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Factors influencing income inequality among farming households of cassava producers, North Central, Nigeria

Olugbenga Omotayo ALABI [1*], Ibrahim MAHARAZU [2], Jeremiah Samuel ALUWONG[3], Jerry Oluwatosin BAKO[1]

[1]*Department of Agricultural Economics, Faculty of Agriculture, University of Abuja, PMB 117 Gwagwalada-Abuja, Federal Capital Territory, Nigeria.*
[2]*Department of Agricultural-Economics, Faculty of Agriculture, Kaduna State University (KASU), Kaduna State, Nigeria.*
[3]*Department of Agricultural-Ex tension and Management, School of Agricultural Technology, Nuhu Bamali Polytechnic, Zaria, Samaru Kataf Campus, Kaduna State, Nigeria.*

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ABSTRACT

This study focused on the factors influencing income inequality among farming households of cassava producers in North Central, Nigeria. A multi-stage sampling method was employed to select 160 cassava producers. The data were analyzed using descriptive statistics, Gini coefficient, and Probit model analysis. The results show that about 87% of cassava producers were male, while 13% were female. Approximate 92% of cassava producers were married. The mean age of cassava producers was 48 years. Averagely, the cassava producers had 13 years' experience in cassava farming. The cassava producers were literate with an average of 12 years of school education. The household sizes were large with an average of 8 people per household. Approximate 77% of cassava producers were member of cooperatives. The average farm size was 1.75 hectares which means that they are small-scale farmers. The estimates of Gini-coefficient show that 67 (41.88%) of cassava producers had values equal or less than 0.5 which means that they belong to low and moderate income inequality class. Similarly, approximate 93 (58.12%) of cassava producers had Gini-coefficient greater than 0.5, this implies that they belong to high income inequality class. The age, level of education, amount of credit accessed, farm experience, farm size, and extension contact were significantly different from zero in influencing the income inequality among farming households of cassava producers. The study recommends that single digit credit facilities should be provided to cassava farmers devoid of cumbersome administrative procedures. Also, mechanized farming using farm technologies with adequate provision of fertilizers, improved cuttings, agrochemicals, at appropriate time and affordable prices will increase productivity, income of cassava farmers.

Manyok üreticilerinin çiftçi haneleri arasında gelir eşitsizliğini etkileyen faktörler, Kuzey Orta, Nijerya

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ÖZET

Bu çalışma, Kuzey Merkez, Nijerya'daki manyok üreticilerinin çiftçi haneleri arasındaki gelir eşitsizliğini etkileyen faktörlere odaklandı. 160 manyok üreticisini seçmek için çok aşamalı bir örnekleme yöntemi kullanıldı. Birincil veriler kullanıldı. Veriler tanımlayıcı istatistikler, Gini katsayısı ve Probit model analizi kullanılarak analiz edildi. Sonuçlar manyok üreticilerinin yaklaşık %87'sinin erkek, %13'ünün ise kadın olduğunu göstermektedir. Manyok üreticilerinin yaklaşık %92'si evliydi. Manyok üreticilerinin ortalama yaşı 48'di. Manyok üreticilerinin manyok tarımında ortalama 13 yıllık deneyimi vardı. Manyok üreticileri okuryazardı ve ortalama 12 yıllık okul eğitimi aldılar. Hane halkı büyüklükleri oldukça büyük olup, hane başına ortalama 8 kişi düşmektedir.
Manyok üreticilerinin yaklaşık %77'si kooperatiflere üyedir. Ortalama çiftlik büyüklüğü 1,75 hektardı, bu da onların küçük ölçekli çiftçi olduğu anlamına geliyor. Gini katsayısı tahminleri, manyok üreticilerinin 67'sinin (%41,88) 0,5'e eşit veya daha düşük değerlere sahip olduğunu, yani düşük ve orta gelir eşitsizliği sınıfına ait olduklarını göstermektedir. Benzer şekilde, manyok üreticilerinin yaklaşık 93'ünün (%58,12) Gini katsayısının 0,5'ten büyük olması, onların yüksek gelir eşitsizliği sınıfına ait olduklarını göstermektedir. Yaş, eğitim düzeyi, erişilen kredi miktarı, çiftlik deneyimi, çiftlik büyüklüğü ve yayım sözleşmesi, manyok üreticilerinin çiftçi haneleri arasındaki gelir eşitsizliğini etkilemede sıfırdan önemli ölçüde farklıydı. Çalışma, manyok çiftçilerine hantal idari prosedürlerden arındırılmış tek haneli kredi olanaklarının sağlanmasını önermektedir. Ayrıca, yeterli miktarda gübre, iyileştirilmiş çelikler ve zirai kimyasalların uygun zamanda ve uygun fiyatlarla temin edildiği çiftlik teknolojilerini kullanan mekanize tarım, manyok çiftçilerinin verimliliğini ve gelirini artıracaktır.

