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Labor utilization and food security among rural maize farmers in Abuja Metropolis, Nigeria: A careful analytical study

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Abstract

This study investigates the relationship between labor use and food security among rural maize farmers in Abuja Metropolis, Nigeria. Using a two-stage sampling procedure, 125 maize farmers were selected from various villages within the study area to participate. A structured questionnaire was employed to gather data, focusing on labor allocation, food security metrics, and socio-economic variables. The collected data were analyzed using descriptive statistics, a food security index, and a probit regression model. Findings indicate that maize farmers in Abuja Metropolis utilize both hired and family labor, with varying implications for household food security. Specifically, higher reliance on family labor tends to enhance food security, whereas increased dependence on hired labor correlates with decreased food security among rural farming households. Based on these findings, the study recommends several interventions to improve food security in the region. These include enhancing access to credit facilities for farming households, promoting agricultural engagement among youth to alleviate dependency on non-agricultural jobs, and advocating for family planning initiatives to manage household size, thereby mitigating food insecurity risks associated with larger families. This research contributes to the understanding of labor dynamics in agricultural settings and offers practical insights for policymakers, governmental agencies, and non-governmental organizations aiming to strengthen food security initiatives in similar contexts.

Keywords: Food Availability; Food Access; Food Utilization; Food Stability; Sustainable Agriculture

1. Introduction

1.1. Food Security

Food security refers to a condition where all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. This concept encompasses four key dimensions: food availability, food access, food utilization, and food stability. Food availability means having a consistent supply of adequate food through domestic production, imports, or food aid. Food access refers to individuals' ability to acquire appropriate foods for a nutritious diet, which is influenced by purchasing power, income levels, and distribution systems. Food utilization involves proper biological use of food, requiring a diet

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providing sufficient energy and essential nutrients, potable water, and adequate sanitation (Onivefu, 2024). Finally, food stability ensures that individuals always have access to adequate food, without risk of losing access due to sudden shocks or cyclical events (World Bank, 2024)

Food security entails ensuring that all individuals consistently have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and preferences for an active and healthy life. With the global population expected to reach 9.3 billion by 2050, achieving food security poses significant challenges. Key strategies to address these challenges include reducing food waste, enhancing infrastructure, and promoting efficient production techniques. Food security is crucial as it accounts for a substantial part of household budgets, particularly in Nigeria, and impacts overall health and productivity. Addressing food insecurity is becoming increasingly urgent due to rising food prices influenced by climate change and population growth, making nutritious food less accessible. The issue of food insecurity encompasses a "triple burden" of malnutrition, affecting nearly 3 billion people worldwide. This includes undernutrition, micronutrient deficiencies, and obesity. To combat these issues, it is essential to adopt sustainable and efficient agricultural practices, improve infrastructure, ensure fair trade, and address the indirect causes of food insecurity such as climate change and socio-economic instability. Strengthening the four pillars of food security—availability, access, utilization, and stability—is vital for improving global food security and ensuring a healthier future for all (Wageningen University & Research, 2024).

Labor plays a crucial role in combating food security issues through several key avenues. Adequate labor, when effectively utilized, enhances agricultural productivity by ensuring timely planting, proper maintenance such as weeding and pest control, and efficient harvesting, resulting in higher crop yields and greater food availability. Labor also enables farmers to diversify crops and implement crop rotation strategies, which help maintain soil fertility, reduce pests and diseases, and ensure continuous production of diverse food types throughout the year. Moreover, labor is essential for building and maintaining agricultural infrastructure such as irrigation systems, storage facilities, and roads, which improve market access, reduce post-harvest losses, and enhance the overall efficiency of food supply chains. Additionally, labor facilitates the adoption of agricultural technologies like improved seeds and mechanization, boosting productivity and resilience against climate change. Education and training programs for laborers equip farmers with modern agricultural practices, while supportive policies and programs from governments and organizations promote sustainable farming and improve access to resources, thereby strengthening agricultural sectors and achieving greater food security globally (Pawlak and Kołodziejczak, 2020).

