

Effect of ICT Utilization on the Efficiency of Rice Marketing in Ogbomoso North, Oyo State, Nigeria

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Abstract

This study examines the impact of ICT utilization on the efficiency of rice marketing in the Ogbomoso North Local Government Area, Oyo State, Nigeria. It highlights the role of ICT tools, such as digital payment systems, mobile phones, and radio, in facilitating real-time information exchange and improving marketing efficiency. Data were collected from 80 rice marketers through structured questionnaires using a combination of descriptive statistics, budgetary analysis, multiple regression, and Tobit regression models. Findings reveal that most rice marketers adopt ICT tools, with digital payment systems being the most commonly used. ICT adoption enhances market access, price transparency, and transaction efficiency, ultimately improving marketing performance. However, challenges like poor internet access, inadequate ICT infrastructure, and low digital literacy hinder full adoption. Despite these limitations, the study underscores ICT's potential to transform rice marketing. It recommends targeted interventions, including digital literacy training and infrastructure development, to maximize the benefits of ICT in the sector.

Keywords: ICT Utilization, Information and Communication Technology, Rice Marketing, Marketing Efficiency, Agricultural Marketing, Ogbomoso North, Oyo State, Nigeria.

Introduction

Marketing is pivotal in agriculture, facilitating the connection between producers and consumers for efficient product exchange (Levins and McEwan, 2016). Additionally, marketing aids in product differentiation and value addition, enhancing profitability (Vengadessane and Jothi, 2018). Moreover, it fosters market access for smallholder farmers, promoting inclusive growth (Bolwig et al., 2010). Overall, agricultural marketing stimulates production, generates employment, and enhances economic integration (D'Souza and Cyphers, 2010).

Rice holds significant importance globally, serving as a staple food for millions of people and contributing to food security (Bouis and Pandya-Lorch, 2010). Its nutritional value,

particularly as a source of carbohydrates, makes it essential for meeting dietary needs, especially in Asia, where rice consumption is highest. Rice cultivation also plays a crucial role in the livelihoods of millions of smallholder farmers, providing income and employment opportunities. Moreover, rice production contributes to national economies and trade balances, with countries like China, India, and Thailand being major exporters. However, challenges such as water scarcity, climate change, and pest infestations pose threats to rice production, highlighting the need for sustainable farming practices and technological innovations (Bouis and Pandya-Lorch, 2010).

Any tool or device that enables data collection or exchange through interaction or transmission is considered information and communication technology (ICT) (Radu, 2016). Data collection, processing, storing, retrieval, dissemination, and implementation are all done through information and communication technologies. Information from optics, microelectronics, and intermediate technologies are among them (Olaniyi, Adetumbi, and Adereti, 2013). Through the internet, wireless networks, mobile devices, and other communication channels like video conferencing, instant messaging, and social networking sites like Facebook, Instagram, and WhatsApp, these technologies make information accessible.

Information and communication technology integration has become a disruptive force in the ever-changing agricultural trade landscape, changing conventional market practices and increasing productivity in a number of industries. The communication media facilitate connection and communication from remote locations, allow people to contact each other directly, and provide instant access to information (Oye, Lahad, and Zairah, 2012 and Omotayo, 2011).

Thus, Market Information System (MIS) is achieved through the facilities. MIS is a service that includes routinely gathering price data from wholesale, retail, and rural markets. Additionally, it entails processing and promptly and regularly disseminating information to farmers, traders, policymakers, and consumers via a variety of media regarding the state and dynamics of agricultural markets (Centre for Technical Agriculture, 2006). ICT-enabled Information about agricultural markets is a sustainable form of communication that gives consumers and marketers easy access to crucial information about these markets. It also assists policymakers in utilizing the electronic medium to achieve agricultural development at the much-needed pace. Essentially, the goal of this research is to shed light on how ICT can revolutionize the effectiveness of rice marketing by providing insights that can guide strategic interventions and promote long-term growth in the agricultural industry.

Statement of the Problem

Despite the growing availability and advancement in Information and Communication Technology tools, the efficiency of rice marketers continues to face challenges that impede optimal performance within the market ecosystem (Omotayo, 2011). The problem lies in the insufficient understanding of how ICT adoption and utilization impacts the efficiency of rice marketers, hindering the efficiency of realization of its full potential in enhancing

market operation and profitability. Many rice-producing regions lack adequate ICT infrastructures, such as internet connectivity and technological devices, which restricts the adoption and effective utilization of ICT tools by rice marketers. Inefficient dissemination of market information, including price trends, demand fluctuations, and supply chain dynamics, constrains rice marketers' ability to make informed decisions leading to inefficiencies in resource allocation and market participation. The lack of standardized platforms and similar ICT solutions exacerbates fragmentation within the rice market ecosystem inhibiting seamless communication and transactional efficiency among rice marketers. This research endeavors to delve into the intricate interplay between ICT tools and the efficiency of rice marketers. By exploring the adoption and utilization of ICT platforms, such as mobile applications, online marketplaces, and data analytics systems, this study aims to uncover how these technologies facilitate communication and transactions and optimize decision making processes within the rice marketing ecosystem. Key issues include limited access to ICT infrastructures, inefficient market information and a fragmented market ecosystem.

Research Questions

1. What are the socioeconomic characteristics of rice marketers?
2. What are the marketing activities performed by the respondents?
3. What is the ICT utilization level of rice marketers?
4. Are the marketers efficient in the performance of marketing functions?
5. What are the challenges of ICT utilization among respondents?
6. What are the factors influencing the marketing efficiency of rice marketers?

Objectives of the Study

The general objective of this study is to determine the effect of ICT on the efficiency of rice marketing in the Ogbomoso North Local Government area, Ogbomoso, Oyo State.

The specific objectives are to:

1. Describe the socioeconomic characteristics of the rice marketers in the study area.
2. Investigate the marketing activities of respondents.
3. Examine the ICT utilization level of the respondents.
4. Estimate the cost, returns, and marketing efficiency of the respondents.
5. Investigate the challenges militating against ICT utilization among rice marketers.
6. Identify the factors influencing the marketing efficiency of rice marketers.

Hypothesis of the Study

This study's hypothesis was expressed in a different way:

H_a: The respondents' socioeconomic characteristics and ICT use are significantly correlated.

Justification of the Study

Effective rice marketing is essential to maintaining food security, lowering post-harvest losses, and improving the standard of living for millions of smallholder farmers around the globe. Nevertheless, despite its significance, little is known about how the use of information and communication technology (ICT) affects rice marketers' productivity. By investigating the precise effects of ICT tools, such as mobile applications, online marketplaces, and data analytics systems, on the effectiveness of rice marketing operations, this study aims to close this gap.

Access to sufficient ICT infrastructure, as well as digital literacy and marketing skills, are frequently lacking in many rice-producing regions. These limitations reduce the potential of ICT tools to improve market efficiency by impeding their effective adoption and use. This study intends to offer useful insights for policymakers, development organizations, and industry stakeholders to create focused interventions that encourage ICT adoption and enhance market efficiency in the rice sector by examining the fundamental causes of these issues and possible remedies.

Additionally, as global markets grow more competitive and interconnected, rice marketers can improve their competitiveness, reach a wider audience, and streamline operations by implementing ICT. The long-term viability and resilience of the rice marketing industry depend on an understanding of how ICT tools can be used to accomplish these goals. This study aids in the creation of strategies that allow rice marketers to prosper in dynamic market environments by illuminating best practices, success factors, and obstacles to ICT adoption.

Literature Review

Concept of Market and Marketing

The dynamic setting where buyers and sellers engage to promote the exchange of resources, goods, or services is included in the idea of a market. Numerous factors, including consumer preferences, governmental regulations, economic conditions, and supply and demand dynamics, all have an impact on it (Mankiw, 2014). There are various types of markets, from monopolies, in which one company controls the supply of a specific good or service, to perfect competition, in which many small businesses compete with identical products (Besanko and Braeutigam, 2015). Other typical market structures include oligopolies and monopolistic competition, which are defined by either a large number of firms controlling the market or a large number of firms selling unique products (Carlton and Perloff, 2014; Pindyck and Rubinfeld, 2017).

Contrarily, marketing refers to a wide range of tactics and actions used by companies to develop, market, provide, and trade offerings that are beneficial to partners, consumers, clients, and society as a whole (Kotler and Armstrong, 2017). It entails comprehending the wants and needs of the consumer, creating goods or services that meet those needs, and successfully marketing and distributing them in the marketplace. Product development,

pricing plans, distribution methods, and promotional techniques are all parts of marketing (Nagle, Hogan, and Zale, 2016).

Concept of Information and Communication Technology in Agriculture

Modernizing agricultural practices and increasing efficiency throughout the value chain are made possible by information and communication technology, or ICT. An overview of ICT in agriculture is given in this section, with an emphasis on how it is transforming conventional farming practices and enhancing the efficiency of agricultural systems.

