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Research Article

Socio-Economic Factors Influencing the Utilization of Information and Communication Technologies (ICTs) among SmallScale Pepper Growers in Kano and Kaduna States, Nigeria[a]

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ABSTRACT

Information and Communication Technologies (ICTs) have been essential instruments for transforming agriculture across the globe. This work evaluated the socio-economic factors influencing the utilization

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of information and communication technologies among small-scale pepper growers in Kano and Kaduna States, Nigeria. A simple random sampling approach was utilized to select and collect primary data from 200 pepper growers within the two states using a well-structured questionnaire. The tools used for data analysis are Probit Dichotomous Regression Model (PDRM), Kendall's coefficient of concordance (W), and the t-Test of difference between means. The findings from this study indicated that pepper cultivation is a profitable enterprise, with significant differences in revenue and cost of production ($p < 0.05$). The outcomes revealed that many of the farmer were male and middle aged (44 years). The ICT tools that were most widely used were mobile phones, radio, and social media, used primarily to access market prices and weather forecasts. The maximum likelihood estimates showed that education, experience, cooperatives, and extension contact significantly affected ICTs utilization at 1% alpha level. The Kendall's analysis placed power supply instability, poor internet connectivity, and financial constraints as the most significant inhibitors to ICTs use. Pepper production remains economically viable but low ICTs utilization because of infrastructural and fiscal constraints affecting productivity. For furthering digital inclusion, policy should focus on rural power supply enhancement, extension of the internet, and empowerment of extension services. Special ICTs training and capital support programs are recommended to raise farmers' productivity and competitiveness in the market.

Keywords: Kendall’s Coefficient of Concordance, Probit Dichotomous Regression, t-Test of Difference between Means, Challenges Faced by Producers, Profitability Analysis

Araştırma Makalesi

Kano ve Kaduna Eyaletlerindeki Küçük Ölçekli Biber Yetiştiricileri Arasında Bilgi ve İletişim Teknolojilerinin (BİT) Kullanımını Etkileyen Sosyo-Ekonomik Faktörler, Nijerya

ÖZ

Bilgi ve İletişim Teknolojileri (BİT'ler), dünya çapında tarımın dönüştürülmesinde önemli araçlar olmuştur. Bu çalışma, Nijerya'nın Kano ve Kaduna eyaletlerindeki küçük ölçekli biber yetiştiricileri arasında bilgi ve iletişim teknolojilerinin (BİT) kullanımını etkileyen sosyo-ekonomik faktörleri değerlendirilmiştir. İyi yapılandırılmış bir anket kullanılarak iki eyaletteki 200 biber yetiştiricisinden elde edilen birincil verileri seçmek ve toplamak için basit rastgele örnekleme yaklaşımı kullanıl mıştır. Veri analizi için kullanılan araçlar Probit ikili regresyon modeli (PDRM), Kendall'ın uyum katsayısı (W) ve ortalamalar arasındaki farkın t-Testi'dir. Bu çalışmadan elde edilen bulgular, biber yetiştiriciliğinin karlı bir girişim olduğunu ve gelir ve üretim maliyetinde önemli farklılıklar olduğunu göster miştir ($p < 0,05$). Sonuçlar, çiftçilerin çoğunun erkek ve orta yaşlı (44 yaş). En yaygın kullanılan BİT araçları, öncelikle piyasa fiyatlarına ve hava durumu tahminlerine erişmek için kullanılan cep telefonları, radyo ve sosyal medya-dır. Maksimum olabilirlik tahminleri, eğitim, deneyim, kooperatifler ve uzantı temasının BİT kullanımını %1 alfa düzeyinde önemli ölçüde etkilediğini göster miştir. Kendall'ın analizi, güç kaynağı istikrarsızlığını, zayıf internet bağlantısını ve finansal kısıtlamaları BİT kullanımına yönelik en önemli engeller olarak belirlenmiştir. Biber üretimi ekonomik olarak uygulanabilir olmaya devam ediyor ancak üretkenliği etkileyen altyapısal ve mali kısıtlamalar nedeniyle düşük BİT kullanımı vardır. Dijital katılımı daha da ileriye götürmek için politika, kırsal güç kaynağının iyileştirilmesine, internetin genişletilmesine ve uzantı hizmetlerinin güçlendirilmesine odaklanmalıdır.