The advancements in zinc oxide nanoparticles (ZnO NPs) underscore the potential of scientific innovation to solve pressing healthcare challenges. The development of ZnO NPs for antimicrobial and UV protection applications represents a significant leap in enhancing healthcare solutions. These nanoparticles offer superior properties that can be utilized in various healthcare products, providing enhanced protection against harmful microorganisms and UV radiation. This not only improves public health outcomes but also contributes to the overall well-being of communities by reducing the incidence of infections and UV-related health issues (Irede, et al., 2024)

Food is any nourishing substance consumed to sustain life, provide energy, and promote growth, making it essential for the survival of mankind and its economic activities, including food production. For food security to exist at national, regional, and local levels, food must be available, accessible, and properly utilized. As a basic necessity of life, adequate food intake in terms of quantity and quality is crucial for a healthy and productive life. Food is the most important commodity linking rural producers and urban consumers, accounting for a substantial part of the typical Nigerian household budget. Consuming various foods in appropriate proportions ensures the intake of essential nutrients such as carbohydrates, proteins, fats and oils, vitamins, and minerals. Therefore, achieving food security is vital for any country's well-being.

Food insecurity in the United States is a persistent issue affecting millions of individuals and families. Despite being one of the wealthiest countries globally, a significant portion of the American population struggles with access to sufficient, safe, and nutritious food. The U.S. Department of Agriculture (USDA) reports that in recent years, around 10-12% of households experience food insecurity, meaning they lack consistent access to enough food for an active, healthy life. This problem is exacerbated by factors such as poverty, unemployment, and rising living costs. Households with children, single-parent families, and minority communities are particularly vulnerable to food insecurity. The COVID-19 pandemic further intensified this issue, with job losses and economic disruptions leading to increased reliance on food assistance programs and food banks. Efforts to combat food insecurity in the United States involve a combination of federal nutrition programs, community initiatives, and policy interventions. Programs like the Supplemental Nutrition Assistance Program (SNAP), Women, Infants, and Children (WIC), and the National School Lunch Program provide critical support to low-income families, ensuring access to nutritious food. Additionally, food banks, non-profit organizations, and community gardens play vital roles in addressing immediate needs and promoting food self-

sufficiency. However, long-term solutions require addressing the root causes of food insecurity, such as economic inequality, affordable housing, and healthcare access. By tackling these underlying issues, the U.S. can make strides toward reducing food insecurity and ensuring that all citizens have the opportunity to lead healthy, productive lives (USDA, 2023).

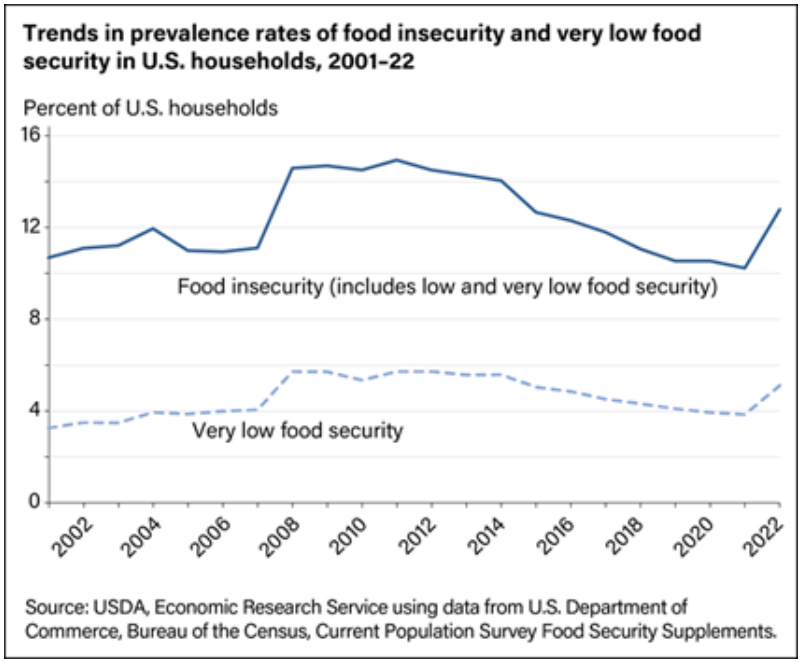

Figure 1 Trends in Food Security in the United States (USDA, 2023)