Evolution of ICT in Agriculture and Roles of ICT in Improving Agricultural Efficiency

ICT integration in agriculture signifies a dramatic change toward automation, digitization, and data-driven decision-making. Mobile devices, sensors, Internet of Things (IoT) devices, Geographic Information Systems (GIS), remote sensing, and data analytics are just a few of the many technologies that fall under the umbrella of ICT. Precision farming, smart farming, and improved stakeholder connectivity have all been made possible by these technologies, which have revolutionized agricultural processes. (Qamar and others, 2017). Geographic Information Systems (GIS) for mapping and analyzing land and computer-based farm management systems are two early examples of how ICT in agriculture has evolved. More complex ICT solutions catered to the unique requirements of farmers, agribusinesses, and agricultural organizations have been developed over time as a result of developments in mobile technology, cloud computing, and data analytics.

Roles of ICT in Improving Agricultural Efficiency

These include access to information, precision agriculture, market access, supply chain management, and capacity building.

Farmers can access real-time weather information, market prices, agronomic data, and best practices thanks to information and communication technology. Farmers can use this information to make well-informed decisions about market participation, input use, and crop management (Barrett et al., 2013). Precision farming is made possible by ICT, which optimizes inputs like water, fertilizer, and pesticides by using data from sensors, drones, and satellite imagery. Crop yields are increased, resource waste is decreased, and environmental sustainability is encouraged by precision agriculture (FAO, 2020).

Platforms for information and communication technology allow farmers and buyers to communicate directly, facilitating clear and effective market exchanges. For agricultural products, digital payment systems, smartphone apps, and online marketplaces increase market reach and optimize the marketing process (Qamar and Qureshi, 2017). By enhancing logistics planning, inventory management, and agricultural product traceability, ICT improves supply chain efficiency. For example, supply chain transactions made possible by blockchain technology are safe and transparent, which lowers fraud and increases stakeholder trust (World Bank, 2016). For farmers and other agricultural professionals, ICT tools offer platforms for knowledge sharing, extension services, and training. Innovative

farming methods, pest management plans, and agricultural best practices are delivered through mobile apps, webinars, and online courses (Zeng and Lu, 2021).

Case Studies and Examples of ICT Adoption in Rice Marketing

Examining specific case studies and examples of ICT adoption in rice marketing provides valuable insights into the practical applications, benefits, and challenges of using these technologies. This section highlights notable examples from different regions, demonstrating how ICT has been successfully integrated into rice marketing practice

Case Study 1: Digital Green in India

Digital Green is a notable initiative in India that leverages ICT to improve agricultural practices and market access for smallholder farmers. By using video-based extension services, Digital Green disseminates best practices and agricultural knowledge to farmers in rural areas. This approach has been particularly effective in promoting efficient rice farming techniques and connecting farmers with markets.

The organization uses a community-driven approach where local farmers are featured in videos demonstrating successful agricultural practices. These videos are shown to other farmers through community meetings and mobile devices, making the content accessible even in remote areas. This initiative has led to significant improvements in crop yields and market efficiency by empowering farmers with the knowledge and tools needed to optimize their production and market their rice effectively (Gandhi et al., 2009).

Case Study 2: e-Choupal in India

Another excellent example of ICT adoption in agriculture, including rice marketing, is the e-Choupal initiative by ITC Limited in India. A digital platform called e-Choupal gives farmers access to weather forecasts, market prices, and farming guidance. Additionally, it makes it easier for buyers and farmers to transact directly, which lessens the need for middlemen and guarantees that farmers receive a higher price.

By setting up internet kiosks in rural villages, e-Choupal enables farmers to obtain real-time information and make informed decisions about selling their produce. This initiative has significantly reduced transaction costs, improved market transparency, and enhanced the efficiency of the rice marketing process. Farmers benefit from higher incomes and better market linkages, while buyers gain direct access to high-quality produce (Annamalai and Rao, 2003).

Case Study 3: Rice-Advice Application in Africa

The Africa Rice Center created the Rice-Advice app, a smartphone application that offers African rice farmers tailored advice. To provide personalized guidance on nutrient management, planting schedules, and pest control, the app gathers information on a number of factors, including soil type, crop variety, and weather.

By using the Rice-Advice application, farmers can optimize their input use, reduce production costs, and improve rice yields. The app also includes features for tracking market prices and connecting with buyers, thereby enhancing the marketing efficiency of rice. This initiative has shown promising results in increasing productivity and profitability for rice farmers in several African countries (Rodenburg et al., 2014).

Case Study 4: M-Farm in Kenya

M-Farm, a mobile platform in Kenya, connects farmers with buyers through SMS and web-based services. The platform provides market information, price comparisons, and direct marketing opportunities for farmers, including rice producers. By using M-Farm, farmers can avoid exploitative intermediaries, access fair market prices, and sell their produce directly to consumers or large buyers.

M-Farm has empowered smallholder farmers by improving their bargaining power and market access. The transparency and efficiency brought about by this platform have led to better income stability and market opportunities for rice farmers in Kenya. Additionally, the platform facilitates bulk selling, which attracts higher prices and reduces logistical challenges (Okello et al., 2012).

ICT Adoption Obstacles and Difficulties in Rice Marketing

Although information and communication technology (ICT) has a lot of potential to increase rice marketing efficiency, a number of obstacles and difficulties prevent its widespread use. This section examines these challenges, classifying them as policy-related, sociocultural, economic, and infrastructure-related barriers, and it talks about possible ways to get past them.

Infrastructural Barriers

The absence of suitable infrastructure is one of the biggest obstacles to the use of ICT in rice marketing. Poor internet connectivity, erratic electricity supplies, and restricted access to digital devices are problems in many rural areas, where rice farming is the main industry. Farmers' ability to effectively use ICT tools is hampered by the digital divide.

- **Connectivity Issues:** In many developing regions, internet penetration remains low. According to the International Telecommunication Union (ITU), as of 2021, only about 34% of households in rural areas of developing countries have access to the internet, compared to 78% in urban areas (ITU, 2021).
- **Power Supply:** Unreliable electricity supply in rural areas affects the use of ICT devices. Frequent power outages and lack of access to electricity limit the ability of farmers to engage with digital platforms consistently (FAO, 2020).

Economic Barriers

Economic constraints also play a critical role in limiting ICT adoption. High costs associated with purchasing and maintaining ICT equipment, software, and services can be prohibitive for smallholder farmers.

- **Cost of Devices:** The upfront cost of smartphones, tablets, and computers can be a significant barrier. Additionally, ongoing costs such as internet subscriptions and software updates add to the financial burden (Aker and Mbiti, 2010).
- **Affordability of Services:** Access to reliable and affordable internet services is often lacking. High data costs can deter farmers from using online platforms and services regularly (World Bank, 2016).

Socio-Cultural Barriers

Socio-cultural factors, including low levels of digital literacy and resistance to change, further impede the adoption of ICT in rice marketing.

- **Digital Literacy:** It's possible that many farmers, particularly those who are older, lack the skills needed to properly use ICT applications and operate digital devices. To close this knowledge gap, education and training initiatives are crucial (FAO, 2020).
- **Resistance to Change:** Farmers may be resistant to new technologies due to their skepticism and traditional farming methods. This obstacle can be addressed by fostering trust and showcasing the concrete advantages of ICT tools (Donner, 2008).

Policy-Related Barriers

Inadequate policy support and regulatory frameworks also pose challenges to the adoption of ICT in agriculture.

- **Regulatory Environment:** Lack of clear regulations regarding digital transactions, data privacy, and cybersecurity can hinder the adoption of ICT tools. Farmers need assurance that their data is protected and that digital transactions are secure (Zeng and Lu, 2021).
- **Policy Support:** Insufficient government support and lack of targeted policies to promote ICT adoption in agriculture can slow down progress. Policies that provide subsidies, financial incentives, and support for infrastructure development are crucial (Tadesse and Bahiigwa, 2015).

Potential Solutions

A multifaceted strategy involving different stakeholders, such as governments, the commercial sector, non-governmental organizations, and farmers themselves, is needed to address these issues.

1. **Infrastructure Development:** It is crucial to make investments in ICT infrastructure, such as enhancing rural areas' power supplies and internet coverage. These developments can be significantly influenced by public-private partnerships (World Bank, 2016).
2. **Financial Support:** Providing subsidies and affordable financing options for purchasing ICT devices and services can help mitigate economic barriers.

Governments and financial institutions should design targeted financial support programs (Aker and Mbiti, 2010).

3. **Capacity Building:** Implementing training programs to enhance digital literacy among farmers is crucial. These programs should be designed to address the specific needs of different farmer groups and be delivered through accessible formats (FAO, 2020).
4. **Policy and Regulatory Frameworks:** Developing clear regulations to ensure data security and promoting policies that support ICT adoption in agriculture are necessary. Governments should work on creating an enabling environment for digital innovation (Zeng and Lu, 2021).
5. **Community Engagement:** Overcoming resistance to change can be facilitated by interacting with farming communities to establish trust and highlight the advantages of ICT tools. The beneficial effects of ICT on rice marketing can be demonstrated through pilot projects and success stories (Donner, 2008).