Çiftçilerin üretkenliğini ve pazardaki rekabet gücünü artırmak için özel BİT eğitimi ve sermaye destek programları önerilmektedir.

Anahtar Kelimeler: Kendall'ın Uyum Katsayısı, Probit İkili Regresyon, Ortalamalar Arasındaki Farkın t-Testi, Üreticilerin Karşılaştığı Zorluklar, Karlılık Analizi

INTRODUCTION

In the last couple of years, Information and Communication Technologies (ICTs) have been essential instruments for transforming agriculture across the globe. Information and Communication Technologies refers to a technology employed in the form of equipment's, tools, and application supports which helps in the collection, storage, retrieval, use, transmission, manipulation, and dissemination of information as accurately and efficiently as possible for the purpose of enriching knowledge, developing communication and decision making as well as problem solving ability of the user (Yewande, 2014). ICTs encompasses the use of radio, video, telephone, computer-based technologies, and the internet to deliver information and communication services to users (FAO, 2020). Amadi and Agwu (2023) noted that even books are now part of ICTs through web publishing or digital formats like dedicated e-readers or e-books. The spectrum of ICTs continues to expand with a convergence occurring between new media such as computers, mobile phones, and the internet, and traditional media including radio, television, telephone, newspapers, and extension bulletins. ICTs have the ability to greatly enhance information sharing among smallscale farmers if deployed effectively. ICTs are devices that help to connect farmers, it helps facilitates farming activities. They are required to sensitize, mobilize, persuade, and sustain farmers' interest with a view to adopt new ideas, practices or technologies that are likely to bring about holistic improvement in the well-being of farmers, thereby enabling them to escape from the trap of poverty. With the advancement in technology, ICTs are offering innovative solutions to help reduce challenges faced by farmers, especially small-scale farm producers (Ayim et al., 2022). ICTs are used for the delivery of agricultural information and knowledge services (i.e. market prices, extension services, etc), it has been used as a means of accessing market prices, weather and other advices. They can be used to provide precise and accurate information and services that are relevant for farmers to facilitate the environment to get greater results than before (Gaol and Gustira, 2020). ICTs enable rural communities to interact with other stakeholders thus reducing social isolation. It provides better access to credit and rural banking facilities. Bolarinwa and Oyeyinka (2011) noted that there will be quick exchange of agricultural information between the extension agents and farmers if ICTs components are integrated in delivery of agricultural information to farmers in Nigeria. ICTs provide recent knowledge and information on best practices, agricultural technologies, markets, weather condition, and price trends (Yimer, 2015). New approach for improving access to relevant agricultural information could be achieved through the utilization of information and communication technologies (Olaniyi and Ismaila, 2016).

Farmers need information on modern farming technologies, improved farm inputs, and climate change to enhance food production for ever increasing population. Important agricultural information such as improving soils, sowing, control pests and diseases, profit maximization, will empower the producer and their decision making capabilities (Lokeswari, 2016).

