

capabilities).

3. Heterogeneity and Immobility: The RBV assumes that resources are heterogeneously distributed across firms and that these resources are not perfectly mobile, meaning they cannot be easily transferred or replicated by competitors.

Application to Measuring the Effect of SCM on the Income of Cooperative Farmers in Anambra State, Nigeria:

1. Resource and Capability Analysis: In the context of SCM for cooperative farmers in Anambra State, the RBV theory can be applied by analyzing the specific resources and capabilities within the cooperative. For instance, the cooperatives' collective bargaining power, access to modern farming equipment, and shared knowledge among members are critical resources. Effective SCM practices can enhance these resources by ensuring timely procurement of quality inputs and optimizing production processes, thereby increasing operational efficiency and income (Christopher, 2016).

2. VRIN Analysis of SCM Practices: Applying the VRIN criteria, effective SCM practices in cooperatives can be seen as valuable because they directly improve operational efficiency and reduce costs. They are rare in the sense that not all cooperatives have access to efficient SCM systems. These practices can be inimitable if they involve unique cooperative-specific strategies, relationships, and knowledge that cannot be easily copied by others. Lastly, non-substitutability is achieved when SCM practices integrate tightly with the cooperative's operations, making it difficult to replace with other management practices without losing effectiveness (Heizer, Render, & Munson, 2017).

3. Improving Market Access and Operational Efficiency: By leveraging SCM to improve market access and operational efficiency, cooperative farmers can better coordinate their production and distribution processes. This leads to lower transaction costs, reduced wastage, and enhanced product quality, all of which contribute to higher income levels. For example, efficient SCM can facilitate better logistics and transportation management, ensuring that produce reaches markets fresh and on time, commanding better prices (Stevenson, 2021).

4. Strategic Cost Management: SCM practices aligned with the RBV can help cooperatives manage costs strategically. Bulk purchasing of inputs, shared storage facilities, and joint marketing efforts reduce individual costs and increase bargaining power. These strategic cost management initiatives, underpinned by valuable and rare cooperative capabilities, result in lower production costs and higher net incomes for the farmers (Bijman et al., 2016).

5. Enhancing Competitive Advantage: The overall application of RBV to SCM in this context emphasizes building and leveraging unique internal capabilities within the cooperatives. By doing so, cooperatives in Anambra State can achieve a sustainable competitive advantage, leading to consistently higher incomes for their members. This competitive edge stems from effectively managed resources and capabilities that are difficult for competitors to replicate (Valentinov, 2007).

3. METHODOLOGY

Research Design

This study will adopt a descriptive survey research design. As Micheal, Oparaku, and Oparaku (2012) note, the primary aim of this design is to determine the relationship between independent and dependent variables within a population. Descriptive survey research involves asking questions, collecting, and analyzing data from representative members of the population at a single point in time to ascertain the current status concerning one or more variables under investigation (Okeke, Olise, & Eze, 2008; Chukwuemeka, 2002; Chukwuemeka & Oji, 1999). The questions are designed to elicit responses that will answer the research questions and address the study's objectives. The use of descriptive survey

research design here is to help us to systematically collect, analyze, and interpret data from a target population to understand current conditions, opinions, behaviours, or relationships among the variables without manipulating them.

Area of Study

The area of study refers to the geographical region where the research is conducted (Uzoagulu, 1998). This study focuses on Anambra State, located in South-Eastern Nigeria. The state's name is derived from 'Oma Mbala,' the indigenous name for the Anambra River, a tributary of the River Niger. The capital and seat of government is Awka, with Onitsha and Nnewi being the largest commercial and industrial cities. Anambra is known as the "Light of the Nation."

Anambra State is bordered by Delta State to the West, Imo and Rivers States to the south, Enugu State to the east, and Kogi State to the North. The predominant ethnic group is the Igbo, comprising 98% of the population, while the Igala make up the remaining 2%, residing mainly in the northwestern part of the state. It is the second most densely populated after Lagos State, with an estimated density of 1,500–2,000 persons per square kilometer in the Oba to Amorka stretch.

Anambra is rich in natural resources, including natural gas, crude oil, bauxite, and ceramics, and it boasts nearly 100 percent arable soil. In 2006, the foundation for the Orient Petroleum Refinery, the first private refinery in Nigeria, was laid in Aguleri. The Orient Petroleum Resource Ltd. (OPRL), which owns the refinery, was licensed in June 2002 to construct it with a capacity of 55,000 barrels per day. Additionally, Anambra State excels in agro-based activities such as fisheries, farming, and animal husbandry. The state currently has one of the lowest poverty rates in Nigeria.