Rice Marketing and ICT Utilization

In the context of rice marketing, ICT solutions play a crucial role in optimizing market access, improving price transparency, and enhancing overall efficiency. Platforms such as e-commerce websites, mobile applications, and digital marketplaces connect rice producers with buyers, streamlining the marketing process and reducing intermediaries' involvement (Ali, 2011).

ICT-enabled market information systems provide real-time updates on rice prices, demand-supply dynamics, and market trends, allowing rice marketers to make timely decisions regarding pricing, storage, and distribution. Additionally, digital payment systems and online trading platforms facilitate secure and efficient financial transactions, reducing transaction costs and improving liquidity in rice markets (Martey, 2014).

The adoption of ICT in rice marketing not only improves operational efficiency but also fosters market competitiveness, promotes fair pricing, and strengthens market linkages along the rice value chain (Okello et al., 2012).

Types of ICT tools in rice marketing includes the mobile applications, online marketplaces, digital payment systems and data analytics and market intelligence

Mobile applications designed for rice marketing provide functionalities such as real-time market updates, price negotiation platforms, inventory management, and communication channels between farmers and buyers. Examples include apps that enable farmers to showcase their produce, receive market demand signals, and negotiate prices directly with buyers (Hossain and Rahman, 2020).

Digital platforms and online marketplaces connect rice producers with a wider range of buyers, both locally and globally. These platforms allow for transparent price discovery, competitive bidding, and direct transactions, reducing the reliance on intermediaries and improving market access for smallholder farmers (Ghosh and Kaur, 2019).

ICT has facilitated the adoption of digital payment systems in rice marketing, eliminating the need for cash transactions and enhancing financial transparency. Mobile money

platforms, e-wallets, and online payment gateways enable secure and efficient financial transactions, reducing transaction costs and improving liquidity in rice markets (FAO, 2020).

Advanced data analytics tools and market intelligence platforms provide valuable insights into market trends, consumer preferences, demand-supply dynamics, and price fluctuations. By leveraging data analytics, rice marketers can make data-driven decisions regarding pricing strategies, inventory management, and market positioning (Zeng and Lu, 2021).

The adoption of ICT tools in rice marketing has led to significant improvements in efficiency and market performance. These include improved market access, enhanced price transparency, streamlined transactions, and data-driven decision-making.

Improved market access is reviewed in the fact that ICT platforms have expanded market access for rice producers by connecting them to a broader network of buyers, including wholesalers, retailers, exporters, and consumers. This increased market reach reduces dependence on local markets and enhances revenue opportunities for farmers (Qamar and Qureshi, 2017).

In the case of streamlined transactions, digital platforms streamline transactions in rice marketing, reducing paperwork, time delays, and transaction costs. Electronic contracts, digital invoicing, and online payment systems facilitate smooth and efficient transactions between farmers and buyers, enhancing trust and reducing operational friction (Hossain and Rahman, 2020). Data-driven decision making is evident in the availability of data analytics and market intelligence tools that enable rice marketers to make informed decisions based on market trends, demand patterns, and consumer behavior. Data-driven insights support strategic planning, inventory optimization, risk management, and marketing strategies, leading to improved operational efficiency and competitive advantage (Ghosh and Kaur, 2019).

Other challenges and barriers to ICT adoption in rice marketing include:

Digital Divide and Access to ICT Infrastructure

One of the primary challenges is the digital divide, which refers to disparities in access to ICT infrastructure, internet connectivity, and digital devices among different segments of the population. In rural areas where rice farming is prevalent, limited access to reliable internet services and inadequate ICT infrastructure can hinder farmers' ability to leverage ICT tools for marketing purposes (World Bank, 2016).

Limited Digital Literacy and Skills

Another challenge is the limited digital literacy and ICT skills among rice farmers and smallholder producers. Many farmers may not be familiar with using digital platforms, mobile applications, or online marketplaces for marketing their produce. Lack of training and awareness about ICT tools can impede adoption and utilization, particularly among older farmers and those with limited education (FAO, 2020).

Cost of ICT Adoption

The cost associated with acquiring and implementing ICT tools is a significant barrier for small-scale rice marketers and farmers. Investments in hardware, software, internet subscriptions, and training programs can be prohibitive for those operating on limited budgets. High upfront costs and ongoing maintenance expenses deter some stakeholders from embracing ICT solutions (Barrett et al., 2013).

Connectivity and Network Reliability

In rural areas, unreliable internet connectivity and network disruptions are common challenges that hamper the seamless use of ICT tools. Poor network coverage, slow internet speeds, and frequent outages can lead to frustration and inefficiencies when attempting to conduct online transactions, access market information, or communicate with buyers (Ghosh and Kaur, 2019).

Data Security and Privacy Concerns

The adoption of ICT tools raises concerns about data security, privacy, and confidentiality. Farmers and marketers may be hesitant to share sensitive information or conduct financial transactions online due to fears of data breaches, identity theft, or unauthorized access. Ensuring robust data protection measures and building trust in digital platforms are crucial for addressing these concerns (Zeng & Lu, 2021).

Regulatory and Policy Challenges

Regulatory frameworks and policy environments can also influence ICT adoption in rice marketing. Inconsistent regulations, lack of supportive policies, and bureaucratic hurdles may create barriers to innovation and investment in ICT infrastructure. Encouraging policy reforms, promoting digital inclusion initiatives, and incentivizing ICT adoption can help overcome these regulatory challenges (Hossain and Rahman, 2020).

Despite these challenges, addressing barriers to ICT adoption and fostering an enabling environment for digital transformation can unlock significant opportunities for enhancing efficiency, market access, and sustainability in rice marketing.

Prospects and Innovations of ICT for Rice Marketing

The future of rice marketing is poised to be increasingly influenced by advancements in Information and Communication Technology (ICT). Emerging technologies and innovative applications hold promise for further enhancing efficiency, market access, and sustainability in the rice value chain. These technologies include the following:

Block-chain Technology for Transparent Transactions

Block-chain technology offers significant potential for improving transparency and trust in rice marketing. By creating immutable and transparent records of transactions, block-chain can ensure the traceability of rice from farm to market. This technology can help reduce fraud, ensure quality control, and enhance consumer trust in rice products.

For instance, block-chain can be used to certify the origin and organic status of rice, providing buyers with verifiable information about the product's journey through the supply chain. This increased transparency can command premium prices for farmers and foster better market relationships (Tian, 2016).

Using the Internet of Things (IoT) to Monitor in Real Time

Interconnected devices that gather and send data in real time are part of the Internet of Things (IoT). IoT can be used in rice marketing to track a number of production and supply chain activities, including crop health, storage conditions, soil moisture content, and logistics of transportation. Real-time data from IoT-enabled sensors can assist farmers in making prompt decisions regarding harvesting, pest management, and irrigation. Furthermore, IoT devices can monitor the location and state of rice while it is being stored and transported, guaranteeing proper handling and lowering losses after harvest (Misra et al., 2020).

Learning and Artificial Intelligence (AI)

Large volumes of data can be analyzed by machine learning algorithms and artificial intelligence (AI) to produce insights and predictive analytics for rice marketing. AI can assist with pricing strategy optimization, market trend forecasting, and opportunity identification.

AI-driven platforms, for instance, can forecast future rice prices by analyzing past market data and current trends. This allows farmers and marketers to adjust their sales strategies accordingly. Machine learning models can also identify patterns in consumer preferences and behavior, helping marketers tailor their approaches to different market segments (Kamilaris et al., 2018).

Mobile Financial Services and Digital Payments

The expansion of mobile financial services and digital payment systems is expected to play a crucial role in the future of rice marketing. Mobile banking and digital wallets provide secure and convenient payment solutions, reducing the reliance on cash transactions and enhancing financial inclusion.

These services can facilitate instant payments, reduce transaction costs, and provide financial records for farmers and marketers. Furthermore, digital payment platforms can integrate with other ICT tools to offer comprehensive solutions for market transactions, financing, and insurance services (Aker and Mbiti, 2010).

Analytics of Big Data for Market Intelligence

Big data analytics is the process of processing and examining sizable datasets in order to derive insightful information. Big data analytics can help marketers better understand consumer behavior, supply chain efficiency, and market dynamics in the rice industry. Stakeholders can improve decision-making, optimize supply chain operations, and spot

trends by utilizing big data. For example, forecasting shortages or surpluses through the analysis of weather, crop yield, and market demand data can improve inventory control and stabilize prices (Sonka, 2014).

Sustainable Practices and Environmental Monitoring

ICT can also contribute to promoting sustainable practices and environmental monitoring in rice marketing. Technologies such as remote sensing and GIS can monitor land use, water resources, and environmental impact, helping farmers adopt sustainable practices.