Nigeria's agricultural sector is one of the drivers of the nation's economy with smallholder farmers playing an important role in the production of food, particularly in staple crops and high-value products such as pepper. Pepper (*Capiscum Species*) has high economic value with Nigeria ranking among the leading producers and exporters of pepper globally (FAO, 2019). Being one of the highly demanded crops both locally and internationally, pepper sustains the livelihoods of several million farmers, especially in northern Nigeria, as it is one of the main cash crops (World Bank, 2017; Opata et al., 2020). Production of pepper involves several activities from planting to harvesting, cultivation, pest control, and post-harvest handling, which can greatly be benefited by integrating ICT tools. Besides its economic significance, pepper is a principal crop in Nigerian cuisine and a main source of income for smallholder farmers (Adeoye et al., 2014). Although pepper is a significant crop in the economy, small farmers are faced with a number of challenges, such as low productivity, limited access to modern agricultural practices, and limited access to reliable market information (Olutumise, 2022). These challenges typically limit the potential of the pepper industry to contribute optimally to food security and rural development. Information and Communication Technologies, which cover mobile phones, internet connectivity, and digital platforms, offer part of the solution to such obstacles in providing the small-scale farmers with timely updates regarding weather forecasts, market prices, farming principles, and disease control (Mapiye et al., 2023). Nobody is aware how extensive ICT application by pepper growers in Kano and Kaduna States is. This is troubling because ICTs have the capacity to make small-scale farming more efficient and profitable (Isah et al., 2023). The utilization of ICTs among pepper farmers in Kano and Kaduna States has been low despite the documented capacity of the technologies to improve farm productivity and revenues. Studies have identified various barriers to ICT adoption includes; a lack of infrastructure, illiteracy, and a lack of awareness (Saidu et al., 2017). However, very little research has been conducted on the socio-economic determinants of ICT use in this region. Factors such as income, level of education, age, gender, infrastructure access, and social relationships are most likely to affect the extent to which or not at all small-scale farmers use and adopt ICT instruments (Agholor et al., 2024). The knowledge about these variables becomes necessary while devising interventions as well as policies that can lead to the adaptation of ICTs into the activities of small-scale farmers in the agricultural sector (Nabaraa et al., 2023). While some research has been done on ICT adoption in agriculture, no focused research on the small-scale pepper farmers in Kaduna and Kano States has occurred. Also, there is a need for region-specific research to investigate the unique socio-economic characteristics of pepper farmers in northern Nigeria since socio-economic conditions may be varied from the other parts of the country (Dennis & Kentus, 2018).

The research gap that this study seeks to fill is the under-researched relationship between socio-economic determinants and the use of ICT among Nigeria's small-scale pepper farmers, particularly in Kano and Kaduna States. While some studies have assessed the general factors influencing ICT adoption in agriculture, empirical evidence on the role of socio-economic determinants, such as age, education level, income, and access to infrastructure, influencing the level of adoption of ICTs by small-scale pepper farmers is scanty (Agholor et al., 2024). Furthermore, scanty literature is available that targets the specific obstacles and opportunities for ICT uptake in the pepper production, which is important in order to better understand the unique requirements of farmers. This gap will be bridged in this study through the analysis of the socio-economic drivers of ICT utilization among small-scale pepper producers in northern Nigeria.

This study has significant implications for agricultural policy, rural development, and the overall agro-food value chain in Nigeria. From the identification of the socio-economic determinants of ICT adoption, policymakers can draw useful lessons on how to craft special

interventions geared toward increasing ICT take-up by small-scale farmers. This, consequently, would boost agricultural productivity, improve the well-being of farmers, and sustain poverty alleviation in rural Nigeria. In addition, the results of the research can be replicated in other similar regions in sub-Saharan Africa where small-scale farmers face similar challenges in the uptake of modern agricultural technologies. The research will also bring to light the ability of ICTs in bridging the information gap between farmers and key agricultural service providers, such as extension officers, providers of inputs, and buyers, thereby promoting more efficient and sustainable agriculture practices (Sarku et al., 2025).

Objectives of the Study

The main aim of the investigation focused on socio-economic factors influencing the utilization of information and communication technologies (ICTs) among pepper growers in Kano and Kaduna States, Nigeria. Nigeria. Specifically, the objectives were:
(i) describe the farm-specific and producers' features of pepper growers,
(ii) determine the various information and communication technologies (ICTs) utilized by pepper growers,
(iii) evaluate the socio-economic predictors affecting the utilization of information and communication technologies (ICTs), among pepper growers,
(iv) determine the challenges faced by pepper growers in utilizing information and communication technologies (ICTs).

Hypotheses of the Study

The research was guided by the following non-null-hypotheses:
(i) Pepper farming is profitable in the study area.
(ii)There is a significant relationship between socio-economic predictors and utilization of information and communication technologies.
(iii)There is a significant difference between challenges faced by pepper growers in utilizing information and communication technologies.

