

Research Article

Factors Influencing Output of Rice Produced and Choice of Marketing Outlets Among Smallholder Farming Households, Abuja, Nigeria

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Abstract | Factors influencing the output of rice produced and choice of marketing outlets among smallholder rural farming households are the main focus to improve rice production and increase the income of the farmers. Primary data were used for this study. Data were obtained using a well-designed well-structured questionnaire. The questionnaires were administered to two hundred and seven (207) smallholder rural rice farming households. Multi-stage sampling technique was adopted. Data were analyzed using Multinomial Logit Model, Gini-Coefficient, Double-Log Regression Model, (Cobb-Douglas) and Principal Component Analysis. The results of the Multinomial Logit regression model show that among the significant factors that influence the choice of rice market outlets were: sex of the household head ($P < 0.10$), educational level ($P < 0.10$), access to credit facilities ($P < 0.05$), extension services ($P < 0.01$), price information ($P < 0.05$), market information ($P < 0.01$) and, marketing experience ($P < 0.05$). The value of Gini-Coefficient calculated was 0.91429. The observed inequality in income distribution among smallholder rural rice farmers was a reflection of inefficiency in the market structure for rice. The results of Double-Log Regression model revealed that quantity of rice output harvested was positively and significantly influenced by farm size ($P < 0.05$), the quantity of seed planted ($P < 0.01$), the volume of chemical applied ($P < 0.05$), labour input ($P < 0.01$), and contract farming ($P < 0.05$). Quantity of fertilizer and expected price of output was negative and significant at ($P < 0.01$), and ($P < 0.05$) probability levels respectively. The coefficient of the multiple determinations (R^2) in the production model was 0.51. This signifies that the explanatory variables included in the model accounted for about 51% variations in the quantity of rice output harvested in the study area. Smallholder rice farmers were faced with the following challenges in rice production and market outlet choice which include: Fire outbreak, thieves, cattle herdsmen attack, flood occurrence, transportation problem, poor storage facility, inadequate capital, lack of land/ tractor, poor price, high cost of chemical, inadequate fertilizer, lack of improved seed, inadequate extension officers, and lack of credit facilities. This study recommends that new innovations and technology that targets increased productivity should be promoted, provision of adequate extension officers is needed, input market supply for provision of seeds, fertilizers and storage facilities should be made accessible to farmers, provision of rice processing equipment should be made available, contract farming and marketing should be encouraged for increased rice production and market outlet choice for profit maximization among rice farmers to eradicate poverty and improve their welfare.

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Introduction

Agriculture in Nigeria is mostly dominated by small-holder and subsistence farmers that are engaged primarily in the production of the required bulk of food for the entire Country. Small-holder farmers are majorly considered and referred to as farmers that have landholdings of less than 10 hectares. These categories of people consist of about 80% of Nigeria's farming population which takes up the responsibilities for 80% – 90% of food production in the Country, and they are the poorest groups of people in Nigeria (Mgbenka and Mbah, 2016). Therefore, any programme which involves poverty reducing strategies which lays more emphases on agriculture is more likely to be effective than any other sectors with regards to poverty alleviation. Poverty reduction strategies that focus on agriculture directly raise farmers' incomes by an additional increase in marketable surplus and indirectly generating employment as agriculture is labour-intensive.

Rice (*Oryza sativa* L) is considered as the third most important staple food in Nigeria in ranking order, maize first followed by wheat. Rice provides ample opportunity for an increase in income, poverty eradication, alleviation and improvement of livelihood among rice producers if value chain and market participation are increased why because local and regional consumption of rice products is anticipated to expand with a rate of increase in population. Based on a report by Price Waterhouse Coopers (PWC, 2017), Nigeria produces 3.7 million tonnes annually. This accounts for a shortfall as 6.4million tonnes of rice are consumed, which explains why Nigeria is the third largest rice importer in the world. According to FAO (2018), Nigeria remained forecast to drive SSA sub-regions rice production in 2019. The FAO forecast that Nigeria will harvest 7.2 million tonnes (4.3 million tonnes, milled bases) in 2018, up 3 percent year-on-year. The Nigeria targets for 2019 rice production output stood at 7.2 million metric tonnes (FAO, 2018). Nigerian rice is grown in about 11 States, with small-holder farmers accounting for 80% of the Country's annual harvest. These States are; Ebonyi, Kaduna, Niger, Kano, Kaduna, Kebbi, Cross-River, Enugu, Taraba, Borno, Benue (PWC, 2017). Nigeria has all it takes and the potential with suitable agro-ecologies (upland, rain-fed lowland, irrigated lowland, deep water and mangrove swamp) to attain the level self-sufficiency in rice production in

the Country (Oikeh *et al.*, 2008; Ugalahi *et al.*, 2016).

A Market is any setting that allows buyers and sellers to exchange any type of goods and services (Heyne *et al.*, 2014). Markets provide a link between the local and global economy and help in facilitating economic efficiency through promoting the exchange of goods and services (FAO, 2009). Rice marketing encompasses all the activities in moving rice from the point of production to where it is needed by final consumers (Bassey *et al.*, 2013). Asogwa and Okwoche (2012) argued that marketing covers all business functions, including production and production decision such that decisions on a variety of crops to grow and sale are marketing decisions. Small holder farmers can be defined as those farmers who own small based plots of land on which they grow at a subsistence level different types of food crops and one or two cash crops depending solemnly on family labour to perform farm operations. It is also often used interchangeably with small scale farmers, 'resource poor farmers and sometimes peasant farmers (Alene *et al.*, 2008). According to Barret (2008), small holder farmers has to accumulate private asset, access infrastructural facilities and services as the prerequisites conditions to escape from small scale production to produce a marketable surplus.

