EFFECT OF EDUCATION AND MEMBERSHIP OF FARMER-BASED ORGANISATIONS ON COMMERCIALIZATION OF PADDY RICE: A GUIDE FOR PUBLIC AGRICULTURAL POLICIES IN NIGERIA

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ABSTRACT
Rice commercialization is the deliberate action on the part of rice farmers to use factors of production in a way that a greater volume of rice produced is exchanged for sale. This study examined the effect of education and membership of farmer-based organizations (FBOs) on rice commercialization in Gwagwalada Area Council, Federal Capital Territory. Cross-sectional data collected from 140 rice farmers were used for this study. The data were collected from 140 rice farmers through multistage sampling technique. The data were analysed using commercialization index and Beta model. The result of the commercialisation index indicates that majority of the farmers highly commercialised rice. The result of the Beta model analysis shows that age of the farmers, education level of the rice farmers, farm size, literacy ratio, household size and membership of farmer-based organisations were important variables that were significant with policy implications. On the results of the constraints militating against rice commercialization in the study area, lack of/ adequate credit for rice production, high cost of fertilizer, and lack of or inadequate proper storage facilities were identified as very serious constraints in the study area. The study recommends that younger farmers should be encouraged to cultivate and commercialize rice and, Governments should take seriously the literacy programmes to address agricultural commercialization literacy, and make education programmes that is geared towards agribusiness development to be much more marketing-oriented rather than the general secular education. Governments and development partners should encourage formation and establishment of farm-based organizations to enhance agricultural commercialisation in Nigeria. Credit facilities more accessible to rice farmers, and there is also need to train rice farmers more in rice commercialization.
Keywords: Education, farmer-based organisations, commercialization, public policies, and Beta model, Agricultural Economics
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1   INTRODUCTION

Rice (*Oryza sativa L.*) is the world's most valuable and important food product, as research has shown that about three billion people world-wide consume rice every day and that the increasing rate of consumption makes most countries import-dependent on rice including

Nigeria (Agbogo, Udouso & Tiku, 2013). The consumption of rice is recorded across all the agrocecological zones of Nigeria, and this made it a major staple crop. The consumption of rice is never commensurate with the production of it due to shift in consumer preference for rice, increasing population, and rapid urbanization, with these the country rely mostly on importation which amount annually to about 3 million tonnes (USD$480 million of foreign exchange) (Kamai, Omoigui, Kamara, & Ekeleme, 2020). The successive governments in Nigeria have been coming up with various agricultural programmes and interventions targeted towards boosting local production of rice, among them are National Cereal Research Institute (NCRI), Badeggi, Niger State with the mandate to conduct research in cereal production, and recently the policies enacted are geared towards making agriculture to be a business.

These efforts made by Nigeria Government yielded considerable results as the production improved from 3.7 metric tonnes in 2017 to 4.0 metric tonnes in 2018 (Kamai et al., 2020), it has increased to about 5.4 metric tonnes in 2022. The increase in local production of paddy also can lead to increase in the rice milled in the country. In 2022, the quantity of milled rice produced in Nigeria was estimated at 5.4 million metric tonnes, there has been constant increase in milled rice production (Sasu, 2022). In addition, the Nigerian Federal Government has raised rice import tariffs at various times in order to safeguard local rice growers against huge imports (Ekeleme et al., 2008). Despite the many initiatives, there remains a significant disparity between domestic rice demand and supply in the country. This is largely due to the fact that, despite the comparative advantage of producing in large quantities for commercialization, rice cultivation in many sections of the country has remained subsistence-oriented.

Commercialization of agriculture also entails a shift from subsistence-oriented to production and use of inputs that is geared towards making the production markets inclined. The basis of this is that households' income can be enhanced when they can participate more in the markets by producing agricultural commodities that provide the highest returns on land and labour and then using the cash to purchase household consumption items, rather than being constrained to produce all of the commodities that the households require to consume (Pingali, 1997). In order to bridge the gap between domestic demand and supply of rice in Nigeria, it is necessary to produce at market-oriented level in order to increase rice production self-sufficiency. This can be accomplished, however, if the elements that influence market-oriented agricultural production are identified and the challenges are addressed.

Agricultural commercialization contributes to global economic growth and development in a passive and supporting manner (Kirsten, Mapil, Okello & De, 2012; Leavy & Poulton, 2007). Much of the discussion focuses on agricultural commercialization as efforts to further alter the agricultural sector to assist increase the livelihood of rural farmers in developing countries progress (World Bank, 2008).

