

IMPACT OF ACCESS TO TRADITIONAL MARKET INFORMATION ON HOUSEHOLD COMMERCIALISATION AND FARM INCOME OF SMALLHOLDER COWPEA FARMERS

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Abstract. The study examines the impact of traditional market information on household commercialisation and farm income in Borno State, Nigeria, using the Uses and Gratifications theory (UGT). A multi-stage sampling method was used, which resulted in a sample of 593 cowpea farmers. Primary data were collected using a structured questionnaire. Inferential statistics (T-test, Chi-square, and propensity score matching) were used to analyse the data. The results revealed that access to traditional market information had no significant impact on both the Household Commercialisation Index (HCI) and farm income of cowpea farmers ($P \geq 0.1$ and $P \geq 0.1$, respectively). However, when further disaggregated, accessing market information from market agents had a positive impact on the Household Commercialisation Index (HCI) ($P \leq 0.1$), increasing it by 4.001%, although this did not translate into improved farm income. Using family and friends as a traditional source of market information improved cowpea farmers' income ($P \leq 0.05$), by ₦96,446.012, compared to reliance on radio programs and government extension agents, which had a negative impact on farmers' income ($P \leq 0.05$ and $P \leq 0.05$, respectively) by ₦75,500 and ₦95,700. It is therefore recommended that, since the farmers' limited education makes them heavily reliant on traditional market information,

and traders and middlemen are taking advantage of the cowpea farmers' marketing practices, a more decentralised, user-friendly digital approach should be adopted to break the exploitative behaviour of traders and middlemen. This could be achieved through mobile-based voice and image recognition applications, interactive voice messaging systems, digital farmer cooperatives, and the utilisation of existing social networks such as farmer cooperatives and community centres that provide training on the use of market information through digital platforms.

Keywords: welfare, propensity score matching, market channels, farmers' direct market, agricultural information system

INTRODUCTION

Background of the study

Cowpea is critically important in sustaining livelihoods for smallholder farmers in Nigeria. Cowpea is rich in protein, its adaptability to different types of soil and intercropping systems, its drought tolerance, its ability

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to improve soil fertility through atmospheric Nitrogen fixation, and its ability to mitigate erosion make it a vital economic crop in various developing countries. The stems and leaves are used as animal feed, and it also serves as a savings avenue for farmers (IITA, 2023). The crop is widely available in rural markets where the traditional market information system is mostly used. Traditional market information refers to any method of market intelligence that uses offline media to reach a clientele. Despite the proven benefits of Information and Community Technology (ICT) for farmers, digital market information sources remain underutilised. Many farmers and extension staff still lack the necessary skills to effectively leverage these technologies, hindering their potential impact (Nugroho, 2021). As a result, non-traditional media are utilised by only a few farmers who have peculiar features; they are still not optimally used in providing information to market participants (Nugroho, 2021).

Market impact studies are crucial in understanding the effects of various factors on market dynamics and participant behaviour. Traditional market information is important in reaching smallholder farmers who are not connected to the internet, lack cell phones, and are less educated, often unable to read or operate ICT apparatus. On the other hand, traditional market information systems could reach a wider audience than modern market information systems. Conversely, studies on traditional market information provide insights into how access to traditional market information informs the strategies of businesses and ultimately impacts their household

commercialisation (the ratio of the value of cowpea sold to the value of cowpeas produced) and farm income. One area where market impact studies are particularly important is analysing traditional market information and its influence on farmers' household commercialisation and farm income. The study adapted Blumler and Katz's (1974) Uses and Gratifications theory (UGT). According to the theory, people utilise media to satisfy particular needs and wants, which, in this case, include HCI and farm income. UGT sees users as active agents who have control over their media consumption, in contrast to many media theories that perceive users as passive recipients of media. The proponents of the theory outlined five fundamental presumptions of a framework for comprehending the relationship between audiences and media. These presumptions are: (i) the audience is thought to be active; (ii) the audience member bears a great deal of the initiative in connecting choice of media and satisfaction in the mass communication process; (iii) the media has competition from alternative sources of fulfilment; and (iv) in terms of methodology, many of the objectives of media use can be obtained from information provided by specific audience members.