Farmers' choice of market outlets and channels is a very important aspect of market participation decision. There are different market channels which include: the informal and formal market channels that provide different price levels and services for sales of produce, which could determine farmers' choices of the different outlets for marketing their produce (USAID, 2010). Informal markets embrace non-official market transactions between farmers and also from farmers directly to consumers, such as intermediary (brokers), other farmers, friends and relatives or neighbours. In formal markets (traders, wholesalers and Cooperatives) have clear methods of measurements and determining grades, quality control, standards, and safety guidelines for proper regulations. Most of the small-holder farmers are facing difficulties to penetrate and enter the formal markets because of high transactional costs, high risks, missing markets, and on collective operations (Jari and Fraser, 2009). According to Barret (2008), there exists a quite number of potentials for small-holder farmers to be market oriented to derive a livelihood from agriculture. Increase in agricultural

markets participation is a key determinant of lifting small-holder rural farming households out of poverty (Heltberg and Tarp, 2002; Balagtas and Coulibaly, 2007). Similarly, the choice of market outlets by small-holder farmers is also playing an important role in increasing incomes of rural households (USAID, 2010). Smallholder farming households that are involved in the rural agricultural sector are the logical focus for enhancing food security and poverty alleviation policies. These policies are for boosting agricultural production and to increase the rates of market participation and market outlet and channel choice as key instruments for improving income and the living standards of rural households. Khadem (2008) pointed out that the way agriculture can boost economic development is by generating sufficient level of market surplus, which plays a crucial part in improving rural capital on the one hand, and on the other help in eradicating rural poverty and regional imbalance.

The agricultural reforms that altered and shifted the production and marketing decisions to small-holder farmers led to the emergence of a large number of rice value chain actors, traders, small scale rice millers, whole-sellers, retailers and large scale private sector rice mills (Barret, 2008). The farmers in the rice anchor borrowers' schemes program in Nigeria are therefore at liberty to produce and sell their rice at any marketing outlets of their choice. The rationale behind any producer is to sale his product at an outlet with an expected price that maximizes profit, or from a coexistence of marketing outlets, and they choose an outlet which maximizes their expected utility that is more convenience (Alene *et al.*, 2008). Rice is highly demanded in Nigeria, and there is an inadequate supply. It has led to massive importation to meet the shortfall in demand; this has made Nigeria the largest rice importer in Africa (Daramola, 2005). Though Nigeria is also the largest producer of rice in the continent, because of her population, she is also the largest consumer of rice in Africa. The successive government regimes had the desire to reverse this trend which has led to the implementation of various policies concerning rice production and importation in the Country which involves the imposition of tariffs on rice importation and provision of various subsidies to encourage local producers as found in Olorunsanya and Ugbong (2014). Other agricultural programmes to stem the trend were also put in place; which include, the (ARP) Abakaliki Rice Project and

the (PIR) Presidential Initiative on Rice. Amidst these laudable government policies and different sets of agricultural programmes, the demand-supply gap for rice and rice products in Nigeria is on the increase, and it widens progressively.

Problems associated with the production and marketing of rice in Nigeria include the constraints which are inherent in Nigeria's agricultural sector which comprises of low crop yield per hectare of an individual farmer, low income, inadequate infrastructural facilities for increased production poor marketing activities coordination, inadequate storage facilities, and low level of production capacity to satisfy the food demand and fibre that are needed by the populace in Nigerians (Olorunsanya and Ugbong, 2014). Small-holder farmers' decisions on the quantity of rice output to sell in a particular market outlet are determined and influenced by access to market information, prices of farm produce, and distance to the market location (Omiti *et al.*, 2009). Non-guaranteed access to good markets by farmers for their farm product and acquiring farm inputs is also another major constraint challenging the small-holders farming households (Gyau *et al.*, 2006). Small-holder farmers lack adequate means to overcome the costs to enter the market, such as assets, access to information (Barrett, 2008; Uchezuba *et al.*, 2009). High transactional costs are major constraints involving in marketing by small-holder farmers in developing countries, specifically in Nigeria. No empirical evidence about why producers choose specific market channels and outlets and how transaction costs influence market channel choices. Although several studies have been conducted on production and marketing of rice and other crops in Nigeria, most of the studies focused on the efficiency of farmers in terms of resources use, structure, conduct and performance of the market (Odok, 2000; Ohen *et al.*, 2013). However, it is not yet clear which of the marketing outlets offered better prices for the farmers' farm produce output. A profit maximizing producer is expected to use a market outlet that will maximize profits and further improve their family welfare. The inadequacy of information concerning factors influencing households rice output and their choices of market outlets is the basic backbone of this study. The study attempt to fill these knowledge gaps. Hence, the purpose of this study is to analyze the factors influencing rice production and choice of marketing outlets among small-holder rural farming

households in Federal Capital Territory, Nigeria.

Research questions

This research work provided answers to the following research questions;

1. What are the factors influencing the choice of market outlets for rice in the Federal Capital Territory?
2. What are the structural intensity and the concentration of participants in the market among small-holder rice farmers?
3. What are the factors influencing the total output of rice harvested?
4. What are the constraints of rice production and choice of marketing outlets?

Objectives of the study

The broad objective was to examine factors influencing the output of rice produced and choice of marketing outlets among small-holder rural farming households, Abuja Nigeria. The specific goals were to:

1. evaluate the factors influencing the choice of market outlet for rice output,
2. determine the structural intensity and concentration of market participation among small-holder rice farmers,
3. evaluate the factors influencing the total output of rice harvested, and
4. identify the constraints of rice production and choice of marketing outlets in the study area.

Hypotheses of the study

The following null hypotheses guided the study;

- **H₀:** socioeconomic factors, marketing variables, and production assets do not have a significant influence on the choice of marketing outlet among small-holder rice farmers
- **H₀:** There is no significant relationship between socioeconomic factors, marketing variables, and production assets and the total output of rice harvested

Materials and Methods

The study area

This study was conducted in FCT, Nigeria. FCT was created and carved out in 1976 from the Kaduna, Niger, Kwara and Plateau States. FCT has a boundary with Kaduna State to North and Kogi State to the South. It is also bounded to the East and West by Nasarawa and Niger States respectively. There are

six Area Councils in FCT, namely: Abaji, Bwari, Gwagwalada, Kuje, Kwali and Abuja Municipal Area Councils. Abuja is located within Latitudes 7° 20" North of Equator and Longitudes 6° 45" and 7° 39". It lies on 416m above sea level, and the city has a tropical climate in winter there is much less rainfall than in summer. The average annual temperature is 26.1 °C. In a year, the average rainfall is 1331 mm and average humidity of 34%. Abuja has a total land area of about 8,000 sq Kilometers with a total population of 776,298 people as at the 2006 census (NPC, 2006). It sustains legumes such as (groundnut and cowpea); grains (maize, sorghum, millet and rice); seeds and nuts (melon seeds and benniseed); fruits and vegetable. Beside crop production, the rural communities also rear livestock such as sheep, goat, cattle and poultry birds at subsistence and likewise commercial level. The main vegetation of the study area is Guinea-savannah (Dawan, 2000).