Commercialization of agricultural producers through increased participation in output markets has been promoted as one of the best strategies to address low agricultural productivity that has led to high levels of poverty and food insecurity among rural farming households in developing countries (Jaleta, Gebremedhin, & Hoekstra, 2009; Olwande & Mathenge, 2011, Thurlow, Kiringai, & Gautam, 2007). Even the market liberalization policy agendas that were widely promoted in sub-Saharan Africa (SSA) in the 1980s and 1990s under Structural Adjustment Programmes (SAP) were broadly aimed at stimulating and enhancing agricultural commercialization. Though these liberalization policies were aimed at opening up new market-led opportunities for economic growth, their results were mixed in most countries. Even to date,

many agricultural producers continue to engage in subsistence agriculture and thus unable to benefit from commercialization opportunities presented by the liberalized markets (Barrett, 2008; Boughton et. al., 2007; Olwande & Mathenge, 2011; Rono, 2002; Shiferaw, Kassie, & Muricho, 2008; Siziba, Nyikahadzoi, Diagne, Fatunbi, & Adekunle, 2011; Woolverton, Okello, Benci, & Neven, 2014). The Special Rice Project (SRP) was initiated and implemented by the Federal Government of Nigeria in all the 36 states of the Federation including the Federal Capital Territory to assist the farmers to access farm inputs at affordable prices and to expose them to the technology of seed production. These are calculated attempts to reduce cost of farm operations. It is in view of these that the study revolves around the effects of education and membership of farmer-based organisations (FBOs) on commercialisation of paddy rice in Gwagwalada Area Council of the Federal Capital Territory.

Previous studies on commercialization in agriculture were carried out not necessarily considering rice among them are Bezabeh, Beyene, Haji, and Lemma (2022) which centres on commercialization was carried out on smallholder malt barley farmers via vertical coordination in Arsi highlands, Oromia region, Ethiopia. Also, Bernard, Taffesse, and Gabre-Madhin (2008) evaluated the influence of marketing cooperatives on commercialization of cereals by smallholders using detailed household data in rural Ethiopia. This involved the use of counter-factual analysis with the application of propensity score matching (PSM) to compare two groups of households on the basis of cooperative membership and non-membership. Ouedraogo, Al-hassan, Amegashie, Zahonogo, and Sarpong (2018) used double hurdle model to analyse smallholders' agricultural commercialization in Burkina Faso. Again, Tafesse et al. (2023) also used Heckman two-stage sample selection model to examine the factors influencing the likelihood of smallholder farmers taking part in maize trading in southern Ethiopia. Muriithi and Matz (2015) assessed the influence of smallholder vegetable commercialization to reduce poverty using panel data household survey data from Kenya. Falola et al. (2019) used Heckman two-stage model to investigate determinants of smallholder rice farmer's participation in market. In addition it also examines the relationship of commercialization and the welfare of smallholder farmers. Konja and Mabe (2023) assessed market participation of smallholder groundnut farmers in Northern Ghana using generalised double-hurdle model approach. Ayele (2022) assessed cereal crops commercialization and its effect on welfare of households in Guji Zone, Ethiopia. Also, Nasir, Mulugeta and Kassa (2017) investigated the impact of commercialization on rural household food security in Jimma Zone of South West Ethiopia.

In addition, there have been some studies conducted on effects of education and cooperative (or association) membership on agricultural activities among them is the study by Ajah (2013) assessed the influence of formal education and cooperative membership on the farm size cultivated by farmers in Abuja, Nigeria. Also, Lawrence, et al. (2023) examined the effect of cooperative education and training for sustainable agricultural marketing co-operative societies in Ukerewe and Sengerema Districts of Tanzania using mainly qualitative data. Kinjuira (2017) assessed the impact of cooperative education/training on cooperative performance which emphasise marketing oriented education.

However, none of this study explained the effects of farmers' education and membership of farmer-based organisations (FBOs) on commercialization of paddy in Federal Capital Territory. The findings of this study could point to policy options that stakeholders in the Nigeria rice industry could adopt, resulting in increased rice production and commercialisation level, as a result, Nigeria's reliance on rice imports will be reduced.

2   LITERATURE REVIEW
Conceptual and Empirical Review

Agricultural commercialization can be defined as the percentage of agricultural production that is sold. It entails the agricultural producer's conscious action to employ production variables in such a way that a greater proportion of crops produced is exchanged or sale (Okozie, 2006). Crop commercialization refers to "the process of transforming subsistence farming into a market-oriented farming system, where crops are grown and sold for profit." This aims at enhancing farmers' income and improving their livelihoods. It is a major strategy for improving agricultural productivity, reducing poverty, and promoting economic growth in rural areas (Food and Agriculture Organization of the United Nations [FAO], 2017).

Research for development in Africa has recently concentrated on smallholder commercialization to guarantee food security and economic growth (World Bank, 2006). This is necessary in order to enhance the farmers' income, welfare, and household food security. Also, the relevant education level of farmers and the literacy level of the household members can be contributing factors to have access to markets.