*Corresponding author e-mail: omotayoalabi@yahoo.com

1. Introduction

Cassava (*Manihot spp*) is a food security crop, which can grow in low rainfall, minimal inputs, and poor soils (Gbigbi, 2021). The crop can withstand stress such as drought, cheap to cultivate, available all year round, and generate income for peasant farmers, hence providing household food security (Akerele et al., 2019). Cassava, apart from being used as a food crop for urban and rural communities, can also be used as bio-fuel, ethanol, to feed livestock, since it is a major source of income and employment for rural inhabitants in Nigeria. Nigeria, presently is the world's largest producer of cassava (60.8 million tons), second is Democratic Republic of Congo (48.8 million tons), third is Thailand (34.0 million tons), and fourth is Ghana (25.6 million tons) (FAO, 2024). Nigeria produced approximately 58,237, 500 tons and 60,835, 539.96 tons of cassava in 2021 and 2022, which represents 17.86% and 18.41% of world output, respectively (Figure 1). Similarly, in Nigeria, the cassava area in 2021 and 2022 approximated 9, 979, 330 hectares and 10, 029, 844 hectares, respectively (Figure 2). The world output of cassava in 2021 and 2022 approximated 326,015,871.5 tons and 330, 408,753.77 tons, respectively (Figure 1). The world area of cassava in 2021 and 2022 approximated 31, 461, 363 hectares and 320, 430, 055 hectares, respectively (Figure 2) (FAO, 2024). However, cassava farms faced low productivity and poor returns on investment (Itam et al., 2015). The sector is characterized by small-scale traditional farming methods with low modern technologies, and low levels of mechanization, leading to low levels of productivity (Abang et al., 2000).