UGT (Fig. 1) is operationalised as cowpea farmers use traditional media to satisfy specific needs or desires (HCI and farm income). For example, cowpea farmers may rely on specific traditional sources to obtain market data, while simultaneously using this information to make informed decisions about the quantity of cowpea to sell at a particular market and time to maximise farm income. In this way, the use of traditional market

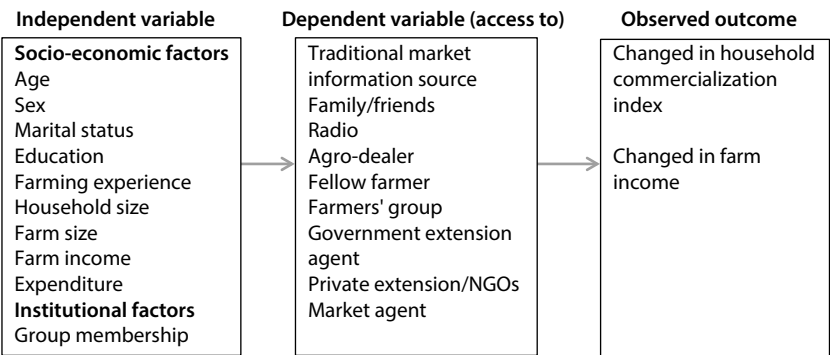


Fig. 1. Conceptual framework showing the impact of traditional market information sources on HCI and farm income
Source: own elaboration.

information serves to satisfy both HCI and farm income goals.

Access to traditional market information plays a vital role in the commercialisation of agricultural products and the overall farm income of cowpea farmers. Research has shown that the availability and access to traditional market information have a significant impact on farmers' decision-making processes related to the commercialisation of their cowpea produce (Diaka et al., 2024; Ali et al., 2021; Zondi et al., 2022). A household's ability to access market information affects their level of participation in the market, which, in turn, has implications for their farm income (Kassie et al., 2021; Uneze et al., 2024).

As a result of limited access to market information about produce prices at different marketplaces, as well as the demand and value of their crops, smallholder cowpea farmers often negotiate prices based on the information provided by traders, brokers and middlemen. This leaves the smallholder farmers at a disadvantage, as the exploitative behaviour of these intermediaries reduces their profits (Magesa et al., 2020; Nugroho, 2021). These factors considerably diminish the bargaining power of smallholder farmers and thus encourage the development of uncompetitive markets (Magesa et al., 2020; Nugroho, 2021). According to Nugroho (2021), relying on traditional sources of agricultural market information sources has not been very beneficial for smallholder farmers.

Despite the potential of digital marketing information, its availability and the technological barriers to accessing these services continue to limit their widespread adoption (Kebebe, 2019). To guide policymakers, researchers and cowpea farmers, empirical analysis is needed to assess the impact of traditional market information. However, such evidence is currently lacking, particularly as Nigeria has yet to establish a functional smart cowpea market information system that effectively reaches farmers. In this context, the study aims to examine the impact of traditional market information on household commercialisation and farm income in Borno State, Nigeria.

The Hypotheses of the study were:

H1: Access to traditional market information sources has no impact on HCI

H2: Access to traditional market information sources has no impact on farm income

H3: Access to family and friends, radio, agro-dealers, fellow farmers, farmers' groups, government extension agents, private extension/NGOs, and market agents has no impact on HCI

H4: Access to family and friends, radio, agro-dealers, fellow farmers, farmers' groups, government extension agents, private extension/NGOs and market agents has no impact on farm income

This study contributes to the existing literature on the impact of access to traditional market information on HCI and Farm income. It specifically examines the effects of various information sources – such as family and friends, radio, agro-dealers, fellow farmers, farmers' groups, government extension agents, private extension/NGOs, and market agents – on these outcomes. Furthermore, the study expands on the application of the Uses and Gratifications Theory (UGT) in understanding how traditional market information influences HCI and farm income in a developing economy. It also explores strategies for effectively disseminating digital information systems to uneducated smallholder farmers.

METHODOLOGY

Study area

The study was conducted in the northern Guinea Savannah region of Borno State, where Improved Cowpea Technologies (ICTs) have been disseminated to farmers due to the region's suitability for cowpea production. These technologies were shared through various projects to improve farmers' income and commercialisation, in collaboration with the Borno State Agricultural Development Program (BOSADP). The area comprises four selected Local Government areas: Biu, Kwaya Kusar, Hawul and Bayo.

The study area (Fig. 2) is situated between latitudes 10° 30'N and 10° 45'N and longitude 12° 23'E and 13° 13'E. It has a population of about 352,886 (NPC, 2006) with a projected 2020 population estimate of approximately 704,468, based on a 3.2% population growth rate. The study area covers an area of 6,874.2 km² (BOSADP, 2020).

The dominant crops grown for home consumption and local markets include cowpea, maize, sorghum, groundnuts, and rice. Livestock species are an integral part of the farming system, providing income and food to households.