As the agricultural sector in developing nation's transitions towards commercialization, smallholder farmers need mechanisms that are responsive to their demands, including access to markets, market information, market intelligence, and effective farmer organization (Martey, Etwire, Wiredu, & Dogbe, 2014). Research has also shown that about 70 percent of the rural poor smallholder farming households living in sub-Saharan Africa (SSA) depends on agriculture for provision of livelihood and food security for the family directly or indirectly (International Fund For Agricultural Development [IFAD], 2012). One of the ways in which smallholder farmers are helped to secure market opportunities, extension and advisory services, and secure access to finance is through farmer-based organisations (IFAD, 2022).

Farmer-based organisations (FBOs) also known as farmers organisations (FOs) "are autonomous membership- based professional organizations of smallholders, family farmers and rural producers, including pastoralists, artisanal fishers, landless people and indigenous people. They are structured beyond the grass-roots or community level, at the local, national, regional and global levels, on either a commodity or a territorial basis. They include all forms of producers' associations, cooperatives, unions and federations" (Longo, 2016). Hence, membership of farmer-based organisations (FBOs) is fundamental to enhancing their market participation. Level of market participation of farmers also shows the level of commercialisation of their agricultural produce.

Ogutu, Godecke and Quaim (2020) evaluated the effects of commercialisation on household food security and dietary quality with a special focus on calorie and micronutrient consumption. They examined transmission channels by looking at the role of income, gender, and possible substitution effects between the consumption of own-produced and purchased foods. They used survey data from farm households in Kenya and a control function approach. Generalised propensity scores are employed to estimate continuous treatment effects. Commercialisation significantly improves food security and dietary quality in terms of calorie, zinc and iron consumption. Commercialisation contributes to higher incomes and increased nutrients from purchased foods, but it does not reduce the consumption of nutrients from own-produced foods.
In their study, Anteneh and Endalew (2023) analyzed the determinants of teff commercialization among smallholder farmers in Hulet Eju Enese Woreda, Ethiopia. The primary data were collected from 384 randomly selected smallholder farmers. They used utput commercialization index, and a beta regression model. The findings show that about 77.2% of smallholder farmers are classified as commercial, while semicommercial farmers account for

22.8% of all observations. The Beta model results revealed that the number of oxen, teff land size, farming experience in teff production, market distance, and agroecology had statistically significant effects on teff commercialization.

Bezabeh, Beyene, Haji and Lemma (2022) used descriptive statistics and tobit regression model to analyze farmer and farm-related factors vis-à-vis vertical coordination and level and determinants of commercialization farm households. The study identified that 11.05% of the respondents had <30% level of commercialization, when 55% were between 30% and 65% and the rest. Tobit regression revealed that farm size, yield, price, quantity of fertilizer applied, contract agreements, mobile phone ownership and access to technology were determinants of level of malt barley commercialization.

Falola, Animashaun, and Olorunfemi (2014) examined the degree of commercial rice production in Kwara state using descriptive statistics, the household commercialization index, and regression models. According to the results of the commercialization index function, household commercialization of rice production is 62%. Education level, farming experience, farm size, and usage of contemporary technology were the variables that impacted the commercialization of rice production in the research area.

The study by Ouedraogo, Al-hassan, Amegashie, Zahonogo, and Sarpong (2018) on analyzing smallholders' agricultural commercialization in Burkina Faso using a double hurdle model, the results showed that schooling years, the number of extension contacts, and the total land size under soybean production all positively and significantly influenced decisions about soybean commercialization, while schooling years, the number of extension contacts, and the total land size under soybean production all positively and significantly determined the intensity of soybean commercialization. With these findings, the study suggests that all genders have equal access to agricultural resources, that exclusive land ownership rights be established, and that the extension system be structured and strengthened.

Awotide, Karimov and Diagne (2016) assessed the determinants of intensity of adoption of Improved Rice Varieties (IRVs) and the effect of market participation on farmers' welfare in Nigeria using the Tobit and Heckman two-stage models, respectively. The sample consists of cross sectional data of 600 rice farmers selected randomly from three notable rice producing States in Nigeria. It was revealed that gender of household head, access to improved seed, years of formal education, and average rice yield were those variables that are positive and statistically significant in increasing the probability that a farmer would participate in the market. The result further suggests that any increase in the farmers' welfare is conditional on the probability of the farmer participating in the rice output markets. In addition, higher yield, income from rice production, gender of household head, and years of formal education are the variables that are positive and statistically significant in determining households' welfare.