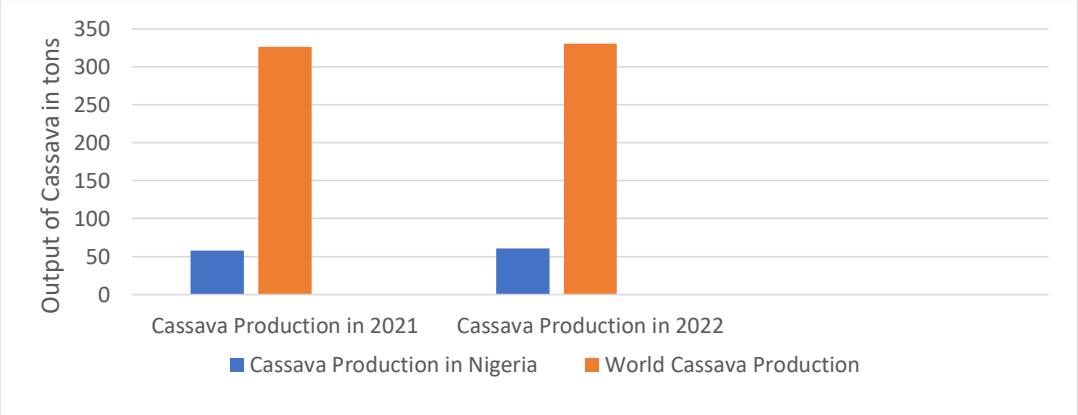

Figure 1. Cassava Production in Nigeria and the World

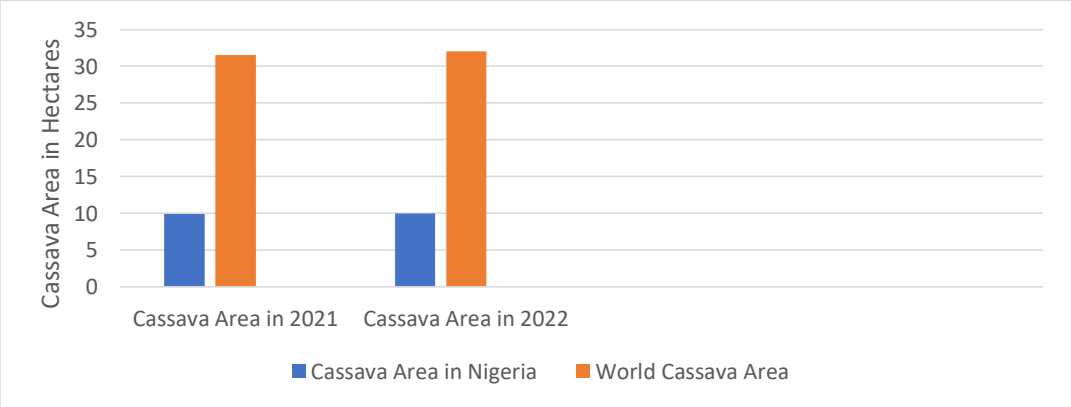

Figure 2. Cassava Area (Hectares) in Nigeria and the World

Income distribution pattern over the years has been a major problem in the determination of the level of economic development and growth (Agwu and Oteh, 2014). The gap between the lower income households and the upper income households has widened (Clarke et al., 2003). Income inequality was seen to be higher in the rural areas, when compared with the urban areas, the employment income increases inequality, while agricultural income decreases it (Addison and Cornia, 2001). Today, two out of five sub-Saharan Africans live in extreme poverty, and they do so among the worst income-wealth inequality (World Bank, 2019b). Economic inequality remains a matter of concern due to its link to extreme poverty, corruption, political stability, and social mobility (Bjornlund et al., 2020). The associations between income inequality, poverty, and growth are particularly important in rural areas, where poverty is most prevalent, typically above 70%, and where agriculture is the principal source of income (World Bank, 2019b). Agriculture-driven economic growth can become a vector of poverty reduction if it is not accompanied by extreme inequality in income and land (FAO, 2003). Economic inequality, whether in terms of income, expenditure, or wealth has long been recognized as a major obstacle to poverty reduction at global, national, and continental levels (Ravallion, 2014). The Gini-coefficient is the most popular inequality measure, given its relative ease of calculation and comparison across countries and population sizes (Manero, 2017). Gini -coefficient measure the degree to which the distribution of income differs from a perfectly equal distribution across all individuals in a group (World Bank, 2011). Its value ranges from zero (0) to one (1) (from total inequality to total equality).

The previous and related studies conducted by Donkor et al. (2022) on income inequality and distribution patterns in cassava value chain in the Oyo State, Nigeria was analyzed using descriptive statistics, Gini-Coefficient and multiple regression model. The result reported the estimated Gini coefficients of 0.44, 0.57, 0.79, and 0.73 among the small-scale cassava farmers, cassava medium scale farmers, cassava processors, and traders, respectively. The significant factors influencing profits of actors in the cassava value chains were age, primary education, secondary education, tertiary education, experience, farm size, labour, and membership of association.

Also, the studies conducted by Manero et al. (2020) on growth and inequality at the micro scale, an empirical analysis of farm incomes within smallholder irrigation systems in Zimbabwe, Tanzania, and Mozambique were analyzed by descriptive statistics, and Gini-coefficient. The estimated Gini-coefficients of 0.61, 0.57, 0.53, 0.61, 0.63 were reported for Mboka, Silalatchani, Kiwere, Magozi, and 25 Setembro among farmers in Zimbabwe, respectively.

The study conducted by Baruwadi et al. (2022) on inequality and income structure, a case study on maize farmer household in Gorontao Regency was analyzed using Gini-Coefficient, and z-test. The estimated Gini-coefficients of 0.61 and 0.35 were reported for Limboto and Tabongo. The previous study of Agwu and Oteh (2014) analyzed income inequalities and food security among farmers in Abia State, South Eastern, Nigeria, the data were analyzed using Gini-coefficient, food security formula, and multiple regression

analysis. The result shows the Gini-coefficient was estimated at 0.67, which implies that there is high income inequality in the study area.