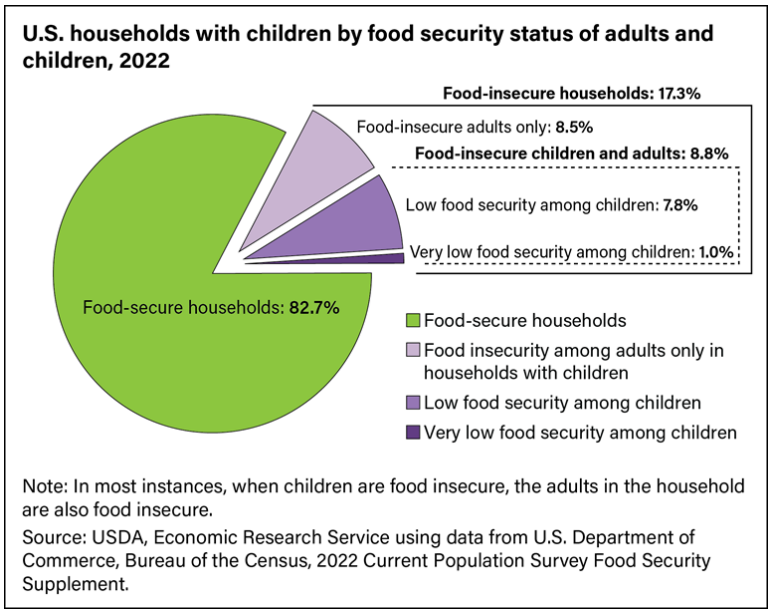

Figure 2 U.S Households with children by food security status of adult and children (USDA, 2023)

1.2. Food security in Africa

Food security in Africa ca remains a critical challenge, with millions facing chronic hunger and malnutrition due to a combination of factors such as poverty, political instability, climate change, and inadequate infrastructure. Agriculture, which employs a large portion of the population, is often hindered by outdated farming techniques, limited access to markets, and insufficient investment in technology and education. Rapid population growth further strains food

resources, making it imperative to adopt sustainable agricultural practices, improve food distribution systems, and strengthen economic policies. Initiatives like improving irrigation, providing access to better seeds and fertilizers, and fostering regional cooperation are essential to enhance food security and build resilience against future food crises on the continent (Wudil et al, 2022).

Implementing sustainable agricultural practices and efficient water management systems can significantly enhance food availability and utilization in Igarra. By promoting crop diversification and the use of organic farming techniques, farmers can improve soil fertility and reduce dependency on chemical fertilizers, which might be influenced by quarry activities. Additionally, constructing proper irrigation and water storage systems can help manage water resources efficiently, ensuring that crops receive adequate hydration even during dry periods. Educational programs for farmers on modern agricultural practices and the importance of maintaining environmental health can further strengthen food security. Addressing these aspects will not only improve the resilience of local agriculture but also contribute to the overall well-being of the community by ensuring consistent access to safe and nutritious food (Onivefu et al, 2024).

Food security in Abuja Metropolis, Nigeria, faces challenges typical of urban centers in developing countries, despite being the capital city. Rapid urbanization, unequal distribution of wealth, and limited access to affordable and nutritious food characterize the food security landscape. Many residents, particularly those in low-income neighborhoods, struggle with inadequate access to food due to high food prices, unemployment, and limited social safety nets. Urban agriculture initiatives, community gardens, and local markets play crucial roles in supplementing food sources, yet significant disparities remain in access to nutritious food. Addressing these challenges requires holistic approaches that integrate urban planning, economic policies, and community engagement to ensure equitable access to food and promote sustainable urban food systems in Abuja.