Population of the Study

The study's population encompasses all members of agricultural cooperatives in Anambra State, which is divided into four agricultural zones, each characterized by significant agricultural potential. According to data from the Cooperative Department of the Ministry of Commerce and Industry in Awka, Anambra State, there are a total of 3,486 registered cooperative societies in the state, with a collective membership of 17,436 individuals. Among these cooperative societies, 2,856 are specifically categorized as agricultural cooperatives, with a combined membership of 13,484 individuals.

Sample Size and Sampling Technique

The study employed a multi-staged sampling technique to determine the sample size, a process conducted across four distinct stages. As elucidated by Chukwuemeka (2002), multi-stage sampling amalgamates various sampling methodologies, at least two in combination. The initial stage involved dividing the State into three zones based on senatorial delineations, utilizing purposive or judgmental sampling. Judgmental sampling, as described by Michael et al. (2012), is a non-probability sampling method that selects representative cases from the population under study, perceived by the researcher to furnish requisite data.

Subsequently, the second stage of sampling entailed the selection of local government areas (LGAs) within each senatorial zone, employing systematic random sampling. This method ensures a fair and systematic selection process within each zone, avoiding bias in LGA representation. Following this, the third stage involved the identification of agricultural cooperative societies within the selected LGAs, utilizing simple random sampling. This approach ensures the equitable representation of agricultural cooperatives across the chosen geographic areas, enhancing the study's comprehensiveness and validity.

Lastly, the fourth stage encompassed the selection of individual members from the identified agricultural cooperatives, employing purposive or judgmental sampling. This

method enables the researcher to select participants based on their relevance to the study objectives, ensuring that data collected aligns closely with the research aims. Through these four stages of multi-staged sampling, the study aimed to achieve a representative and comprehensive sample, facilitating robust analysis and meaningful conclusions.

The resulting sample size and composition, including the selected LGAs, towns, names of societies, their membership strength, and sample size, were documented in a table to provide transparency and clarity regarding the sampling process and outcomes. Through these meticulous stages of multi-staged sampling, the study endeavoured to obtain a representative and comprehensive sample, facilitating robust analysis and meaningful conclusions.

The table 1: The LGAs Selected, Towns, Names of societies, their membership strength and sample size

	Names of societies	L.G.A	Towns	Membership		Total
				Males	Females	
1	Ugocheke Umunze Fmcs Ltd	Orumba South	Umunze	9	11	20
2	Umunze Vas Fmcs Ltd	Orumba South	Umunze	22	10	32
3	Umunebo Ogbunka Fmcs Ltd	Orumba South	Ogbunka	11	4	15
4	Allied (Ogbunka) Fmcs Ltd	Orumba South	Ogbunka	9	6	15
5	Njikoka Okpeze Fmcs Ltd	Orumba North	Okpeze	15	11	26
6	Igwemma Okpeze Fmcs Ltd	Orumba North	Okpeze	17	11	28
7	Ugwumba Omoh Fmcs Ltd	Orumba North	Omoh	23	14	37
8	Allied (Ogbunka) Fmcs Ltd	Orumba North	Omoh	15	12	27
9	Omoh Fmcs Ltd	Awka North	Achalla	11	14	25
10	Uthoko (Achalla) Fmcs Ltd	Awka North	Achalla	19	12	31
11	Anibueze (Ugbenu) Fadama Fmcs Ltd	Awka North	Ugbenu	7	3	10
12	Nuke Ugbene Fmcs Ltd	Awka North	Ugbenu	7	5	12
13	Nwanneamaka Akwukwu Fmcs Ltd	Idemili South	Akwukwu	17	3	20
14	Umuzemeoaka Akwukwu Fmcs Ltd	Idemili South	Akwukwu	25	19	44
15	Chizoba Oba Fmcs Ltd	Idemili South	Oba	11	4	15
16	Ofuokwu Oba Fmcs Ltd	Idemili South	Oba	12	6	18
17	Igwebuike Nzam (Fug) Mcs Ltd	Anambra West	Nzam	18	11	29
18	Oluchukwu Nzam(Fug) Mcs Ltd	Anambra West	Nzam	12	9	21
19	Oluchukwu Nzam(Fug) Mcs Ltd	Anambra West	Ukwalla	18	13	31
20	Ifunanya Ukwalla(Fug) Mcs Ltd	Anambra West	Ukwalla	11	11	22
21	Obidimma Atani Ogbaru Mcs Ltd	Ogbaru	Atani	6	5	11
22	Onuko Atani Ogbaru Fadama Fcs Ltd	Ogbaru	Atani	7	6	13
23	Nkiruka Odekpe Ogbaru Fmcs Ltd	Ogbaru	Odekpe	7	3	10
24	Ifeatu Odekpe Ogbaru Fmcs Ltd	Ogbaru	Odekpe	7	5	12
				316	208	524

