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Assessment of the Factors Affecting Smallholder Livestock Farmers' Use of Information and Communication Technologies to Access Market Information in Nasarawa State, Nigeria

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ABSTRACT

The objective of this study was to assess the factors impacting the utilization of information and communication technologies (ICT) by smallholder livestock farmers for accessing market information in Nasarawa State, Nigeria. A multi-stage sampling method was used to select 200 livestock smallholder livestock farmers. The gathered data underwent analysis using descriptive statistics and a logit regression model. The findings revealed that the majority of farmers (76%) were married, and 30% had only primary education. Approximately 39% of respondents were aged between 21 and 30 years, with an average age of 34 years. More than half (86%) of the smallholder livestock farmers had farm sizes between 1.1 and 2.0 hectares, with an average of 1.73 hectares, and 38% had a monthly income ranging from ₦21,000 to ₦40,000. About 32% of the respondents used mobile phones. The results of the logit regression revealed that marital status and the educational level of farmers had a positive and significant relationship (P<0.1) with ICT use. Age, household size, and farm size also had a positive and significant influence (P<0.01) on ICT use, while credit access and income had a positive and significant impact (P<0.05) on ICT use. The primary constraints identified were poverty among the farmers (97.5%) and inadequate capacity and affordability, along with poor access to ICT infrastructure (96.3%), ranking first and second, respectively. The study discovered that ICT use was influenced by the socio-economic factors of the respondents. The study suggested that television and radio be consistently used to disseminate adequate and timely information to smallholder livestock farmers, as these media are easily accessible, affordable, and user-friendly for rural communities.
Keywords: *ICTs, small-scale, livestock farmers, market, information, industry.*

1.0 Introduction

The livestock industry in Nigeria has advanced significantly over the years, becoming one of the key agricultural enterprises. The current estimated livestock population is 32 million, with domestic chickens comprising 98% and other species making up the remaining 2% [1]. According to a World Bank report [1], growth in the livestock sector is twice as effective at reducing poverty in developing countries compared to other sectors. The report also highlighted that livestock farming can alleviate poverty directly by increasing farm incomes and indirectly by creating employment opportunities and lowering food prices.

The focus of poverty reduction initiatives through agriculture is on rural smallholder farmers, who constitute the majority of farmers in Africa. [2] suggested that livestock farming can further facilitate poverty reduction by commercializing smallholder farmers' production through technological adoption and increased market participation. This strategy of agricultural commercialization, particularly targeting rural poor livestock farmers in Nigeria, led to the creation of the Ministry of Livestock Development by President Bola Ahmed Tinubu. The aim was to improve meat and dairy production and reduce violence between migrant herders and farmers. However, there is an emerging consensus that achieving growth in smallholder farmers' production is challenging due to structural constraints linked to geographical and historical factors in Sub-Saharan Africa.

In Nigeria, livestock production and marketing are structured based on the structure-conduct-performance model at every stage, from production to consumption. Many farmers have strong connections with local market consumers and face intense competition both locally and internationally. For smallholder farmers, livestock production provides income and contributes to food security, playing a significant role in poverty alleviation strategies. Access to market information is crucial for smallholders' market participation, helping them make informed economic decisions about buying and selling, thereby enhancing their competitive edge. Farmers need accurate and timely market information to better understand market dynamics, which ensures a fair distribution of expected revenue through more organized price formation for all market participants.

Smallholder livestock farmers face difficulties in reaching and engaging with markets. Gaining access to high-value markets, such as local, municipal, and city markets, can improve living standards and help alleviate poverty in rural areas. However, issues like information asymmetries, inadequate market research, and limited market access hinder smallholder farmers from reaching these markets, leading to significant disparities between supply and demand. Additionally, imbalances in information reduce the adoption of modern technology among smallholder farmers.

Poor access to market prices and ineffective selection of market channels are among the key factors impacting the commercialization of the livestock sector. Livestock marketing is often hampered by ineffective pricing systems and the excessive involvement of intermediaries.

Despite these challenges, efforts have been made in recent years to address the issues through the use of information and communication technology (ICT). ICT tools such as radio, television, and mobile phones play a crucial role in supporting producers and strengthening the agricultural sector amid ongoing changes. The integration of ICT is pivotal in determining the success of agricultural management firms. By providing communication channels, ICT reaches a majority of farmers, provided they possess basic e-literacy skills. Research

institutions and universities are increasingly developing multimedia DVDs, expert systems, and agricultural portals to disseminate information related to livestock production and marketing to farmers. For livestock smallholders with limited income, cost-effective ICT channels with basic phone features like voice calls and SMS are essential.