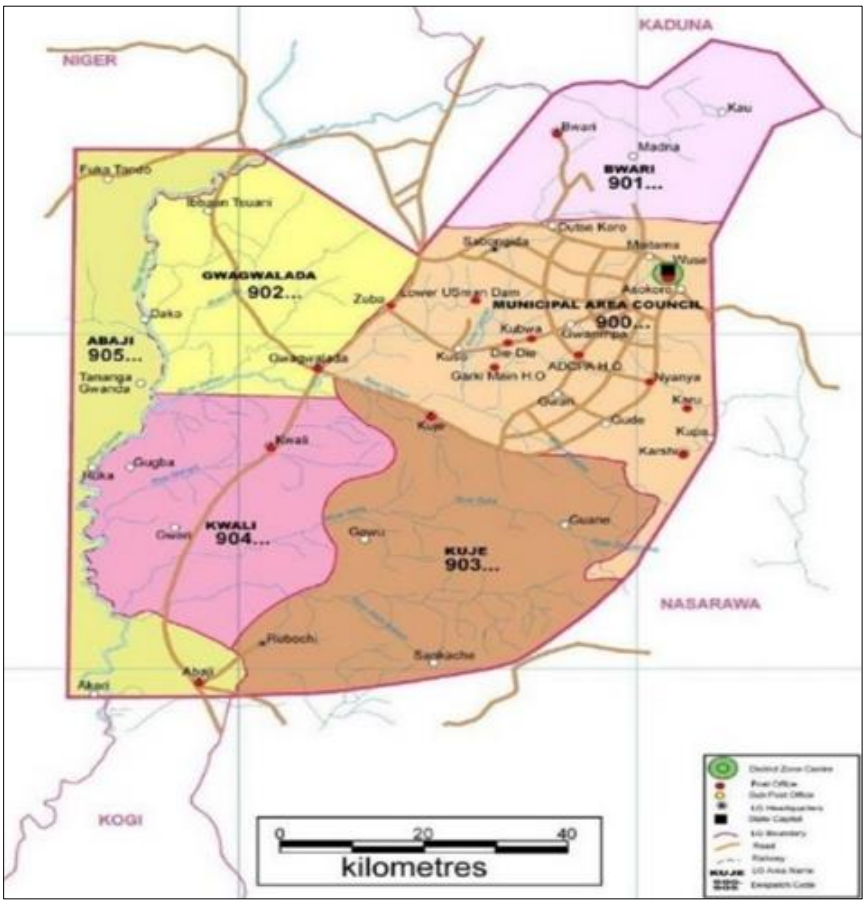

Figure 3 Map of Abuja Metopolis (Ozioma et al, 2017)

1.3. Statement of problem

Nigeria, Africa's most populous country with approximately 150 million people according to the Nigerian Population Census of 2006, faces significant food insecurity challenges, particularly in rural areas where over 70% of the population resides. Agriculture plays a crucial role in Nigeria's economy, contributing more than 48% to the annual GDP, employing

about 68% of the labor force, and supplying over 80% of the country's food needs. Despite these contributions, food insecurity remains a critical developmental issue, with rural areas experiencing increasing rates of food insecurity from about 18% in 1986 to approximately 41% in 2004. This trend underscores food security as a key measure of poverty, limiting access to adequate nutrition and exacerbating socio-economic disparities. Addressing poverty is therefore essential to improving household food security in Nigeria (World Bank, 2024)

Essentially, this study seeks to address the following inquiries:

- What are the socioeconomic profiles of maize farmers in the research area?
- What are the various sources of labor accessible to participants in the study area?
- How do maize farmers utilize the available labor resources?
- What is the current food security status of the participants?
- What are the determinants of household food security of the respondent?

Objectives of the study

The primary aim of this study is to evaluate labor utilization and food security within the study area. Specifically, it aims to analyze the socioeconomic profiles of maize farmers, identify the various sources of labor accessible to respondents, investigate how labor is allocated among maize farmers, assess the current food security status of participants, and ascertain the factors that influence household food security among farmers. By addressing these objectives, the study aims to provide insights into the dynamics of labor use and its impact on food security among maize farmers in the research area.

