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Assessing agricultural commercialization and rural infrastructure development in rural Southwestern Nigeria: evidence from smallholder cassava farmers

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Abstract: This study assessed agricultural commercialization and rural infrastructure development of smallholder cassava farmers in rural Southwestern Nigeria. The study was conducted in Nigeria with cross-sectional data collected from 352 smallholder cassava farmers. Crop commercialization index (CCI) was used to compute each farmer's CCI and categorized into four levels while ordered logit model was employed to analyze the determinants of agricultural commercialization of cassava farmers in the study areas. Availability of some important rural infrastructures were assessed across cassava farmers' commercialization levels. The results revealed that 13.1 % of cassava farmers did not participate in the sale of cassava roots while 86.9 % of them participated actively in the output market. The mean and maximum CCI in the study areas was 59.1 and 95.5 respectively. The results also showed that less than 40 % and 20 % of cassava farmers in all commercialization levels had access to electricity and piped water respectively. The ordered logit regression analysis indicated that age, transport cost, cassava marketing experience, and distance to market were among the determinants of agricultural commercialization. Therefore, stakeholders should expedite policy actions capable of promoting rural infrastructure development that will enhance agricultural production, marketing and improve the quality of life of rural farming communities.

Key words: Crop Commercialization Index (CCI); cassava farmers; subsistence agriculture; rural infrastructure; ordered logit model

Ocena tržne usmerjenosti in razvoja infrastrukture na podeželju na kmetijskih območjih jugozahodne Nigerije: primer manjših pridelovalcev manioke

Izvleček: V raziskavi je bil ocenjen razvoj podeželske infrastrukture in razvoj tržne usmerjenosti pri manjših pridelovalcih manioke na podeželju jugo-zahodne Nigerije. Raziskava je bila izvedena z zbiranjem različnih podatkov pri 352 manjših kmetih, ki pridelujejo manioko. Za vsakega kmeta je bil izračunan indeks tržne usmerjenosti (CCI) vseh poljščin, njegove vrednosti so bile nato razvrščene v štiri nivoje, za analizo glavnih determinant tržne usmerjenosti pridelovalcev manioke na območju je bil uporabljen model hierarhične logistične regresije. Dostopnost nekaterih pomembnih podeželskih infrastruktur je bila med pridelovalci manioke ocenjena glede na raven tržne usmerjenosti. Rezultati raziskave so pokazali, da 13,1 % pridelovalcev manioke ne sodeluje pri prodaji pridelka, 86,9 % pa jih aktivno sodeluje na trgu. Vrednosti poprečnega in maksimalnega indeksa (CCI) sta bili v preučevanih območjih 59,1 in 95,5. Rezultati so še pokazali, da ima manj kot 40 % in 20 % pridelovalcev manioke na vseh ravneh razvoja tržne usmerjenosti dostop do elektrike in vodovoda. Model hierarhične logistične regresijske analize je pokazal, da so imele danosti kot so starost, stroški transporta, izkušnje s prodajo manioke in oddaljenost do trga največji vpliv na razvoj tržne usmerjenosti. Zaradi tega bi morali odločevalci razviti aktivnosti, ki bi vzpodbujale razvoj infrastrukture na podeželju, kar bi pospešilo kmetijsko proizvodnjo, razvoj trga in izboljšalo kvaliteto življenja v ruralnih kmečkih skupnostih.

Ključne besede: indeks tržne usmerjenosti (CCI); pridelovalci manioke; samooskrbno kmetijstvo; infrastruktura na podeželju; hierarhični logit model

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1 INTRODUCTION

In recent time, access to food by over 7 billion people has become one of the most challenging issues in our contemporary world (Otekunrin and Otekunrin 2021a; Ayinde et al. 2020). The number of people affected by hunger has increased globally by the emergence of COVID-19 pandemic in early 2020, bringing the achievement of the decline in the prevalence of undernourished (PoU) from 2005 to 2014 to an abrupt end (FAO et al. 2021). From 2019-2020, the PoU witnessed a surge from 8.4 % (650.3 million) to about 9.9 % (768.0 million), making the achievement of Sustainable Development Goal 2 (SDG 2) by 2030 close to becoming a mirage especially in the developing countries (FAO et al. 2021). In 2022, the PoU further increased with estimated value between 702 and 828 million people in the world with an unprecedented impact occassioned by COVID-19 (FAO et al. 2022).

As world food demand escalates with attendant global population increase especially in low- and middle-income countries (LMICs), the subsistence agriculture (small-scale farming) practiced by most farmers in the developing countries can no longer meet the food demand of the people and thereby, in dire need of real transformation. The rejigging of subsistence agriculture in Africa is pivotal to the economic prosperity of the region especially those that depend mainly on agriculture (von Braun, 1994, 1995; Pingali and Rosegrant, 1995; Timmer, 1997; World Bank, 2008; Gebremedhin and Jaleta, 2010; Otekunrin et al. 2019). Transforming the small-scale agricultural practice will lead to the promotion of agricultural commercialization that enhances commerce and optimum productivity at both national and household levels. The increased income gain by the household will equally promote food consumption and nutritional outcomes of both rural and urban households (Carletto et al. 2017)

According to Agricultural Policy Research in Africa (APRA), agricultural commercialization emerges when agricultural enterprises depend mainly on the market for the sale of produce and for the purchase of production inputs (APRA, 2018). In another word, agricultural commercialization implies increased market transactions (that is, market participation) for capturing the gains from specialization (Carletto et al. 2017). Commercialization process may occur on the output-side of production usually with sales of farm produce or on the input-side mainly through increased use of purchased inputs. The estimation of the level of commercialization of subsistence agriculture from the output-side of production gives the opportunity to gain the marketing behavior of each household (APRA, 2018; Carletto et al. 2017; Otekunrin et al. 2019).

In past decades, agricultural commercialization in Africa is synonymous to large-scale farming involving cash crops (Martey et al. 2012). Moreover, this is no longer the same in recent time as these cash crops which are usually rain-fed and are negatively impacted by the unfavorable weather conditions. These lead to a reduction in annual harvest of the crops and hence, calls for urgent crop diversification (Martey et al. 2012; Obisesan, 2012; Opondo et al. 2017). Recently, food crops such as cassava and sorghum are being supported for their drought-resistance and other attributes which make them suitable as food security crops in the Africa (Martey et al. 2012; Obisesan, 2012; Opondo et al. 2017).