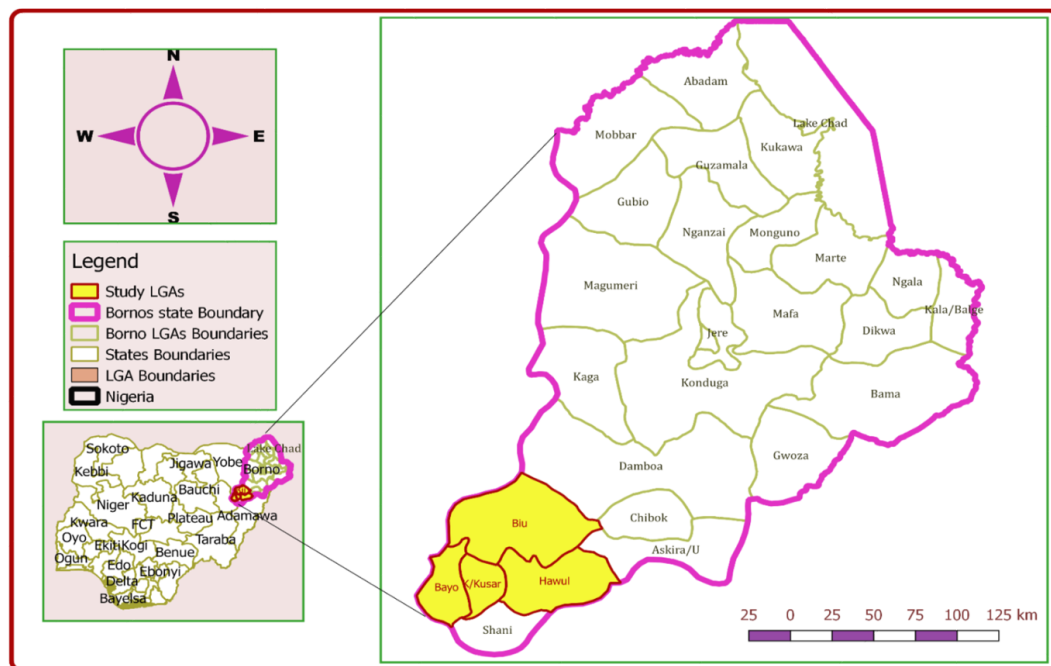


Fig. 2. Map of Borno State showing the study area
Source: authors, 2024.

Sampling procedure

The multi-stage sampling technique was used to select communities and respondents across the four LGAs. The technique reduces the time and cost of surveying samples from a vast population to a manageable size by passing through several stages to ensure equitable representation (Xie and Lu, 2015).

In the first stage, four Local Government Areas (LGAs) were purposively selected: Bayo, Biu, Hawul, and Kwaya-Kusar, based on factors such as civil unrest and concentration of cowpea production. In the second stage, thirty communities with high concentrations of cowpea production were randomly selected from the four LGAs. This selection was based on the presence of registered households in these communities. In the third stage, respondents were randomly selected from each of the thirty communities.

The list of cowpea farmers in the various communities was obtained from the service department of BOSADP. A total of six hundred respondents were selected for the study; however, seven questionnaires were dropped due to improper completion, leaving 593 for analysis.

Method of Data Collection

Primary data were collected from the cowpea farmers using a structured questionnaire in November 2020. Trained enumerators, under the supervision of the researcher, were used to collect data electronically on annual cowpea production, improved cowpea varieties used, and socio-economic characteristics of the farmers, among others.

Method of Data Analysis

The study used propensity score matching (PSM) and employed different matching estimators to test for robustness. The principal concept behind PSM is to match each cowpea farmer who had access to market information with a similar cowpea farmer who did not have access and then estimate the mean variation in their respective HCI and farm income between the cowpea farmers that accessed market information and their counterparts.

Essentially, the study addresses the question: “How would the HCI and farm income of smallholder cowpea farmers have changed if the farmers who accessed market information had chosen not to access it?” This

is given by an average treatment effect on the treated (ATT). According to Imbens and Wooldridge (2009), the ATT is defined as:

$$\text{“ATT} = E\{Y(1) - Y(0) | T=1\}”$$

where $Y(1)$ and $Y(0)$ are outcome indicators (i.e. HCI and farm income of the cowpea farmers that accessed market information and their counterparts, respectively), and T is a treatment indicator.

However, we can only observe $ATT = E\{Y(1) | T = 1\}$ in the data set, while $ATT = E\{Y(0) | T = 1\}$ is missing. In essence, the study cannot observe what the HCI and farm income of the cowpea farmers would have been if they had not received market information. Once farmers have accessed cowpea market information, the counterfactual outcome – what would have happened without it – cannot be observed.

A simple comparison of HCI and farm income between cowpea farmers with and without access status introduces bias in estimated effects due to self-selection bias. The magnitude of self-selection bias is formally presented as:

$$E[Y(1) - Y(0) | T = 1] = ATT = E(Y(0) | T = 1 - Y(0) | T = 0]$$

By establishing comparable cowpea farmers with and without access to market information, PSM reduces the bias due to observable variables. Once households are matched with observable characteristics, PSM assumes there are no differences in unobservable characteristics between cowpea farmers who accessed market information and those who did not.

Given this assumption of conditional independence and the overlap condition, ATT is computed as follows:

$$ATT = E(Y(0) | T = 1, P(x)) - E[Y(0) | T = 0 / P(x)]$$

A potential test for robustness involves using different matching techniques. This study employed the nearest neighbour, stratification, radius, and kernel approaches.