The research gap is that no available data on income inequality among cassava producers in North central, Nigeria, secondly, no available data on factors influencing income inequality among cassava producers in the North Central Nigeria utilizing Probit model.

1.1. Research questions

This study provided answers to the following research questions:
(i)What is the socio-economic profiles of cassava producers?
(ii) What is the income inequality among cassava producers?
(iii) What are factors influencing income inequality among cassava producers?

1.2 Objectives of the study

The main aim of the study is to evaluate factors influencing the income inequality among farming households of cassava producers in North West, Nigeria. The specific objectives include:
(i) description of the socio-economic profiles of cassava producers,
(ii)estimation the income inequality among cassava producers, and
(iii)evaluation the predictors influencing the income inequality among cassava producers in the study area.

2. Materials and Method

This study was carried out in North Central which is comprised of Federal Capital Territory and Niger State, Nigeria. They are predominantly known for cassava farming. The study employed a multi-stage sampling technique. The multi-stage sampling technique was chosen because of flexibility, time and cost-effective, the method helps cut down the population into smaller groups. The method is useful in collecting primary data from a geographically dispersed population, since it does not need a complete list of all members of the target population thereby reducing the sample preparation cost. In the first stage, Federal Capital Territory and Niger State were chosen using simple random sampling method. Second-Stage, two area councils were chosen in the Federal Capital Territory, and two local government areas were chosen in Niger State using simple random sampling method. Third-stage, two villages were chosen from each area council and local government area, respectively. The sample frame of cassava producers approximates 267 respondents. In the fourth and final stage, the total sample number of cassava producers was randomly selected from the villages which approximate 160 respondents comprising of 80 cassava producers each from Federal Capital Territory and Niger State, respectively. Primary sources of data were used based on a well-structured questionnaire that was passed through reliability and validity test. This sample number was calculated following the estimated formula of Slovin (1960) as follows:

$$n = \frac{N}{1+N(e^2)} = \frac{267}{1+267(0.05^2)} = 160 \quad (1)$$

Where,
n = The Sample Number
N = The Total Number of Cassava Producers (Number for the 2 States)
e = 5%
The data obtained were analyzed using both inferential and descriptive statistics:

2.1 Probit dichotomous regression model (PDRM)

The Probit model is chosen and well-suited for characterizing dichotomous (binary outcome variable) binomial response variable. The Probit model is based upon the normal distribution. The Probit model analysis ensures that your estimated probabilities are between 0 and 1. The Probit model also gives better results when the probabilities are small or large. The model following the work of Alabi et al. (2014) is explicitly stated as:

$$Y_i = P_i^* = \alpha_0 + \sum_{i=1}^{6} \alpha_i Z_i + \cdots \alpha_n Z_n + \mu_i \quad (2)$$

$$Y_i = P_i^* = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \mu_i \quad (3)$$

$$Y_i = \begin{cases} 1, & if \quad P_i^* > 0.5 \\ 0, & if \quad P_i^* \leq 0.5 \end{cases}$$

Where,
Y_i = The Dependent Variable, (1, Lower and Moderate Inequality; 0, Higher Inequality)
P_i^* = Gini Inequality
α_0 = Constant Term
α_1 - α_6 = Regression Coefficients
Z_1 = Age (Years)
Z_2 = Education Level in Years
Z_3 = Amount of Credit Accessed (Naira)
Z_4 = Farm Experience (Years)
Z_5 = Farm Size (Hectares)
Z_6 = Number of Extension Contact (Number per Month)
μ_i= Noise Term