It is evident that infrastructural development especially in the rural settings in Africa (like Nigeria) will promote agricultural commercialization. Moreover, infrastructure development in the region is crucial to advancing economic growth and promoting quality of life of the people (AfDB, 2020). With the recent population increase in Africa coupled with the United Nations (UN) projection of the continent's population increase from 1.3 billion in 2019 to 2.4 billion in 2050. Noting that the majority of the growth is projected to come from Sub-Saharan Africa (SSA) (UNDESA, 2019; OECD/ACET, 2020). In order to meet up with the growing demand for food, there is need for the African countries (Nigeria inclusive) to scale up infrastructure development especially in the rural areas to match the demands of ever-increasing population in the region mainly in the aspects of production capacity, labour participation and food security (OECD/ACET, 2020).Where rural infrastructural facilities like good rood network, reliable information and communication technology, uninterrupted power supply, healthcare facilities and access to improved water and sanitation are available and functioning properly, will create an enabling environment for smallholder farmers and enhance the production and processing of agricultural produce that would lead to increased income for farmers, improve quality of life of the rural households.

Cassava (*Manihot esculenta* Crantz) is regarded as one of the most cultivated root crops in the tropics and unarguably the six most important crop in the world after wheat, rice, maize, potato, and barley (Saranraj et al. 2019; Otekunrin & Sawicka, 2019). Cassava is commonly referred to as "drought-tolerant crop" (Otekunrin & Sawicka, 2019). Global production of cassava reached 303.6 million tonnes with countries like Nigeria, Democratic Republic of Congo (Congo, DR), Thailand and Ghana were among the top 5 producers globally in 2019. The cassava production in Africa reached 192 million and is recognized as the largest cassava growing region while Nigeria maintained the top position as the highest producer of the crop both in Africa and globally with an

estimated value of 59 million tonnes and 19.5 % share of total global production in 2019 (FAOSTAT, 2021).

Cassava in Nigeria, is regarded as the most important crop by production and second most important by consumption (SAHEL, 2016; Otekunrin & Sawicka, 2019). Majority (90 %) of the fresh cassava roots are consumed locally as food, about 10 percent is used for industrial purposes while Nigeria is yet to tap the enormous trade potential of the crop because less than 1 percent of cassava produced in the country entered the international market (Otekunrin & Sawicka, 2019).

This study assesses agricultural commercialization and rural infrastructure development among smallholder cassava farmers in South West Nigeria. This study contributes to the body of knowledge on the importance of rural infrastructure development in Africa especially in Nigeria which is capable of boosting agricultural productivity, marketing of agricultural produce and, enhancing the quality of life of the rural households in South-West Nigeria.

This study stated five hypotheses and are given as follow;

H_0: Gender of the cassava farmers does not have any relationship with commercialization levels of the farmers.

H_1: Gender of the cassava farmers have relationship with commercialization levels of the farmers.

H_0: Farmers' educational qualification does not have any relationship with commercialization levels of the farmers.

H_1: Farmers' educational qualification have relationship with commercialization levels of the farmers.

H_0: Farmers' transport cost does not have any relationship with commercialization levels of the farmers.

H_1: Farmers' transport cost have relationship with commercialization levels of the farmers.

H_0: Farmers' cassava marketing experience does not have any relationship with commercialization levels of the farmers.

H_1: Farmers' cassava marketing experience have relationship with commercialization levels of the farmers.

H_0: Farmers' distance from farm to nearest market does not have any relationship with commercialization levels of the farmers.

H_1: Farmers' distance from farm to nearest market have relationship with commercialization levels of the farmers.

The study therefore, contributes to the existing body of knowledge by analyzing factors affecting agricultural commercialization and the challenges confronting smallholder cassava farmers in South-West Nigeria.

2 MATERIALS AND METHODS

2.1 STUDY AREA

Nigeria is the seventh most populous nation in the world. Based on Worldometer elaboration of the latest United Nations data, the current population of Nigeria (at September 4, 2021) is 212,108,984 people representing 2.64 % of total world population (Worldometer, 2021). South-West is one of the six geopolitical zones of Nigeria and is located in Western region of Africa with total land mass of 923,768 square kilometer (Maps of World 2021). Nigeria is a multi-ethnic country having Hausa, Igbo and Yoruba as the three predominant ethnic groups and national languages. The six states in South-West are; Lagos, Ekiti, Ogun, Ondo, Osun and Oyo. The region lies between latitude 9° 4.9199ˡ N and longitude 8° 4.9199ˡ E (Find Lattitude and Longitude, 2021). It is largely a Yoruba speaking region of the country with diversity of dialects within and across the states in the zone. There are two distinct seasons in the zone i.e. rainy and the dry seasons. Agriculture remained the most common means of livelihood of about 70 percent of the rural population (Lawal & Samuel, 2010; Otekunrin & Otekunrin 2021b). The main cash crops mostly grown in the zone include cocoa, citrus and timber, while the food crops are cassava, yam, maize, cowpea, melon, and millet. Livestock production include pigs, rabbits, sheep, goats, poultry and snails (Lawal & Samuel, 2010; Otekunrin & Otekunrin 2021b).

2.2 DATA COLLECTION AND SAMPLING PROCEDURE

The study employed multi-stage sampling procedure. In the first stage, random sampling of two (Ogun and Oyo) from six cassava producing States in the South western region of the country was done. The 2nd stage involved random selection of five Local Government area (LGAs) (Egbeda, Ona-Ara, Ido, Afijio and Oyo East) from Oyo State and three LGAs (Odeda, Ewekoro and Odogboolu) from Ogun State. In stage 3, 24 villages (Badeku, Akintayo, Ajoda, Bodunde, Ajoda-Ajobo, Kupalo, Jago, Akinwaare, Morakinyo, Akinmoorin, Abujakan, Bodija-Omikiti, Bodija-Tekun; Olodo, Adao-Alabata, Ogbere, Oluwaji, Imodi-Ijebu, Surulere, Omu-Ijebu, Oke-Ola, Sabo-Imodi, Ita-Ale Imodi, Eyiwa) were selected from the eight LGAs. The Stage 4 involved a random selection of 16 cassava farming households resulting in a

total of 384 farming households. The data were collected through structured, interviewer-administered questionnaire which include; the household socioeconomic characteristics, food consumption and expenditure pattern, rural infrastructure related factors and other salient information. These questionnaires were answered by the smallholder cassava farmers in the study areas. After data cleaning, 32 out of 384 (resulting to a total of 352 respondents) of the questionnaires were discarded due to incomplete information resulting in 91.7 % total responses from the survey.