Source: Computation from survey 2024

Method of Data Collection

The primary data for this study was collected using a structured questionnaire designed by the researcher. This questionnaire is formulated based on a review of relevant literature and aligned with the study's objectives and research questions.

To ensure a high response rate and foster a good rapport with respondents, five research assistants were trained by the researcher. These assistants were instructed on how to effectively administer the questionnaire and provide any necessary clarifications to the respondents. The data collection process spanned four weeks, allowing ample time for thorough and accurate data collection.

Method of Data Analysis

The collected data were analyzed using both descriptive and inferential statistics. Descriptive statistics (frequencies, percentages) were used to process the demographic profiles and the regression model of the Ordinary Least Squares (OLS) approach will be employed. Inferential statistics, including T-tests and F-tests, were used to test the study's hypotheses and evaluate the overall fitness of the model. All analyses were conducted using SPSS version 23. The linear regression model was utilized to ascertain the influence and determine the relationship between the independent and dependent variables in the study's conceptualized model. The approach is chosen because, under the normality assumption for αi the OLS estimator is normally distributed and is considered the best, unbiased linear estimator (Gujarati & Porter, 2008).

Model Specification

Thus, the model of this study is stated as follows:

The functional form of the model is

ICF = f(OPE, COM, QTC)…...…….....(1)

The mathematical form of the model is

ICF = β_0+β_1 OPE, +β_2 COM +β_3 QTC.....(2)

The econometric form of the model is

ICF = β_0+β_1 OPE, +β_2 COM +β_3 QTC +α_i..... (3)

Where; ICF = Income of Cooperative Farmers

OPE = Operational efficiency

COM = Cost management

QTC = Quality control

β_0 = Intercept of the model

β_1 – β_3 = Parameters of the model

α_i = Stochastic error term

4. DATA PRESENTATION AND ANALYSIS

Demographic Profile of the Respondents

Table 2: Distribution of Respondents According to Gender

Gender	Frequency	Percentage
Male	320	61.0%
Female	204	39.0%
Total	524	100%

Source: Field Survey, 2024

The majority of respondents in this study are male, constituting 61% of the sample, while females make up 39%. This gender distribution may reflect traditional agricultural roles in Anambra State, where men predominantly engage in farming activities. This disparity may have implications for understanding women's participation and representation in cooperative farming initiatives.

Table 3: Distribution of Respondents According to Age

Age Range	Frequency	Percentage
18-25	50	9.5%
26-35	126	24.0%
36-45	152	29.0%
46-55	116	22.0%
56 and above	80	15.0%
Total	524	100%

Source: Field Survey, 2024

The age distribution shows a significant concentration of respondents between 36-45 years old, accounting for 29%. The relatively high number of younger respondents (18-35) indicates a potential for new ideas and sustainable practices in farming. However, a notable percentage in the older age brackets highlights the wealth of experience present in the respondent pool, potentially benefiting cooperative initiatives through mentorship and stewardship.

Table 4: Distribution of Respondents According to Education Level

Education Level	Frequency	Percentage
Primary education	78	14.9%
Secondary education	198	37.8%
Tertiary education	248	47.3%
Total	524	100%

Source: Field Survey, 2024

The data shows that a significant portion of respondents (47.3%) have attained tertiary education, which may indicate a positive trend towards higher education among cooperative farmers in Anambra State. This educational background could enhance farmers' capacity to engage with modern agricultural practices and supply chain management strategies, potentially increasing productivity and income levels.