MATERIALS AND METHODS

This investigation was carried out in North West, Nigeria. The simple random sampling approach was utilized to select Kaduna and Kano States because pepper is mostly grown in the two states. The approach was utilized because it avoids element of bias in selecting the respondent. Secondly, the sampling design gives the opportunity for every respondent to have equal chance of being selected. The disadvantages of the simple random sampling design

were under-representation of certain sub-groups, time consuming, difficulty accessing lists of the full population, the process may cost individual a substantial amount of capital, cumbersome, sample selection bias can occur, and challenging when the population is heterogeneous and widely spread. The sample frame of pepper growers approximately 400 respondents. The total sample number consists of 100 pepper producers selected each from the two states, respectively. In Kano and Kaduna States, smallholder pepper farmers, who constitute a significant proportion of the rural agricultural workforce, can be significantly empowered to take advantage of ICTs for higher productivity, improved access to markets, and simplicity of knowledge transfer. However, even with the application of ICT instruments, their utilization and uptake remain low among farmers. Primary data of cross-sectional sources were utilized based on a well-organized questionnaire that was subjected to reliability and validity test. Ethic committee approval for the field survey was given by University of Abuja, Nigeria.

The sample number was estimated based on the established formula of Yamane (1967) as follows:

$$n = \frac{N}{1+N(e^2)} = \frac{400}{1+400(0.05)^2} = 200 \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,
n = The sample number
N = The total number of pepper producers
e = 5%
The data obtained were evaluated utilizing descriptive statistics, Probit model, Kendall's coefficient of concordance, and t-test statistics.

Probit Dichotomous Regression Model (PDRM)

The choice of the model was based on the studies of Itse et al. (2023) who applied it to analyze the variables to explain the utilization of information and communication technologies among rice farmers in western agricultural zone of Bauchi State, Nigeria. The model also follows the studies of Olaitan et al. (2024) who applied the model to analyze the variables influencing the utilization of information and communication technologies among women farmers in North-Eastern, Nigeria.

The model is explicitly stated as:

$$Y_i = \alpha_0 + \sum_{i=1}^{6} \alpha_i Z_i + \cdots \alpha_n Z_n + \mu_i \qquad (2)$$

$$Y_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \mu_i \qquad (3)$$

$$Y_i = \begin{cases} 1, if\ \ Information\ and\ Communication\ Technologies\ is\ Utilized \\ 0,\ \ if\ Otherwise \end{cases}$$

Where,
Y_i = The Dependent Variable, (1, Utilized Information and Communication Technologies (ICTs; 0, Otherwise)
α_0 = Constant Term
α_1 - α_6 = Regression Coefficients
Z_1 = Age (Years)
Z_2 = Education Level in Years
Z_3 = Household Size (Number)
Z_4 = Farm Experience (Years)
Z_5 = Membership of Cooperative Association (1, Membership of Cooperative; 0, Otherwise)
Z_6 = Number of Extension Contact (Number per Month)
μ_i= Noise Term

Kendalls' Coefficient of Concordance (W)

The choice of this formula follows the studies of Amesimeku and Anang (2021) who use it to analyze the constraints faced by soybean producers in Northern Region of Ghana. The Kendalls' Coefficient of Concordance (W) is stated below:

$$W = \frac{12S}{m^3(n^3 - n) - mT} \qquad (4)$$

Where:
n = Number of Attributes or Objects that is Evaluated by Respondents
m = Number of Respondents
S = Sum Overall Subjects
T = Correction Factor estimated for Tied Ranks

$$T = \sum_{k=1}^{g} (t_k^3 - t_k) \qquad (5)$$

Where;
t_k= Number for Tied Ranks for each (k) in 'g' Groups of Ties
Friedmans' Chi Square (χ^2)

$$\chi^2 = m(n-1)W \qquad (6)$$

The t-Test of Difference Between Means

This is stated thus:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad (7)$$

Where,
$\overline{X}_1$= Mean of Values in Group 1
$\overline{X}_2$= Mean of Values in Group 2
s_1^2, s_2^2 = Standard Deviation in Group 1 and Group 2
$n_1 n_2$= Number of Observation in Group 1 and Group 2