For example, remote sensing can detect changes in crop health and soil conditions, allowing for targeted interventions that minimize resource use and environmental degradation. GIS can map areas suitable for rice cultivation, supporting land-use planning and conservation efforts (Moran et al., 2018).

Policy Implications and Recommendations for Enhancing ICT Adoption in Rice Marketing

To fully harness the benefits of Information and Communication Technology (ICT) in rice marketing, supportive policies and strategic interventions are essential. This section outlines key policy implications and provides recommendations for enhancing ICT adoption among rice marketers includes the following

Infrastructure Development: Governments and development agencies need to invest in ICT infrastructure, particularly in rural areas where rice farming is prevalent. Ensuring widespread access to reliable internet connectivity and digital devices is fundamental to bridging the digital divide and enabling farmers to benefit from ICT tools (World Bank, 2016).

Capacity Building and Training: Initiatives to enhance digital literacy and ICT skills among rice farmers and marketers are crucial. Training programs, workshops, and awareness campaigns can help farmers understand and effectively utilize ICT tools for marketing their produce. Tailored training should be provided to address the specific needs and challenges faced by different farmer groups (FAO, 2020).

Supportive Regulatory Framework: Developing a conducive regulatory environment that supports ICT adoption in agriculture is vital. Policies should address issues such as data security, privacy, and the regulation of digital transactions. Clear guidelines and standards for ICT use in agriculture can foster trust and encourage broader adoption (Zeng& Lu, 2021).

Incentives for ICT Adoption: Providing financial incentives, subsidies, or grants to farmers and marketers to adopt ICT tools can mitigate the cost barriers associated with digital transformation. Governments and financial institutions can design programs that offer affordable financing options for purchasing ICT equipment and services (Aker and Mbiti, 2010).

Public-Private Partnerships: Collaboration between the public sector, private companies, and non-governmental organizations can drive innovation and investment in ICT solutions for rice marketing. Public-private partnerships can leverage the strengths of different stakeholders to develop and scale up effective ICT applications (Misra et al., 2020).

Reviewed studies recommended the following:

Developing Comprehensive ICT Strategies: Governments and agricultural organizations should develop comprehensive ICT strategies that integrate ICT into agricultural policies and development plans. These strategies should outline clear objectives, implementation roadmaps, and monitoring mechanisms to track progress and impact (Tadesse and Bahiigwa, 2015).

Promoting Mobile-Based Solutions: Given the widespread use of mobile phones among farmers, promoting mobile-based solutions for market information, financial transactions, and communication can significantly enhance ICT adoption. Mobile applications that provide real-time market data, weather updates, and advisory services should be prioritized (Aker, 2011).

Enhancing Market Access Platforms: Developing and supporting digital platforms that connect rice farmers directly with buyers can improve market access and reduce transaction costs. These platforms should facilitate transparent price discovery, secure payments, and efficient logistics, benefiting both producers and consumers (Ghosh and Kaur, 2019).

Ensuring Data Privacy and Security: Implementing robust data protection measures and educating farmers about data privacy and security practices is essential. Clear policies and regulations should be established to safeguard sensitive information and build trust in digital platforms (Zeng and Lu, 2021).

Encouraging Innovation and Research: Supporting research and innovation in ICT applications for agriculture can lead to the development of new tools and technologies tailored to the needs of rice farmers. Investments in research can drive the creation of scalable solutions that enhance efficiency and productivity (Kamilaris et al., 2018).

Monitoring and Evaluation: Regular monitoring and evaluation of ICT initiatives in rice marketing are necessary to assess their impact and effectiveness. Feedback from farmers and other stakeholders should be incorporated to continuously improve and adapt ICT solutions to changing needs and challenges (Tadesse and Bahiigwa, 2015).

Comparative Analysis of ICT Adoption in Developed and Developing countries

Understanding the differences in ICT adoption in rice marketing between developed and developing countries provides valuable insights into the varying challenges and opportunities faced by rice marketers

In developed countries, ICT infrastructure is generally well-established, with widespread access to high-speed internet, advanced digital devices, and sophisticated software solutions. The agricultural sector, including rice marketing, benefits from cutting-edge technologies that enhance efficiency, productivity, and market access.

Developed countries often employ advanced technologies such as precision agriculture, which utilizes GPS, IoT sensors, and data analytics to optimize farming practices. These technologies enable farmers to monitor crop health, soil conditions, and weather patterns in real-time, leading to more efficient resource use and higher yields (Schimmelpfennig, 2016). In rice marketing, these advancements ensure high-quality produce and streamlined supply chains.

E-commerce platforms are widely integrated into the agricultural sector in developed countries. These platforms facilitate direct transactions between rice producers and consumers, reducing the need for intermediaries and lowering transaction costs. Farmers can leverage online marketplaces to reach broader audiences, access real-time market data, and secure better prices for their produce (Dutta, 2016).

Governments in developed countries often provide strong policy support and substantial investments in agricultural research and development. Policies that promote innovation, data security, and digital literacy further bolster ICT adoption. Additionally, public-private partnerships drive the development and implementation of ICT solutions in agriculture (Eastwood et al., 2017).

However, in developing countries, ICT adoption in rice marketing faces numerous challenges, including limited infrastructure, low digital literacy, and financial constraints. However, innovative solutions and increasing mobile phone penetration offer promising avenues for enhancing rice marketing efficiency. Developing countries often struggle with inadequate ICT infrastructure, particularly in rural areas where rice farming is predominant. Limited access to high-speed internet, unreliable electricity, and lack of digital devices hinders the widespread adoption of ICT tools. Addressing these infrastructure gaps is crucial for scaling up ICT adoption in rice marketing (World Bank, 2016).

Low levels of digital literacy and ICT skills among farmers pose significant barriers to adoption. Training programs and capacity-building initiatives are essential to equip farmers with the knowledge and skills needed to effectively use ICT tools. NGOs, government agencies, and private sector players can collaborate to provide these educational resources (FAO, 2020).

Economic Importance and Nutritional Value of Rice

The economic importance of rice extends beyond its role as a staple food, influencing trade dynamics, agricultural economies, and rural livelihoods worldwide. Rice cultivation serves as a primary source of income for millions of smallholder farmers, particularly in developing countries where it is a mainstay crop (Bouis and Pandya-Lorch, 2010). The revenue generated from rice production not only sustains farming communities but also contributes significantly to national economies through employment generation, export revenues, and rural development initiatives (Bouis and Pandya-Lorch, 2010). Furthermore, rice plays a crucial role in addressing malnutrition and ensuring food security, especially in regions where rice constitutes a significant portion of the daily diet (Bouis and Pandya-Lorch, 2010). As a carbohydrate-rich food, rice provides essential energy for daily activities and is a staple source of nutrition for billions of people, particularly in Asia and Africa (Bouis and Pandya-Lorch, 2010). Additionally, rice consumption is associated with micronutrient intake, as certain varieties of rice can be fortified with essential vitamins and minerals to address specific nutritional deficiencies (Bouis and Pandya-Lorch, 2010).

Theoretical Framework

The Theory of Access and the Technology Acceptance Model (TAM) serve as the foundation for this investigation.

1. **Technology Acceptance Model (TAM):** Davis (1989) developed the TAM, which suggests that users' attitudes toward adopting new technologies are influenced by perceived utility and perceived ease of use. According to this study, rice marketers' use of ICT tools such as smartphones, online marketplaces, and digital payment systems is impacted by how practical and user-friendly these tools are. The applicability of TAM is confirmed by the high daily ICT usage rate among marketers (87.5%).

2. **Theory of Access (Ribot & Peluso, 2003):** According to this theory, access is the capacity to gain something from a resource, not just the right to use it. The capacity (literacy, training), institutions (policies, cooperative societies), and access to ICT infrastructure (devices, internet connectivity) all affect marketers' ability to use ICT tools efficiently. This theory sheds light on why, in rural areas like Ogbomoso North, low ICT literacy and digital divides continue to exist despite the potential advantages.

Empirical Review of Studies on the Effect of ICT Utilization on Agricultural Production and Marketing

Mahmud and Ahsan (2016) investigated the use of ICTs in Taiwanese agriculture. According to the study, producers benefited the most from using ICTs because it eliminated the need for middlemen. In order to ensure the best possible coordination between research and extension for the benefit of farmers, ICTs were utilized to improve research findings among the stakeholders. Using panel data for 34 African countries from 2000 to 2011, Chavula (2014) found that ICTs significantly increased agricultural production, even though mobile phones had little effect and telephone main lines significantly boosted agricultural growth. According to the findings, the adoption and use of new technologies can effectively increase agricultural production, but only if certain socioeconomic traits, like greater education and skill levels, are present.

The most crucial communication tools for giving farmers knowledge and information about agriculture were the internet, cell phones, radio, and television, according to Chhachhar et al. (2014). Television also played a significant role in spreading agricultural information in developing nations, while radio was the preferred medium for communication in remote areas, broadcasting numerous agricultural programs. The distance between farmers and marketers was lessened by mobile phones. Farmers obtained product prices from the market and interacted directly with consumers. Before applying pesticides on their farms, farmers received the most recent weather information from the meteorological department. Information about product prices and marketing was also shared online, and farmers worldwide could access it in a matter of minutes.