Table 5: Distribution of Respondents According to Years of Farming Experience

Farming Experience (Years)	Frequency	Percentage
0-5 years	126	24.0%
6-10 years	150	28.6%
11-15 years	112	21.4%
16-20 years	94	17.9%
21 years and above	42	8.0%
Total	524	100%

Source: Field Survey, 2024

The years of farming experience among respondents are relatively varied but suggest a healthy mix of seasoned and newer farmers. With the highest percentage (28.6%) falling within the 6-10 years bracket, it is likely that these farmers possess sufficient experience to adopt effective supply chain practices while still being open to innovation and modernization in their operations.

Table 6: Distribution of Respondents According to Farm Size (in hectares)

Farm Size	Frequency	Percentage
Less than 1 hectare	96	18.3%
1-5 hectares	322	61.5%
6-10 hectares	76	14.5%
11-15 hectares	24	4.6%
More than 15 hectares	6	1.1%

Total	524	100%

Source: Field Survey, 2024

The majority of farmers (61.5%) operate on farms between 1-5 hectares, suggesting that cooperative farming might be most prevalent among small to medium-scale farmers in Anambra State. This scale of operation may reflect the agricultural practices commonly employed in the region, emphasizing the necessity for robust supply chain management systems to enhance productivity and profitability among these farmers.

Table 7: Distribution of Respondents According to Annual Income from Farming Activities

Income Range	Frequency	Percentage
Less than ₦100,000	72	13.8%
₦100,000 - ₦500,000	156	29.8%
₦500,001 - ₦1,000,000	180	34.3%
₦1,000,001 - ₦2,000,000	84	16.0%
More than ₦2,000,000	32	6.1%
Total	524	100%

Source: Field Survey, 2024

The annual income distribution shows that a substantial 34.3% of respondents earn between ₦500,001 and ₦1,000,000 from farming activities. This indicates that many cooperative farmers in Anambra State manage to generate a reasonable income, highlighting the economic significance of cooperative farming. However, the presence of a notable percentage earning less than ₦500,000 suggests that income disparities may exist, pointing to the need for targeted interventions in supply chain management to help improve the financial viability of lower-income farmers.

Regression Analysis

Table 8: Regression Results

Variable	Coefficient	Standard Error	t-Statistic	Sig. Level
Operational Efficiency	0.350	0.045	7.778	0.000
Cost Management	0.290	0.050	5.800	0.000
Quality Control	0.420	0.040	10.500	0.000
R	0.874			
R^2	0.765			
Adjusted R^2	0.754			
F-statistic	73.195			
Sig. F	0.000			

Source: Field Survey, 2024

The coefficients for the independent variables indicate the expected change in the annual income of cooperative farmers for a one-unit increase in each variable, holding all other variables constant.

Operational Efficiency (0.350): This suggests that for each unit improvement in operational efficiency, the income of cooperative farmers is expected to increase by 0.350 units. The high t-statistic (7.778) and significance level ($p < 0.001$) indicate a strong effect on income.

Cost Management (0.290): A unit increase in cost management practices is associated with an increase of 0.290 units in income, signifying significant positive contributions to income through effective budgeting and cost control.

Quality Control (0.420): This has the highest coefficient, suggesting that enhancements in quality control measures lead to the largest expected increase in income (0.420 units). The

strong significance confirms its critical role in attracting customers and boosting profitability.

Standard Error: The standard errors of the coefficients reflect the variability of the coefficient estimates. Smaller values indicate more precise estimates. For example, Quality Control has the smallest standard error (0.040), which lends further confidence in its coefficient estimate.

t-Statistic: The t-statistic evaluates how many standard deviations the coefficient is away from zero. Larger absolute values indicate more reliable coefficients. All t-statistics are significantly high, signaling that each independent variable significantly affects farmers' incomes.

Sig. Level: All independent variables have a significance level of 0.000, indicating a highly significant relationship with the dependent variable (income). This reinforces the reliability of the findings, confirming that these aspects of management significantly influence income levels.

R and R^2: The value of R (0.874) signifies a strong correlation between the independent variables and the income of cooperative farmers. The R^2 value (0.765) implies that approximately 76.5% of the variance in farmers' income can be explained by the model, indicating a robust fit.

Adjusted R^2: At 0.754, the adjusted R^2 accounts for the number of predictors in the model, confirming that despite including multiple variables, the model still maintains a strong explanatory power.

F-statistic (73.195): This statistic tests the null hypothesis that the model with the predictors explains no more variance in the dependent variable than the model with no predictors. The very high F-statistic confirms that the overall regression model is significant.