3.   METHODOLOGY

Study Area: This study will be conducted in Gwagwalada, Abuja, Nigeria. Gwagwalada is an Area Council located in the heart of Federal Capital Territory (FCT), Nigeria. Its geographical coordinates are $8.56^o 29^1$ North, $7.5^o 31^1$ East. Before the creation of Federal Capital Territory, Gwagwalada under the Kwali District of the former Abuja Emirate. Gwagwalada Area Council was created on 15th October, 1984. The relocation of the seat of government from Lagos to Abuja in 1992 and the recent demolition of illegal structure within the Federal City Centre brought a massive influx of people into the Area Council being one of the fastest growing urban centres in the FCT. The population of the area has grown to over 1,000,000 people. Subsistence

agriculture is the main economic activity of the rural populace (FCT Bulletin, 2006). Gwagwalada is also favourable for livestock production because of the abundant grazing land. It is strategically located and this makes it easily assessable to other bordering Area Councils such as Kuje, Abaji and Abuja Municipal. Gwagwalada is located at an elevation of 210 meters above sea level. It has an area of 1069.589km^2 with ten wards namely, Zuba, Dobi, Tunga-Maje, Ibwa, Kutunku, Ikwa, Paiko, Gwako, Staff Quarters and Gwagwalada Central (FCT Bulletin, 2006).

Figure 1: Map showing the study area (Gwagwalada Area Council of Federal Capital Territory).
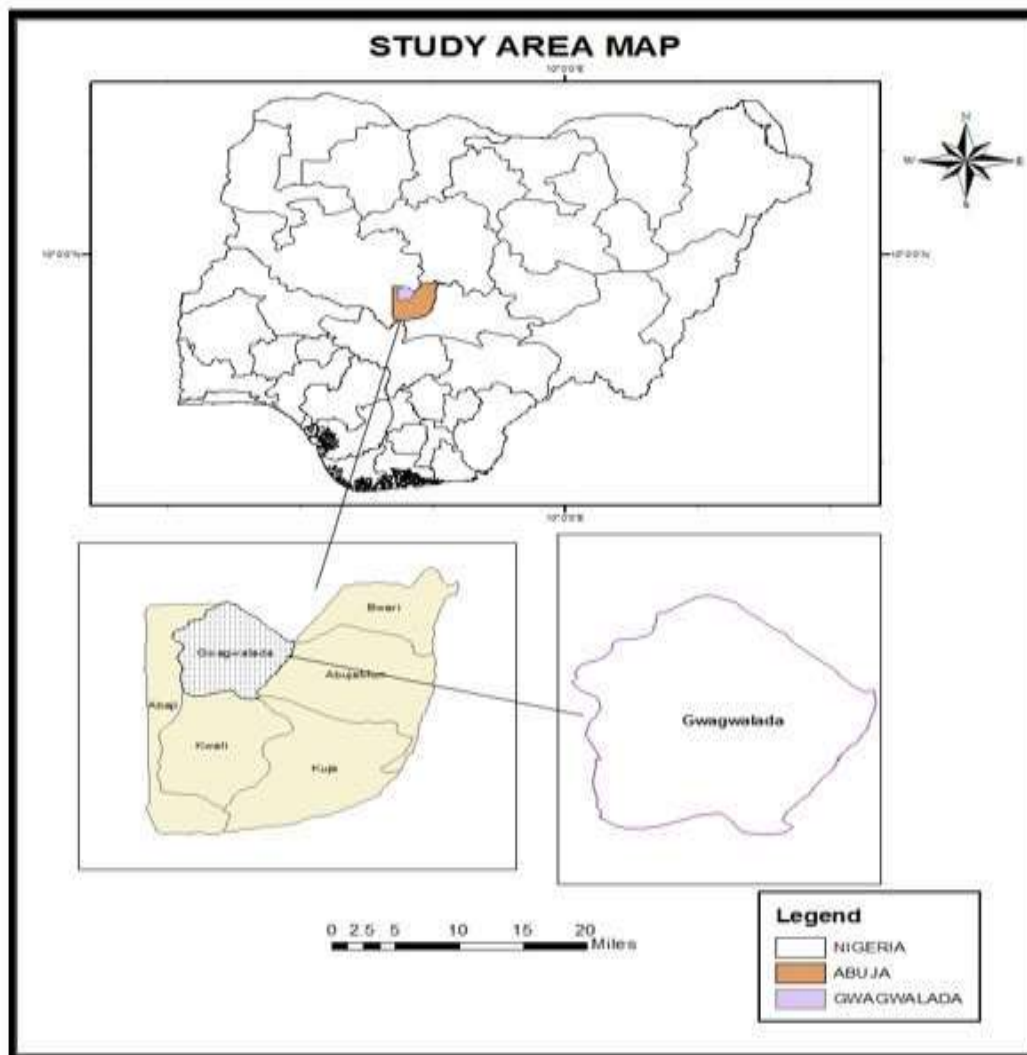
Sampling Technique and sample size: This study was conducted using multi-stage sampling technique to select the respondents. The choice of Gwagwalada Area council is due to the preponderance of rice farming activities in this area of Federal Capital Territory. In the first stage, four agricultural blocks in Gwagwalada Area Council were purposively selected. In the second stage, a simple random sampling was adopted to select 35 farmers (equal-size sampling) from each block amounting to 140 rice farmers in all. The list of the farmers was collected

from the Agricultural Development Programme (ADP) Gwagwalada Office, to form the sampling frame. The unit of analysis is rice farmers.