In a study conducted in India, Kumar (2018) also showed that ICTs offer farmers easy and affordable ways to enable precision agriculture. He also suggested the latest advancements in agriculture that will help rural farmers use ICTs. It is possible to tailor big data analytics to enhance crop quality, which raises the rate of production overall.

Another study by Domguia (2021) provided empirical evidence that the agricultural sector benefits greatly from ICT use as measured by the penetration of fixed-line, mobile, and Internet telephones. Furthermore, the mediation analysis showed that ICTs also have a negative indirect effect through energy consumption and a positive indirect effect through their influence on trade openness and financial development. Nonetheless, the overall impact is favorable and demonstrates how ICTs are assisting in the growth of the sub-Saharan African agriculture industry.

According to a study conducted in Malawi and Kenya by Masambuka-Kanchewa et al. (2020), which looked at farmers' opinions about the role extension agents play in the spread of innovations, agriculture is recognized as a significant economic sector in these nations. Unfortunately, despite the existence and implementation of new extension policies, the low adoption rates of improved technologies continue to be cited as a challenge in these countries (as well as other developing countries) because of the low productivity of small farms. Delivering agricultural extension services via ICTs necessitates a change in strategy to meet this challenge.

ICT was emphasized as a disposable tool to combat poverty in a study conducted in Bangladesh by Chowhan (2020) on the role of ICT in agriculture and its future scope. As a result, it is also recognized that ICT can significantly improve the contribution to rural development and agriculture. By providing data for research and development projects, ICTs can effectively be used to gather and disseminate timely and accurate news about markets, prices, weather, and inputs.

Methodology

The research was conducted in Oyo State's Ogbomosho North Local Government Area (LGA). Derived from the previous Ogbomosho Local Council, which was founded in April 1973, Ogbomosho North LGA was created on September 27, 1991. Ogbomosho North LGA has an average temperature of 28 degrees Celsius and covers an area of about 207 square kilometers. The area receives about 1830 mm of precipitation annually, and the average wind speed is 9 km/h. The city's main traditional residence is the Soun Palace. With a land mass of 235 km², Ogbomosho North LGA is the most populous local government area in the city and serves as its main economic hub. According to the 2006 census, it is the most populated local government in the city. Ogbomosho is roughly situated where latitude 8° 10' North and longitude 4° 15' East converge. It is considered a lowland rain forest area and a derived savannah vegetation zone. The climate there supports the production of maize and the zone experiences both wet and dry seasons every year. Approximately 8° 07' east of the Greenwich Meridian is where Ogbomosho North LGA is located. The town serves as a gateway to northern Nigeria and is located in the derived savannah region. Aaje/Ogunbado, Abogunde, Aguodo/Masifa, Alasa, IsaleAfon, Jagun, Okelerin, Osupa,

Sabo/Taara, and Saja/IsaleOra are the ten political wards that make up Ogbomoso North. The Ogbomosho North Area, which is in Nigeria's tropical climate zone, has consistently high temperatures. Based on the availability of rice marketers, four significant commodity marketplaces in the LGA were purposefully chosen for the first stage. These included the marketplaces in Sabo, New Wazobia, Adenike, and Under G. Twenty (20) marketers were chosen from each designated marketplace for the second stage. There were eighty (80) responders in all. The majority of the data used in this study came from primary sources. A structured questionnaire that was given to literate respondents and utilized as an interview schedule for illiterate respondents helped collect data. The purpose of the questionnaire was to record the particular goals of the research. Inferential statistical tools and descriptive statistics, which use means and percentages, were used to analyze the data.

Descriptive Analysis

The frequency distribution, percentage table, and population mean are all included in the basic descriptive analysis. The specific objectives 1, 2, and 5 were tested using this method. The specific goals were to describe the socioeconomic characteristics of the rice marketers in the study area, look into the respondents' marketing activities, and look into the obstacles that prevent rice marketers from using ICT (1, 2, and 5).

Budgetary Analysis

Budgetary analysis is the process of examining and interpreting financial data to understand the budgetary implications of different decisions or scenarios. This analysis will be used to analyze specific objective 4.

The specific objective 4 was to estimate the cost, returns, and marketing efficiency of the respondent.

Total Revenue (TR) = Price x Quantity Sold

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

Gross Margin (GM) = TR - TVC

Profit = TR – TC

Benefit Cost Ratio TR/TC

Marketing Efficiency = Value added by marketing/Total marketing Cost x 100

Utilization Index

A utilization index will be generated to analyze the ICT utilization level of respondents (specific objective 3). The ICT tools were listed, and the respondents indicated the ones they use. The ICT tools include radio, television, mobile phones, social media (e.g. facebook, whatsapp), mobile applications, online marketplaces (e.g Ayoba), digital payment systems (mobile POS)

Utilization index = Number of tools used by respondents/number of tools listed

Multiple Regression Analysis

Multiple regression analysis was employed to determine factors influencing the marketing efficiency of rice marketers (Specific objective 6).

Tobit Regression Analysis

The Tobit regression model was used to analyze the relationship between socioeconomic characteristics of respondents and use of ICT (study hypothesis).

Specification of the Models

Multiple Regression Model

To determine the factors influencing the marketing efficiency of rice marketers.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots$$

$$Y = F(X_1, \dots, X_n)$$

Where Y = Dependent Variable (Marketing Efficiency)

$$Y = F(X_1, X_2, X_3, X_4, \dots, X_{14})$$

X₁ = Age (Years)

X₂ = Sex (Male = 1, female = 0)

X₃ = Marital Status (Married=1, Otherwise = 0)

X₄ = Household size (actual number)

X₅ = Educational level (years of schooling)

X₆ = Marketing experience (Years)

X₇ = Membership of marketers association (member = 1, otherwise = 0)

X₈ = Radio (Usage=1, otherwise=0)

X₉ = Television (Usage=1, otherwise=0)

X₁₀ = Mobile phones (Usage=1, otherwise=0)

X₁₁ = Social media (Usage=1, otherwise=0)

X₁₂ = Mobile applications (Usage=1, otherwise=0)

X₁₃ = Online marketplaces (Usage=1, otherwise=0)

X₁₄ = Digital payment systems (Usage=1, otherwise=0)

Tobit Regression Model

To determine the relationship between the socioeconomic characteristics and use of ICT by rice marketers (study hypothesis).

$$Y = F(X_1, \dots, X_n)$$

Where Y = Dependent Variable (ICT Utilization Index)

$$Y = F(X_1, X_2, X_3, X_4, \dots, X_{12})$$

X₁ = Age (Years)

X₂ = Sex (Male = 1, female = 0)

X₃ = Marital Status (Married=1, Otherwise = 0)

X₄ = Household size (actual number)

X₅ = Educational level (years of schooling)

X₆ = Marketing experience (Years)

X₇ = Membership of marketers association (member = 1, otherwise = 0)

X₈ = Membership of cooperative society (member = 1, otherwise = 0)

X₉ = Price per bag of rice (Actual price)

X₁₀ = High cost of transportation (Yes=1, No=0)

X₁₁ = Poor market information (Yes=1, No=0)

X₁₂ = Inadequate storage facilities (Yes=1, No=0)

Results and Discussion

Socio-economic Characteristics of the Respondents

Frequency distribution of the respondents based on socio-economic characteristics.

Age group	Frequency	Percentage	Mean
<=30	13	16.25	42
31-40	33	41.25	
41-50	17	21.25	
51-60	9	11.25	
Above 60	8	10.00	
Total	80	100.00	
Sex			
Female	48	60.00	
Male	32	40.00	
Total	80	100.00	
Marital status			
Separated	5	6.25	
Single	8	22.50	
Married	51	63.75	
Total	80	100.00	
Household size			
<=5	63	78.75	5
6-10	16	20.00	
Above 10	1	1.25	
Total	80	100.00	
Education status			
No formal education	23	28.75	
Primary education	2	2.50	
Secondary education	3	3.75	
Tertiary education	18	22.50	
Total	80	100.00	
Religion			
Christianity	36	45.00	
Islam	43	53.75	
Traditional	1	1.25	
Total	80	100.00	

Year in school

<=6	29	36.25	8
7 -12	28	35	
Above 12	23	28.75	
Total	80	100.00	

Market Exp.