2.3 ANALYTICAL FRAMEWORK

2.3.1 Estimating agricultural commercialization

The agricultural commercialization levels of cassava farmers was estimated using Crop commercialization Index (CCI) by Strasberg et al. 1999; Carletto et al. 2017; Otekunrin et al. 2019 defined as :

$$CCI_i = \frac{Gross\ value\ of\ crop\ sale_{hhi,\ \ yearj}}{Gross\ value\ of\ all\ crop\ production_{hhi,yearj}} \times 100 \qquad (1)$$

We have hh_i is the ith household in year *j*.

The commercialization levels of the cassava farmers in the study areas can be represented by a scale from absolute subsistence farmer (*CCI* = 0) to perfectly commercialized (*CCI* = 100) (Carletto et al. 2017; Otekunrin et al. 2019). This method allows for more than just the usual dicotomy of sellers and non-sellers, or between staple and cash crop producers (Carletto et al. 2017; Otekunrin et al. 2019). This also informs about how much of the harvested produce farmers decided to offer for sale in the output market. The crop sold ratio is the ratio of gross value of crop sold and gross value of all crop production (Shively & Sununtnasuk, 2015).

Cassava farmers were categorized based on their cassava commercialization levels. Farmers that did not participate (non-sellers) in the sale of the cassava roots were categorized as zero commercialization level (CCI 1 = 0 %) while those that participated actively (sellers) are grouped into; low commercialization level (CCI 2 = 1.00-49.9 %), Medium-High commercialization level (CCI 3 = 50.0-75.9 %) and Very High commercialization level (CCI 4 = 76.0-100.0 %) levels (Otekunrin and Otekunrin, 2021b).

2.4 MODELLING THE DETERMINANTS OF COMMERCIALISATION LEVELS AMONG CASSAVA FARMERS

2.4.1 Ordered Logit Model (OLM)

The multivariate ordered Logit model is used to determine factors influencing commercialisation levels of smallholder cassava farming households in South West Nigeria. This analysis is adopted when the dependent variable has more than two categories and the values of each category have an ordered sequential structure where a value is indeed "higher" than the previous one (Torres-Reyna, 2014).

The logit coefficients are in log-odds unit and they are not read as OLS coefficients as such in interpreting, we need to estimate predicted probabilities of Y = 1 or the marginal effects which measures changes in the probability of commercialisation outcome with respect to a change in the regressors. The probabilities of the respondents of being in any of the identified levels are estimated using natural log of the cumulative distribution (Booroah, 2002; Obayelu, 2012). A positive marginal effect estimate for a category indicates that an increase in that variable will increase the probability of being in that category while a negative estimate implies a decrease in probability of being in that category.

In the ordered logit model, there is an observed ordinal variable Y which is a function of another variable y^* that is not measured. The latent variable y^* has various threshold points.

In this study, following Oluwatayo & Rachoene (2017); Ogutu et al. (2020) and Hussayn et al. (2020), this model specification was used:

$$y_i^* = x_i'\beta + \varepsilon_i \qquad (2)$$

where y_i^* is the latent variable of the commercialization levels of cassava farmer *i*, x'_i is a vector of explanatory variables describing farmer *i*, β is a vector of parameters to be estimated and is a random error term which follows a standard normal distribution.

Choice rule:

$$y_i = \begin{cases} 1 & if\ y_i^* \le \mu_1\ (Zero\ level\ (0.0\%)) \\ 2 & if\ \mu_1 \le y_i^* \le \mu_2\ (Low\ level\ (1.0 - 49.9\%)) \\ 3 & if\ \mu_2 \le y_i^* \le \mu_3\ (Medium - High\ level\ (50.0 - 75.9\%)) \\ 4 & if\ y_i^* > \mu_3\ (Very\ High\ level\ (76.0 - 100.0\%)) \end{cases} \qquad (3)$$

μ_1 to μ_3 are the cut-off values for the ordered logit model.

Hence, the dependent variable is the commercialisation levels; CCI 1, 2, 3 and 4 are the various categories (Zero, Low, Medium-High and Very High levels). As the ordered classes increase, the parameter set (β) is interpreted as: positive signs (+) indicate higher commercialisation level as the value of the variables increase, while negative signs (-) suggest the opposite (Hussayn et al. 2020). These interplays will be compared to the ranges between the various thresholds, μ_1, so as to establish the appropriate commercialisation level for a particular farmer.

The description and definition of the selected explanatory variables indicating the mean, standard deviation, minimum and maximum of each of the selected variables are shown in

Table 1.

3 RESULTS AND DISCUSSION

3.1 DESCRIPTION OF SOCIOECONOMIC CHARACTERISTICS OF CASSAVA FARMERS

The socioeconomic description of cassava farming households are presented in Table 1 and 2. The results indicated that about 40 percent of the farmers were between the age of 41 and 50 years while the mean age was 51 years revealing that cassava farmers are in their advanced age. This result was similar to findings from Adeyemo et al. (2019) and Adepoju et al. (2019). About 79 percent of the farmers were men indicating that cassava production is male dominated in the study areas. This result agrees with Otekunrin (2011), Awoyemi et al. (2015) and Adepoju et al. (2019) that cassava production are male dominated in South West Nigeria.

About 69 percent of cassava farmers in Ogun State were male while only 14.7 % were female in Oyo State. Majority (86.6 %) of the cassava farmers in the study areas were married while those that are still single were less than 5 percent. The large percent of married respondents indicated that more members of farm family were possibly going to be available for cassava production in the study areas. According to Awoyemi et al. (2015) and Kolapo et al. (2020) who also corroborated that large percent of married respondents in cassava production and processing could imply that cassava farmers in the study areas were matured and ready to take vital farming decisions jointly with their spouses.

About 46 percent of the farmers in the study areas had family size that is less than 5 persons. The mean household size in the study areas was 6 persons, implying that the farmers had relatively large family size which could possibly be available as family labour against short fall of hired labour. This results corroborates the findings of Effiong (2005); Adepoju et al. (2019) and Kolapo et al. (2020) that a relatively large household size enhances the availability of family labour which reduces constraint on labour demand in cassava production, processing and marketing.