Method of Data Collection: In this study, data was obtained from primary source. The data was collected through survey by the researcher with the help of well-trained enumerators from Agricultural Development Programme (ADP) Office. The data was obtained using well-structured questionnaire, which focused on the factors that have influence on rice commercialization (education level, membership of FBOs, age, sex, household size, farm size, literacy ratio), and the constraints militating against rice commercialization by rice farmers. The data was collected between 1st April to 15th April, 2023 (2 weeks).

Models Specification

Crop Commercialization Index:

Crop Commercialization Index (CCI) was used to estimate commercialization

Crop Commercialization Index (CCI$_i$) =

$$\frac{Total\ Volume\ of\ Crop\ Sold\ (kg)}{Total\ Volume\ of\ Crop\ Produced\ or\ Harvested\ (kg)} X\ 100 \text{-- --------}\quad (1)$$

For rice commercialization, equation (1) becomes,

Rice Commercialization Index (CCI$_i$) =

$$\frac{Total\ Volume\ of\ rice\ paddy\ sold\ (kg)}{Total\ volume\ of\ rice\ paddy\ produced\ or\ â„žarvested\ (kg)} X\ 100 \text{--- ----}(2)$$

The commercialization index estimates the extent to which rice farming/production is directed towards the market. This index falls between 0 and 1, the closer the index to 1, the more commercialized the farmer, the closer the value to 0, the more subsistent-oriented the farmer is (Bazea & Ahmed, 2016; Govereh, Jayne, & Nyoro, 1999; Mohammed,).

Econometric Model: Beta Model

Beta Model was adopted to analyse the effects of farmers' education and membership of farmer-based organizations on commercialization of paddy. Utilizing the beta regression model, it was possible to ascertain how post-harvest loss reduction measures affected household welfare. The open standard unit interval (0, 1) is a good range of values for continuous variables y to model using beta regression. Components like proportions, percentages, and fractions are limited to (0, 1) in this response. Ferrari and Cribari-Neto (2004) are the authors of the beta regression model. Using a monotone differentiable function known as the link function, which links the response variable's mean function to a group of linear predictors. The variate mean and a precision parameter are two additional ways that the beta density is parameterized in this model (Ferrari & Cribari-Neto, 2004). Assume that y is a continuous random variable with a probability density function of the following, following a beta distribution:

$$f(y;\mu,\varphi) = \frac{\gamma(\phi)}{\gamma(\mu\phi)\gamma((1-\mu)\phi)}y\mu^{\varphi-1(1-y)(1-\mu)\varphi-1}, 0 < y < 1 \qquad 3$$

where $\gamma(.)$ is the gramma function and ϕ is the accuracy parameter. The beta probability distribution has the following mean and variance:

$$E(y) = \mu,\ var(y) = \mu(1-\mu)^{\sigma 2}. \qquad 4$$

The model permits μi, depending on variables, using the logit link function.
Here is a definition of the beta regression model:

$$g(\mu_i) = \log\left(\frac{\mu i}{1-\mu i}\right) = X_i^T \beta = \eta\iota \qquad 5$$

Where: the systematic and random components are related by a monotonic differentiable link function denoted by g(.).

where $\beta = (\beta_1,...,\beta_k)^T$ is a k × 1 unknown regression parameters vector (k <η),

$xi=(x_{i1}, \ldots, x_{ik})^T$ is the independent variables or covariates and ηi isa linear predictor (i.e., ηi = $\beta_1 x_{i1} + \cdots + \beta_k x_{ik}$; usually $x_{i1} = 1$ for all *i* so that the model has an intercept).

One uses the maximum likelihood estimator to estimate the beta regression parameters (MLE) method that requires that both a link and distribution functions are specified.

The beta regression model's log-likelihood function can be found by:

$L(\mu_\iota, \phi, y_i) = \sum_{i=1}^{n}\{log_\gamma(\beta) - \log_\gamma(\mu_\iota)(C)) - \log_\gamma((1-\mu_\iota)(\mu_\iota)) + (\mu_\iota(\phi)-1)\log(y_i) + ((1-\mu)(\phi)-1)\log(1-yi)\}$ 6

$LogL(\beta) = \sum_{i-1}^{N} wi \log_\gamma(\phi) - wi\, log_\gamma(\grave{X}_1\beta\phi) - wi\, log_\gamma[(1-\grave{X}_1\beta\phi)\phi] + wi(X_1\beta\phi -1)\log CCI_1 + wi[(1-\grave{X}_1\beta\phi-1]\log(1-X CCI_1)$ 7

Where; crop commercialization index (CCI) is the dependent variable, N denotes sample size, X is a matrix of independent variables for post-harvest loss reduction measures, *wi* is an optional weight, ϕ is the precision parameter, and $_\gamma$ is the gamma link function. The link function $_\gamma$ (.) follows a logit distribution such that equation (6) turns into Equation (7) below;

$$g(X\grave{}_1\beta) = \frac{e^{x_1\beta}}{1+e^{X'_1\beta}} \qquad 7$$

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon_i$ 8
Where Y= dependent variable (Crop Commercialization Index)

X_i = explanatory variables (education level, membership of farmer-based organizations, and other control variables).

