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Investigating the Level of Farmers' Awareness of using Computer Network in Improving the Supply Chain of Raw Materials to Industries in Nigeria

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Abstract

This work examines the level of awareness among Nigerian farmers regarding in use of computer networking hubs to advance the agricultural supply chain. The research examines farmers' understanding of this technology, identifies barriers to its adoption, and explores the perceived benefits of networking hubs in augmenting supply chain efficiency. To actualize this, we adopted a descriptive survey design. A sample of 350 farmers in Owerri Senatorial District of Imo State, Nigeria gave us a concrete data. We deployed a stratified proportionate sampling method and data were collected through a researcher-made validated questionnaire with a Cronbach Alpha reliability coefficient of 0.87. Data harvested were scrutinized using mean and standard deviation. The revision found that farmers exhibited a low level of awareness about networking hubs, with limited engagement despite recognizing their potential to improve communication, market access, traceability, and reduce transaction costs. Additionally, task such as inadequate infrastructure, lack of training, and financial constraints were noticed as main obstacles to technology adoption. Consequently, the duty of education and agricultural extension services in raising awareness and enhancing farmers' understanding of technology was also emphasized. The results propose that enough training programs and outreach initiatives are essential to support the implementation of technology in Nigeria's agricultural sector. It was suggested among others that farmers should profoundly engross with local governments and organizations to prioritize the growth of reliable internet and electricity in rural areas, ensuring admittance to the necessary infrastructure for adopting new technologies.

Introduction

The agricultural domain in Nigeria plays a vital role in the country's economic development, contributing significantly to the supply of raw materials for various industries. However, the efficiency of the agricultural supply chain has often been hindered by poor infrastructure, lack of technological integration, and ineffective communication between farmers and industries. In addition, the agricultural information propagation is also essential to the productivity of farmers in order to be familiar about those things which they are not aware of. In recent years, the potential of computer networking hubs to expand supply chain management has become recognized globally embraced. These hubs, which facilitate the seamless connection and communication within several stakeholders in the supply chain, it offers farmers and industries a powerful tool to enhance coordination, reduce inefficiencies, and allows the seamless exchange of real-time data, such as market trends, product availability, weather conditions, and transportation logistics, thereby improving decision-making, reducing

delays, and optimizing the flow of raw materials. Despite the growing benefits of digital technologies, the level of awareness and adoption of computer networking hubs among farmers in Nigeria remains limited.

According to earlier research, Nigeria's agriculture industry has shown a consistent drop in productivity [1]. But according to indexes, the industry has recently begun to show signs of slow growth [2]. According to earlier research, timely availability, agricultural innovation, and technology have an impact on this consistent rise [1]. However, the adoption of such technological solutions remains limited, particularly in rural areas where many Nigerian farmers operate. The rate of awareness among farmers vis-à-vis the potential benefits of computer networking hubs and their ability to enhance the supply chain is unclear. While these technologies hold the potential to modernize agricultural practices and improve the efficiency of supply chains, many farmers still lack the knowledge and infrastructure to leverage them fully. Computer networking is the process of connecting various supply chain participants using digital platforms and internet technologies, enabling real-time information sharing, coordination, and tracking of items [3]. The use of computer networking helps in streamlining operations by offering precise data on inventory levels, schedules for delivering, thus minimizing delays and improves transparency in the raw material supply chain process [4]. The technology is also linked to the concept of "smart supply chains," which integrate Internet of Things (IoT) devices, sensors, and cloud computing to enable automated decision-making processes [5]. In agriculture, computer networking can be used to improve the coordination between farmers, suppliers, and industries, ensuring that raw materials are delivered on time and meet the required standards [6]. With the increasing digitization of agricultural processes globally, there is an emerging interest in applying such technologies to improve the logistics and management of agricultural supply chains, predominantly in developing countries for instance Nigeria as case a study.