Sampling technique and sample size

A sampling of the area involved a purposive selection of FCT, due to the concentration of rice farming in the area, and proximity of the area to the base of the researcher. A sampling of the respondents was done using a Multi-stage sampling technique. The first stage, two (2) area councils were selected using simple random sampling technique, the six (6) area councils were written on a piece of paper placed in a box, the papers were well-shuffled, out of the six (6), two (2) area councils were picked and selected. The area chosen councils were: Kuje and Kwali. The second stage, a simple random sampling technique, was used to select three (3) from ten (10) wards from each area council. The third stage, a simple random and proportionate sampling technique, was used. The simple random sample was accomplished using a Table of random numbers. The probability proportionates to the sample size sampling technique as used by Cochran (1977) was adopted. A total sample frame of 5,400 farmers was available, and a total sample size of 207 respondents as calculated from Equation 1 and shown in Table 1 were selected for interview. The required sample size (207) was determined as used by Cochran (1977), Mugenda and Mugenda (2003) is shown below:

$$n = \frac{pqZ^2}{e^2} = 207 \dots (1)$$

Where;

n= Sample Size; p=0.16; q=0.84; Z=1.96 (α=0.05); e=

0.05 Allowable Error.

Table 1: Sampling matrix, sample size and sample frame of the rice farmers.

Area coun- cils	Wards	No. of rice farmers proportion		Sample size
Kuje	Kuje Central	1200	0.22	45
	Kujekwa	800	0.15	31
	Yanche	1000	0.18	38
Kwali	Ashara	900	0.17	35
	Kilankwa	900	0.17	35
	Kwali Ward	600	0.11	23
Total		5400	1.00	207

Source: Author (2019).

Method of data collection

Primary data were used. Data were collected with the use of questionnaires. The designed questionnaire was pre-tested on selected few farmers in the study area to evaluate the appropriateness of the research design, clarity of purpose, and relevance of the questions to the targeted respondents. The appropriate modifications were made on the pre-tested questionnaire in order to ensure relevant information are captured which is related to the study objectives. The questionnaire was validated, and the appropriate reliability test was carried out. Five (5) enumerators were employed and trained based on the content of the questionnaire and the methods of interviewing process. In each of the Area Councils, two (2) Agricultural Extension Agents who are conversant with the geographic location and socioeconomic characteristics of the people were also recruited, trained and mobilized as enumerators. Thereafter, Primary data were collected through the distribution of structured questionnaire by a team of trained enumerators to 207 sampled small-holder rice farming households in the area.

Method of data analysis

Data collected from the field were collated, edited, coded, and cleaned to ensure consistency, uniformity, and accuracy. Data were entered into computer software for analysis. Both SPSS version 20 and STATA version 12 computer application programs were used to process the data. Descriptive statistics and Inferential statistics or econometric analysis were used for analyzing the collected data from the field. The following analytical tools were used to achieve the stated objectives of the study (i) multinomial logit model; (ii) gini-coefficient; (iii) double-log regression model; (cobb-douglas regression model); (iv) principal

component analysis; (v) correlation matrix; (vi) t-test analysis; (vii) Z- test analysis.

Multinomial Logit model

The Multinomial Logit model is stated thus:

$$Y_i = b_0 + \sum_{i=1}^{13} \alpha_i X_i + U_i \dots (2)$$

The explicit function is stated thus:

$$P_i = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + \alpha_9 X_9 + \alpha_{10} X_{10} + \alpha_{11} X_{11} + \alpha_{12} X_{12} + \alpha_{13} X_{13} + U_i \dots (3)$$

Where,

α_0 = Constant Term; $\alpha_1 - \alpha_{13}$ = Regression Coefficients; Y_i = Choice (0, None; 1, Farm Gate; 2, Local Market; 3, Urban Market); X_1 = Age of Household Head (Years); X_2 = Gender Dummy (1, Male; 0, Female); X_3 = Educational Level (Number of Years Spent in School); X_4 = Household Income (Naira); X_5 = Price of Output (Naira); X_6 = Farm Size (Hectares); X_7 = Access to Credit Dummy (1, Yes; 0, Otherwise); X_8 = Extension Services Dummy (Number of Extension Contacts per Month); X_9 = Price Information Dummy (1 Yes; 0, Otherwise); X_{10} = Rice Output (Kg); X_{11} = Market Information Dummy (1, Yes, 0, Otherwise); X_{12} = Market Cooperative Organization Dummy (1, Yes; 0, Otherwise); X_{13} = Marketing Experience (Years); U_i = Error Term; This was used to achieve specific objective (i)

Gini coefficient

The Gini- Coefficient is stated thus:

$$G.C = 1 - \sum_{i=1}^k X_i Y_i \dots (4)$$

Where,

$G.C$ = Gini-Coefficient (Units); X_i = Proportions of Rice Sellers in the i^{th} Class of Smallholder Farmers, (Kg); Y_i = Cumulative Proportion of Rice Sellers in the i^{th} Class of Smallholder Farmers. (Kg); Σ = Summation Sign; k = Observed values; Gini Coefficient (GC) Varies from Zero (0) to 1.

$$0 \leq GC \leq 1$$

Where;

0 = Implies Perfect Equality in the Distribution; 1=

Represent Perfect Inequality in the distribution.
This was used to achieve a specific objective (ii)

Double log regression model (Cobb-Douglas regression model)

The implicit model stated thus;

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12}, X_{13}, U_i) \dots (5)$$

$$\ln Y = \beta_0 + \sum_{i=1}^{13} \beta_i \ln X_i + U_i \dots (6)$$

The explicit function is stated thus:

$$\ln Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + \beta_9 \ln X_9 + \beta_{10} \ln X_{10} + \beta_{11} \ln X_{11} + \beta_{12} \ln X_{12} + \beta_{13} \ln X_{13} + U_i \dots (7)$$

Where;

Y_i = Output of Rice (Kg); X_1 = Age of Farmer (Years); X_2 = Farm Size (Hectares); X_3 = Quantity of Seed (Kg); X_4 = Volume of Chemical (Litres); X_5 = Labour input (Man-days); X_6 = Extension Contact (Number of Contact per Month); X_7 = Quantity of Fertilizer input (Kg); X_8 = Level of Education (Number of Years Spent in School); X_9 = Non-Farm Income (Naira); X_{10} = Farming Experience (Years); X_{11} = Expected Price of Rice Output (Naira); X_{12} = Market Information Dummy (1, Yes; 0, Otherwise); X_{13} = Contract Farming Dummy (1, Yes; 0, Otherwise); $b_1 - b_{13}$ = Regression Coefficients; b_0 = Constant Term; U_i = Error Term. This was used to achieve a specific objective (iii)