Description and Measurement of Variables
Table 1: Description and Expected signs of Explanatory Variables in this study

Explanatory Variables	Parameter	Variable	Expected sign (*a priori* expectation)
Age (years)	β_1	X_1	-
Household size (number of persons in the household)	β_2	X_2	+
Sex (Dummy1= male, 0= female)	β_3	X_3	+
Membership of farmer-based organizations (1 if yes, 0 otherwise)	β_4	X_4	+
Education level (years of schooling)	β_5	X_5	+
Farm size (hectares)	β_6	X_6	+
Literacy ratio in the household	β_7	X_7	+

4.   RESULTS AND DISCUSSION

Rice Produced and Commercialized by Farmers in the Study Area
Information was obtained on the volume or rice produced and commercialised (sold) in Gwagwalada Area Council of the Federal Capital Territory as presented in Table 2. The result shows that 10% of the respondents produced between 500-1500kg of rice, 16.4% of them produced 1501-2500kg of rice, 28.6% of them produced 2501-3500kg of rice, 28.6% of them produced 3501-4500kg of rice, 12.9% of them produced 4501-5500kg of rice, 2.9% of them produced 5501-6500kg of rice, while 0.7% of them produced 7501-8500kg of rice.
Analysis on rice sold showed that 0.7% of the respondents sold less than 500kg of rice, 19.3% of them sold 500-1500kg of rice, 35.7% of them sold 1501-2500kg of rice, 27.1% of the farmers sold 2501-3500kg of rice, 13.6% of them sold 3501-4500kg of rice, 2.9% of the respondent sold 4501-5500kg of rice while 0.7% of them sold 6501-7500kg of rice.

Table 2: Frequency Estimation of Rice produced and commercialized (sold)

Rice Volume	Rice produced		Rice sold	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Less than 500	-	-	1	0.7
500 – 1500	14	10.0	-	-
1501 – 2500	23	16.4	27	19.3
2501 – 3500	40	28.6	50	35.7
3501 – 4500	40	28.6	38	27.1
4501 – 5500	18	12.9	13.6	13.6
5501 – 6500	4	2.9	4	2.9
6501 – 7501	-	-	1	0.7
7501– 8500	1	0.7	-	-
Total	**140**	**100.0**	**140**	**100.0**

Source: Computed from field data, 2023.

Rice Commercialization Index among Rice Farmers in the Study Area

This analysis on rice commercialization index shows that 60% of the respondents had their rice commercialization index between 0.75-1.00 which implies that they have been able to commercialize, 37.1% of the respondents has their rice commercialization index between 0.51-0.75, while 2.9% of the respondents has their rice commercialization index between 0.26-0.50 which means they are subsistence oriented as shown in Table 3.

Table 3: Frequency Distribution of the Respondents by their Rice Commercialization Index

Rice Commercialization Index	Frequency	Percentage
0.26 - 0.50	4	2.9
0.51 - 0.75	52	37.1
0.76 - 1.00	84	60.0
Total	**140**	**100.0**

Source: Computed from field data, 2023.

The Influence of Formal Education and Membership of Farmer-Based Organisations (FBOs) on Rice Commercialization in Gwagwalada Area Council of Federal Capital Territory

According to Table 4, the analysis shows that rice commercialization are influenced by certain factors. The result of the Beta model indicates that some factors such as socio-economic characteristics (age of the farmer, household size, sex of the farmer, education level, farm size, literacy ratio). The likelihood ratio Chi-square is 48.83, and statistically significant at 1% level of probability, and loglikelihood value is 128.555. Out of the seven factors included in the model, seven explanatory variables were statistically significant and they influenced rice commercialization in the study area.

Age of the farmers: Table 4 revealed that age of the farmers (-0.00261) is negatively and statistically related to rice commercialization at 1% level of significance. This implies that younger farmers commercialised their rice output than their older counterparts. This might be as a result of the Federal Government of Nigeria agricultural and agribusiness policies that encouraged youth to participate profitably and productively in agriculture. This result agrees with the work of Ouedraogo et al. (2018) that age influenced smallholders' agricultural commercialization in Burkina Faso.

Household size: This is positively and statistically related to the probability of commercializing rice at 1% level of significance as shown in Table 4. This implies that a unit increase in the household size would increase rice commercialization by 0.05103). Household size is essential in the provision of family labour.