RESULT

Description of Continuous Variables by Treatment

The result in Table 1 found no significant differences between cowpea farmers who accessed traditional market information and those who did not, with respect to age, farming experience, household size, Household Commercialisation Index, farm income, expenditure, farm

Table 1. Descriptive statistic of continuous variables by treatment

Variable	Accessed	Not-accessed	T-value	Df	Mean difference
	traditional market information				
	mean ($n = 228$)	mean ($n = 365$)			
Age (years)	45.1	45.6	-0.4	591	-0.5 (1.2)
Education (years)	8.90	7.41	3.0***	591	1.5 (0.5)
Farming experience (years)	21.66	21.7	-0.2	591	-0.2 (1.0)
Household size (person)	8.61	8.14	1.4	591	0.5 (0.3)
Farm income (₦)	317 848.9	379 724.1	-1.4	591	-61 875.2 (45 725.8)
Expenditure (₦)	187 713.4	192 194.6	-0.4	591	-4 481.2 (12 056.6)
Farm size (ha)	0.9	0.8	1.6	591	0.1 (0.1)
Value of cowpea harvest (₦)	262 265.4	308 117.7	-1.1	591	-45 852.4 (40 609.5)
Amount of cowpea sold (₦)	144 887.7	187 119.9	-1.6	591	-42 232.2 (26 715.8)
Household commercialization index (%)	53.9	55.6	-1.1	591	-1.7 (1.6)

Source: own elaboration.

size, value of cowpea harvest and amount of cowpea sold. These variables provide a solid basis for comparison (i.e. comparing cowpea farmers with similar characteristics).

Additionally, the average years of formal education of those who accessed traditional market information and those who did not were 8.90 and 7.41 ($P \leq 0.01$) years, respectively. This revealed a significant difference in their education levels.

The average farming experience was 21.66 and 21.7 years respectively, showing no difference in farming experience due to access to traditional market information, with a high level of experience among both groups.

Household sizes were found to be 8.61 and 8.14 people for the cowpea farmers who accessed traditional market information and those who did not, respectively. This showed that the household sizes were similar between the two groups.

Farm income was ₦317848.9 and ₦379724.1 for those who accessed traditional market information and those who did not, respectively. This revealed that farm income for cowpea farmers was similar when segregated by access to market information.

In addition, the expenditure of cowpea farmers was ₦187,713.4 and ₦192,194.6 for those who accessed

traditional cowpea market information and those who did not, respectively. The farm size of the cowpea farmers was 0.9 ha and 0.8 ha for those who accessed traditional cowpea market information and those who did not, respectively.

Furthermore, the value of cowpea harvests was ₦262,265.4 and ₦308,117.7 for those who accessed traditional cowpea market information and those who did not, respectively. Additionally, the amount of cowpeas sold by cowpea farmers was ₦144,887.7 and ₦187,119.9 for those who accessed traditional cowpea market information and those who did not, respectively.

Lastly, the household commercialisation index (HCI) of cowpea farmers who accessed traditional market information and those who did not were 53.9% and 55.6%, respectively. These findings suggest that cowpea farmers' HCI does not differ based on access to traditional market information in Borno State, Nigeria. Hence, traditional market information may not have an impact on the HCI of cowpea farmers.

Description of Nominal Variables by Treatment

Table 2 revealed that the Chi-square model was reliable, as shown by the Pearson Chi-square of 9.401 ($P \leq 0.01$).

Table 2. Descriptive statistic of nominal variables by treatment

Variable			Market information		Total	Pearson Chi square	Df	Sig.
			not accessed	accessed				
Sex	Female	Observed frequency	90 ^a	60 ^a	150	9.401 ^a	1	0.002
		Expected frequency	92.33	57.67	150			
	Male	Observed frequency	275 ^a	168 ^a	443			
		Expected frequency	272.67	170.33	443			
	Total	Observed frequency	365	228	593			
		Expected frequency	365	228	593			
Group membership	Non-member	Observed frequency	188 ^a	88 ^b	276	9.401 ^a	1	0.002
		Expected frequency	169.88	106.12	276			
	Member	Observed frequency	177 ^a	140 ^b	317			
		Expected frequency	195.12	121.88	317			
	Total	Observed frequency	365	228	593			
		Expected frequency	365	228	593			

^a and ^b shows a statistical difference between access to market information and otherwise.
Source: own elaboration.

The result showed no differences in accessing market information between females and males. However, there is a significant difference ($P \leq 0.01$) between group and non-members.

Sources of traditional market intelligence of cowpea farmers

Table 3 revealed that 37.81% of cowpea farmers sourced their market information through fellow farmers. Furthermore, 35.04% obtained their traditional market intelligence through family and friends. Other sources of traditional market information included agro-dealers (10.76%), farmers' groups (6.50%), government extension agents (4.15%), radio (3.41%), private extension/NGOs (1.92%) and market agents (0.43%). Farmers accessed more information through their family and friends due to the ease of access and the trust they had in them.