Table 2 also revealed that 53.4 % of the farmers in the two states had only primary education qualification while 15.9 % were with no formal education. The results

Table 1: Description and definition of study explanatory variables

Variable	Description	Mean	Std. Dev	Minimum	Maximum
AGE	Age of farmers (years)	51.29	11.31	27	89
HHS	Number of Household members	6.18	2.82	20	1
EDUCATION	Number of years spent in school	7.05	4.28	0	16
FSIZE	Size of the farm used for cassava production (hectare)	1.50	1.05	0.20	4.86
FEXP	Cassava Farming experience of the farmers (years)	15.30	10.61	1	50
FINCOME	Farm income of the farmers (Naira)	129,420.82	113,164.30	0	950,000
NFINCOME	Non-farm income of the farmers (Naira)	58,616.48	71,380.35	0	500,000
MKTEXP	Cassava marketing experience of the farmers (years)	11.46	9.31	0	45
TRANSCOST	Cost of transport incurred by farmers (Naira)	3,576.70	1,334.45	0	10,000
DISTMKT	Distance from farm to closest market (km)	8.86	3.93	1	10,000
FOODEXP	Farmers' household Food expenditure (Naira)	21,974.43	9,668.99	20,000	60,000

Computed from field survey data, 2020

Table 2: Socioeconomic characteristics of cassava farmers

	Ogun State (n = 141)	Oyo State (n = 211)	Pooled (n = 352)
Variable	Frequency (%)	Frequency (%)	Frequency (%)
Age (years)			
≤ 40	11 (7.8)	40 (19.0)	51 (14.5)
41-50	52 (36.9)	88 (41.7)	140 (39.8)
51-60	46 (32.6)	49 (23.2)	95 (27.0)
> 60	32 (22.7)	34 (16.1)	66 (18.8)
Gender			
Male	97 (68.8)	180 (85.3)	277 (78.7)
Female	44 (31.2)	31 (14.7)	75 (21.3)
Marital Status			
Married	118 (83.7)	187 (88.6)	305 (86.6)
Single	5 (3.5)	10 (4.7)	15 (4.3)
Divorced	9 (6.4)	5 (2.4)	14 (4.0)
Widowed	9 (6.4)	9 (4.3)	18 (5.1)
Household size (Persons)			
≤ 5	65 (46.1)	95 (45.0)	160 (45.5)
6-10	75 (53.2)	97 (46.0)	172 (48.9)
> 10	1 (0.7)	19 (9.0)	20 (5.6)
Education background			
No formal education	5 (3.5)	51 (24.2)	56 (15.9)
Primary	100 (70.9)	88 (41.7)	188 (53.4)
Secondary	35 (24.8)	59 (28.0)	94 (26.7)
Tertiary	1 (0.7)	13 (6.2)	14 (4.0)
Farm size (hectare)			
≤ 1.00	63 (44.7)	85 (40.3)	148 (42.0)
1.01-2.00	53 (37.6)	69 (32.7)	122 (34.7)
2.01-3.00	22 (15.6)	33 (15.6)	55 (15.6)
> 3.00	3 (2.1)	24 (11.4)	27 (7.7)
Farm Experience (years)			
≤ 10	57 (40.4)	94 (44.5)	151 (42.9)
11-20	52 (36.9)	74 (35.1)	126 (35.8)
21-30	22 (15.6)	28 (13.3)	50 (14.2)
> 30	10 (7.1)	15 (7.1)	25 (7.1)
Cassava marketing Experience (years)			
≤ 10	73 (51.8)	132 (62.6)	205 (58.2)
11-20	47 (33.3)	51 (24.2)	98 (27.8)
21-30	17 (12.1)	19 (9.0)	36 (10.2)
> 30	4 (2.8)	9 (4.2)	13 (3.7)

Continued on next page

Farm Income (Naira)			
≤ 50,000	27 (19.1)	46 (21.8)	73 (20.7)
51,000-100,000	48 (34.0)	52 (24.6)	100 (28.4)
101,000-200,000	53 (37.6)	76 (36.1)	129 (36.6)
> 200,000	13 (9.2)	37 (17.5)	50 (14.2)
Food Expenditure (Naira)			
≤ 10,000	6 (4.3)	25 (11.8)	31 (8.8)
11,000-20,000	62 (44.0)	117 (55.5)	179 (50.9)
> 20,000	73 (51.8)	69 (32.7)	142 (40.3)
Transport cost (Naira)			
≤ 2,000	24 (17.0)	33 (15.6)	57 (16.2)
2,100-5,000	115 (81.6)	166 (78.7)	281 (79.8)
> 5,000	2 (1.4)	12 (5.7)	14 (4.0)
Distance from farm to market (km)			
≤ 5	12 (8.5)	69 (32.7)	81 (23.0)
6-10	98 (69.5)	92 (43.6)	190 (54.0)
> 10	31 (22.0)	50 (23.7)	81 (23.1)

Computed from field survey data, 2020

also indicated that only 4.0 % had tertiary education qualification while farmers' mean year spent in school was 7.05 (Table 1) years in the study areas. This results indicated relatively low level of education among the cassava farmers in the study areas. This means that higher formal education may not be a prerequisite to engaging in smallholder crop production and marketing but rather hands-on (on-farm) experience may be more crucial (Huffman 2001; Awotide et al. 2012; Adepoju et al. 2019).

Table 2 also revealed that 44.7 % and 40.3 % of the farmers had less than 1.0 hectare of cassava farm land in Ogun and Oyo respectively. The mean size of the farmland used for cassava production in the last cropping season was 1.50 hectare, indicating that most of the farmers in the study areas are largely smallholder farmers cultivating less than 5.00 hectare farmland. These findings are supported by the works of Sebatta et al. 2014; Rapsomanikis, 2015; Otekunrin et al. 2019; Otekunrin & Sawicka, 2019; Ikuemonisan et al. 2020.

The distribution of cassava farmers by their experience in farming activities (Table 2) indicated that about 36 percent of them had years of farming spanning from 10-20 years in both Oyo and Ogun State. The mean cassava farming experience in the two states was 15.30 years. This revealed that cassava farmers had considerably high years of farming experience which may possibly translate to increased productivity. This results agreed with Okoye et al. (2016) in the study of smallholder cassava farmers in Madagascar with 15 years farming experience while Kolapo et al. (2020) in the study of cassava bio-fortified Vitamin-A processors with 17 years.

Furthermore, the income distribution of cassava farmers in the study areas revealed that 20.7 % of the farmers in the two states earned less than ₦50 000 annually while 36.6 % of the farmers' income in both Ogun and Oyo States ranged between ₦101 000 to ₦200 000 annually. The mean farm income of cassava farmers was ₦129, 420.82 (Table 1).

Meanwhile, nearness to closest market centers promotes higher income, provides employment opportunities especially in the rural communities and enhances seamless access to farm inputs especially for smallholder farmers. The results (Table 2) indicated that about 70 percent and 44 percent of cassava farmers were 6-10 km far away from closest market centers in Ogun and Oyo States respectively. The mean distance from farm to market of cassava farmers was 8.86 km (Table 1). The farther the farmers to the closest market centers, the lower the likelihood of the farmers' market participation and this may lead to reduced household income (Renkkow et al. 2004; Otekunrin et al. 2019).