The adoption of computer networking technologies is often influenced by various factors, including awareness, training, infrastructure, and proximity to technology. In Nigeria, evaluation have shown that various farmers have limited or no cognizance of the potential benefits of digital technologies in enhancing agricultural productivity and supply chain management [7]. A major plight to farmers embracing computer networking is their limited comprehension of how these technologies can be practically applied to enhance their business activities [7]. In research conducted by Olusanya et al., it was revealed that most smallholder farmers in Nigeria were not aware of digital tools in agriculture [8]. These farmers, mainly located in rural area, often find themselves inaccessible from technological advancements that could enhance their productivity and improve supply chain connections. The study indicated that there exists a limited understanding among farmers regarding the potential uses of computer networks in agriculture, along with a deficiency in targeted educational programs and awareness initiatives to address this issue. A related study by Olorunfemi and Adebiyi examined the barriers to technology adoption among farmers in Nigeria, noting that factors such as inadequate infrastructure, high costs of technology, and limited technical knowledge

hindered the widespread use of computer networks in agriculture [9]. Furthermore, the study highlighted that farmers in the urban and peri-urban areas generally had better access to information and training on new technologies compared to their rural counterparts. This suggests that a significant urban-rural divide exists in terms of digital literacy and awareness among Nigerian farmers.

Education and training are crucial to increasing farmers' awareness and fostering the adoption of computer networking technologies. Several studies emphasize the importance of extension services and agricultural training programs in disseminating information about the benefits and usage of digital knowhow [10]. Extension services, which involve providing farmers with information, advice, and support, are vital in educating them about how computer networks can be leveraged for improved supply chain management. In Nigeria, the government and non-governmental organizations (NGOs) have made efforts to close the technology gap through various capacity-building programs, such as ICT training initiatives and digital agriculture platforms [11]. However, these programs often face setbacks, to mention but a few such as limited coverage, lack of follow-up support, and the failure to tailor the training to the specific needs of farmers. A study by Nwaogu et al. revealed that farmers who underwent preparation on ICT tools were more likely to integrate computer networks into their farming practices, especially to improving communication with suppliers and industries [12]. The research also highlighted the role of farmer cooperatives and local agricultural organizations in facilitating awareness campaigns and coaching programs, which can help to bridge the knowledge gap in rural areas.

In addition to awareness, several other challenges prevent Nigerian farmers from adopting computer networks in supply chain management. First, limited access to reliable internet and electricity in rural areas remains a significant barrier [13]. The lack of digital infrastructure hampers the ability to implement effective computer networking systems that require consistent and stable connectivity. Second, the financial constraints faced by farmers, especially smallholder farmers, make the cost of technology adoption prohibitive. In many cases, the money involved to obtain devices, such as smartphones and computers, and as well internet subscriptions, which is too high for many agriculturalists to justify the venture, especially when they are not fully convinced of the immediate benefits. Lastly, the complexity of computer networking systems can pose a challenge to farmers who may have limited technical skills. Even when they are expose of the technology's potential benefits, the lack of user-friendly platforms and interfaces can discourage adoption [11].

This work seeks to explore the level of farmers' awareness of using computer networking hubs to improve the supply chain of raw materials to industries in Nigeria. By examining the current understanding of this technology among farmers, identifying barriers to its adoption, and exploring its potential impact on the agricultural-industrial supply chain, the research aims to provide valuable insights into the role of digital tools in modernizing Nigeria's agricultural sector. The reveals will notify policymakers, agricultural extension services, and industry stakeholders on how to better support farmers in embracing

technology for more efficient and sustainable supply chain management.

Purpose of the Study
The main reason of this study is to assess farmers' current understanding of the technology and identify the factors influencing its adoption in the agricultural supply chain. This study sought to:

1. Determine the level of awareness among farmers about networking hubs and how they function within the supply chain context.
2. Explore the challenges and obstacles that farmers face in adopting new technologies, such as limited access to infrastructure, lack of training, and financial constraints.
3. Find out how farmers perceive the potential advantages of using computer networking hubs, such as better communication, increased market access, improved product traceability, and reduced transaction costs.
4. Explore the role of education and extension services in raising awareness and increasing farmers' understanding of technology.
5. Test for the Effectiveness of the suggested system.