The adoption of ICT services has positively impacted livestock production and farmers' income. The use of mobile phones has decreased the costs associated with searching for market information and enhanced access to vital agricultural production-related information. Moreover, mobile phones have strengthened the bargaining power of farmers. ICT encompasses the entire value chain, though significant gaps still exist regarding the extent of ICT adoption in accessing livestock market information, its influence on farm prices, and the selection of marketing channels.

In Nigeria, the integration of ICT in agriculture, similar to other developing nations, is still in its early stages. There are indications of ICT use at both individual and organizational levels. However, it remains uncertain whether livestock smallholder farmers effectively utilize ICT facilities to achieve their objectives. The problems associated with ICT use in rural areas are likely linked to both socioeconomic and non-socioeconomic factors. Given the significant benefits ICT offers to farmers and agricultural processes, it is important to understand the factors that influence farmers' adoption of these technologies. While similar studies have been conducted in other regions, research in Nasarawa State, where a large number of livestock smallholder farmers operate, particularly in area development councils, remains limited.
The broad objective of this study is to assess the factors affecting smallholder livestock farmers' use of ICT to access market information in Nasarawa State, Nigeria.

2.0 Materials and Methods

2.1 Study Location

The study was conducted in Nasarawa State, Nigeria, covering a total area of 27,117 km² and home to a population of 1,863,256, with the majority residing in rural areas [3]. Geographically, the state lies between latitudes 8°05' and 9°01' north of the equator and longitudes 6°05' and 7°01' east of Greenwich. Nasarawa experiences a tropical climate with average temperatures ranging from 25°C to 35°C, and annual rainfall varying from 1,100 mm in the northern part to 1,600 mm in the southern regions [4].

Livestock production, particularly dairy farming, is the primary agricultural activity in the area, although production levels remain comparatively low by global standards [1].

2.2 Population of the Study and Research Design

The population of this study consisted of smallholder livestock farmers in Nasarawa State, Nigeria. The target group included all categories of smallholder livestock farmers, regardless of the type of livestock they rear. The study adopted a descriptive survey research design, an effective method for capturing the opinions, attitudes, and behaviors of a large population, providing a solid basis for identifying trends and patterns [5].

2.3 Sample Size and Sampling Techniques

The study was conducted in Nasarawa State, which has 13 Local Government Areas (LGAs). To provide a broad representation of the state, five LGAs were randomly selected. A multi-stage sampling technique was employed to select respondent livestock farmers. In the first stage, five LGAs—Karu, Keffi, Lafia, Akwanga, and Wamba—were purposively selected for data collection due to their significant livestock farming activities, collectively contributing over 70% of the state's livestock business. A random number generator was then used to

select a sample size of 200 smallholder livestock farmers for the study.

2.4 Data Collection

The primary data collection instrument for this study was a structured questionnaire. The questionnaires were administered to collect data over a period of about 1 hour and 20 minutes. Key themes addressed in the survey included the socio-economic characteristics of smallholder livestock farmers, types of ICT tools available and accessible, and barriers to accessing ICT and market information. To ensure validity and reliability, the questionnaire was pre-tested in a pilot study among three staff members responsible for livestock management at the Department of Animal Science, University of Abuja Research Farm, Faculty of Agriculture.

2.5 Data Analysis

Data collected for the study were analyzed using descriptive statistics such as frequency counts, percentages, and means. Additionally, a logit regression model was employed to identify the factors influencing the utilization of ICT by smallholder farmers for accessing market information in the study area. The analysis was performed using IBM SPSS Statistics, version 27. The logit regression model was used to ascertain the factors affecting the utilization of ICT by smallholder farmers. The implicit form of the logit model is specified as: $Y = f(X_1, X_2, X_3, X_4, X_6, X_7, X_8, X_9, X_{10})$

The Logit model in its explicit form is expressed as:

$$Y = \beta o + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \beta 8X8 + \beta 9X9 + \beta 10X10 + e$$

Where;

Y = ICT use by the livestock smallholder livestock farmers

X1 = Age

X2 = Gender

X3 = Marital status

X4 = Household size

X5 = Education level

X6 = Household size

X7 = Household income

X8 = Access to credit

X9 = Farm size

X10 = Membership of cooperative

βo = constant

3.0 Results

3.1 Socio-economic Characteristics of Livestock Farmers

The findings presented in Table 1 indicated that approximately 34% of the farmers fell within the age bracket of 41-50 years, while only about 12% were over 50 years old, with a mean age of 34 years. Also, the largest proportion (46%) of farmers were married, followed by 35% who were single, and 19% who were divorced. The majority of male respondents, accounting for 61%, while 39% were female, 38% of farmers had a monthly income falling within the range of ₦41,000 to ₦60,000, while 29.5% earned between ₦61,000 and ₦80,000 monthly.