Membership of farmer-based organisations: This is positively and statistically related to the probability of rice commercialization at 1% level of significance as shown in Table 4. This shows that an increment in the participation of farmers in social and farm-based organisations will raise the level of rice commercialization by 0.459. Membership of social and farm-based organisations is very paramount in the participation of farmers in rice commercialization. This contradicts the findings of the study of Bernard, Taffesse, and Gabre-Madhin (2008) that marketing cooperatives obtained higher prices for their members but this did not have any significant increase in the overall share of cereal production sold commercially by their members. Membership of farmer-based organizations (FBOs) has the tendency to enhance the production skills of farmers through access to market information, and other resources including production inputs and credit (Asante, Afari-Sefa, & Sarpong, 2011).

Education Level of the rice farmers: Tables 4 revealed that the level of education (-0.0278) is negatively related and statistically significant to rice commercialization at 1% level of probability. This implies that the higher the level of education, the less the farmer's level of rice commercialization. This result is contrary to the expected micro-economic theory. But the reason could be that the farmers that are highly educated do not have adequate knowledge and skills of rice commercialization. This result disagrees with the work of Ouedraogo et al. (2018) that education influenced smallholders' agricultural commercialization in Burkina Faso. This negative relationship of farmers' education level with paddy commercialization could be that more educated farmers are less likely to engage in rice farming because of the have better access to alternative off-farm income opportunities (Kijima et al., 2011), and they may have more sources of income (Ellis, 1998). The finding of Abdullah et al. (2019) might suggest that vocational business training, which is more of marketing-oriented in nature might be of much relevance to agricultural commercialization (market participation).

Farm size: Table 4 shows that the farm size (0.1888) is positively related and statistically significant to the probability of the farmers to commercialise their rice output at 5% level of

probability. This implies that a unit increase in the farm size would increase the commercialization of rice. This implies most farmers that have a larger farm size are more liable to move from subsistence to commercial rice farming. This study agrees with the work of Bezabeh et al. (2022) that landholding size and farm size influenced the commercialization of smallholder malt barley farmers in Arsi highlands, Oroma region in Ethiopia. This agrees with the findings of Lopera, Gonzalez, and Martinez (2023) that farm holding had direct influence on market participation (total rice paddy sales) in Eastern Bolivia. It is also in agreement with the work of Ouedraogo et al. (2018) that farm size per worker significantly increase the likelihood of household intensity of commercialization. Tafesse et al. (2023) posited that land size had positive significant relationship with commercialisation of maize in Ethiopia, which agrees with the findings of this study. The finding of Abdullah et al. (2019) is also in support of this. This means that farm size is an important variable worth considering for a market-oriented rice farming.

Literacy ratio: Table 4 reveals that number of literates in the farmers' households (0.7214) is positively and significantly related to the likelihood of rice (paddy) commercialization at 1% level of probability. This implies that increase in the number of those that can read and write in the farmers' households the increases the likelihood of the farmers commercializing their rice produced. This result agrees with micro-economic theory on literacy.

Table 4: The Results from Beta Model Analysis that shows the Influence of Education, Membership of Farm-Based Organisations, and other Control Factors on Likelihood of Rice Commercialization

Explanatory Variable	Coefficient	Standard Error	t-value	P>|t|
Age of the farmer (Years) (X_1)	-0.0261	0.00805	-3.25***	0.001
Household size (Number) (X_2)	0.05103	0.0189	2.69***	0.007
Sex (Dummy, 1 if male, 0 otherwise) (X_3)	-0.1496	0.187	-0.80	0.424
Membership of farm-based organizations (FBOs) (Dummy, 1 if yes, 0 otherwise) (X_4)	0.459	0.1314	2.97***	0.003
Education level (years of schooling) ((X_5)	-0.0278	0.00949	-2.93***	0.007
Farm Size (hectares) (X_6)	0.1888	0.994	1.90*	0.058
Literacy ratio (the ratio of number of literates to the total number of persons in the household) in the household ((X_7)	0.7214	0.2431	2.97***	0.003
Constant	1.5012	0.3654	4.11	0.000

Diagnostic statistics:

Number of Observation   = 140

Likelihood Ratio Chi-square (7) = 48.83

Prob > Chi-square = 0.0000

Log likelihood = 128.555

Source: Computed from field data, 2023

Constraints Militating against Rice Commercialization by Farmers in the Study Area