<=5	35	43.75
6 -10	17	21.25
11 - 15	11	13.75
16 – 20	4	5.00
Above 20	13	16.25
Total	80	100.00

Member of Cooperative Society

No	46	57.50
Yes	34	42.50
Total	80	100.00

Market

No	71	88.75
Yes	9	11.75
Total	80	100.00

Access to Credit

No	41	34.17
Yes	79	65.83
Total	80	100.00

Source of Finance

Personal	38	47.50
Cooperative loan	35	43.75
Bank loan	4	5.00
Other Grants	3	3.75
Total	80	100.00

Annual Income(#)	Frequency	Percentage
<=100000	3	3.75
101000-200000	11	13.75
201000-300000	11	13.75
301000-400000	11	13.75
401000-500000	9	11.25
Above 500000	35	43.75

No of bags	Frequency	Percentage
≤ 5	44	55.00
6-10	19	23.75
Above 10	17	21.25
Total	80	100

Means of conveying rice to market	Frequency	Percentage
Vehicle	54	67.50
Motor bike	22	27.50
Head load	4	5.00
Total	80	100

Household assistance	Frequency	Percentage
No	34	42.50
Yes	46	57.50
Total	80	100

Use of Hired labor	Frequency	Percentage
No	29	36.25
Yes	51	63.75
Total	80	100

Problems	*Frequency	Percentage
High cost of transportation	59	73.75
Poor market information	34	42.50
Irregular supply	31	100
Lack of uniform measure	25	31.25
Insect pest infestation	17	21.25
Inadequate storage facilities	14	17.50
Theft	11	13.75
Others (High importation duty)	1	1.25

Note * indicates multiple responses

Access to Credit	Frequency	Percentage
No	57	72.15
Yes	22	27.85
Total	80	100

Amount of Credit(#)	Frequency	Percentage
≤100000	59	73.75
101000-200000	8	10.00
201000-300000	8	10.00
301000-400000	1	1.25
401000-500000	1	1.25
Above 500000	3	3.75
Mean = 135312.5		
Total	80	100

Use of ICT	Frequency	Percentage
No	6	7.50
Yes	74	92.50

Types of ICT tools	*Frequency	Percentage
Digital payment system	67	83.75
Mobile phones	60	75.00
Radio	22	27.50
Social media	18	22.50
Television	16	20.00
Online marketplaces	1	1.25
Mobile applications	1	1.25

Note * indicates multiple responses

Period of Usage	Frequency	Percentage
Rarely	7	8.75
Weekly	3	3.75
Daily	70	87.50

Challenges	Frequency	Percentage
No	21	26.25
Yes	59	73.75
Total	80	100

Challenges	*Frequency	Percentage
Lack of internet access	33	41.25
Limited technical knowledge	30	37.50
High Cost of ICT tools	22	27.50

Note * indicates multiple responses

Mode of addressing the issues	Frequency	Percentage
Training	8	10.00
Investment in ICT infrastructures	22	27.50
Collaboration with other marketers	41	48.75
Others (Employment of expertise)	1	1.25

Age of Respondents

According to the age distribution of the respondents, 41.25% of them were between the ages of 31 and 40, 21.25% were between the ages of 41 and 50, 16.25% were under or equal to 30, 11.25% were between the ages of 51 and 60, and 10% were over 60. The average age was forty-two. This indicated that the majority of those surveyed were middle-aged adults. The findings of Nkandu and Phiri (2022), who found that 29.6% of respondents were between the ages of 41 and 50, are consistent with this outcome.

Sex of Respondents

According to the respondents' sex distribution, 40 percent were men and 60% were women. This suggests that women made up the majority of responders. This finding contrasts with that of Nkandu and Phiri (2022), who found that 65% of respondents were men.

Marital Status of Respondents

The findings of the distribution according to marital status revealed that 63.75% of the respondents were married, 22.50% were single, 6.25% were separated, 5% were divorced, and 2.50% were widowed. This suggests that married people made up the majority of the respondents. The findings of Muhammad, Adesiji, Tyabo, Muhammed, and Loko (2019), who found that 90% of the respondents were married, are consistent with this outcome.

Household Size of Respondents

78.75% of respondents had a household size of no more than five people, 20% had a household size of six to ten people, and 1.25 percent had a household size of ten or more, according to the results of the dwelling size distribution. Five was the average size of the household. According to this, the majority of responders have a moderately sized family. The findings of Muhammad, Adesiji, Tyabo, Muhammed, and Loko (2019), which show that 90% of households are between six and ten people, are in conflict with this result.

Religion of Respondents

The results of the distribution of respondents by religion showed that 53.75% of them were Muslims, 45% were Christians, and 1.25 percent were traditionalists. This proved that Muslims made up the majority of local responders. This result is contradicted by the findings

of Oke, Adeoye, Jatto, Adelusi, and Ojo-Fakuade (2019), who discovered that 68.8% of the respondents identified as Christians.

Educational Status of Respondents

The distribution of responders by educational attainment was displayed in Table 1. Of the respondents, 42.50% had a tertiary education, 28.75% had no formal education, 22.50% had a secondary education, 18% had a secondary education, 3.75% had a primary education, and 2.50% had an adult education, according to the results. This showed that the majority of local respondents have a high level of education. The findings of Oke, Adeoye, Jatto, Adelusi, and Ojo-Fakuade (2019), who found that 31.1% of respondents lacked formal education, are in conflict with this result.

Years of Schooling of Respondents

The distributions of respondents' total years of education were displayed in Table 1. According to the results, 82.50% of the respondents had completed more than 12 years of education, while 17.50% had completed 7 to 12 years. This indicated that the majority of those surveyed had attended school for more than 12 years. Eight years was the mean. The findings of Oke, Adeoye, Jatto, Adelusi, and Ojo-Fakuade (2019), who found that the majority of respondents did not attend school at all, are in conflict with this result.

Membership of Cooperative Society among Respondents

According to the results of the distribution based on cooperative membership, 42.50% of the respondents are members of a cooperative group, whereas 57.50% are not members of any cooperative society. This suggests that over 50% of the local respondents are not members of a cooperative society. This outcome runs counter to the findings of Adedokun et al. (2017), who found that 60% of respondents belonged to cooperative societies.

Marketing Activities

Respondents Years of Marketing Experience

43.75% of the respondents had less than five years or five years of marketing experience, 21.25% had six to ten years, 16.25% had twenty years or more, 13.75% had eleven to fifteen years, and 5% had sixteen to twenty years, according to the results of the distribution based on years of marketing experience. Eleven years was the mean. This demonstrated that the majority of those surveyed had five years or less of experience. The findings of Muhammad, Adesiji, Tyabo, and Muhammad (2019), who found that 46% of respondents had six to ten years of marketing experience, are in conflict with this result.

Respondents Annual Income

The result of distribution based on annual income of the respondents showed that 43.75% earned above five hundred thousand per annum, 13.75% earned one hundred and one thousand to four hundred thousand naira, 11.25% earned four hundred and one thousand to five hundred thousand naira while 3.75% earned less than or equal to one hundred

thousand naira. This implies that majority of the marketers earned above five hundred thousand naira. The average income was ₦791094. The result contradicts the findings Muhammad, Adesiji, Tyabo and Muhammed (2019) where 5% of the respondents earned less than ₦100000 per annum.

Respondents Main Source of Finance

The results of distribution based on main source of finance revealed that 47.50% of the respondents claimed that main source of finance was personal savings, 43.75% claimed cooperative loans, 5% were identified with bank loans while other (3.75%) identified with grandchildren support as their main source of finance. The result revealed that most of the respondents depend on personal savings as main source of financing their marketing activities. This result contradicts the findings of Syed, Urooj and Nikhith where 8.55% major source of financing their marketing activities was family and friends.

Marketers Association Membership

The result showed that 88.75% of the marketers do not belong to any marketer association while 11.75% belonged to marketer association. The majority of the marketers does not belong to any marketer association. This result is in line with the findings of Oke, Adeoye, Jatto, Adelusi and Ojo-Fakuade (2019) where 86% of the marketers do not belong to any marketing association.

Number of Bags of Rice Sold Per Week

The result revealed that 55% of the marketers sold less than five bags or less than five bags per week; 23.75% sold between six and ten bags per week, while 21.23% sold more than 10 bags. The average number of bags of rice sold per week was 9 bags. This implies that the majority of the marketers sold less than five bags or five bags in a week. This result contradicts the findings of Kakali and Rajeev (2019), where an average of 25 bags was sold per week.

How to Convey Bags of Rice to Market

The distribution based on how bags of rice are conveyed to market showed that 67.50% of the marketers used vehicles, 27.50% used motorcycles, and 5% used head loads. This implied that the majority of the marketers used vehicles to convey bags of rice to market. This result contradicts the findings of Ray, Danilo and Lewis (1999), where the majority of the marketers used human and animal power to convey bags of rice to market.

Household Members Assistance in Marketing Activities

The distribution based on household assistance in marketing showed that 57.50% of the marketers claimed household members assisted in marketing while 42.50% claimed to have no household member assistance in marketing. This implies that majority of the respondents enjoyed assistance from household members. This result is in line with the

findings of Kotler and Keller (2016), where more than 50% of the household members assisted in marketing activities.