Principal component analysis

Constraints faced by small-holder rice farming households were subjected to Principal Component Analysis or Factor Analysis. The Principal Component Analysis is stated thus:

$$x = (x_1, x_2, x_3, \dots, x_p) \dots (8)$$

$$\alpha_K = (\alpha_{1k}, \alpha_{2k}, \alpha_{3k}, \dots, \alpha_{pk}) \dots (9)$$

$$\alpha_k^T X = \sum_{j=1}^p \alpha_{kj} X_j \dots (10)$$

$$\text{Var} = [\alpha_k^T X] \text{ is Maximum} \dots (11)$$

Subject to:

$$\alpha_k \alpha_K = 1 \dots (12) \text{ and}$$

$$\text{cov} [\alpha_1^T X - \alpha_2^T X] = 0 \dots (13)$$

The variance of each of the principal components are:

$$\text{Var}[\alpha_k^T X] = \lambda_k \dots (14)$$

$$S = \frac{1}{n-1} (X - \bar{X})(X - \bar{X})^T \dots (15)$$

$$S = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X}_i)(X_i - \bar{X}_i)^T \dots (16)$$

Where;

X = Vector of p Random Variables; α_k = Vector p Components; λ_k = Eigen Value; T = Transpose; S = Covariance Matrix.

This was used to achieve a specific objective (iv).

Test of hypothesis

t-test: The t-Test was used to test for the significant relationship between economic factors and a total output of rice harvested as inherent in the double-log regression model.

$$t = \frac{\bar{X} - u_0}{\frac{s}{\sqrt{n-1}}} \dots (17)$$

Where;

t = Calculated t - Value; \bar{X} = mean of quantity of paddy rice sold (Kg); μ_0 = mean of total quantity of paddy rice harvested (Kg); S = standard deviation between the quantity of paddy rice produced and quantity sold (Kg); n = Number of Respondents (Units).

Z- Test

The Z- Test Statistics was used to test for the significant relationship between economic factors and the choice of marketing outlets among small-holder rice farmers as inherent in the Multinomial Logit Model. Z- Test is stated thus:

$$Z_c = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \dots (18)$$

Where;

Z_c = Calculated Z-Value (Units); \bar{X}_1 = Mean of Rice Output Sold (Kg) \bar{X}_2 = Mean of Rice Output Harvested (Kg); n_1 = Number of Households Respondents that Sold Rice (Units); n_2 = Number of Households Respondents that do not Sell Rice (Units). S_1^2, S_2^2 = Variance between Households Respondents that Sold and do not sale Rice (Units).

Table 2: Descriptions and measurements of explanatory variables included in multinomial logit model and apriori expectations.

Var- iable code	Variable	Measurement of var- iables	Ex- pected signs
Dependable variable			
Y _i	Household choice of (None,1; Farm gate,1; Local market,2; Urban market, 3); Rice market- ing outlets		
Independent variable			
X ₁	Age of household head	In Years (Continuous)	+
X ₂	Sex	(1, Male; 0, Female)	+/-
X ₃	Educational level	Years (Continuous)	+
X ₄	Household income	In Naira (Continuous)	+
X ₅	Expected price of output	In Naira (Continuous)	+
X ₆	Farm size	In Hectares (Contin- uous)	+
X ₇	Access to credit	(1, Yes; 0, Otherwise)	+
X ₈	Extension services	Number of contact per month (Continuous)	+
X ₉	Price information	Dummy (1, Yes; 0, Otherwise)	+
X ₁₀	Quantity harvested (Rice output)	(Kg)(Continuous)	+
X ₁₁	Market information	(1, Yes; 0, otherwise)	+/-
X ₁₂	Marketing cooperative organization	(1, yes; 0, Otherwise)	+/-
X ₁₃	Marketing experience	In years (Continuous)	+

Source: Author (2019).

Table 3: Descriptions and measurements of explanatory variables included in double-log model and apriori expectations.

Dependent variables output of rice	Pa- rame- ters	Varia- bles Y	Expected signs (Apriori) ex- pectations)
Age (Years)	β_1	X ₁	±
Farm size (Hectares)	β_2	X ₂	±
Quantity of seed (Kg)	β_3	X ₃	±
Volume of chemical (Litres)	β_4	X ₄	±
Labour (Man-days)	β_5	X ₅	+
Extension contact	β_6	X ₆	+
Quantity of fertilizer input (Kg)	β_7	X ₇	±
Level of education (Years)	β_8	X ₈	+
Non-farm income (Naira)	β_9	X ₉	+
Farming experience (Years)	β_{10}	X ₁₀	+
Expected price of rice output (Naira)/Kg	β_{11}	X ₁₁	+
Market information(1, Yes; 0, Otherwise)	β_{12}	X ₁₂	+
Contract farming(1, Yes; 0, Oth- erwise)	β_{13}	X ₁₃	+

Source: Author (2019).

Results and Discussion

Factors influencing smallholder rural rice farmers' choice of marketing

Table 4 gives a summary of the results of the Multinomial Logit model and the estimated marginal effects of the variables in the model. The Prob Chi-square value 0.000 showed that Log-Likelihood ratio statistics of -2218.6673 was highly significant ($P < 0.01$). This model suggests that it had a strong explanatory power. The Pseudo R² was 0.2605, implying that the explanatory variables included in the model explained about 26% of the variations, in the choice of the market outlets by the small-holder rice farming households. The coefficients of the estimates indicated the direction of the effect of the explanatory variables on the dependent variables. To determine the magnitude of the change on the choice of the available market outlets with respects to a unit change in independent variables, the marginal effects were estimated from Multinomial Logit model, this measure the unit change in probability of choice being made associated with a unit change in explanatory variables [Gujaratti and Sageetha \(2007\)](#). The variables that were included in the model were age of the household head, sex of the farmer, years of education, farm size, access to credit, extension service, price information, a quantity of output harvested, market cooperative organization, and marketing experience.