2.2 The gini coefficient

The Gini-coefficient is used to calculate the income inequality among farming households of cassava producers. The Gini coefficient has values ranging between zero and one. The formula following the work of Taru and Lawal (2011) is stated as:

$$GC = 1 - \sum_{i=1}^{n} X_i Y_i \quad (4)$$

Where,
GC = Gini Coefficient
X_i =Percentage Share of Each Class or Producers
Y_i = Cumulative Percentage of their Sales
$0 \leq GC \leq 1$ = Gini coefficient varies between zero and one. According to Todaro (2011) the classification of income inequality using Gini Coefficient (GC) is as follows:
$0.20 \leq GC \leq 0.35$ = Low Inequality
$0.35 \leq GC \leq 0.50$ = Moderate Inequality
$GC > 0.50$ = High or Extreme Inequality
$GC = 0$ Perfect Equality
$GC = 1$ Perfect Inequality

3.Results and Discussion

3.1 Summary profiles of household head among smallholder Cassava producers

The summary profiles of household head among cassava producers are presented in Table 1. Approximate, 87% of cassava producers were male, while 13% of the respondents were female. The mean age of cassava producers is 47 years. This means that they are strong, young, energetic and resourceful. This result is supported with the findings of Donkor et al. (2022) who obtained and average age of 48 years among cassava farmers in Oyo State, Nigeria. Averagely, 92% (SD = 0.48) of cassava producers were married, while 8% of the respondents were not married. The producers had 12 years' experience in cassava farming. This result is in line with Gbigbi (2021) who reported that 5 1.7% of cassava farmers had between 6 – 10 years' experience in cassava farming in Delta State, Nigeria.

Table 1. Summary Profiles of Smallholder Cassava Producers

Variables	Unit of measurement	$\bar{X}_i$	SD
Sex	1, Male; 0, Otherwise	0.87	0.48
Age	Years	48	11.16
Marital Status	1, Married; 0, Otherwise	0.92	0.48
Cassava Farming Experience	Years	13	6.27
Formal Education	Years	12	3.74
Household Size	Number	8	2.45
Farm Size	Hectare	1.75	0.54
Membership of Cooperatives	1, Member; 0, Otherwise	0.77	0.47

Source: Field Survey (2024), SD = Standard Deviation

The more years of farming experience a farmers have, the higher farm output than those with lesser years of farming experience. Durojaiye and Ogunjimi (2015) reported that educated farmers are capable of understanding and evaluating innovations. The household sizes were large with an average of 8 people per household. This work is in line with Alabi and Safugha (2022), and Alabi et al. (2022). According to Idrisa et al. (2012) who documented that large household sizes provide adequate supply of family labour for activities of farm production. This outcome conforms to the findings of Oladeebo and Oluwaranti (2012) who reported an average of 8 persons per cassava farmers in South West, Nigeria. They are small-scale farmers who cultivated an average farm size of 1.75 hectares of cassava farms. Approximate 77% (SD = 0.47) of cassava producers belongs to cooperative organization, while 23% of the respondents do not belong to any cooperative organizations. Membership of cooperatives enables the cassava producers access credit, share ideas, information, and sell in bulk the cassava produce. This finding is supported with the outcomes of Bizikova et al. (2020), Manda et al. (2020), and Olagunju et al. (2021) who reported that the memberships of association are important social capital for the cassava value chain actors, enabling them to access to certain economic resources such as training, innovations, credit, and relevant market information. This study is supported with Donkor et al. (2022) who documented that

membership of association enables the cassava actors to receive support in the form of training on innovations and finance from the non-governmental and government organizations. Moreso, members of association share information on available market, prices and innovations that enhance their productivity and profit. The collective action by cooperative members reduce transactions costs and enables cassava actors access to better markets.

3.2 Estimate of gini coefficient among farming household of cassava producers

Table 2 presents the values of Gini coefficient among farming households of cassava producers in the study area. Approximately 67 (41.88%) of cassava producers had Gini coefficient values less or equal to 0.5 this implies that they had low and moderate income inequality. Similarly, approximately 93 (58.12%) of cassava producers had Gini coefficient values greater than 0.5, this means that they had high income inequality. This study is similar to the findings of Taru and Lawal (2011) who obtained Gini coefficient of 0.52 for yam retailers and 0.5 for yam wholesalers in Taraba State, Nigeria. This finding is also in line with findings of Baruwadi et al. (2022) who obtained Gini coefficients of 0.61 and 0.35 for yam farming households in Limboto and Tabongo Gorontalo Regency, Indonesia. This result agrees with the findings of Donkor et al. (2022) who obtained the estimated Gini coefficients of 0.44, 0.57, 0.79 and 0.78 among small-scale cassava farmers, cassava medium-scale farmers, cassava processors, and traders in Oyo State, Nigeria. This result is supported with the findings of Agwu and Oteh (2014) who reported that there is a high income inequality for an estimated Gini-coefficient of 0.67 among farmers in Abia State, Nigeria.