RESULTS AND DISCUSSION

The Continuous Variables of Farm-Specific and Farmers Features of Pepper Growers

Table 1 below presents the continuous variables of farm-specific and farmers features of pepper growers. The average age of the respondent approximately 44 years having standard deviation (SD) of 8.90. This suggests that pepper farmers are predominantly middle-aged, which has been associated with moderate ICT utilization (Ogunbo, 2015). This study is in line with Oluleye et al. (2024) who obtained an average age of 39 years among farmers in Kaduna State, Nigeria. Similarly, Oluleye et al. (2022) noted that the average age of cowpea farmers in Nasarawa State, Nigeria was 45 years The average farming experience approximately 14 years among the respondents in pepper production, indicating that they had high exposure to pepper farming methods. Past work on pepper production have shown that the adoption of ICTs by long-

standing farmers, for information-related purposes on improved practice, is low, yet there is variation depending on digital literacy (Hassani et al., 2023). This study is in line with Oluleye et al. (2022) and Oluleye et al. (2024) who obtained an average farm experiences of approximately 10 and 7 years among farmers in Kaduna and Nasarawa States, Nigeria, respectively. Approximately, the respondents have 11 years of attending school education, reflecting a high percentage of respondents with at least secondary education. Education level has been proven to have a positive correlation with ICT adoption, as well-educated farmers tend to access and comprehend digital farming information (Abioye et al., 2024). The household size approximately 10, which indicates a reliance on household labor, which can influence the level of ICT usage, as bigger households may have economic constraints in embracing new technology. Farm size of the respondents averaged 1.92 hectares, which reveals that the respondents are predominantly small-scale farmers. Farm size was regarded as a major ICT adoption determinant by considering that a larger farm may bring bigger finance, allowing the farmer to invest in digital technology (Mcfadden et al., 2022). The mean yield was 8 tons per hectare, reflecting productivity variations that may be influenced by availability of timely farm information, such as weather conditions and market prices through ICT platforms (Sennuga, 2019).

Table 1. The Continuous Variables of Farm-Specific and Farmers Features of Pepper Growers

Variables	Description of Variables	Mean	SD
Age	Age of the respondents (years)	44	08.90
Experience	Number of years spent in pepper farming	14	6.82
Education	Number of years spent in school education	11	4.76
Household Size	Number of people per household	10	5.26
Farm Size	Average Cultivated Farm Land in Hectares	1.92	0.93
Output	tons/hectare	8	0.61

Source: Field Survey (2024), SD-Standard Deviation

The Categorical Variables of Farm-Specific and Pepper Farmers' Features

Table 2 below shows the categorical variables of pepper growers features. The results indicated that 80% of the respondents were married, and 20% were unmarried. Marital status may also affect ICTs utilization since married individuals may have greater financial responsibilities that affect their interest in investing in ICT tools (Zuzu et al., 2024). In addition, 60% of the respondents were males and 40% were females. Through research, gender differences have been identified in ICT adoption, such that men tend to have wider access to digital resources than women due to socio-cultural factors (Qazi et al., 2022). The findings indicated that 61.5% of the farmers had contact with agricultural extension agents, which is a critical determinant of ICT adoption. Extension services introduce farmers to knowledge regarding digital tools and how to implement them in their farming activities (Olagunju et al., 2021). Another 82% of the respondents were members of cooperatives. Cooperative membership enables the sharing of

farm data and enhances the availability of ICT tools because cooperatives have a tendency to provide common access to digital tools (Manda et al., 2020).

Table 2. The Categorical Variables of Pepper Growers Features

Variables	Frequency	Percentage
Marital Status		`
Single	40	20.00
Married	160	80.00
Gender		
Male	120	60.00
Female	80	40.00
Extension Contact		
Yes	123	61.50
No	77	38.50
Cooperatives		
Yes	164	82.00
No	36	18.00
Total	**200**	**100.00**

Source: Field Survey (2024)

The Various Information and Communication Technologies (ICTs) Utilized by Pepper Growers

Table 3 below shows information and communication technologies (ICTs) utilized by pepper growers. The results revealed that various ICT tools utilized by pepper farmers. Television (21.26%) and Radio (17.39%) were the two most utilized platforms for farm information. The utilization of internet-based technologies such as e-commerce (2.45%), mobile applications (8.07%), and social media (7.45%) were relatively low. Approximately, 7.34% of farmers used mobile phones, supporting Adenubi et al. (2021) argument that mobile technology has a critical role to play in spreading information in agriculture. Use of other advanced ICTs like drones and Geographic Information Systems (GIS) at 0.07% each reflects limited technical awareness and affordability.