3.2 CASSAVA FARMERS' AGRICULTURAL COMMERCIALIZATION LEVELS

This section presents the agricultural commercialization levels of cassava farmers in Ogun and Oyo States

(Table 3). The results were computed through crop commercialization index (CCI) of each cassava farmers as specified above. The results showed that about 13 percent of the cassava farmers in the study areas (Ogun, 8.5 %; Oyo, 16.1 %) did not participate in sale of their cassava produce (non-sellers) in the last cropping season and are categorized as zero commercialization level (CCI 1). About 30 percent of the cassava farmers in the two states were categorized as medium-high commercialized farmers while the highest percentage (40.1 %) of the farmers sell above 75 % of their cassava roots categorizing them as "very high commercialization level" (CCI 4). The mean crop commercialization index in the study areas was 59.08 (Ogun, 67.24; Oyo, 53.64), belonging to medium-high commercialization level (CCI 3). These results are similar to that of Hussayn et al. (2020) and Kolapo et al. (2020) who reported higher level of market participation by cassava farmers and processors in South-West, Nigeria.

The results of the Chi-Square test to show if there exist any significant relationships between cassava farmers' commercialization levels and some selected explanatory variables is presented in Table 4. The results indicated that there were no significant relationships between cassava farmers' commercialization levels and farmers educational qualification, gender and distance from farm to market. This revealed that the educational levels, gender of the farmer and farmers' distance from farm to market may not possibly determine the extent of commercialization of cassava produce by the cassava farmers in both Ogun and Oyo states, Southwest Nigeria. In terms of education attainment, this result was in line with Huffman (2001); Awotide et al. (2012); Adepoju et al. (2019) who posited that educational background of the farmers may not be a necessary condition for smallholder households' decision to increase investment in the cassava value chain.

Furthermore, the results (Table 4) also revealed that transport cost incurred ($p < 0.01$) and cassava farmers' marketing experience ($p < 0.01$) had significant association with the cassava farmers' commercialization levels in the study areas. This is in line with *a priori* expectation that the cost of transporting farmers' produce to the market (as determined by the distance from farm to nearest market) may determine the extent of their output market participation. This agrees with the findings of Renkkow et al. (2004); Okoye et al. (2016); Otekunrin et al. (2019a) that the farther the farmers to the closest market centers, the lower the likelihood of their market participation and also their commercialization levels. However, the marketing experience of the cassava farmers also had a significant association with the extent of

Table 3: Smallholder cassava farmers' commercialization levels

	Ogun State	Oyo State	Pooled
Crop commercialization index (CCI) levels	Frequency (%)	Frequency (%)	Frequency (%)
Zero Level (Non-sellers)	12 (8.5)	34 (16.1)	46 (13.1)
< 50.0% (Low Level)	15 (10.6)	45 (21.3)	60 (17.0)
50.0-75.9% (Medium-High Level)	44 (31.2)	61 (28.9)	105 (29.8)
76.0-100.0% (Very High Level)	70 (49.6)	71 (33.6)	141 (40.1)
Mean CCI	67.24	53.64	59.08
Minimum CCI	18.23	7.62	7.62
Maximum CCI	95.45	95.45	95.45
N	141	211	352

Source: computed from field survey data, 2020. N means number of cassava farmers

Table 4: Hypotheses testing

Hypothesis	Pearson Chi-Square statistic (χ^2)	Asymp. Sig (2-sided)	Decision
a	7.949	0.242	Do not reject H_0
b	3.748	0.290	Do not reject H_0
c	6.237	0.101	Do not reject H_0
d	16.105	0.001	Reject H_0
e	42.901	0.000	Reject H_0

cassava commercialization of farmers in the study areas. As the farmers gain more experience in the sale of their cassava produce in the output market, it tend to improve the extent of their cassava commercialization and leading to increased farm income (Okoye et al., 2016; Otekunrin et al., 2022a).

3.3 RURAL INFRASTRUCTURE-RELATED FACTORS ACROSS CASSAVA FARMERS' COMMERCIALIZATION HOUSEHOLD LEVELS

Tables 5-8 present the distribution of cassava farmers' commercialization levels according to availability of infrastructure-related factors. Among the factors considered are; (i) access to electricity (ii) access to improved toilet, (iii) access to healthcare service, (iv) access to piped water in the study areas of Ogun and Oyo State, Nigeria. Table 5 revealed the level of access to electricity of smallholder cassava farmers across their four commercialization levels in the study areas. The result indicated that in the two states, above 50 percent of farmers in all the four commercialization levels opined that they did not access to electricity while the highest percent (69.5 %) of farmers in this category belonged to medium-high commercialization level (Ogun, 47.7 % and Oyo, 85.2 %). This result is lower than the national average (38.9 %) of rural households who have access to electricity as reported in 2018 Nigeria Demographic Household Survey (NDHS) (NCP & ICF, 2019; Otekunrin et al. 2022b; Otekunrin 2022). Similarly, in Table 5, the relationship between access to electricity and cassava farmers' CCI levels in the two states are not statistically significant (Ogun, $p = 0.16$; Oyo, $p = 0.45$).

However, according to Africa Infrastructure Development Index (AIDI) 2020 where Africa's Electricity index (one of the AIDI components) revealed that Nigeria's electricity index score fluctuate between 2.56 in 2010 to 2.72 on the scale of 100 in 2020, revealing critical challenge in the country's power sector. It is worthy of note that many rural areas in Nigeria are not connected to the national grid. Electricity is pivotal to the farmers' increased production and processing of the agricultural produce (AfDB, 2018; 2020).