Use of Hired Labor in Marketing

The distribution based on use of hired labor showed that 63.75% of the marketers used hired labor while 36.25% of the marketers did not use hired labor. This implies that the majority of the marketers used hired labor, suggesting that rice marketing is a labor-intensive business. This result is in line with the findings of FAO (2022), where 60–70% of marketers used hired labor in marketing activities.

Problems Encountered in Rice Marketing

The findings showed that 73.75% of respondents had concerns about high transportation costs, 42.50% had concerns about inadequate market information, 38.75% had concerns about irregular supply, 31.25% had concerns about a lack of uniform measures, 21.25% had concerns about insect pest infestation, 17.50% had concerns about inadequate storage facilities, and 13.75% had concerns about theft. Additionally, 1.25 percent of respondents had concerns about high importation tariffs and unfavorable government policies. This suggests that the high cost of transportation was a problem for the majority of respondents. This outcome is consistent with research by Oladimeji et al. (2016), which found that 65% of respondents cited high transportation costs as their biggest obstacle.

Access to Credit

According to the results, 27.85% of the respondents said they had access to credit, whereas 72.15% said they did not. This suggests that the vast majority of marketers were unable to obtain credit. This runs counter to Diagana and Zeller's (2011) findings, which showed that most of their respondents had access to credit.

Amount of Credit

According to the results, 73.75% of the respondents had access to less than or equal to 100,000 naira, 10% had access to between 100,000 and 300,000 naira, 3.75% had access to more than 500,000 naira, and 1.25% had access to between 300,000 and 400,000 naira. ₦135,312.5 was the mean. This suggests that less than 100,000 naira in credit was available to the majority of marketers. This outcome is consistent with research by Ezech et al. (2015), which found that 68% of respondents had access to a comparatively small amount of credit.

ICT Utilization Level

Use of ICT

The result showed that 92.50% of the respondents used ICT tools while 7.50% did not use any ICT tool. This implies that the majority of the marketers used ICT tools. This result is in line with the findings of Muhammad, Adesiji, Tyabo, Muhammed, and Loko (2019), where 95% of the marketers used ICT tools.

Types of ICT Tools

The result showed that 83.75% of the respondents used a digital payment system, 75% of the respondents used mobile phones, 27.50% of the respondents used radio, 22.25% of the respondents used social media, 20% of the respondents used television, 1.25% of the respondents used mobile application, and 1.25% of the respondents used online marketplaces. This implies that majority of the respondents used digital payment systems. This result contradicts the finding of Muhammad, Adesiji, Tyabo, Muhammed, and Loko (2019), where 63.75% of the respondents used mobile phones as the main marketing tools.

Frequency of Usage of ICT Tools

The result showed that 87.50% used ICT tools on a daily basis, 8.75% used it on a rare basis, 3.75% used the tools on a weekly basis. This implies that majority of the marketers used ICT tools on a daily basis. The result contradicts the findings of Usman, Adeboye, Oluyole and Ajijola (2012) where utilization of ICT is very low among their respondents.

Cost and Returns Per Week

Cost Analysis

Table 2 shows the estimate cost of marketing. The average cost of items identified include labor cost per week (#3262.75), transportation cost per week (#9270), annual rent (#58606.26), cost of rice per bag (#67957.5), total variable cost (#611617.50) and revenue (#691882.5). The findings indicate that more money was spent in marketing activities (running cost). This result is in line with the findings of Afolabi (2012) where labor, transportation and rent were the major contributors to marketing costs.

Table 2: Distribution Table based on Cost and Returns

Cost	Average cost (#)
Labor	3262.75
Transportation	9270.00
Rent	1127.04
Bag of rice	611617.50
Total cost	625277.29

Source: Field Survey, 2024

Gross Margin Analysis

$$GM = TR - TVC$$

$$TR = \text{\#}691882.50$$

$$TVC = \text{\#}625277.29$$

$$GM = \text{\#}691882.50 - \text{\#}625277.29$$

$$GM = \text{\#}66605.21$$

$$BCR = TR / TC$$

$$BCR = \text{\#}691882.50 / \text{\#}625277.29$$

= 1.11

Positive gross margin and BCR of greater than one indicates that rice marketing is a profitable enterprise in the study area.

Marketing Efficiency Analysis

Marketing Efficiency (ME) = $BCR \times 100\%$

ME = 1.11×100

ME = 111%

ME of greater than 100% is an indicator that rice marketers in the study area performed marketing functions efficiently, although there is room for improvement.

Challenges of ICT Utilization

Challenges in Using ICT Tools

The result showed that 73.75% of the marketers faced some challenges while 26.25% claimed not to have any challenge. This suggests that the vast majority of marketers encountered some sort of difficulty. This outcome is consistent with research by Yusuf et al. (2018), which found that 70% of marketers encountered major difficulties.

Issues Marketers Face When Using ICT Tools

According to the results, 41.25% of respondents said they had trouble accessing the internet, 37.50% said they had trouble understanding technical matters, and 27.50% said they had trouble paying for ICT tools. This suggests that the majority of respondents talked about the difficulties in training. This outcome runs counter to Showole and Hashim's (2014) findings, which indicated that 25% of respondents experienced irregular power supply.

How the Challenges Faced were Addressed

According to the results, 48.75% of the respondents said that they overcame these difficulties by receiving training, 27.50% said that they overcame these difficulties by investing in ICT infrastructure, 10% said that they overcame these difficulties by working with other marketers, and 1.25% said that they overcame these difficulties by using specialized knowledge of ICT tools. This suggests that the majority of respondents talked about the difficulties in working with other marketers. The outcome runs counter to Unwin's (2017) findings, which used training programs to address the difficulties encountered.

Estimates of Parameters to Find Out What Affects the Use of ICT Tools

Factors Affecting Rice Marketers' Marketing Effectiveness

The results of the multiple regression model on the variables affecting the respondents' marketing efficiency are displayed in Table 3. The findings indicated that the key factors influencing the effectiveness of rice marketers utilizing ICT tools were television, mobile applications, digital payment systems, years of marketing experience, marital status, and household size. With a coefficient of determination (Adjusted R²) of 0.6282, the results

indicated that the explanatory variables included in the model account for roughly 63% of the variation in marketing efficiency. The given regression model's goodness of fit is indicated by an F-value of 2.67 that is significant at the 5% level.

The results showed that a unit increase in marital status would result in a 0.4539695 increase in rice marketers' efficiency. The coefficient of marital status was positive and statistically significant at the 5% level, suggesting that marital status is positive and directly influences marketing efficiency. According to this finding, married respondents are probably more productive than those in other marital status categories. This could be related to the possibility that family members will help with marketing initiatives.

The household size coefficient was positive and statistically significant at the 5% level, suggesting that household size is positive and directly influences marketing efficiency. It also showed that an increase of one unit in household size will result in a 0.3921745 increase in rice marketers' efficiency. This finding suggests that the effectiveness of rice marketers will be impacted by household size. More hands are available to help with marketing initiatives when there are more household members.

The year of experience had a positive and direct impact on marketing efficiency, as indicated by the positive and statistically significant coefficient at the 5% level. It also showed that an increase of one unit in year of experience would result in a 0.38,0729 increase in the efficiency of rice marketers. This finding suggests that the efficiency of rice marketers will be impacted by an increase in years of experience. Additionally, the television utilization coefficient was positive and statistically significant at the 1% level, suggesting that television use was beneficial and directly impacted marketing efficiency. It also showed that for every unit increase in television use, rice marketers' efficiency would rise by 0.0427132.

This finding suggests that the effectiveness of rice marketers will be impacted by a rise in television usage. By watching pertinent television shows, marketers most likely have access to market information.

A unit increase in the use of mobile applications will result in a 0.188084 increase in the efficiency of rice marketers, according to the positive and statistically significant coefficient of mobile applications at the 1% level. This suggests that the use of mobile applications was beneficial and directly influenced marketing efficiency. This finding suggests that the effectiveness of rice marketers will be impacted by a rise in the use of mobile applications. Mobile applications make it easier to connect with potential customers.

A unit increase in the use of digital payment systems will increase rice marketers' efficiency by 0.8374876, according to the coefficient of digital payment systems, which was also positive and statistically significant at the 10% level. This suggests that the use of digital payment systems had a positive and direct influence on marketing efficiency. This result indicates that an increase in the use of digital payment systems will influence efficiency of rice marketers. It's likely that this tool will make paying for purchases and sales easier. This outcome is consistent with the results of Akinbode et al. (2019), who found that years of marketing experience had a positive and significant impact, that the adjusted R² was 0.60,

the F-value was 2.59, that the marital status was positive and significant at the 5% level, and that the coefficient of household size was 0.35.