Table 3. Information and Communication Technologies (ICTs) Utilized by Pepper Growers

Information and Communication Technologies (ICTs) Utilized	*Frequency	Percentage
Television	582	21.26
Radio	476	17.39
Internet	372	13.59
Mobiles Application	221	08.07
Newspapers and Magazines	207	07.56
Social Media	204	07.45
Mobile Phones	201	07.34
Computer Controlled Devices	130	04.74
Text Messages	127	04.64
E-Mails	119	04.34
E-Commerce	67	02.45
Twitters	23	00.84
Sensing Technologies	04	00.15
Geographic Information Systems	02	00.07
Drones and Remote Sensing	02	00.07
Total	**2737**	**100.00**

Source: Field Survey (2024), *Multiple Responses

The Predictors Affecting the Utilization of Information and Communication Technologies (ICTs) among Pepper Growers

Table 4 below shows the MLEs (Maximum Likelihood Estimates) of the Probit regression model The results show that the education level, farm experience, members of cooperative associations, and extension contact had a significant effect on the use of ICT at 1% alpha level. That the positive education level coefficient of 0.2470 has the effect of increasing the probability of the use of ICT goes in line with the findings of Idu et al. (2023). The coefficient of members of cooperative organizations and farm experiences were positively and significantly (0.2512) and (0.2903) respectively, effective, implying farm owners with memberships in cooperative associations will be able to share ideas and information's among group members and therefore will be inclined towards investing in ICT tools to boost productivity. Extension contacts (0.2367) similarly emerged as an important determinant, confirming the efficacy of agricultural extension services in spreading ICTs utilization as noted by Idu et al. (2023). Meanwhile, age and household size were not statistically significant since young and older farmers both make

use of ICTs in the same way, which contradict the findings Olaitan et al. (2024), who found that women and young farmers were more likely to utilize ICT instruments.

Table 4. The MLEs (Maximum Likelihood Estimates) of the Probit Regression Model

Variables	Parameters	Coefficient	Standard Error	$P > \|Z\|$
Constant	α_0	0.2107***	0.0541	0.000
Age	α_1	0.2109	0.1935	0.786
Education Level	α_2	0.2470***	0.0549	0.000
Household Size	α_3	0.2104	0.2083	0.867
Farm Experience	α_4	0.2903***	0.0611	0.000
Members of Cooperative Organizations	α_5	0.2512***	0.0433	0.000
Extension Contact	α_6	0.2367***	0.0363	0.000
Diagnostic Statistics				
LR_{χ^2} (6)	94.04***			
Pseudo R^2	0.8205			
LLF (Log Likelihood)	-176.59			
Prob $>_{\chi^2}$	0.00000***			

Source: Field Survey (2024),
*Significant at ($P < 0.10$)., **Significant at ($P < 0.05$), ***Significant at ($P < 0.01$).

The Challenges Faced by Pepper Growers

Table 5 below shows the Kendall's coefficient of concordance results showing the challenges faced by pepper grower. The most severe constraints include; lack of power supply having a mean rank of 15.97, impede ICT access and use. The inadequate internet having a mean rank of 15.74, hinders farmers from accessing farm resources online. The mean rank of lack of ICT tools was15.53, suggesting that it could hinder farmers from accessing ICT solutions. The mean rank of lack of finance was 14.58, suggesting that farmers cannot afford to invest in ICTs infrastructure. The mean rank of lack of education was 13.42, which is similar to the results of the Probit model, indicating that education is also crucial for ICT utilization.
These are some of the issues that indicated the need for improved infrastructural support, financial support, and digital literacy programs for ICTs utilization in agriculture.