1.4. Justification of study

The importance of maize as a staple food in sub-Saharan Africa, particularly for low-income and resource-poor households, cannot be overstated. It serves as a crucial source of carbohydrates, protein, iron, vitamin B, and minerals, meeting the dietary needs of over 200 million Africans, especially after the dry season. In Nigeria, maize is paramount, comprising 43% of West Africa's production and providing about 43% of the calorie intake for Nigerians. Despite its significance, agricultural production in Nigeria heavily relies on small-scale, resource-poor farmers who face challenges such as labor constraints during crucial farming stages like planting, weeding, and harvesting. This reliance on human labor, which constitutes up to 80% of total farm power and a significant portion of production costs, underscores the need for improved agricultural technologies to enhance productivity and ensure food security. Addressing these issues is vital as rural-urban migration, educational priorities, and demographic shifts continue to affect labor availability and agricultural productivity, ultimately impacting food security across the country.

2. Methodology

2.1. Description Of Study Area

Abuja, Nigeria's capital city, is centrally located within the Federal Capital Territory (FCT), serving as the administrative and political nucleus of the nation. Geographically, it experiences a tropical wet and dry climate, marked by distinct rainy and dry seasons. Annually, Abuja receives rainfall ranging between 1,100 to 1,500 millimeters, with the rainy season typically spanning from April to October. This climate supports diverse agricultural activities, including livestock rearing of cattle, goats, sheep, and poultry, which are integral to the local economy and food supply.

Abuja boasts a dynamic population exceeding 3 million people, reflecting its role as a melting pot of various Nigerian ethnicities and expatriates drawn to its capital status. The city's agricultural landscape features fertile farmlands conducive to growing maize, cassava, yams, vegetables, and fruits. Agriculture remains a cornerstone of the local economy, engaging a significant segment of the population in small-scale farming and labor-intensive agricultural practices. Both household labor and hired laborers play crucial roles throughout the agricultural seasons, from planting and tending crops to harvesting. Abuja stands as a vital hub for administrative and economic activities in Nigeria, distinguished by its strategic location, diverse agricultural production, and burgeoning urbanization (Abubakar, 2020).

2.2. Sources of Data

The tool employed in this research is a questionnaire divided into three sections. The first section aims to capture the socio-demographic characteristics of the respondents. The second section assesses the levels and determinants of food security status and labor utilization among farming households. The third section gathers data on factors influencing

household food security challenges, while the final section examines the relationship between labor utilization and food security. The questionnaire was chosen for its comprehensive coverage of the study's key themes and variables.

2.3. Sample and Sampling Procedure

A two-stage sampling approach was utilized to select maize crop farmers from the study area. Initially, six villages were randomly chosen from the Local Government Area during the first stage. In the second stage, one hundred and twenty five (125) maize farmers were selected at random from each of these villages within Abuja metropolis. Ultimately, complete information was gathered from one hundred to one hundred and ten (100 - 110) maize crop farmers, which was used for the final analysis.

2.4. Method of Data Analysis

Descriptive statistics used includes measure of central tendency such as frequency distribution and percentages; mean scores, median, mode, standard deviation with the minimum and maximum values.

2.5. Food Security Measure

To determine the food security status of the rural maize farming households, the households were classified using the food security index. Foster, Greer and Thorbecke (FGT) weighted poverty measures was used as employed by (Onasanya and Obayelu, 2016)

2.6. Mean per capital household food expenditure (MPCHFE) =

$$\frac{\text{Total per capital household food expenditure}}{\text{Total number of households}}$$

The FGT index is given mathematically as:

$$P\alpha = \frac{1}{N}\sum_{i=1}^{q}\left[\frac{z-Yi}{z}\right]\alpha$$

α = Food security aversion parameters of the FGT index

Where
Yi = per capita household food expenditure
(i = 1, 2 .....q)
Z = Food security index
N = Total number of population
q = Number of food secure household
Pα ≥ 0 and it can take values of 0, 1 and 2

Therefore,

Food insecure = household whose per capita food expenditure falls below two-third of the mean

Food secure =household whose per capita monthly food expenditure falls above or is equal to two third of the mean per capita food expenditure.