Table 3. Traditional market information sources

Market information	Frequency*	%
Fellow farmer	355	37.81
Family/friends	329	35.04
Agro-dealer	101	10.76
Farmers' group	61	6.5
Government extension agent	39	4.15
Radio	32	3.41
Private extension/NGOs	18	1.92
Market agent	4	0.43
Total	939	100

*Multiple responses.

Source: own elaboration.

Propensity score matching of the respondents

Table 4 showed that a significant LR Chi-square (10) = 35.59 ($P \leq 0.01$) demonstrating the reliability of the model, as shown by the log-likelihood of -374.37. Marital status, education, group membership and farm size were found to be positively significant ($P \leq 0.01$, $P \leq 0.01$, $P \leq 0.05$ and $P \leq 0.1$, respectively). Sex and farm income were found to be negative but significant ($P \leq 0.01$ and $P \leq 0.1$, respectively).

Table 4. Propensity score matching of the respondents

Variable	Coef.	S.E	Z-value
Age	-0.0037	0.0069	-0.53
Sex	-0.5016	0.1593	-3.15***
Marital status	0.5959	0.2040	2.92***
Education	0.0267	0.0102	2.62***
Farming experience	0.0070	0.0084	0.83
Household size	0.0050	0.0139	0.36
Farm size	0.1615	0.0844	1.91*
Group membership	0.2761	0.1118	2.47**
Farm income	-1.91e-07	1.13e-07	-1.69*
Expenditure	-1.91e-07	1.13e-07	-0.38
Constant	-0.8731	0.3050	-2.86
Log likelihood	-374.37		
LR chi ² (10)	35.59***		
Pseudo R ²	0.045		

Source: own elaboration.

Marital status was found to be positively significant ($P \leq 0.01$), indicating that it was a significant determinant of accessing traditional market information in Borno State, Nigeria. The results showed that if a cowpea farmer was married, the likelihood of obtaining market intelligence from traditional sources increased by 0.5959, assuming other variables were held constant. This is probably because married individuals have dependents they need to provide for, motivating them to seek market information to make informed marketing decisions.

Similarly, education was found to be positively significant ($P \leq 0.01$). This showed that as the farmers' formal education level increased by one year, the propensity to access market information from traditional sources also increased by 0.0267, assuming other variables were held constant. Educated farmers tended to utilise available sources of market intelligence to make wise decisions regarding the appropriate time and place to sell their cowpea produce.

Group membership was also found to be positively significant ($P \leq 0.05$). This indicates that if a cowpea farmer was a group member, the probability of accessing traditional market intelligence increased by 0.2761,

assuming other variables were held constant. This might be because cowpea farmers form groups to gain benefits, particularly agricultural-related information, that helps them make informed decisions.

Similarly, farm size was found to be positively significant ($P \leq 0.1$). This indicates that as farm size increased by 1 ha, the propensity to access market information from traditional sources also increased by 0.1615, assuming other variables were held constant.

In addition, sex was found to be negative but significant ($P \leq 0.01$). This indicates that if a cowpea farmer was female, the likelihood of accessing traditional market information increased by 0.5016, assuming other variables were held constant.

Likewise, farm income was found to be negative but significant ($P \leq 0.1$). This revealed that if farm income increased by ₦1, the tendency for the cowpea farmer to access traditional market information decreased by 1.91×10^{-7} , assuming other variables were held constant. This is probably because wealthier individuals are more likely to strive to access non-traditional market information for their farm produce.

Impact of Access to Traditional Market Intelligence on Cowpea Farmers' Household Commercialisation

Table 5 showed that access to traditional market information had no significant impact ($P \geq 0.1$) on HCI. This lack of impact is likely due to the activities of brokers and middlemen, who make traditional market information inefficient and exploit the market situation, leaving cowpea farmers with limited benefits.

Table 5. Impact of market information on cowpea farmers' household commercialisation

Matching method	Treatment	Control	ATT	Std. err.	T-value
Nearest neighbour	227	146	-0.547	2.199	-0.249
Radius	227	354	-1.497	1.535	-0.975
Stratification	227	354	-0.731	1.529	-0.478
Kernel	227	354	-0.827	1.574	-0.525

Source: own elaboration.

Impact of access to traditional marketing intelligence on cowpea farmers' farm income

Table 6 revealed that there was no significant ($P \geq 0.1$) impact of access to traditional market information on farm income (i.e., no benefit), possibly due to the activities of traders, brokers and middlemen who create an uncompetitive market and exploit the situation, leaving cowpea farmers at a disadvantage.

Table 6. Impact of marketing information on cowpea farmers' farm income

Matching method	Treatment	Control	ATT	Std. err.	T-value
Nearest neighbour	227	146	24 583.92	44 760.96	0.549
Radius	227	354	-654.394	37 042.94	-0.018
Stratification	227	354	10 490.99	34 490.75	0.304
Kernel	227	354	7 643.295	40 573.52	0.188

Source: own elaboration.