Table 2. Estimates of Gini Coefficient among Farming Household of Cassava Producers

Gini Coefficient	Frequency	Percentage
≤ 0.5	67	41.88
> 0.5	93	58.12
Total	160	100.00

Source: Field Survey (2024)

3.3 Factors influencing income inequality among farming households of cassava producers

Table 3 presented the maximum likelihood estimates of factors influencing income inequality among farming households of cassava producers. The analysis was done using Probit model analysis. The log likelihood ratio statistics was estimated at -156.48 which was significant at 1% probability level, this signifies that the model has strong explanatory power. The Pseudo R^2 was evaluated at 0.8709, this means that 87.09% of the variations in the dependent variable was explained by the stated predictors in the model.

Table 3. The MLEs (Maximum Likelihood Estimates) of the Probit Regression Model

Variables	Parameters	Coefficient	Standard error	$P > \|Z\|$
Constant	α_0	0.4306***	0.1107	0.000
Age	α_1	0.2803***	0.1562	0.001
Level of Education	α_2	0.2168**	0.0852	0.026
Amount of Credit Accessed	α_3	0.2502*	0.1368	0.060
Farm Experience	α_4	0.2408**	0.1257	0.027
Farm Size	α_5	0.2209***	0.0561	0.000
Extension Contact	α_6	0.1309**	0.0578	0.028
Diagnostic Statistics				
LR_{χ^2} (6)	96.23***			
Pseudo R^2	0.8709			
LLF (Log Likelihood)	-156.48			
Prob $>_{\chi^2}$	0.00000***			

Source: Field Survey (2024),
*Significant at ($P < 0.10$)., **Significant at ($P < 0.05$), ***Significant at ($P < 0.01$).

Approximately six (6) predictors were included in the Probit model analysis. All the predictors had positive coefficient with income inequality of cassava producers. The significant predictors include age, level of education, amount of credit accessed, farm experience, farm size, and extension contact. The coefficient of age is positive (0.2803) and significantly different from zero at 1% probability level. This signifies that 1% increase in age, while keeping all other variables fixed will give rise to 28.03% increase in further lowering the income inequality among farming household of cassava producers. According to Donkor et al. (2022) who reported that the value addition activities from cassava production to trade in cassava products are labour intensive and require more energy, therefore, as actors advance in age, they become less active and their labour productivity tends to reduce. The low labour productivity leads to reduction in their total output and profit. The observation of the work is supported with the existing empirical study by Donkor et al. (2019) who reported that age of cassava farmers reduced their profits in Oyo State, Nigeria. The coefficient of level of education was 0.2168, and was significant at 5% probability level. This means a 1% increase in the level of education keeping all other variables constant will give rise to 21.68% increase in further lowering the income inequality among farming household of cassava producers. The coefficient of amount of credit accessed was positive (0.2502) and was significantly different from zero at 10% probability level. Thıs shows that a 1% increase in amount of credit accessed, while keeping all other factors constant will give rise to 25.02% increase in further lowering the income inequality among farming household of cassava producers. According to Oyibo et al. (2021) who reported that an increase in accessibility of credit will lead to a reduction in technical efficiency of the cassava farmers. Also, Mohammed and Falola (2016) who stated that access to credit affects input availability and efficiency and those producers who have access to credit tend to improve their income. The coefficient of farm experience is positive (0.2408) and significantly different from zero at 5% probability level. This signifies that a 1% increase in farm experience, while keeping all other factors fixed will give rise to 24.08 increase in further lowering the income inequality among farming households of cassava producers. According to Akerele et al. (2019) who reported that farming experience is

used as a measure of management ability, the more experienced the farmers is, the more his ability to make farm decision. This study is supported with findings of Donkor et al. (2022) who documented that farm experience is another important human capital, most farmers develop agribusiness skills overtime through experience, therefore, farmers use the knowledge gained through experience to improve their productivity and profit.