Research Questions
The following research questions guided the study:

1. What is the level of awareness among farmers about networking hubs and how they function within the supply chain context?
2. What are the challenges and obstacles that farmers face in adopting new technologies, such as limited access to infrastructure, lack of training, and financial constraints?
3. To what extent do farmers perceive the potential advantages of using computer networking hubs, such as better communication, increased market access, improved product traceability, and reduced transaction costs?
4. What is the role of education and extension services in raising awareness and increasing farmers' understanding of technology?

Methodology
This study adopted a descriptive survey design. The area of study was Owerri Senatorial district of Imo State, Nigeria. The population of the study consisted of all the 2786 registered agriculturalists in the focus area. Based on Taro Yamane formula for finding the sample size from finite population was used to determine the sample size of 350 farmers for the study. A stratified proportionate sampling was adopted in selecting the participants. The parameter for data gathering was the researcher-made validated questionnaire titled: Farmers' Awareness of using Computer Network Scale (FACNS) with a Cronbach Alpha reliability coefficient of 0.87. Data collected were analyzed using mean and standard deviation to answer the research questions. Any mean above the criterion means value of 2.50 falls within the range of high awareness (agree), otherwise, it falls within the range of low awareness (disagree).

Results
Table 1: Mean level of awareness among farmers about networking hubs and how they function within the supply chain context

S/N	Items	Mean	SD	Remarks
1	I am acquainted with the concept of networking hubs in agriculture.	2.05	1.234	Low Awareness
2	I understand how networking hubs function within the agricultural supply chain.	2.25	1.348	Low Awareness
3	I have used or been involved in any form of networking hub for agriculture.	1.95	1.145	Low Awareness
4	I believe networking hubs can play a noteworthy part in improving agricultural supply chains.	2.50	1.192	High Awareness
	Grand Mean	**2.28**	**1.230**	**Low Awareness**

The data from Table 1 reveals that farmers have a generally low level of awareness about networking hubs and their function in the agricultural supply chain. The mean scores range from 1.95 to 2.50, indicating limited familiarity with the concept. Specifically, farmers show low awareness of networking hubs, with a mean of 2.05 for familiarity and 2.25 for understanding how they function. The lowest mean of 1.95 for involvement suggests minimal direct engagement with these hubs. While farmers recognize the potential benefits of networking hubs in improving supply chains (mean of 2.50), their overall awareness remains low, as shown by the grand mean of 2.28. This indicates a need for further education and outreach to increase farmers' understanding and participation in networking hubs.

Table 2: Challenges and obstacles that farmers face in adopting new technologies

S/N	Items	Mean	SD	Remarks
5	I have access to the necessary infrastructure (e.g., internet, electricity) to adopt new technologies in farming.	2.30	1.218	Disagree
6	I feel that training and support for new agricultural technologies are readily available to me.	2.25	1.409	Disagree
7	Financial constraints make it difficult for me to adopt new technologies in farming.	2.75	1.371	Agree
8	The cost of new farming technologies is affordable and does not pose a significant barrier to adoption.	2.35	1.394	Disagree
	Grand Mean	**2.41**	**1.348**	**Disagree**

Table 2 shows that farmers face significant challenges in adopting new technologies. With a mean of 2.30, they generally disagree that they have proximity to necessary infrastructure (e.g., internet, electricity). Similarly, a mean of 2.25 indicates that training and support for new technologies are not readily available. Financial constraints are identified as a key obstacle, with a mean of 2.75, indicating agreement that finances make adoption difficult. Additionally, farmers disagree with the statement that the cost of new technologies is affordable, as shown by the mean of 2.35. The grand mean of 2.41 confirms that farmers face considerable barriers in terms of infrastructure, training, and financial constraints when adopting new technologies.