Age of the household head influences the sale of rice but not significant at farm gate market, the local market and urban market respectively. A unit increase in the age of the household head was associated with the probability of small-holder farmer to sell at farm gate and local market, and urban market. The marginal effect of the age of the household head was 0.024 at the farm gate. This implies that a unit increase by one year in the age of the farmer results in 2.4% probability of selling rice at farm gate, likewise 2.9%, and 2.1% likelihood 2 of selling at local and urban markets respectively. Sex of the household head had a significant influence on the choice of the local market. Male headed household had a lower probability of selling at farm gate market by 61% probability and more likely to sell at the local market by 94% at ($P < 0.01$) probability level, and also less likely to sell at urban market by 65% probability. Male headed household takes more risk; thus, they are capable of searching for distant markets which are more competitive for value addition. This finding

is in agreement with Benard (2015), who founded that female household's head mostly don't go to distant market places that are far away from home. This finding is also in consonance with findings of Morrison *et al.* (2007). They found that female farmers are mostly faced with gender specific problems that are timely; this serves as a burden that limits them from accessing the best market for their output.

The educational level of the small holder rural rice farming households head negatively and significantly influences ($P < 0.10$) the choice of local and urban markets, respectively. The marginal effect of the level of education of the household head signifies a unit increase in the level of education of the small-holder farmers, and they are less likely to sell their rice at local and urban markets by 22 % and 16% probability levels respectively. This result is in agreement with the report of Agbola *et al.* (2010) who reported that farmers who had a higher level of education could have better skills in marketing, especially the formal marketing systems in urban areas. Therefore, an increase in the level of education, exposes a farmer to be profit-

oriented and struggle to lower the transactional costs of marketing. The results are also in agreement with Alabi *et al.* (2016) who reported that it is more likely for the more educated farmers to work off the farm which will enhance their level of productivity that will make them choose a profitable market outlet. Farm size influenced the choice of market outlet negatively for the local market and was significant at ($P < 0.10$). A unit increase in the farm size (ha) results in the likeliness of the small-holder rice farmers to sell at the local market. The marginal effect of farm size at the local market was 0.239. This signifies that a unit increase in the farm size results in the choice of sale at the local market by 24% probability. Farm size is assumed to be proxy to productivity scale. The larger the land size, the larger the production scale and vice versa. This is consistent with Boughton *et al.* (2007) who posited that private household assets owned by the farmers, determine the level of quantity of output produced and could have a strong association with market entry opportunities by small-holder farmers, it will also help farmers in overcoming entry barriers and thus market access increases.

Table 4: Marginal effects and parameter estimates from multinomial logit on the choice of marketing outlets among smallholder farming households.

Variable	Farm gate local market urban market											
	Coeff	$\delta y / \delta x$	Z	$P > z $	Coeff	$\delta y / \delta x$	z	$P > z $	Coeff	$\delta y / \delta x$	z	$P > z $
Age H Head	0.0350	0.0244	1.43	0.152	0.0025	0.0290	0.09	0.929	0.0161	.02146	0.75	0.453
Sex	0.0469	0.6199	0.08	0.940	-1.6900	0.935***	-1.81	0.071	-0.9631	.65311	-1.47	0.140
Edu Level	0.0050	0.2084	0.02	0.981	-0.4097	0.216***	-1.89	0.058	-0.1933	.1638***	-1.18	0.238
HH Income	-3.47e-06	4.07e-0	-0.85	0.395	-4.41e-06	3.89e-1	-1.13	0.258	-4.57e-0	3.15e-0	-1.45	0.147
Expected Price	-0.00006	0.0001	-1.09	0.276	0.0000	0.000	0.90	0.367	-0.00002	.00005	-0.43	0.665
Farm Size	0.0859	0.116	0.74	0.460	-0.4147	0.239***	-1.73	0.084	0.1104	.09167	1.20	0.228
Access Credit	0.0692	0.8197	0.08	0.933	1.6141	0.805**	2.01	0.045	0.0921	.67195	0.14	0.891
Extension Contact	0.1412	0.3157**	2.11	0.035	-0.3074	0.108*	-2.84	0.004	0.0748	.06051	1.24	0.216
Price Infor	-0.1654	1.1131	-0.15	0.882	3.3379	1.4475**	2.31	0.021	-0.7282	1.0252	-0.71	0.478
Quantity Harvested	0.0001	0.0001*	1.56	0.120	0.0001	0.00007	1.35	0.177	0.0001	.0006***	1.68	0.093
Market Infor	-0.9161	-1.1266	-0.81	0.416	-4.0990	1.4591*	-2.81	0.005	1.1877	1.0608	1.12	0.263
Market Org	-0.5210	-0.7747	-0.67	0.501	0.0330	0.7529	0.04	0.965	-0.3198	.59063	-0.54	0.588
Market Exp	-0.1180	-0.065***	-1.81	0.070	0.1045	0.0657	1.59	0.112	-0.1250	.0546**	-2.29	0.022
Constant	-1.6666	-1.5554	-1.07	0.284	2.8350	1.9772	1.43	0.152	0.3282	1.415	0.23	0.817
Number Observation= 207												
LR chi ² (52) 154.07												
Prob > chi ² 0.0000												
Pseudo R ² 0.2605												
Log-Likelihood -218.66473												

Source: Field Survey (2019); * Significant at 1%; ** Significant at 5%; *** significant at 10% probability levels.

Access to credit was significant and positively ($P < 0.05$) influence the small-holder rice farming households' decision to sell their rice produce at the local market. The marginal effect of the local market was 0.805. This implies that a unit increase in the access to credit by 1 Naira results in the small-holder rural rice farming household's choice of selling their rice produce at the local market by 80% probability. This could be because the more farmers have access to credit the more ability of the farmer to purchase production inputs which will result in high yield production and marketable surplus. Extension contact positively and significantly influences the choice of farm gate ($P < 0.05$), and the local market ($P < 0.01$). The marginal effect of the sales at the farm gate is 0.3157 and at local market 0.108. This implies that a unit increase in the access to extension contact by one day within a month will results in the rise in choice of rice sales at farm gate and local market by 32% and 10.8 % respectively. Price information was significant ($P < 0.05$) and positively influence the probability of farmer to likely sell their rice produce at the local market. Price information informs the farmer on the prevailing pricing condition. Market information was significant ($P < 0.01$) and negatively influenced the probability of the small-holder rice farmers of the likelihood to sell at the local market. Marketing experience was negatively and significantly ($P < 0.10$) influence the small-holder households rice farmers' choice of farm gate market outlet, and also positively and significantly ($P < 0.05$) influence the choice of urban market outlet. The marginal effects of the marketing experience of farm gate market (-0.0651), local market (0.0657), and urban market (0.0546) imply that a unit increase in marketing experience by one year results in the decrease in the farmers' choice to sell at the farm gate market by the probability of 6.5%, and increase in the choice of local and urban markets of 6.6% and 5.5% probability levels respectively. This result is consistent with findings of Montshwe (2006), who reported that the farm gate sales reduces farmers' revenue because the prices are relatively low at the farm gate. Those who are willing to take risk will transport their farm produce to distant places while those that are risk-averse will always end up selling their rice at farm gate market.