Additionally, 4% reported a monthly income ranging from ₦81,000 to ₦100,000, with a mean monthly income of ₦42,000. In addition, 24% of respondents are members of a livestock farmers' organization, whereas 76% are not.

Characteristics	Frequency	Percentage (%)	Mean
Respondents' age (years)			
21-30	78	39	
31-40	68	34	34 years
41-50	30	15	
Above 50	24	12	
Marital status			
Single	70	35	
Married	92	46	
Divorced	38	19	
Gender			
Female	78	39	
Male	122	61	
Educational Level			
No formal education	44	22	
Primary education	60	30	
Secondary education	58	29	
Tertiary education	38	19	
Household size			
3-Jan	48	24	
6-Apr	92	46	
10-Jul	40	20	7 persons
13-Nov	10	5	
14 and above	10	5	
Farming experience			
10-Jan	60	30	
20-Nov	68	34	12.5 years
21-30	44	22	
31-40	16	8	
41-50	7	3.5	
51 and above	5	2.5	
Monthly Income			
21,000-40,000	76	38	
41,000-60,000	59	29.5	₦42,000
61,000-80,000	32	16	
81,000-100,000	8	4	
101,000 and above	25	12.5	
Membership of Cooperative			
No	152	76	
Yes	48	24	
Access to Credit			
No	130	65	
Yes	70	35	

Source: *Field survey, 2024*

3.2 ICT Tools Available and Accessible of Respondents

The result of this study as shown in Table 2, indicated that 32% of livestock farmers use mobile phones to access market information, followed by 25% who rely on radio and 15% who use television for the same purpose. Only a small percentage of respondents use the internet (13%), personal computers (11%), video conferencing (2%), DVDs and CDs (1%), or digital cameras (1%)

Table 2: ICT tools used by the respondents

ICT Tools	Frequency	Percentage
Radio	50	25.0
Television	30	15.0
Mobile phones	64	32.0
Internet	26	13.0
Computer	22	11.0
Video Conferencing	4	2.0
DVD and CDS	2	1.0
Digital Camera	2	1.0

Source: Field survey, 2024

Table 3: Logit regression of factors that influence the use of ICT by small scale livestock farmers for accessing market information

Variables	Coef.	Std. Err.	t-value
Age	-0.046	0.078	0.000***
Gender	1.539	1.792	0.859^{NS}
Marital status	2.507	1.268	1.977*
Household size	0.626	0.250	2.499***
Farm size	-0.478	0.212	0.001***
Education	0.336	0.177	1.902*
Income	-0.154	0.216	0.018**
Credit access	4.969	2.050	2.423**
Coop. membership	-0.542	1.367	1.673^{NS}
Constant	-9.265	4.359	-2.125**
N	200		
R^2	84.99%		
Prob>chi^2	0.000		
Pseudo R^2	0.483		
Adjusted R^2	0.315		
Log likelihood	61.3132		

Note: ***, **, * and ^{NS} indicate significance at 1%, 5%, 10% probability level and Not significant respectively.

Source: Field Survey (2024)

Table 4: Constraints Hindering the Use of ICT to Access Market Information by the Respondents

Constraints	Frequency*	Percentage	Rank
Inadequate capacity and affordability	180	96.3	2nd
Poor network coverage	160	92.5	6th
Erratic power supply	167	93.4	5th
Poor access to ICT infrastructure	180	96.3	2nd
Illiteracy/educational level	155	86.3	8th
Poverty	192	97.5	1st
Language barrier	158	90.0	7th
Poor financial support	173	95.0	4th

*Multiple responses
Source: Field survey, 2024

4.0 Discussion

The socio-economic characteristics of livestock farmers showed that the majority of farmers were relatively young adults, actively engaged in farming activities. Consequently, this demographic characteristic of the livestock farmers is likely to be receptive to learning and utilizing ICT tools for accessing market information relevant to their agricultural practices. This observation aligned with the findings of [6], who similarly showed that a significant proportion of respondents in their study area were youthful and actively involved in farming, thus predisposed to embracing ICT solutions.