Table 3: Parameter Estimate of Factors Influencing Marketing Efficiency of Rice Marketers

Marketing efficiency	Coefficient	Standard error	T	P> t
Age	0.0254474	0.1517204	0.17	0.867
Sex	-0.6276527	1.81121	-0.35	0.730
Marital status	0.4539695	0.1953507	2.32**	0.023
Household size	0.3921745	0.1801647	2.18**	0.033
Years of schooling	-0.2231552	0.1500748	-1.49	0.142
Marketing Experience	0.3840729	0.1780387	2.16**	0.035
Marketers Association	0.327821	0.0538891	0.61	0.545
Radio	2.89022	2.412306	1.20	0.235
Television	0.0427132	0.013254	3.22***	0.002
Mobile phones	0.0025207	0.0102556	0.25	0.807
Social media e.g Twitter	0.2389848	0.1450209	1.65	0.104
Mobile Applications e.g Rideeat	0.188084	0.0717625	2.62***	0.011
Online marketplaces e.g Ayoba	0.3656527	0.5125652	0.71	0.478
Digital payment systems e.g Mobile POS	0.9233947	0.4865092	1.90*	0.062
Constant	0.8374876	0.1011777	8.28	0.000
Prob >F = 0.0039				
R-squared = 0.6650				
Adj R-squared = 0.6282				
Root MSE = 7.019				

Note: *, ** and *** represent 10%, 5% and 1% level of significance respectively

Source: Data Analysis, 2024

Hypothesis Testing

The Connection between Respondents' Socioeconomic Features and ICT Use

Using Tobit regression analysis, Table 4 illustrates the connection between respondents' socioeconomic traits and ICT use. The findings showed that the key factors influencing ICT use for rice marketing were age, household size, marketer association, price per bag of rice, high transportation costs, and inadequate market knowledge. This suggested that the likelihood of respondents using ICT for rice marketing will rise in tandem with an increase in each of these variables.

The results showed that a unit increase in respondents' age would result in a 0.1870547 increase in their likelihood of using ICT for rice marketing. The age coefficient was positive and statistically significant at the 5% level. A unit increase in household size will result in a 0.1097792 increase in the likelihood that respondents will use ICT for rice marketing, according to the positive and statistically significant coefficient of household size at the 10% level. Additionally, the marketers

association coefficient was positive and statistically significant at the 1% level. This meant that for every unit increase in marketers association, the respondents' likelihood of using ICT for rice marketing would increase by 0.07767118.

According to the price per bag of rice coefficient, which was positive and statistically significant at the 1% level, there will be a 0.1758559 increase in the likelihood that respondents will use ICT for rice marketing for every unit increase in price per bag. A unit increase in transportation costs will result in a -0.3596747 decrease in the likelihood of using ICT for rice marketing, according to the coefficient of high transportation costs, which was negative and statistically significant at the 1% level. Additionally, the coefficient of poor market information was negative and statistically significant at the 1% level. This meant that the likelihood of respondents using ICT for rice marketing would decrease by -0.1266893 for every unit increase in poor market information.

The result is in line with the findings of Onemolease et al., (2017) where age, household size, membership in marketers' association, price per bag of rice, cost of transportation and poor market information were significant and had impact on the utilization of ICT tools.

Table 4: Distribution Table based on the Relationship between ICT Utilization Index and Marketing Efficiency

ICT Utilization Index	Coefficient	Standard Error	T	P > t
Age	0.1870547	0.078483	2.38**	0.020
Sex	-0.0249825	0.0501246	-0.50	0.620
Marital status	-0.0259984	0.0334639	-0.78	0.440
Household size	0.1097972	0.0659608	1.66*	0.101
Years of schooling	0.0024824	0.0043101	0.58	0.567
Marketing Experience	0.0767118	0.0049342	-1.08	0.284
Marketers Association	0.0767118	0.0293552	2.61***	0.011
Membership of cooperative group	0.0769322	0.053256	1.44	0.153
Price per bag of rice	0.1758559	0.077293	2.41***	0.019
High cost of transportation	-0.3596747	0.1258225	-2.86***	0.006
Poor market information	-0.1366893	0.0515142	-2.65***	0.010
Inadequate storage facilities	-0.0090646	0.069213	-0.13	0.896
Constant	0.305204	0.1520856	2.01	0.049
Number of observations = 80				
Uncensored = 80				
Left censored = 0				
Right censored = 0				

Note: *, ** and *** represents 10%, 5% and 1% level of significance respectively

Source: Data Analysis, 2024

Summary

This study looked into how the efficiency of rice marketers in Ogbomoso North Local Government Area, Oyo State, was affected by their use of ICT. Since the effectiveness of rice marketers relies on the use of ICT tools, the core of this project cannot be compromised. Eighty rice marketers completed a well-structured questionnaire that was used to gather data on their socioeconomic characteristics, marketing activities, level of ICT utilization, cost and return, and challenges related to ICT utilization. The factors influencing the respondents' use of ICT tools were identified. The data was analyzed using descriptive analysis, budgetary analysis, multiple regression analysis, and tobit regression analysis.

The findings of the descriptive analysis of the socioeconomic characteristics of the marketers showed that the percentage of female rice marketers in Ogbomoso North Local Government was higher than the percentage of male marketers, with 60% of the farmers being female and 40% being male. The average age of the respondents was 42 years, and the majority of the farmers were married (63.75%), with a mean household size of five. The majority of the farmers in the study area were literate or semi-literate, with 28.75% having no formal education, 2.50% having adult education, 3.75% having primary education, 22.50% having secondary education, and 42.50% having tertiary education. The mean marketing experience of the respondents was 11 years. In contrast to 27.85% of respondents who said they had access to credit, 72.15% of respondents said they did not. Personal savings accounted for 47.50% of the study area's funding, while cooperative loans were also heavily utilized (43.75%). The remaining 8.75% used grants and bank loans, among other sources of funding.

The results of the multiple regression analysis showed that the primary factors influencing how effectively rice marketers use ICT tools for marketing are marital status, household size, marketing experience, television use, mobile applications like Farmgate, and digital payment systems like mobile point-of-sale (POS). According to the tobit regression model, the primary factors influencing the relationship between ICT use and marketing effectiveness are age, household size, marketers' associations, price per bag of rice, the issue of high transportation costs, and inadequate market knowledge.

Conclusion

This study offers empirical proof that the use of ICT in Ogbomoso North LGA greatly improves the effectiveness of rice marketing. Better market access, price transparency, and lower transaction costs have resulted from the widespread use of mobile phones and digital payment systems. The profitability of rice marketing operations in the region is reflected in marketing efficiency, which is determined by a benefit-cost ratio of 1.11 and marketing efficiency of 111%. However, optimal utilization is hindered by capacity-related and infrastructure-related barriers, such as low digital literacy (37.5%), poor internet access (41.25%), and high ICT tool costs (27.5%).

Implication for Policy

ICT Infrastructure Investment: Governments and stakeholders should prioritize expanding rural broadband and reliable electricity. Similar interventions in Kenya's M-Farm (Okello et al., 2012) and India's e-Choupal (Annamalai & Rao, 2003) have shown success in enhancing agricultural market systems.

Digital Literacy and Training: To close skill gaps in the use of ICT tools, capacity-building initiatives must be put into place. FAO (2020) evidence emphasizes the value of locally tailored training materials.

Financial Incentives: According to Aker and Mbiti (2010), financial aid or grants for the purchase of ICT devices and internet access can enhance digital inclusion.

Policy and Regulatory Framework: Policies that safeguard data privacy and enable mobile transactions in agriculture are required (Zeng & Lu, 2021). These can increase self-assurance when utilizing ICT tools.

Multi-Stakeholder Collaboration: To scale ICT innovations, public-private partnerships (PPP), akin to India's Digital Green initiative, should be promoted (Gandhi et al., 2009).

Future Research Direction

ICT Impact Longitudinal Analysis: Monitor the effects of ICT on marketing revenue and efficiency over time to evaluate enduring advantages and patterns of adaptation.

Gender Analysis of ICT Adoption: Future research should look into gender-specific barriers and digital inclusion tactics, especially since women make up 60% of marketers.

Comparative Research Across LGAs or States: In order to enable policy benchmarking, comparable research should be carried out in other rice-producing regions of Nigeria or West Africa in order to generalize findings.

Integration of Emerging Technologies: Examine how local rice value chains use blockchain for traceability (Tian, 2016), IoT for logistics (Misra et al., 2020), and artificial intelligence (AI) for price prediction (Kamilaris et al., 2018).

Consumer Perspective: Examine the ways in which demand forecasting, market pricing, and consumer behavior are impacted by ICT-enhanced marketing.

Recommendations

- Regular ICT training programs for rice marketers are necessary to improve their technical knowledge and ability to use ICT tools effectively, as evidenced by the findings that ICT utilization positively affects their level of income and profitability.
- There should be easier access to credit facilities to support investments in ICT tools and marketing initiatives, given that the majority of respondents lacked credit.
- Given that the majority of respondents reported having trouble with high transportation costs, stakeholders should work to lower these expenses as they have been identified as a significant obstacle in rice marketing.

- Based on the finding that there is a high use of cooperative loans, cooperative societies should be strengthened and encouraged, as they provide a key source of financing for rice marketers.

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