Table 3: Farmers' perception on the potential advantages of using computer networking hubs

S/N	Items	Mean	SD	Remarks
9	I believe that computer networking hubs can advance communication with farmers, suppliers, or buyers.	2.65	1.431	Agree
10	I believe that computer networking hubs could provide me with better access to new markets for my products.	2.55	1.316	Agree
11	I think networking hubs could help improve product traceability in my farming activities.	2.95	0.998	Agree
12	I believe that networking hubs could reduce transaction costs in my farming business (e.g., transport, payment processing).	2.75	1.371	Agree
	Grand Mean	**2.73**	**1.279**	**Agree**

Table 3 indicates that farmers perceive computer networking hubs as having potential advantages for their farming activities. The mean scores show agreement on the benefits of networking hubs. With a mean of 2.65, farmers believe that networking hubs can increase communication with other farmers, suppliers, or buyers. The mean of 2.55 suggests they also think these hubs could provide better access to new markets for their products. Additionally, a mean of 2.95 reflects that farmers agree networking hubs could improve product traceability in their farming activities. The mean of 2.75 indicates that farmers believe networking hubs could reduce transaction costs, such as transport and payment processing. The grand mean of 2.73 confirms that, overall, farmers view computer networking hubs as beneficial, particularly in terms of communication, market access, traceability, and cost reduction.

Table 4: Role of education and extension services in raising awareness and increasing farmers' understanding of technology

S/N	Items	Mean	SD	Remarks
13	I am aware of education or extension services that promote the use of new technologies in agriculture.	2.52	1.399	Agree
14	I find that current education or extension programs effectively raise awareness about new agricultural technologies.	2.75	1.251	Agree
15	I believe more training programs are needed to increase farmers' understanding and awareness of new agricultural technologies.	2.85	1.431	Agree
16	I think outreach methods such as community meetings, media, and online platforms would be effective in educating farmers about new technologies.	2.55	1.503	Agree
	Grand Mean	**2.66**	**1.396**	**Agree**

Table 4 reveals that education and extension services play a significant role in raising farmers' awareness and understanding of new agronomic technologies. The mean scores indicate that farmers generally agree with the statements about the efficacy of these services. With a mean of 2.52, farmers are aware of education or extension services that promote the use of novel technologies in agriculture. A mean of 2.75 suggests that they believe current education or extension programs are effective in raising awareness about new agricultural technologies. Farmers also agree that more training programs are desirable, as indicated by the mean of 2.85, highlighting a demand for further educational initiatives to improve their understanding. Additionally, a mean of 2.55 suggests that farmers believe outreach methods, such as community meetings, media, and online platforms, would be effective in educating them about new technologies. The grand mean of 2.66 confirms that farmers generally agree on the importance and effectiveness of education and extension services in increasing their awareness and understanding of new agricultural technologies.

Discussion

The outcomes of this revision reveal that farmers usually have poor awareness of networking hubs and their role in the agronomic supply chain. They demonstrate limited familiarity with the idea and minimal direct engagement with these hubs, though they recognize the potential benefits of these networks for improving supply chains. Farmers face significant obstacles in embracing these new technologies, including no access to necessary infrastructure, limited training and support, and financial restraints. High cost of new technologies further hinders adoption, making it harder for farmers to fit in these tools into professional practices. Despite these barriers, farmers perceive several potential advantages of computer networking hubs, such as improved communication, access to new markets, better product traceability, and reduced transaction costs. Additionally, education and extension services play a critical part in raising farmers' awareness and understanding of new agricultural technologies. Farmers acknowledge the effectiveness of these services but express a need for more training programs

and outreach efforts, such as community meetings and media campaigns, to enhance their knowledge. Therefore, while farmers are alert of the benefits of new technologies, there is a clear need for increased education, improved infrastructure, and financial support to overcome the challenges that hinder their widespread adoption.

The findings from this study align with and build upon existing research on farmers' awareness, challenges, perceptions, and the role of education in technology adoption. In terms of awareness about networking hubs, the results indicate that farmers commonly have poor levels of familiarity with and understanding of these hubs and their potential benefits in the agricultural supply chain. Previous studies have similarly shown that limited awareness and exposure to digital tools and networking technologies hinder their adoption among farmers, particularly in rural areas [11]. This might be credited to a lack of infrastructure, such as internet connectivity and electricity, which are essential for the effective use of networking hubs (Adeoti & Akinwale, 2021). Additionally, the limited direct engagement with these hubs highlights the gap between theoretical recognition and practical application, as noted in earlier studies on technology adoption barriers in agriculture [3].