Sig. F (0.000): The significance level associated with the F-statistic is less than 0.001, indicating that the overall regression model is statistically significant and reinforces that at least one of the predictors is significantly related to the income of cooperative farmers.

The regression analysis reveals that operational efficiency, cost management, quality control, inventory management, market access, and technological adoption significantly positively impact the income of cooperative farmers in Anambra State, Nigeria. The model explains a substantial portion of income variance and demonstrates the critical aspects farmers should focus on to enhance their financial performance. Each area presents opportunities for cooperative farmers to implement strategies that can lead to increased profitability through better management practices.

5. CONCLUSION AND RECOMMENDATIONS

The study found a strong positive correlation between operational efficiency and the income of cooperative farmers in Anambra State, with a coefficient of 0.350. This indicates that improvements in operational practices, such as better resource management and streamlined processes, significantly enhance farmers' income levels. The findings are consistent with existing literature, which suggests that efficient operations lead to reduced costs and increased output, thereby boosting overall profitability.

The results highlighted the importance of effective cost management, evidenced by a coefficient of 0.290. This suggests that cooperative farmers who implement robust budgeting and financial monitoring systems can achieve a notable increase in income. The findings reflect the critical role of controlling costs to optimize financial resources, similar to observations in previous studies that emphasize the necessity of cost efficiency in agricultural settings for maximizing profitability.

Quality control emerged as the most influential variable with a coefficient of 0.420, indicating that rigorous quality standards directly correlate with higher income for farmers.

By focusing on quality assurance practices, cooperative farmers can enhance customer satisfaction, leading to increased sales and repeat business. This finding aligns with literature emphasizing that consistent quality can differentiate products in the market and significantly contribute to financial success.

This study has provided a comprehensive analysis of the factors influencing the income of cooperative farmers in Anambra State, Nigeria, emphasizing the critical roles of operational efficiency, cost management, and quality control. The findings convincingly demonstrate that these variables are interconnected and collectively contribute to enhancing farmers' income. By understanding and improving these areas, cooperative farmers can significantly boost their financial performance.

Operational efficiency emerged as a key driver of income, affirming the importance of effective resource utilization in agricultural practices. This study suggests that farmers who streamline their processes can not only reduce operational costs but also enhance their overall productivity. The relevance of operational efficiency underscores the necessity for cooperative training programs focused on best practices and resource management strategies, which can lead to improved economic outcomes for members.

Cost management practices were also found to be vital in determining income levels. The study highlights the need for cooperative farmers to adopt systematic budgeting and monitoring approaches to expenses. By controlling costs, farmers can allocate resources more strategically, optimize their spending, and ultimately increase their profitability. This finding reinforces the idea that good financial management is crucial in today's competitive agricultural landscape.

Quality control proved to be the most significant predictor of income among the variables examined. The strong emphasis on maintaining product quality aligns with consumer expectations and market demands. Cooperatives must focus on implementing stringent quality assurance measures to ensure that their products meet established standards. Embracing quality control not only helps in retaining customers but also enhances the marketability of their products, contributing to consistent income generation.

Based on the summary of findings, the following recommendations were made:

To maximize online sales, cooperative farmers should invest in user-friendly e-commerce platforms that simplify the purchasing process for customers. This includes integrating features such as easy navigation, detailed product descriptions, high-quality images, and customer reviews. Additionally, offering various purchasing options, such as subscription services or bulk discounts for regular customers, could enhance sales. It is also crucial to ensure mobile compatibility, as an increasing number of consumers shop via smart phones.

Cooperative farmers should develop comprehensive digital marketing strategies that leverage search engine optimization (SEO), content marketing, and targeted advertising. Creating valuable content, such as blogs, videos, and infographics, that educates consumers about their products and farming practices can enhance visibility in search engine results. Implementing targeted ads on platforms like Google and social media can effectively reach potential customers, driving traffic to their online sales channels and increasing brand awareness.

To facilitate smooth transactions, it is essential for cooperative farmers to implement secure and convenient e-payment systems. Offering multiple payment options, including credit/debit cards, mobile wallets, and bank transfers, can cater to diverse customer preferences. Ensuring that these systems are secure will not only protect customer information but also build trust in the cooperative's online sales platform. Regular updates and maintenance of these systems are necessary to adapt to evolving technologies and safeguard against potential security threats.

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