Table 5. The Kendall's Coefficient of Concordance Results showing the Challenges Faced by Pepper Grower

Constraints	Overall Rank	Mean Rank Score
Lack of Power Supply	1	15.97
Lack of Internet	2	15.74
Lack of ICTs Tools	3	15.53
Lack of Financial Resources	4	14.58
Lack of Education	5	13.42
Poor Access to Extension Services	6	13.37
Lack of ICT knowledge for Farmers	7	13.36
High Cost of Internet Packages	8	13.24
Lack of Training in Utilizing ICTs Tools	9	12.89
High Cost of ICTs Tools	10	12.38
Interrupted Power Supply	11	11.09
Lack of Information on Pepper Pest Management and Diseases	12	11.01
Lack of Market Information to Sell Pepper	13	10.79
Number of Observation	200	
Kendall's Coefficient (W)	0.187	
Chi Square	469.72	
df	12	
F-Critical	9.74	
F-Calculated	89.701	
Asymptotic Significance	0.0000	

Source: Computed from Field Data (2024)

Confirmation of Profitability in Pepper Farming

Table 6 below shows t-Test of difference between costs and returns in pepper farming. The output indicates that the mean returns (₦1,365,038.41) are significantly greater than the costs (₦ 642,702.43) and clearly depict the profitability of pepper production. The t-value calculated (9.976) is significantly higher than the t-table value (1.96), which testifies that the difference between the returns and the costs is statistically significant. This highlights the economic

feasibility of pepper cultivation, as long as the key limitations—such as ICTs tool and market information access—are properly addressed.

Table 6. The t-Test of Difference Between Costs and Returns in Pepper Farming

Variable	Estimates (Number)
Costs	642,702.43
Returns	1,365,038.41
Standard Deviation Cost	261,203.64
Standard Deviation Returns	762,708.54
t-Calculated	9.976
t-Table	1.96

Source: Field Survey (2024)

CONCLUSION

This investigation focused on socio-economic factors influencing the utilization of information and communication technologies (ICTs) among pepper growers in Kano and Kaduna States, Nigeria. A simple random sampling approach was utilized to select 200 pepper growers. The following conclusions were based on the research hypotheses:

Pepper farming is profitable in the study area.

The hypothesis that pepper farming is profitable in the study area is accepted. The difference between returns and cost analysis revealed that pepper farming was highly profitable, with the average revenue being well over the cost of production. The t-test results confirmed that the difference was statistically significant, revealing that pepper farming remains a profitable venture. This implies that concurrent challenges such as market volatility and low ICT utilization does not necessary impedes pepper farming and tremendous economic benefits are still provided to the farmers.

There is a significant relationship between socio-economic predictors and utilization of information and communication technologies.

The hypothesis that there is a significant relationship between socio-economic predictors and utilization of information and communication technologies is accepted. The result from the Probit regression analysis indicated that socio-economic factors such as the level of education, members of cooperative associations, and extension contact were significant in affecting ICT use at 1% alpha level. This exuberate that farmer with higher levels of education, cooperative memberships, and regular extension contact were more likely to utilized ICT tools for agriculture. The findings highlight the crucial contribution of access to knowledge and institutional support in facilitating digital utilization. Furthermore, the hypothesis is accepted implying that need for policies supporting digital literacy, providing targeted ICT training to farmers, and strengthening agricultural extension services to enhance ICT usage.

There is a significant difference between challenges faced by pepper growers in utilizing information and communication technologies.

The hypothesis there is a significant difference between challenges faced by pepper growers in utilizing information and communication technologies is accepted. Ranking of the constraint farmers faced in utilizing of ICT was done using Kendall's Coefficient of Concordance analysis, indicating strong differences in their impact. Among the constraints, limited access to ICT tools, power instability, lack of access to the internet and financial constraints were the most binding constraints, with lower-ranking constraints having relatively less impact. This implies that, while all the farmers experience difficulties in using ICTs, some constraints especially infrastructural and financial constraints are more binding than others. The acceptance of this hypothesis indicates that addressing these challenges requires a prioritized approach, beginning with the development of power supply, internet connectivity, and investment in the acquisition of ICT devices.

CONFLICT OF INTEREST

No known or potential conflict of interest exist for any author.

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