Impact of access to different forms of traditional market information on household commercialisation and farm income

Table 7 showed no impact from most sources of traditional market information (no benefit) on HCI; only market agents were found to have a positive impact ($P \leq 0.1$) on HCI. This indicates that if a farmer sources information from a market agent, their HCI improves by 4.001% compared to those who use other sources. However, the results showed no impact on cowpea farmers' farm income ($P \geq 0.1$).

Furthermore, in the farm income model, family and friends were found to have a positive impact ($P \leq 0.05$) on cowpea farmers' farm income in the radius matching algorithm. Negative but significant impacts were found for radio and government extension agents ($P \leq 0.05$ and $P \leq 0.05$, respectively).

Radio was found to have a negative but significant impact ($P \leq 0.05$), indicating that if a cowpea farmer accessed market information through radio, their farm income decreased by ₦73000 to ₦75,500 compared to their counterparts. Government extension agents were also found to have a negative but significant impact ($P \leq 0.05$).

Table 7. Impact of traditional market information on household commercialisation and farm income

Variable	Matching algorithms	Household commercialization index			Farm income		
		No. of treated	No. of control	ATT	No. of treated	No. of control	ATT
Family/friends	Kernel	328	258	1.978 (1.668)	328	258	78,322.227 (43558.99)*
	Stratification	322	257	1.852 (1.574)	322	257	39,246.196 (38303.202)
	Radius	328	258	1.688 (1.594)	328	258	96,446.012 (43416.320)**
	Nearest neighbor	328	158	1.537 (2.193)	328	158	74,872.091 (56849.034)
Radio	Kernel	32	505	-4.116 (3.550)	32	505	-73000 (34741.877)**
	Stratification	32	505	-3.567 (3.908)	32	505	-75,500 (34091.713)**
	Radius	32	505	-4.423 (3.682)	32	505	-76400 (35727.559)**
	Nearest neighbor	32	30	-1.680 (5.139)	32	30	-294,000 (209,000)
Agro-dealer	Kernel	99	478	-1.322 (2.351)	99	478	-42400 (29749.645)
	Stratification	99	478	-1.215 (2.077)	99	478	-49100 (31911.602)
	Radius	99	478	-1.481 (2.151)	99	478	-36200 (33417.561)
	Nearest neighbor	99	92	-1.588 (2.897)	99	92	-42200 (42067.008)
Fellow farmer	Kernel	353	235	-0.008 (1.860)	353	235	42384.078 (43579.499)
	Stratification	348	232	-0.088 (1.595)	348	232	-7423.472 (34368.802)
	Radius	353	235	-0.403 (1.612)	353	235	40837.476 (41625.786)
	Nearest neighbor	353	165	-0.006 (1.954)	353	165	29790.229 (47964.206)
Farmers' group	Kernel	61	496	-3.5 (2.715)	61	496	22279.666 (44574.657)
	Stratification	61	496	-3.835 (2.569)	61	496	17268.522 (39049.190)
	Radius	61	496	-3.744 (2.644)	61	496	18458.284 (38370.516)
	Nearest neighbor	61	56	-4.426 (3.222)	61	56	14663.115 (47312.762)
Government extension agent	Kernel	39	505	2.682 (3.613)	39	505	-130000 (60171.328)**
	Stratification	37	499	3.764 (3.749)	37	499	-95700 (41706.487)**
	Radius	39	505	2.737 (3.683)	39	505	-67400 (42508.149)
	Nearest neighbor	39	34	9.903 (5.019)	39	34	-429000 (251,000)*
Private extension/NGOs	Kernel	18	481	-7.025 (4.414)	18	481	51761.348 (68591.872)
	Stratification	18	481	-6.75 (4.673)	18	481	31591.209 (55124.718)
	Radius	18	481	-7.038 (4.948)	18	481	63716.311 (80036.586)
	Nearest neighbor	18	17	-5.444 (6.129)	18	17	67594.444 (88942.490)
Market agent	Kernel	4	226	3.855 (2.866)	4	226	447000 (391,000)
	Stratification	—	—	—	—	—	—
	Radius	4	226	4.001 (2.128)*	4	226	453000 (398,000)
	Nearest neighbor	4	4	9 (15.426)	4	4	598000 (402,000)

** sig. 5%, * sig. 10%. — did not found matchable stratum

Source: own elaboration.

DISCUSSION

The study found that cowpea farmers, regardless of their primary information source (traditional or otherwise), were predominantly middle-aged, suggesting they were in their prime agricultural years. However, their level of education significantly influenced both their access to and use of information. Less educated farmers tended to rely more on traditional sources, such as family and friends, while more educated farmers were likely to explore a wider range of sources, including digital technologies.