Income status of the rural rice farming household heads from the sales of rice

Table 5 revealed that (45.7%) of the sampled respondents earned less than 100,000 Naira from the

sales of rice, while 17.3% earned an income of 201-300 thousand Naira per one cropping season. The household that has a higher income from rice sales is considered as wealthy it has a significant positive effect on the small-holder farmers' decision to participate in rice marketing. This result is consistent with the findings of Akidi *et al.* (2018) who opined that wealthy farmers have the ability to break market entry barriers; therefore small-holder farming households must reach a minimum income or above the threshold to be able to participate in the rice market.

Table 5: Distributions of income among sampled respondents according to rice sales.

Income (₦) (000)	Frequency	Percentage
≤100	96	45.7
101-200	33	15.9
201-300	36	17.3
301-400	12	5.8
401-400	7	3.4
401-500	5	2.4
501-600	19	9.1
Mean of income	238,496	
Total	207	100

Source: Field Survey (2019).

Structural intensity and concentration of market participation among smallholder rural rice farming households

Table 6 showed the Gini-coefficient computation for the small-holder rural rice-farming households. The Gini-coefficient value calculated is 0.91429. The value lies between 0 and 1. The Gini-coefficient revealed the relative measure of the income distribution. Zero (0) value indicates perfect equality of income, whereas the value one (1) indicates perfect inequality in income, the value of G.C greater than 0.35 is high signifying that there is inequality in the distribution of sales income from the rice output as reported by (Bakare, 2012). The calculated value of Gini-coefficient of 0.914 for the sample of this study showed more inequality in income distribution among the small-holder rice farmers, and this result is in line with the report of Muhammad *et al.* (2018). This result is also in agreement with the findings of Abah *et al.* (2015) and Lorenzo (2005) that both reported more inequality in the income distribution of small-holder. The observed inequality in income distributions among small-holder rice farmers is a reflection of inefficiency in the rice market structure.

Table 6: Results of the gini coefficient for rice sales income among smallholder rice farmers in the study area.

Range of income (000) Naira	No of sellers	Proportion of sellers (X)	Cumulative proportion	Cumulative frequency	Total sales (₦)	Proportion of sales (Y)	Cumulative proportion	(XY)
1-100	67	0.37	0.37	67	1568200	0.052	0.052	0.00192
101-200	33	0.18	0.55	100	1928000	0.064	0.116	0.00115
201-300	36	0.20	0.75	136	3769500	0.125	0.241	0.025
301-400	12	0.07	0.82	148	1712500	0.057	0.298	0.00399
401-500	7	0.04	0.86	155	1850000	0.061	0.359	0.00244
501-600	5	0.03	0.89	160	2202500	0.073	0.432	0.00219
≥601	19	0.09	0.98	179	17202500	0.569	1.001	0.05121
Total	179	1.00			30233200	1.001		0.08571

Note: Gini coefficient = $1 - XY = 1 - 0.08571 = 0.91429$. Source: Field Survey (2019).

Table 7: Factor influencing quantity of rice output harvested in the study area (Double log functional model).

Explanatory variables	Coefficients	Standard error	t	P> t
Age of household head	-0.0485043	1680485	-0.29	0.773
Farm size	0.3054555	0.1271881	2.40**	0.017
Quantity of seed	0.3446229	0.1126842	3.06*	0.003
Volume of chemical	0.1545468	0.0768134	2.01**	0.046
Labor input	0.4166499	0.0803019	5.19*	0.000
Extension contact	0.0804443	0.0708153	1.14	0.257
Quantity of fertilizer	-0.0551429	0.0282554	-1.95**	0.052
Educational level	0.0508358	0.0503535	1.01	0.314
Non-farm income	0.0786851	0.1314179	0.60	0.550
Farming experience	-0.0500378	0.1296184	-0.39	0.700
Expected price of output	-0.0704064	0.0209051	-3.37*	0.001
Market information contract farming	0.0567	0.114361	0.49	0.06
	0.0912	0.003491	26.12**	0.003
Constant	2.07231	0.3398073	6.10*	0.000
R ²	0.5114			
Adjusted R ²	0.4838			
F-Value	18.55*			

Source: Field Survey (2019); *Significant at 1%; ** Significant at 5%; *** significant at 10% probability levels.

Factors influencing quantity of rice output harvested in the study area (Double log functional production model)

The main objective of defining a functional production model was to determine the quantity of rice output harvested. Table 7 showed the results of the Double-log multiple regressions as the lead equation. The coefficients that are positive and significant include: farm size ($P < 0.05$), a quantity of seed ($P < 0.01$), the volume of chemical ($P < 0.05$), and labour input ($P < 0.10$). This indicates that a unit increase in farm size will result in 30.55% increase in the output of rice.

Also, 1% increase in the quantity of seed, the volume of chemical and labour input as a result of more usage of these inputs will result in 34.46%, 15.45%, and 41.66% increase in the quantity of output of rice harvested respectively in the study area. Extension contact coefficient is positive but not significantly influencing the output of rice harvested. This finding is consistent with Usman and Fatima (2014), who indicated that an increase in these inputs would lead to an increase in the total output harvested. The implications of positive and significant coefficients of labour and non-farm income are that the more access to non-farm income by a farmer, there is the tendency for the farmer to be able to pay for hired labour and also expand his farm size which will result in an increase in production and this will tend to increase their profit levels.