Ologundudu and Eniola [5] highlights the significance of marital status among livestock smallholder farmers, suggesting that it reflects the importance of farming within family units. This notion was reinforced by [7], which indicated that most farmers are married, potentially leading to increased productivity and welfare within the agricultural business due to the availability of additional labour from family members such as spouses and children.

Additionally, Ologundudu and Eniola [5] suggested that individuals with families tend to approach farming with a greater sense of commitment, motivated by the desire to generate supplementary income to support their families. The results presented in Table 1 showed a majority of male respondents, accounting for 61%, while 39% were female. This male predominance may be attributed to the accessibility of capital required for livestock farming, a factor that is often more readily available to men, as noted by [8].

According to the finding in Table 1, the result revealed that 30% of farmers had primary education, 29% had secondary education, 19% had tertiary education, and 22% had no formal education. This suggested a significant portion of farmers possessed basic literacy skills, increasing the likelihood of their engagement with ICT to enhance their farming methods in the region.

Educated farmers are generally more adept at comprehending and utilizing new technologies and information delivered through ICT channels [9]. This observation is consistent with the findings of [10], who noted that individuals lacking literacy skills are at a disadvantage and may struggle to reap the benefits of ICT. Consequently, many respondents are capable of grasping various livestock management practices and utilizing ICT tools to access market information. As a result, farmers in the area are likely to readily embrace modern technology in farming, recognizing its potential benefits.

The results showed that many respondents had a household size ranging from 4 to 6

members, accounting for 46% of the sample. Meanwhile, 24% of respondents had a household size of 1 to 3 members, and 20% had a household size of 7 to 10 members. The smallest percentages, each at 10%, were recorded for respondents with a household size of 11 to 13 members and those with more than 14 members, respectively, with a mean of 7 people. Household size can be viewed as a means of enhancing productivity through family labour because more farm families will be engaged to care for livestock, this can also reduce cost of hiring labour. However, [8] pointed out that the contribution of the household to productivity may vary based on individual interests. This is because an increase in household size could lead to higher household expenditure, thereby reducing farmers' annual income.

Table 1 also revealed that a significant percentage of respondents, 34%, had farming experience ranging from 11 to 20 years, followed by 30% who had 1 to 10 years of farming experience. Furthermore, 22% of respondents had farming experience ranging from 21 to 30 years. The smallest percentages were recorded for respondents with 31 to 40 years of farming experience, accounting for 8%, while 3.5% had 41 to 50 years of farming experience, and only 2.5% had more than 50 years of farming experience. This suggested that the majority of farmers in the study area have been engaged in livestock production for a relatively long period. This finding aligned with the work of [6], who reported that their respondents had significant experience in livestock production.

According to Table 1, 38% of farmers had a monthly income falling within the range of ₦41,000 to ₦60,000, while 29.5% earned between ₦61,000 and ₦80,000 monthly. Additionally, 4% reported a monthly income ranging from ₦81,000 to ₦100,000, with a mean monthly income of ₦42,000. This suggested that farmers in the study area were predominantly low-income earners, a factor that could potentially hinder their utilization of ICT resources. This finding aligned with the research conducted by [11] who similarly observed that a majority of respondents in their study area were low-income earners.

This result from this study indicated that 24% of respondents are members of a livestock farmers' organization, whereas 76% are not. Consequently, the establishment of livestock farmer-based organizations or groups aims to aid livestock smallholders in enhancing their productivity and accessing market information [8,9]. The survey findings indicated that 35% of respondents have access to credit, while 65% do not. Limited access to credit persists as a significant challenge for smallholder producers, despite its potential to significantly enhance agricultural productivity, as noted by [12]. Those who can access credit typically do so through informal institutions, as formal institutions often require substantial collateral, which small producers may not meet.

4.1 ICT Tools Available and Accessible of Respondents

Higher percentage of livestock farmers use mobile phones (32%) to access market information, followed by 25% who rely on radio and 15% who use television for the same purpose. Only a small percentage of respondents use the internet (13%), personal computers (11%), video conferencing (2%), DVDs and CDs (1%), or digital cameras (1%) as shown in Table 2. This suggested that mobile phones and radio are the primary ICT tools used by farmers in the study area, likely because they are readily available, portable, and relatively affordable, especially radio. This finding was consistent with the research conducted by [13], who also found that mobile phones and radio are commonly used by farmers to access information. It indicated that farmers have the potential to explore various market opportunities by leveraging these tools.