Similarly, the coefficient of farm size was estimated at 0.2209 and was significant at 1% probability level. This signifies that a 1% increase in farm size of cassava producers keeping all other predictors fixed will give rise to 22.09% increase in further lowering the income inequality among farming households of cassava producers. This result is consistent with Obayelu et al. (2013) who reported that farm size was positively related to farm profit of cassava farmers in Ogun and Oyo States, Nigeria. The coefficient of extension contact is positive (0.1309) and statistically different from zero at 5% probability level. This means a 1% increase in extension contact, while keeping all other factors fixed will give rise to 13.09% increase in further lowering the income inequality among farming households of cassava producers. This study is supported with outcomes of Mohammed and Falola (2016) who documented that the contact with extension workers enables the cassava farmers to acquire the technical knowledge as well as to have access to improved production technology which will make them more efficient, productive with more profit. This work is also supported with Ofuoku et al. (2006) who reported that frequency of extension contacts enhanced adoption of improved technologies in Delta State, Nigeria.

4. Conclusion

This study focused on the factors influencing income inequality among farming household of cassava producers in North Central, Nigeria. A multi-stage sampling technique was employed to select 160 farming households of cassava producers. The sampling frame was 267 cassava producers. Primary data were used for this study. The data were analyzed using descriptive statistics, Gini coefficient, and Probit model analysis. The following conclusion were made based on the research questions:

What is the socio-economic profiles of cassava producers?

The cassava producers had a mean age of 48 years. They attended formal education with an average of 12 years of school education. The average farm size was 1.75 hectares, this shows that they are small-scale farmers based on the classification of farm holdings in Nigeria by Olayide (1980) who reported that small, medium, and large scale producers hold 0.1 – 5.99, 6.0 – 6.99, and above 10 ha, respectively.

What is the income inequality among cassava producers?

The estimates from Gini-coefficient revealed that approximately 67 (41.88%) of farming households among cassava producers had values less or equal to 0.5, this signifies that they belong to low and moderate income inequality class. Similarly, approximately 93 (58.12%) of farming households among cassava producers had Gini coefficient values greater than 0.5, this means that they belong to high income inequality class. The Gini coefficient is a value ranging from zero to one. The economic inequality remains a matter of concern due to its link to extreme poverty, corruption, political instability and social mobility (Rothman, 2015). Approximately two in five sub-Saharan

Africans live in extreme poverty, they do so amid some of the world severe wealth and income inequality (World Bank, 2019b). According to World Bank (2019b), the world most unequal countries by Gini coefficient are South Africa (0.63) (occupies 1st), Namibia (0.59) (occupies 2nd) heading the list, Nigeria (0.35) occupies 93rd position. These countries also score among the world's lowest on the Human Development Index, a composite of average life expectancy, education, and income (UNDP, 2017). The associations between inequality, poverty, and growth are particularly important in rural areas where poverty is prevalent, typically above 70%, and where agriculture is the principal source of income (World Bank, 2019b). Agriculture-driven economic growth can become a vector for poverty reduction if it is not accompanied by extreme inequality include in land and income (FAO, 2003).

(iii) What are factors influencing income inequality among cassava producers?

The significant predictors influencing income inequality among farming households of cassava producers include age, level of education, amount of credit accessed, farm experience, farm size, and extension contact. Based on the findings the following recommendations were made:

(i) Credit facilities at low interest rate should be giving to cassava producers to increase productivity and income. The credit facilities should be accessed devoid of cumbersome administrative procedures

(ii) The fertilizer input, agrochemicals, improved cuttings should be made available to cassava producers at affordable prices to increase productivity and income.

(iii) Extension contact should be employed to disseminate research findings and innovations to cassava farmers.

(iv) Farm land should be made available to youths, and farmers with appropriate farm technologies for mechanized farming to increase productivity should be presented concisely.

Author Contribution

The authors declare that they have contributed to the study on the subjects mentioned above.

Conflict of Interest Declaration Information

There is no conflict of interest.

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