More so, the quantity of fertilizer is negatively and significantly ($P < 0.05$) influence the total output of harvest by the small-holder rice farming households. The coefficients of fertilizer (-0.050) indicated that a unit increase in the quantity of fertilizer applied to rice farm would result in a decrease in the quantity of rice output harvested by 5.5%. Furthermore, farming experience and expected price of rice output negatively influence the total quantity of rice output harvested. The coefficients of farming experience and the expected price of output harvested were (-0.05) and (-0.070). This implies that a unit (1N) increase in the expected price of output harvested in a given market results in a 7% decrease in the quantity of rice output harvested at 1% probability level. This result contradicts Nwaobiala and Adesope (2013), who indicated that increases in farming experience lead to a corresponding increase in the output of upland rice. Market information had a positive and

non-significant influence on the quantity of rice harvested. The coefficient of market information was (0.0567). This signifies that a unit increase in access to market information results in the non-significant increase in the quantity of rice output harvested. This finding is in line with results of Jagwe (2011), who revealed the source of information remains critical for crop production and market participation. Market information empowers farmers on the prevailing market prices, market opportunities, and market demand. Contract farming was also a significant factor ($P < 0.01$) influencing the quantity of rice output harvested by small-holder farming households. The coefficient of contract farming (0.0912) implies that a unit increase in the access to contract farming results in a 9.12% increase in the quantity of rice output harvested. The coefficient of the multiple determinations (R^2) was 0.511. This signifies that the explanatory variables included in the model accounted for about 51% variations in the quantity of rice output harvested in the study area. The F-value 18.55 was highly significant at 1% probability level indicating the goodness of fit. This is in line with the findings of (Ayedun and Adeniyi, 2019).

Constraints faced by smallholder rice farming households regarding decisions for market participation

Table 8 shows the results of the rotated varimax principal component analysis to determine the major constraints militating against the decision of the small-holder farmer's participation decision in rice marketing. About 17 variables were subjected to principal component analysis (PCA). Five (5) factors were extracted based on the Kaiser Meyer Olkin (KMO) and Bartlett's Test of Sphericity computed by SPSS version 20, based on the index which ranges from 0 to 1 the sample is therefore considered suitable for PCA if this index is greater or equal to 0.5. Also, the Bartlett's test of Sphericity should be significant at ($P < 0.05$). The results of the analysis show that the data used was adequate for PCA. In deciding the components retained in the model, the components with an eigenvalue greater than one which represents the amount of variance that is accounted for by some given components, a measure of explained variance of greater than one was retained. The first five components have Eigen-values greater than one. The first five components accounted for about 51.5% of the total variability; the PCA transformed the 17-dimensional variable of the information in the original variables. This is consistent with results of

Otufale *et al.* (2018), and Oose (2016) who transformed 17 dimensional factors into a 2 dimensional variable and 8 dimensional behavioural intervention variable was transformed into a 4 dimensional variable using PCA respectively. The rotation method forms the factor pattern matrix, which contains the loadings of every variable on the retained factors; five variables were retained in the analysis. Only variable with factor loadings of approximately 0.5 and above 5% variance was considered in naming the factors. Variables with factor loadings of less than 0.50 were not considered.

Table 8: Result of the varimax rotated components matrix/factors militating against rice marketing decision among smallholder rural rice farming households in Abuja, Nigeria.

Factor variables	FAC1	FAC2	FAC3	FAC4	FAC5
Lack of improved seed	-0.079	0.369	0.522	-0.006	-0.113
Transportation problem	0.267	0.455	0.028	0.128	0.050
Poor storage facility	0.077	0.669	0.073	0.016	-0.037
Inadequate capital	-0.330	0.639	0.104	-0.091	0.212
Fire out break	0.629	-0.045	-0.091	0.244	0.188
Insects outbreak	0.038	-0.084	-0.036	0.045	0.816
Poor price	0.199	0.132	0.479	0.019	0.302
Cattle herdsman	0.718	0.033	0.025	-0.188	-0.021
High cost of chemical	-0.116	0.065	0.762	0.023	0.233
Thieves	0.775	-0.045	-0.015	-0.035	0.058
Erosion problem	0.148	0.182	0.127	0.799	-0.006
Lack of land/ tractor	-0.220	0.587	-0.093	0.157	0.004
Inadequate extension officers	-0.115	0.057	0.048	0.746	0.244
Inadequate fertilizer	0.022	-0.186	0.701	0.209	-0.109
No good roads	0.183	0.438	0.313	0.330	0.050
Flood problem	0.472	0.000	0.105	0.322	-0.159
No provision of credit	0.023	0.170	0.187	0.133	0.624
Variance	12.350	10.995	10.431	9.513	8.233
Cumulative variance	12.350	23.345	33.775	43.288	51.521

Source: Field Survey (2019). Extraction Method: Principal component analysis; Rotation Method: Varimax with Kaiser Normalization.

After rotation, the first factor accounted for 12.350% of the variance, the second factor accounted for 10.995% of the variance, the third factor accounted for 10.431% of the variance, the fourth factor accounted for 9.513% of the variance. The fifth factor accounted for 8.233% of the variance in the 17 components or variables in the model. The loadings under factor 1,

shows the constraint variables militating against the rice marketing decisions among small-holder farming households, this includes: fire outbreak (0.629), thieves (0.775), cattle herdsmen attack (0.718), and flood problem (0.472). Fire outbreak consumed farmers crop as a result of bush burning, according to the farmers, Fulani herdsmen used to destroy their rice farm even before the harvest, this indicates that farmers are not sure of the safety of their produce thereby discouraged from producing a marketable surplus that will enable them to participate in the rice market, flooding was another major problem, this could wash away farm produce thereby, leaving the farmer with or no yield at all. Variables that loaded under factor 2 include: transportation problem (0.455), poor storage facility (0.669) inadequate capital (0.639), and lack of land/Tractor (0.587). transportation of rice seed to farm and harvested crop from farm gate to market was a constraint to the rice farmers in the study area. This is in line with results of [Aboki and Yuguda \(2013\)](#) who discovered that the high cost of transportation was as a result of the bad nature of roads. The variables that loaded under factor 3 include: lack of improved seed (0.522), poor price (0.479), high cost of chemical (0.799), and inadequate fertilizer (0.701). This result agreed with findings of [Akidi et al. \(2018\)](#) who observed that lack of input, financial constraint, poor storage facilities, poor price, and lack of implement were the major constraints to production and marketing among farmers. The poor market price could be due to lack of capital or poor quality of the product produced. Variables that loaded under factor 4 include: erosion problem (0.799), inadequate extension officers (0.746). This result is in agreement with findings of [Amusa \(2010\)](#) who discovered that inadequate agricultural extension services as a major constraint among small-holder farming households in Ekiti State, Nigeria. The loadings under factor 5 include insect outbreak (0.816), and no Provision of credit (0.624). The results are in consonance with findings of [Bashir et al. \(2018\)](#) who reported that inadequate funds and disease outbreak are the most very severe constraints encountered by farmers.