Table 6 indicated the level of access to improved toilet among cassava farmers' households as categorized by their commercialization levels in the study areas. The results showed that in all the four commercialization levels, only "very high commercialization level" (CCI 4) farming households had 39.0 % access to improved toilet in the study areas. Less than 30 percent of other commercialization levels (CCI 1-3) had access to improved toilet

Table 5: Percent distribution of access to electricity among cassava farmers' commercialization household levels

		State	
		Ogun (n = 141)	Oyo (n = 211)
CCI levels	Access to Electricity	n (%)	n (%)
Zero Level (Non Seller)	Have access to electricity	9 (75.0)	6 (17.6)
	No access to electricity	3 (25.0)	28 (82.4)
	Total	12 (100)	34 (100)
Low Level	Have access to electricity	11 (73.3)	12 (26.7)
	No access to electricity	4 (26.7)	33 (73.3)
	Total	15 (100)	45 (100)
Medium-High Level	Have access to electricity	23 (52.3)	9 (14.8)
	No access to electricity	21 (47.7)	52 (85.2)
	Total	44 (100)	61 (100)
Very High Level	Have access to electricity	50 (71.4)	16 (22.5)
	No access to electricity	20 (28.6)	55 (77.5)
	Total	70 (100)	71 (100)
Total	Have access to electricity	93 (66.0)	43 (20.4)
	No access to electricity	48 (34.0)	168 (79.6)
	Total	141 (100)	211 (100)
Pearson Chi-Square (χ^2) or Fisher's exact, p-value		–, 0.16	2.65, 0.45

Computed from field survey data, 2020

in both Ogun and Oyo states. Cassava farming households belonging to Zero commercialization level had the lowest percentage (17.4 %) access to electricity among the four commercialization levels. Generally, only 29.3 % of the cassava farming households (Ogun, 46.1 % and Oyo 18.0 %) had access to improved toilet. This result is lower than the national average of 39.1 %. The NDHS 2018 revealed that only 39.1 % of rural households had access to improved toilet and about 33 percent of rural households use open defecation (NPC & ICF 2019). Similarly, in Table 6, the relationship between access to toilet facilities and cassava farmers' CCI levels in the two states are not statistically significant (Ogun, $p = 0.05$; Oyo, $p = 0.52$). This is not unconnected to the fact that many of the cassava farm households did not have access to toilet facilities in the study areas rural Ogun and Oyo states.

Likewise, Nigeria was ranked 24th (out of 54 countries in Africa) in 2020 composite AIDI with 23.26 (23.26/100). Nigeria was ranked 30th (among 54 African countries) with index score of 65.62 in the 2020 Africa water supply and sanitation index (WSS). This result indicated that Nigeria is not among the top 10 countries with best WSS index in the region (AfDB, 2020). According to United Nations Children's Fund (UNICEF), Nigeria is ranked second globally with 38 million people practicing open defecation while West and Central Africa accounted for about 24 percent of global open defecation (UNICEF 2021). This portends high risk of malnutrition and diarrheal disease incidence especially in young children in Nigeria (UNICEF 2021, Omotayo et al. 2021).

When considering rural infrastructure, healthcare service (rural social infrastructure) is categorized as one of the three main classes of rural infrastructures in Nigeria (Idachaba, 1985). Table 7 indicated the level of access to healthcare service across the four categories of cassava commercialization farm household levels in the study areas of Ogun and Oyo States, Nigeria. The results showed that more than 50 percent of all the four commercialization household levels had access to healthcare in the study areas. The result indicated that low level commercialization households (CCI 2) had the highest level (61.7 %) of access to healthcare service in the two states (Ogun, 73.3 % and Oyo, 57.8 %). Comparing access to healthcare among the cassava commercialization households in the study areas, the result revealed that cassava farming households in Ogun State had higher access to healthcare service (80.9 %) than that of Oyo State (41.7 %). Similarly, in Table 7, the relationship between access to healthcare service and cassava farmers' CCI levels was found to be statistically significant in Ogun state ($p < 0.01$) while it was not statistically significant in Oyo state ($p = 0.23$). This results reflected the fact that more

Table 6: Percent distribution of access to improved toilet among cassava farmers' commercialization household levels

		State	
		Ogun (n = 141)	Oyo (n = 211)
CCI levels	Access to Toilet	n (%)	n (%)
Zero Level (Non Seller)	Have access to toilet	3 (25.0)	5 (14.7)
	No access to toilet	9 (75.0)	29 (85.3)
	Total	12 (100)	34 (100)
Low Level	Have access to toilet	7 (46.7)	10 (22.2)
	No access to toilet	8 (53.3)	35 (77.8)
	Total	15 (100)	45 (100)
Medium-High Level	Have access to toilet	15 (34.1)	8 (13.1)
	No access to toilet	29 (65.9)	53 (86.9)
	Total	44 (100)	61 (100)
Very High Level	Have access to toilet	40 (57.1)	15 (21.1)
	No access to toilet	30 (42.9)	56 (78.9)
	Total	70 (100)	71 (100)
Total	Have access to toilet	65 (46.1)	38 (18.0)
	No access to toilet	76 (53.9)	173 (82.0)
	Total	141 (100)	211 (100)
Pearson Chi-Square (χ^2) or Fisher's exact, *p*-value		–, 0.05	2.25, 0.52

Computed from field survey data, 2020

than half of the population of smallholder cassava farmers in Ogun state had access to healthcare service.

The results in Table 8 showed the distribution of access to piped water among CCI levels farm households in the study areas. However, access to piped water is another aspect of WSS index (fourth component of the indicators used to compute AIDI). As indicated above, access to improved water and sanitation is crucial to the nutrition and health status of members of households both in rural and urban settings in Nigeria (AfDB, 2020). The recent report of NDHS revealed that 74 % of households in urban area have access to improved source of drinking water while 42 % of the rural households in Nigeria did not have access to improved source of drinking water (NPC & ICF, 2019). Table 8 revealed the level of access to piped water among cassava commercialization households in Ogun and Oyo States. The results showed that in all the four categories of cassava commercialization households, less than 20 percent (14.5 %) had access to piped water in the study areas of Ogun and Oyo States. This result is lower than the national average of 42 % access to improved sources of water in rural households in Nigeria (NPC & ICF, 2019; Otekunrin et al. 2022b; Otekunrin 2022). Similarly, in Table 8, the relationship between access to piped water and cassava farmers' CCI levels was not statistically significant in the two states (Ogun, p = 0.96; Oyo, 0.67). Additionally, this result portends grave challenge on the unavailability of safe sources of drinking water in the rural settings of Ogun and Oyo states.

Zero commercialization households had the least percentage (10.9 %) of cassava farmers' households' access to piped water. Access to piped water among the cassava commercialization households in the study areas indicated that cassava farming households in Ogun State had higher access to piped water (30.5 %) compared to those in Oyo State (3.5 %). Both of these results are still below the national average of 42 % water access by rural households in Nigeria. This revealed the rural infrastructure gaps in the study areas which has the potential of posing serious health and environmental concern in the rural settings of Ogun and Oyo states (NPC & ICF, 2019; Otekunrin et al. 2022b; Otekunrin 2022).