4.2 Factors Influencing ICT Use in Accessing Market Information by Smallholder Livestock Farmers

The age of the household head was observed to have a positive and statistically significant impact on the use of ICT for accessing market information, with a significance level of 1%. This suggested a positive correlation between the household head's age and the use of ICT tools for market information. The survey showed that the average age of the household head was 34 years, indicating that most respondents were 34 years or older. Thus, it can be inferred that older farmers are more inclined to use ICT for market information.

This finding was consistent with [5], who also found that older farmers, due to their accumulated experience, may be better at evaluating technological information compared to younger farmers.

Household income also had a positive and statistically significant effect on the use of ICT, with a significance level of 5%. This indicated that as household income rises, the likelihood of farmers using ICT tools increases. This result was supported by [8], who found that higher income levels improve the respondents' ability to afford the potential costs associated with using ICT for market information, such as purchasing airtime, securing electricity, and buying batteries for radios. Among the variables analyzed, marital status and educational level showed a positive relationship and significantly influenced ICT use ($P<0.10$). Education is crucial in raising farmers' awareness, access, and use of ICT tools, suggesting that farmers with higher education levels are more likely to use ICT for accessing agricultural information, potentially enhancing productivity. On the other hand, marital status can affect farmers' decision-making, experience, and ICT use due to family responsibilities. This finding aligns with [7], who noted that married individuals are more likely to seek information through ICT motivated by income effects.

Additionally, household size had a positive relationship and significantly influenced farmers' ICT use ($P<0.01$). A larger household size provides a cheap labour source for farmers, encouraging them to seek better production information to enhance productivity in livestock farming. Credit access and extension contact also positively and significantly influenced ICT use ($P<0.05$). Furthermore, increased credit access improves a farmer's ability to acquire ICT tools for accessing agricultural information. This suggested that farmers with credit access are better positioned to use ICT to enhance agricultural production [12].

4.4 Constraints Hindering the Use of ICT to Access Market Information by the Respondents

The limitations on the use of ICTs by livestock smallholder farmers in the study area are detailed in Table 4. Poverty emerged as the most significant constraint, with 97.5% of respondents identifying it as the top issue.

This was followed closely by insufficient capacity and affordability (96.3%), and inadequate access to ICT infrastructure (96.3%), which were ranked second.
Additional challenges included inadequate financial support (95.0%), unstable power supply (93.4%), poor network coverage (92.5%), language barriers (90.0%), and high levels of illiteracy (86.3%). These constraints hinder the effective use of ICT by livestock smallholder farmers to boost agricultural production in the study area. These findings aligned with those of [13], who reported similar barriers, such as the lack of ICT tools, limited knowledge and skills, and high purchase costs, affecting ICT use in their study area.

5.0 Conclusion and Recommendations

Based on the findings of this study, it is concluded that most respondents were young and in their active age, indicating a strong potential for effective utilization of ICT to obtain market information, particularly for the livestock they rear. Mobile phones and radios were identified as the primary ICT tools used by farmers for accessing information. Additionally, factors such as

age, marital status, educational level, household size, income, access to credit, and farm size were found to influence ICT use among respondents. However, several constraints were identified that impede the use of ICT by livestock smallholder farmers in the study area. These constraints include poverty, inadequate capacity, affordability of ICT tools, and poor access to ICT infrastructure. Addressing these challenges is crucial for promoting greater adoption and effective utilization of ICTs among livestock smallholder farmers, which can ultimately enhance agricultural productivity and improve livelihoods in the study area. It was therefore recommended that:

i. The consistent use of Mobile phone to disseminate adequate and timely information to livestock smallholder farmers should be emphasized, as these mediums are easily accessible, affordable, and user-friendly for rural settlers.
ii. Adult literacy programmes should be organised for those with informal and primary education as their educational level enhances their ability to use contemporary ICT such as Internet and video conference.
iii. Extension agents should sensitize and encourage livestock smallholder livestock farmers to participate in poverty alleviation programs that provide access to ICT tools.
iv. Stakeholders in the ICT sector should prioritize the development of ICT infrastructure and provide capacity-building opportunities for livestock smallholder farmers.
v. Information and Communication Technologies tools should be subsidized to a level that is affordable for livestock smallholder farmers.

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