Table 5 shows the constraints militating against rice commercialization by farmers in Gwagwalada area council. Lack of/inadequate funds/credit for rice production was a major constraint with 86.4% of the rice farmers attested that it a very serious challenge, 11.4% of them attested to it as a serious constraint, 1.4% of them confirmed it as a less serious problem and 0.7% of the respondents believed it not to be a serious problem. Also, 84.3% of the respondents strongly agreed that high cost of fertilizer is a very serious constraint and 15.7% of the respondents attested that it is a serious constraint. Also, 76.4% of the respondents agreed that inadequate access to quality rice seed was a very serious constraint, 10.7% of them attested to it as a serious constraint, 10.0 % attested that it is a less serious constraint and 2.9% of them attested that it is not a serious constraint. Also, 69.3% of the respondents agreed that lack of/inadequate proper storage facilities is a very serious problem, 29.3% of them attested that it is a serious problem and 1.4% of them attested that it is a less serious problem. More so, 67.9% of the respondents agreed that high cost of herbicide is a very serious constraint, 30.7% of them agreed that it is a serious constrain and 1.4% of them agreed that it is a less serious constraint. Again, 65% of the respondents agreed that high cost of labor is a very serious constraint, 32.1% of them agreed that it is a serious constraint, 2.9% of them agreed that it is a less serious constraint. In the same vein, 65% of the respondent agreed that inadequate rice processing facilities is a very serious problem, 33.6% of them agreed that it is a serious problem, while 1.4% agreed that it is a less serious constraint. Also, 59.3% attested that inadequate agricultural extension and advisory service is a very serious constraint, 15.7% of them attested that it is a serious constraint, 15.0% of them attested that it is a less serious constraint, while 10.0% of them believed it not to be a serious problem. Also, 45% of the respondent believed that difficulty of access to market is a very serious constraint, 31.4% of them believed that it is a serious constraint, 22.1% of them believed that it is a less serious constraint, while 1.4% of them believed that it is not a serious constraint. More so, 38% of the respondents agreed that inadequate marketing information is a very serious problem, 39% of them agreed that it is a serious problem, 21.4% of them agreed that it is a less serious problem, while 0.7% of them agreed that it is not a serious problem. Also, 32.9% of the respondents agreed that disease infection is a very serious constraint, 45% of them agreed that it is a serious constraint, while 22.1% of them agreed that it is a less serious constraint. Also, 22.9% of the rice farmers attested that pest infestation e.g birds is a very serious problem, 60% of them attested that it is a serious problem, while 17.1% of them attested that it is a less serious problem.

Table 5: Factor Analysis of the Constraints militating against Rice Commercialization

Constraints	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean (Standard deviation)
Lack of/inadequate funds/credit for rice production	121(86.4)	16(11.4)	2(1.4)	1(0.7)	3.84(0.459)
Inadequate access to quality rice seed	107 (76.4)	15 (10.7)	14 (10.0)	4 (2.9)	3.61(0.459)
High cost of labour	91 (65.0)	45 (32.1)	4 (2.9)	-	3.62(0.543)
High cost of fertilizer	118 (84.3)	22 (15.7)		-	3.84(0.365)

High cost of herbicide	95 (67.9)	43 (30.7)	2 (1.4)	-	3.66 (0.503)
Disease infection	46 (32.9)	63 (45.0)	31 (22.1)	-	3.11 (0.736)
Pest infestation e.g birds	32(22.9)	84(60.0)		24 (17.10)	3.06 (0.632)
Inadequate marketing information	54 (38.6)	55(39.3)	30 (21.4)	1 (0.7)	3.16(0.7799
Difficulty of access to market	63 (45.0)	44 (31.4)	31 (22.1)	2 (1.4)	3.20 (0.833)
Inadequate agricultural extension and advisory services	83 (59.3)	22(15.7)	21 (15.0)	14 (10.00)	3.24 (1.045)
Inadequate rice processing facilities	91 (65.0)	47 (33.6)	2 (1.4)	-	3.64 (0.512)
Lack of / inadequate proper storage facilities	2 (1.4)	41 (29.3)	2 (1.4)	-	3.68 (0.499)

Source: Computed from field data, 2023.

5. CONCLUSION AND POLICY IMPLICATIONS

This study reveals the factors that determine paddy rice commercialization among rice farmers in Gwagwalada Area Council of Federal Capital Territory, Nigeria. The result revealed that majority of the farmers participated in markets, which implies their level of commercialisation (i.e are not subsistence-oriented). Education and membership of farmer-based organisations (FBOs) and some other factors (age of the farmers, household size, farm size, and literacy ratio) influenced rice commercialization. There is need for putting in place policies and programmes that will make the rice farming households to be proactive in the commercialization of rice produced. The following are recommended to guide policy advice and formulation:

i. Federal Capital Territory Authority should take seriously the literacy programmes through the National Mass Literacy Agency to ensure members of households are literate to address agricultural commercialization literacy.

ii. Governments at the Area Council levels should take actions to encourage formation and establishment of farm-based organizations among rice farmers to enhance agricultural commercialization in the area.

iii. In order to encourage rice commercialization, the government and development partners are urged to increase support to rice farming households so that they can increase the land size (that is hectreage) for rice production.

iv. Proactive regulatory land use acts in the Federal Capital Territory that will make rice farming households to participate in more secured land ownership systems should be put in place for land tenants to benefit so that they can be able to invest and use sustainable production strategies to maximise benefits.

v. Also, agricultural financing agency should ensure to make credit facilities more accessible to rice farmers to enhance commercialization.

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