The findings align with existing literature. Chen and Lu (2020) highlighted the role of marital status in information-seeking, noting that married individuals prioritise survival and skill-related information. Similarly, Masegela and Oluwatayo (2018) emphasised the positive impact of education on farmers' access to market information.

Farm size also played a crucial role. Larger farms tended to adopt improved technologies and utilise diversified information sources due to higher affordability and the need for advanced management practices. This is consistent with the findings of Abiri et al. (2023), Maru et al. (2018), and Deichmann et al. (2016).

The study raised concerns about the effectiveness of certain information sources. Although market agents are widely used, they are often perceived as serving their own interests more than those of the farmers – a view supported by Asad et al. (2019). Additionally, radio as an information source was found to be less effective due to its limited availability and lack of real-time updates, corroborating findings by Kassie et al. (2021).

Government extension agents were also identified as an inefficient source of information. This is likely due to limited resources and staff shortages in Nigeria's agricultural extension system. Kassie et al. (2021) further emphasised the importance of timely and accurate market information for improving farmer outcomes.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, we can conclude that, on the whole, access to traditional market information had no significant impact on both HCI and farm income of cowpea farmers in Borno State, Nigeria. However, when analysed separately, accessing market information

from market agents increased the HCI by 4.001%, though this did not translate into improved farm income. Relying on family and friends as a traditional source of market information increased cowpea farmers' income by ₦96,446.012, while reliance on radio programs and government extension agents reduced farmers' income by ₦75,500 and ₦95,700, respectively.

It is therefore recommended that, given farmers' generally low education levels, which lead them to rely heavily on traditional market information, along with the exploitative practices of traders, brokers and middlemen in cowpea markets, a more decentralised digital approach should be adopted to reduce these dependencies. This could be achieved through a mobile-based Voice & Image Recognition Application, enabling farmers to use voice commands or take pictures of their produce to access real-time market information. This will overcome literacy barriers and limited internet access in rural areas while providing relevant market information.

Additionally, an Interactive Voice Messaging System could allow farmers to receive market information through pre-recorded voice messages in their local language, delivered via mobile phones. This would work on phones with minimal internet connectivity, with trusted institutions managing the content to ensure reliability while reaching a large number of farmers.

Furthermore, Digital Farmer Cooperatives, an online platform that links farmers directly to consumers or fair-trade establishments, could bypass exploitative middlemen. Utilising existing social networks, such as farmer cooperatives and community centres, could provide training on accessing market information through digital platforms.

Contract farming offers another promising strategy. This method, which promotes cooperation and negotiation among farmers, addresses asymmetric information issues while ensuring that small-scale producers in Nigeria continue to participate in markets. Contract farming has been shown to help smallholder farmers in developing economies increase their wealth, income, and productivity (Nazifi et al., 2021; Ruml and Qaim, 2020; Yusuf et al., 2021).

The main limitation of this study was its restriction to observable variables. Future studies could improve upon this by controlling for non-observable variables through the use of endogenous switching regression and inverse probability weighting with regression adjustment (IPWRA) in addition to propensity score matching

(PSM). Alternatively, panel data or an experimental approach could be used to address the issue of endogeneity. The study could be extended to examine gender differences in the impact of traditional market information on HCI and farm income.