In terms of tasks faced by agriculturalists in adopting new technologies, the results underscore significant obstacles related to infrastructure, training, and financial constraints. This mirrors findings from other research which points out that inadequate infrastructure, such as poor internet access and unreliable electricity, is a critical barrier to the adoption of agricultural technologies [12]. Furthermore, the perceived lack of readily available training and support for new technologies is consistent with the literature, which emphasizes that knowledge gaps and insufficient extension services impede technology transfer in agriculture [8]. Financial constraints, identified as a major barrier in this study, have been extensively documented as a key obstacle in adopting modern farming technologies, especially in resource-poor settings [13]. The high costs of new technologies and the affordability issues faced by farmers, as shown in the results, further support the findings of prior studies, which argue that without adequate financial support, the implementation of new farming innovations is limited [1].

Farmers' perceptions of the potential benefits of computer networking hubs also align with previous research. The results indicate that farmers recognize the advantages of networking hubs, such as improved communication, better market access, enhanced product traceability, and reduced transaction costs. Studies by Kumar, et al. and Mamman et al. have similarly highlighted that networking hubs can enhance communication and market access, particularly in terms of facilitating faster information exchange and connecting farmers with larger markets [6,10]. The perceived potential for improved product traceability and reduced transaction costs supports findings from research on supply chain management in agriculture, which proposes that digital tools can reorganize operations and reduce inefficiencies [2]. However, while farmers acknowledge these potential benefits, the actual adoption of such technologies remains slow due to the barriers mentioned earlier.

Finally, the impact of education and extension services in raising farmers' awareness and understanding of new technologies was found to be significant, as farmers generally agreed that education and extension programs help increase their knowledge. This resonates with the existing literature that emphasizes the importance of extension services in bridging the knowledge gap and enhancing technology adoption in agriculture [2]. However, the plea for robust training curricula and effective outreach methods, such as community meetings and media campaigns, reflects a common concern raised in prior studies, which stress the need for continuous, context-specific education to improve technology uptake [9]. The findings suggest that meanwhile learning and extension services play a crucial role in raising awareness, extra targeted energies are needed to ensure that farmers fully comprehend and put in use the new technologies available to them.

Thus, these findings highlight the importance of addressing the multifaceted barriers to technology adoption, including infrastructure, financial constraints, and the need for better education and extension services. As previous studies have shown, overcoming these barriers requires a coordinated effort from governments, extension services, and technology providers to ensure that farmers not only understand the benefits of novel technologies but also have the means to embrace and benefit from them.

Conclusion

This study highlights the significant barriers farmers face in adopting new technologies, particularly in relation to networking hubs and agricultural innovations. The findings indicate a general lack of awareness about networking hubs and their role in the agricultural supply chain, which is compounded by challenges such as inadequate infrastructure, insufficient training, and financial constraints. While farmers recognize the potential benefits of these technologies, such as improved communication, market access, traceability, and cost reduction, their limited engagement with these tools suggests a need for more targeted education and extension services. Additionally, the study underscores the significance of addressing the infrastructural and financial gaps that hinder technology adoption. To enhance the effectiveness of agricultural technologies, it is crucial to invest in comprehensive education, training, and outreach programs that are shaped to the exact needs of farmers, while also improving access to affordable technologies and infrastructure. By doing so, it may be possible to foster greater participation in digital agricultural tools and ultimately improve the efficiency and sustainability of agricultural supply chains.

Recommendations

1. Farmers should actively engage with local governments and organizations to prioritize the development of reliable internet and electricity in rural areas, ensuring access to the necessary infrastructure for adopting new technologies.
2. The government and NGOs should enhance the availability and reach of tailored training programs and extension services, focusing on the practical applications of new technologies to help farmers successfully incorporate them into their practices.

3. Governments, in collaboration with technology providers, should introduce financial support programs or subsidies to make new agricultural technologies more affordable and accessible, especially for farmers in financially constrained areas.

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