3.4 DETERMINANTS OF AGRICULTURAL COMMERCIALIZATION AMONG CASSAVA FARMERS

Table 9 presents the factors influencing agricultural commercialization in the study area. This analysis was carried out to assess the drivers of agricultural commercialization among smallholder cassava farmers in the

Table 7: Percent distribution of access to healthcare service among cassava farmers' commercialization household levels

		State	
		Ogun (n = 141)	Oyo (n = 211)
CCI levels	Access to Healthcare service	n (%)	n (%)
Zero Level (Non Seller)	Have access to healthcare	11 (91.7)	12 (35.3)
	No access to healthcare	1 (8.3)	22 (64.7)
	Total	12 (100)	34 (100)
Low Level	Have access to healthcare	11 (73.3)	26 (57.8)
	No access to healthcare	4 (26.7)	19 (42.2)
	Total	15 (100)	45 (100)
Medium-High Level	Have access to healthcare	32 (72.7)	30 (49.2)
	No access to healthcare	12 (27.3)	31 (50.8)
	Total	44 (100)	61 (100)
Very High Level	Have access to healthcare	60 (85.7)	20 (28.2)
	No access to healthcare	10 (14.3)	51 (71.8)
	Total	70 (100)	71 (100)
Total	Have access to healthcare	114 (80.9)	88 (41.7)
	No access to healthcare	27 (19.1)	123 (58.3)
	Total	141 (100)	211 (100)
Pearson Chi-Square (χ^2) or Fisher's exact, p-value		–, 0.23	12.11, <0.01

Computed from field survey data, 2020

Table 8: Percent distribution of access to piped water among cassava farmers' commercialization household levels

		State	
		Ogun (n = 141)	Oyo (n = 211)
CCI Household levels	Access to Piped water	n (%)	n (%)
Zero Level (Non Seller)	Have access to piped water	3 (25.0)	2 (5.9)
	No access to piped water	9 (75.0)	32 (94.1)
	Total	12 (100)	34 (100)
Low Level	Have access to piped water	5 (33.3)	2 (4.4)
	No access to piped water	10 (66.7)	43 (95.6)
	Total	15 (100)	45 (100)
Medium-High Level	Have access to piped water	13 (29.5)	1 (1.6)
	No access to piped water	31 (70.5)	60 (98.4)
	Total	44 (100)	61 (100)
Very High Level	Have access to piped water	22 (31.4)	3 (4.2)
	No access to piped water	48 (68.6)	68 (95.8)
	Total	70 (100)	71 (100)
Total	Have access to piped water	43 (30.5)	8 (3.8)
	No access to piped water	98 (69.5)	203 (96.2)
	Total	141 (100)	211 (100)
Fisher's exact, *p*-value		–, 0.96	–, 0.67

Computed from field survey data, 2020

study areas. The cassava commercialization categories were ordered and the commercialization levels were significant ($p < .001$) (Table 9). The threshold value indicating the commercialization levels; (cut1, cut2 and cut3) indicated that a value of the latent variable with -0.4382 or less represented zero commercialization (CCI 1), between -0.4382 and 1.080 was low commercialization (CCI 2), between 1.080 and 2.7352 represented medium-high commercialization (CCI 3) while a value ≥ 2.7352 was very high commercialization (CCI 4). The dependent variable is the agricultural commercialization levels (crop share ratio) categorized into four outcomes (1= Zero Level, 2 = Low Level, 3 = Medium-High Level and 4 = Very High Level). The predicted probabilities of Y = 1 or the marginal effects was estimated which measured changes in the probability of agricultural commercialization outcome with respect to a change in explanatory variables.

Tables 9 revealed the results of the ordered logistic regression and the marginal effects of each of the explanatory variable on the probability of agricultural commercialization levels.

The marginal effects provide insights into how the explanatory variables shift the probability of cassava farmers' CCI between the four ordinal levels. The statistical significance of the coefficients and the marginal effects as discussed as follows. Age, marital status, farm experience, farm income, distance to market, transport cost, cassava marketing experience, access to toilet and motorcycle ownership were the explanatory variables that had significant influence on agricultural commercialization of cassava farmers (Table 9).

The estimated results indicated that age of cassava farmers are significant at 1% level of probability, and has a negative relationship with the probability of being in the "very high commercialization level (CCI 4). The results of the marginal effects showed a unit increase in age is expected to lead to 0.0097 decrease in the probability of attaining very high commercialization level. This result agrees with *a priori* expectation that the younger the farmer, the higher the productivity which may equally lead to increasing the extent of agricultural commercialization. The result is similar to other works that opined that the older the farmer becomes, the lower the likelihood of market participate and more less likely the farmer increases the extent of his commercialization (Martey et al. 2012; Olwande & Mathenge 2011; Okoye et al. 2016). This result is contrary to the work of Enete et al. 2009 who posited that older farmers are most likely to increase the extent of cassava sales.

The results indicated that a unit increase in married respondents is expected to lead to 0.07 and 0.10 decrease

in the probability of falling in the categories of zero (CCI 1) and low commercialization (CCI 2) levels respectively. But a unit increase in married farmer is expected to lead to 0.16 increase in the probability of extending cassava commercialization to very high level (CCI 4).

This implies that the married farmer will have more household size as well as opportunity of available family labour to work on the farm in case of short fall in hired labour which can result in the increase in commercialization levels of the farmers. This results is similar to that of Effiong (2005); Adepoju et al. (2019) and Kolapo et al. (2020) who opined that larger household size enhances the availability of family labour which reduces constraint on labour demand in cassava production, processing and marketing. A unit increase in farmer's farm experience will increase the probability of the farmer extending cassava commercialization from zero, low and medium-high levels by 0.0064, 0.0121 and 0.0034 respectively. Consequently, a unit increase in farm experience is expected to lead to a decrease in farmer attaining the highest level of commercialization (CCI 4) by 0.0220 assuming other factors are held constant.

Moreover, as the distance from farm to market decreases by a kilometer, the probability of the cassava farmer falling in the categories of zero, low and medium-high commercialization levels is expected to increase by 0.81 %, 1.53 % and 0.44 % respectively. Meanwhile, as the distance from farm to market increases by a kilometer, the probability of farmers engaging in very high level of commercialization (CCI 4) increases by 2.77 %. This implies that farmers may not be willing to participate in very high commercialization level if they are very far from market centers usually because of higher transaction costs. This is in line with the studies of Omiti et al. (2009), Gebremedhin & Jeleta (2010), Agwu (2012), Opondo et al. (2017) and Otekunrin & Sawicka (2019) who found that distance to market centers inhibits access to the market and market participation of smallholder farmers.