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REFERENCES

- Abiri, R., Rizan, N., Balasundram, S.K., Shahbazi, A.B., Abdul-Hamid, H. (2023). Application of digital technologies for ensuring agricultural productivity. *Heliyon*, <https://doi.org/10.1016/j.heliyon.2023.e22601>
- Ali, E.B., Agyekum, E.B., Adadi, P. (2021). Agriculture for sustainable development: A SWOT-AHP assessment of Ghana's planting for food and jobs initiative. *Sustainability*, 13(2), 628. <https://doi.org/10.3390/su13020628>
- Asad, M., Mehdi, M., Ashfaq, M., Hassan, S., Abid, M. (2019). Effect of marketing channel choice on the profitability of citrus farmers: evidence from Punjab-Pakistan. *Pak. J. Agric. Sci.*, 56, 1003–1011. <http://dx.doi.org/10.21162/PAKJAS/19.8671>
- Blumler, J.G., Katz, E. (1974). *The Uses of Mass Communications: Current Perspectives on Gratifications Research*. Sage Annual Reviews of Communication Research (vol. III).
- Bradley, D., Hill, B., O'Prey, L., Griffiths, E., Williams, E. (2021). Understanding farmer motivations: Very small and small farms. *IHS Markit*.
- Chen, Y., Lu, Y. (2020). Factors influencing the information needs and information access channels of farmers: An empirical study in Guangdong, China. *J. Inf. Sci.*, 46(1), 3–22. <https://doi.org/10.1177/0165551518819970>
- Claussen, K. (2004). The utility of Iowa State University's Agriculture Extension online resources to Iowa farmers: a uses and gratifications perspective.
- Deichmann, U., Goyal, A., Mishra, D. (2016). Will digital technologies transform agriculture in developing countries? *Agric. Econ.*, 47(S1), 21–33. <https://doi.org/10.1111/agec.12300>
- Diaka, I., Tawiah, J.K., Mensah-Akoto, J. (2024). Smallholder Rice Farmers' Information Needs and Access: An Empirical Study in the Asunafo North Municipality, Ghana. *J. Rural Comm. Dev.*, 19(2). Retrieved from: <https://journals.brandonu.ca/jrcd/article/view/2457>
- IITA (2023). Cowpea (*Vigna unguiculata*). Retrieved Sep 20th 2023 from: <https://www.iita.org/cropsnew/cowpea/#:~:text=All%20parts%20of%20the%20cowpea,use%20during%20the%20dry%20season.>
- Imbens, G.W., Wooldridge, J.M. (2009). Recent developments in the econometrics of program development. *J. Econ. Lit.*, 47(1), 5–86. [10.1257/jel.47.1.5](https://doi.org/10.1257/jel.47.1.5)
- Kassie, G.T., Abshiro, F., Dessalegn, Y., Asnake, W., Rischkowsky, B.A. (2021). Impact of market information on market participation and income of small ruminant keepers: Experimental evidence from Ethiopia. *SmaRT Ethiopia Brief*.
- Kebebe, E. (2019). Bridging technology adoption gaps in livestock sector in Ethiopia: A innovation system perspective. *Technol. Soc.*, 57, 30–37. <https://doi.org/10.1016/j.techsoc.2018.12.002>
- Magesa, M.M., Michael, K., Ko, J. (2020). Access and use of agricultural market information by smallholder farmers: Measuring informational capabilities. *Elect. J. Inf. Syst. Dev. Count.*, 86(6), e12134. <https://doi.org/10.1002/isd2.12134>
- Maru, A., Berne, D., Beer, J.D., Ballantyne, P.G., Pesce, V., Kalyesubula, S., ..., Chavez, J. (2018). Digital and data-driven agriculture: Harnessing the power of data for smallholders. *Global Forum on Agricultural Research and Innovation*. Retrieved from: <https://cgspace.cgiar.org/server/api/core/bitstreams/32dd3d52-775a-4879-b1ee-aa754dcd4677/content>
- Masegela, C., Oluwatayo, I. (2018). Value chain mapping and marketing efficiency of smallholder cowpea farmers in Capricorn and Waterberg districts of Limpopo province. In: 2018 Annual Conference, September 25-27, Cape Town, South Africa (No. 284751). *Agricultural Economics Association of South Africa (AEASA)*. <http://dx.doi.org/10.22004/ag.econ.284751>
- Nazifi, B., Bello, M., Suleiman, A., Suleiman, M.S. (2021). Impact of contract farming on productivity and food security status of smallholder maize farmer's households in Kano and Kaduna States, Nigeria. *Int. J. Agric. Environ. Food Sci*, 5, 571–579. <http://dx.doi.org/10.31015/jaefs.2021.4.17>
- Nugroho, A.D. (2021). Agricultural market information in developing countries: A literature review. *Agric. Econ.*, 67(11), 468–477. <https://doi.org/10.17221/129/2021-AGRICECON>
- Ruml, A., Qaim, M. (2020). Effects of marketing contracts and resource-providing contracts in the African small farm sector: Insights from oil palm production in Ghana. *World Dev.*, 136, 105110. <https://doi.org/10.1016/j.worlddev.2020.105110>

- Shehu, A., Kadafur, M.I., Yusuf, H.A., Saddiq, N.M. (2024). Gendered path to market participation of small-holder cowpea (*Vigna. Unguiculata* (L.) Walp.) farmers in Nigeria. *J. Agric. Agric. Technol.*, 4(2), 147–159.
- Uneze, C., Egor, H., Otaokpukpu, N. (2024). Digitilization In Agricultural Cooperatives: A Perspective From Members In Rice Value Chain Of Anambra State, Nigeria. *J. Agribus. Rural Dev.*, 71(1), 93–101. <https://doi.org/10.17306/J.JARD.2024.01800>
- Xie, Y., Lu, P. (2015). The sampling design of the China family panel studies (CFPS). *Chin. J. Soc.*, 1(4), 471–484.
- Yusuf, I.H., Umar, G.S., Jamiu, W.M. (2021). Impact of a contract farming scheme on income, food security, and nutrition among maize farmers in North Western, Nigeria. *J. Nutr. Food Sec.*, <https://doi.org/10.18502/jnfs.v6i2.6060>
- Zondi, N.T.B., Ngidi, M.S.C., Ojo, T.O., Hlatshwayo, S.I. (2022). Factors influencing the extent of the commercialization of indigenous crops among smallholder farmers in the Limpopo and Mpumalanga Provinces of South Africa. *Front. Sustain. Food Syst.*, 5, 777790.