The scree plot is another method used for factor extraction of factors to be retained. This one is a subjective method which requires the researchers' judgements. According to this criterion, the significant factors are shown like a cliff, having a big slope while trivial factors are disposed at the cliff ([Figure 1](#)).

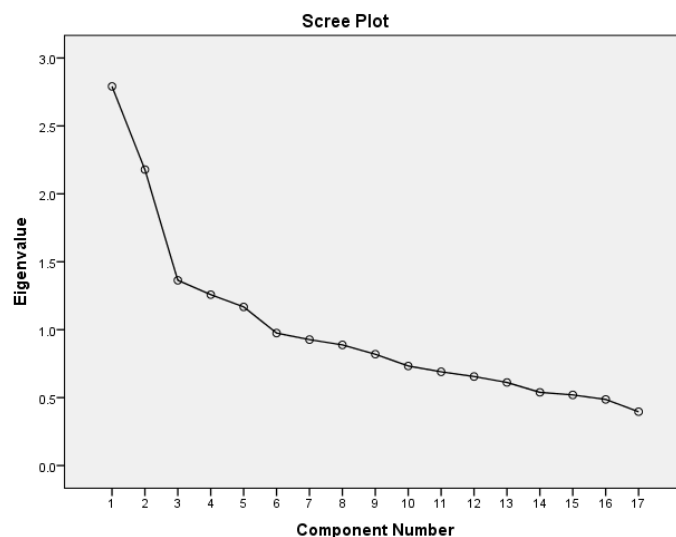


Figure 1: Scree plot for initial variable.

Hypotheses tested

The null hypothesis that states that socioeconomic factors, marketing variables, and production assets have no significant influence on the choice of marketing outlets among small-holder rice farmers was tested. The Multinomial Logit (MNL) result shows that age of the small-holder farming households head, sex of the small-holder farming households head, years of education, farm size, expected price, access to credit facilities, extension contact, price information, a quantity of output harvested, market information, and marketing experience were the significant factors influencing market outlet choice. Therefore, based on these findings, the null hypothesis was rejected, and the alternative hypothesis was accepted.

The null hypothesis that states there is no significant relationship between socioeconomic factors, marketing variables, and production assets and the total output of rice harvested was tested. The Double Log regression model revealed that the coefficients of farm size, a quantity of seed, the volume of chemical, labour input, a quantity of fertilizer, expected price, market information, and contract farming were significant factors influencing the output of rice harvested. Therefore, the alternative hypothesis was accepted, while the null hypothesis was rejected.

Conclusions and Recommendations

Based on the research findings, the following conclusion was made: The significant factors that influence the choice of market outlets were: sex of the household head, educational level of the sampled respondents, access to credit, extension services, price information,

and market information. The level of inequality of income distribution is high among small-holder rice farming households. Quantity of rice output harvested was significantly influenced by farm size, labour input, a quantity of seed planted, and contract farming. Smallholder rice farming households were faced with the following challenges in rice production and market participation: Fire outbreak, thieves, cattle herdsmen attack and flood, transportation problem, poor storage facility, inadequate capital, lack of land/tractor, means of transportation of rice seed to farm and harvested crop from farm gate to house and market; poor price, high cost of chemical, inadequate fertilizer, lack of improved seed, inadequate extension officers, and lack of credit facilities. Therefore, the study recommends that: New innovations and technologies that target increased agricultural productivity should be promoted. Also, the government should consider advances in knowledge through training in farm production and farm business management for increased productivity, and market participation through provision of adequate extension officers to train farmers on modern agricultural production. Input supply market development is highly recommended to ensure improved seeds and inorganic fertilizers are more accessible and affordable to small-holder household's rice farmers. Improving access to market information through appropriate sources could lower the transaction costs associated with searching for trading partners, contract farming and marketing should be encouraged, which will enhance market participation. Policies geared towards enabling farmers to access and utilize telecommunication technologies for trade purposes should be supported. Therefore, the locations of market and commodity price information should be broadcasted over the radio or made available through mobile phones. An example of such is e-wallet in Nigeria, Trade Net, in Ghana. Trade Net allows farmers to sign-up for SMS (short message service) this initiative should be taken to rural farming households. Access to markets by the provision of better rural road infrastructure could be a vital policy intervention. Improving rural road infrastructure would also lead to more traders penetrating the rural areas, and this will increase competition and could benefit small-holder farmers through better prices and enabling them to take advantage of profitable market outlets. Addition non-farm income from other sources will help reduce inequality among small-holder rural farming households, Policies and interventions which support

small-holders' asset building and wealth creation should be encouraged. Policies to improve access to assets will enhance small-holders' productivity and capacity to produce surpluses that will result in better participation in the market by the rice farmers and profitable market outlets choice. Such policies could involve designing appropriate property right regimes that enable small-holders to acquire, own and transfer production assets such as farmland, seeds, livestock, fertilizers, equipments and technology. Increasing rice production will have a positive impact on rice marketed surplus and market participation in Nigeria. Therefore, government policies that are directed towards increasing rice production need to be sustained and improved. Farmers need to be introduced to improved rice varieties and better production technologies, and they need to get access to credit facilities in order to be able to afford costly technologies. Collective actions through organizations are also a critical factor in enabling farmers' access to rice production assets. However, there is a need for policies and programs that support inclusiveness so that small-holder farmers will be involved in more profitable marketing outlets. This can be done through supporting the development and strengthening of functional, effective and sustainable farmer production and marketing groups, which could reduce transaction costs, improve collective action, and rural household welfare. Moreover, providing institutional support from different stakeholders from the agricultural sector (like NGOs and government organizations) could have a positive impact and improve market participation among small-holder farmers in rural areas. This can be achieved via public-private partnerships.

Novelty Statement

Determining the factors influencing output of rice produce and the choice of marketing outlets among smallholder farming households and the use of Gini coefficient, multinomial logit and principal components contributed and added more knowledge to the research article and the academia.

Author's Contribution

All authors jointly contributed in designing the research article, data collection, data analyses, interpretation of results and writing of research manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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