The results also indicated that as farmers increase their marketing experience, they are able to extent their level of commercialization up to the highest level (CCI 4). This is in line with *a priori* expectation because farmers with increased marketing experience tend to have good bargain power (for prices of farm produce) at the market than those with little or no experience. This corroborates the findings of Okoye et al. (2016) who concluded that farmers' higher cassava farming experience has significant influence on the probability of households participating in markets and attaining increased commercialization level than selling at the farm gate in Central Madagascar.

Moreover, a unit increase in farmers' motorcycle ownership is expected to increases the probability of farmers extending their cassava commercialization by 0.0445, 0.0854 and 0.0305 from zero, low and medium-high commercialization levels respectively. This indicated that motorcycle ownership enhances agricultural commercialization in the study area.

3.5 STUDY LIMITATIONS AND AREAS FOR FURTHER RESEARCH

The study employed cross-sectional survey data from only rural cassava farmers in Ogun and Oyo states, South-West Nigeria while the findings from this study may not be generalized for all cassava farmers in rural settings and in all geo-political zones of the country. However, all rural cassava farmers involved in this study were smallholder farming households with not more than 5 hectares of cassava farm land while those > 5 ha of farmland are excluded in this study which may give an entirely different result outlook.

Additionally, other studies that investigate agricultural commercialization and infrastructure development in other geo-political zones (e.g. North-East, North-West, North-Central, South-South among others) of Nigeria should be carried out to capture the findings that may stem out of geo-political zone differences among smallholder cassava farmers. Also, further studies may capture the urban commercial farmers cultivating on more than 5 ha farmland

4 CONCLUSIONS

Transition from subsistence to commercial agriculture is a crucial pathway to the growth and development of most developing countries especially those that depend mainly on agriculture. It is equally important to assess the role of rural infrastructure development in promoting agricultural commercialization in Ogun and Oyo States, Nigeria. In this study, we assessed agricultural commercialization and rural infrastructure development among smallholder cassava farmers in Southwestern Nigeria. Crop commercialization index (CCI) was used to categorize cassava farming households into levels and OLM was employed to analyze the drivers of agricultural commercialization of cassava farmers in the study areas. The CCI was computed for each farm household while we explored level of rural infrastructure development across the four cassava farmers' commercialization levels in the study areas. The study found that about 87 percent of cassava farmers participated in the marketing of their cassava produce with mean CCI of 59.1 %.

Table 9: Determinants of agricultural commercialization

Variable (X)	Estimated values	Marginal effects of zero level	Marginal Effect of low level	Marginal Effect of medium-high level	Marginal Effect of very high Level
Age	-0.0424***	0.0028***	0.0053***	0.0015	-0.0097***
	(0.0127)	(0.0009)	(0.0017)	(0.0010)	(0.0029)
+Gender	-0.3680	0.0235	0.0456	0.0160	-0.0850
	(0.2450)	(0.0148)	(0.0303)	(0.0147)	(0.0572)
+Marital Status	0.7850***	-0.0671**	-0.1021***	0.0086	0.1606***
	(0.2903)	(0.0299)	(0.0391)	(0.0215)	(0.0523)
Household Size	0.0556	-0.0037	-0.0070	-0.0020	0.0127
	(0.0508)	(0.0034)	(0.0065)	(0.0021)	(0.0116)
Year of schooling	-0.0030	0.0002	0.0004	0.0001	-0.0007
	(0.0382)	(0.0025)	(0.0048)	(0.0014)	(0.0087)
Farm Size	0.0300	-0.0020	-0.0038	-0.0011	0.0068
	(0.2138)	(0.0142)	(0.0269)	(0.0078)	(0.0488)
Farm Experience	-0.0962***	0.0064***	0.0121***	0.0034*	-0.0220***
	(0.0315)	(0.0023)	(0.0044)	(0.0020)	(0.0070)
Farm Income	2.11e-06**	-1.40e-07**	-2.66e-07**	-7.56e-08	4.82e-07**
	(1.04e-06)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Nonfarm Income	-9.01e-07	5.98e-08	1.14e-07	3.22e-08	-2.06e-07
	(5.95e-07)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Distance from farm to Market	-0.1215***	-0.0081***	-0.0153***	-0.0044	0.0277***
	(0.0317)	(0.0023)	(0.0043)	(0.0028)	(0.0072)
Transport Cost	0.0003***	-0.00002***	-0.00003***	-9.71e-06	0.00006***
	(0.00009)	(0.00001)	(0.00001)	(0.00001)	(0.00002)
Food Expenditure	0.00003*	-1.79e-06*	-3.40e-06*	-9.64e-07	6.15e-06*
	(0.00001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Cassava marketing Experience	-0.2014***	-0.0134***	-0.0254***	-0.0072*	0.0460***
	(0.0352)	(0.0029)	(0.0053)	(0.0041)	(0.0078)
+Access to credit	-0.6126	0.0521	0.0803	-0.0068	-0.1256
	(0.8666)	(0.0919)	(0.1138)	(0.0521)	(0.1547)
+Access to Extension	0.0552	-0.0036	-0.0069	-0.0021	0.0126
	(0.3040)	(0.0200)	(0.0381)	(0.0117)	(0.0697)
+Access to healthcare services	-0.0490	0.0032	0.0062	0.0018	-0.0112
	(0.2888)	(0.0190)	(0.0363)	(0.0109)	(0.0661)
+Access to toilet	0.7743**	-0.0454***	-0.0916***	-0.0452	0.1822**
	(0.3072)	(0.0164)	(0.0339)	(0.0299)	(0.0738)
Own motorcycle	-0.6966**	0.0445***	0.0854**	0.0305	-0.1604**

Continued on next page

	(0.2858)	(0.0169)	(0.0352)	(0.0210)	(0.0661)
/cut1	-0.4382				
	(0.7125)				
/cut2	1.0801				
	(0.7137)				
/cut3	2.7352				
	(0.7250)				

Note: (+) is dummy variable from 0 to 1, ***Significance at 1 % level **Significance at 5 % level
*Significance at 10% level. Figures in parentheses are robust standard errors
Number of observation = 211, Log Pseudo likelihood = -376.53844, Wald $chi^2(18)$ = 86.00
Probability >chi^2 = 0.0000, Pseudo R^2 = 0.1739

Furthermore, the study revealed many cassava farming households did not have access to some rural infrastructure such as electricity, improved toilet, access to healthcare service and access to piped water especially farming households from Oyo State. The ordered logit regression analysis showed that age, marital status, transport cost, cassava marketing experience, distance to market and ownership of motorcycle were among the significant factors influencing agricultural commercialization in the study areas. Therefore, stakeholders should expedite policy actions capable of promoting rural infrastructure development that will enhance agricultural production, marketing and improve the quality of life of rural households.

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