2.7. Probit Model

The study employed probit model to determine factors affecting food security status of the rural maize farming households in the study area.

The model is specified as follows:

$$Y = \beta 0 + \beta iXi + \varepsilon i$$

Where ε =N (0, 1).
Y= is a dependent variable (dichotomous variable) which assumes the value 0 if an household is food insecure and 1 if the household is food secure.
B0= intercept

βiXi= slope (coefficient) of independent variables
Independent variables (the explanatory variables) X;

where X= X_1, X_2……X_{11} are:

X_1= age of the farmer (years);
X_2= Gender of farmer (male=1, female=0);
X_3= Marital status of farmer (married=1, 0 otherwise);
X_4= Household size (number);
X_5= Years spent in school (Years);
X_6= Farming experience (years);
X_7= Farm size (hectares);
X_8= Access to extension contact (yes=1, otherwise=0);
X_9= Hired labour (man-days);
X_{10}= Family labour (man-days);
X_{11}= Diversification index (using the Herifindal Index);

The diversification variable (DIVER) would be measured by using the Herfindal index as defined as:

$$\sum_{i=1}^{n} R2$$

Where, $R_i = \frac{Ai}{\sum_{i=1}^{n} Ai}$

A=share of farm revenue from enterprise

Data Limitations

During the data collection process, several challenges were encountered. Initially, some respondents exhibited hostility upon initial contact, which posed a barrier to gathering information. Additionally, there were difficulties in obtaining complete disclosure, particularly regarding income details, as respondents were hesitant to fully disclose this sensitive information. Moreover, the information provided on expenditure was based on respondents' recollection over a recent period, which may have introduced recall bias. Another challenge was the variability in respondents' income flows, making it challenging to accurately estimate monthly incomes. Furthermore, the study faced constraints due to a limited timeframe, which restricted the geographical scope that could be covered comprehensively. Despite these challenges, efforts were made to ensure the reliability of the estimates and information gathered, which were subsequently used in the analysis.

2.8. Data Presentation, Analysis and Interpretation

This chapter focuses on the quantitative analysis of the study, detailing the statistical methods employed to examine food security and labor use among rural maize farmers in Abuja Metropolis State. Data were gathered from 100 rural maize farmers using a well-structured questionnaire designed for this purpose. The collected data underwent analysis using descriptive statistics to summarize key variables, the food security index to assess household food security levels, and the probit regression model to explore factors influencing food security outcomes. These analytical tools were chosen to provide a comprehensive understanding of the socio-economic characteristics, labor patterns, and food security status within the study area.

2.9. Presentation and Interpretation Data

The data collected from the survey exercise are presented and interpreted as follows:

Table 1 Socio-Economic Characteristics of Respondents

Household characteristics	**Family labour (%)**	**Hired labour (%)**	**All (%)**
Sex			
Male	29(67.4)	46(74.2)	75(71.4)
Female	14(35.6)	16 (25.8)	30(28.6)
Total	43(100)	62(100)	105(100)
Age (years)			
< 30	26(60.5)	44(70.9)	70 (66.7)
31-40	10(23.3)	18(29.1)	28(26.9)
41-50	4(9.3)	0	4(3.8)
51-60	1(2.3)	0	1(1.0)
> 60	2(4.7)	0	2 (1.9)
Total	43(100)	62(100)	105(100)
Mean	28.9	29.8	29.1
Standard deviation	9.1	8.5	8.9
Minimum	21	20	20
Maximum	64	40	64
Primary occupation			
Farming	41(95.3)	58 (93.5)	99 (94.3)
Otherwise	2 (4.7)	4 (6.5)	6 (5.7)
Total	43(100)	62(100)	105(100)
Marital status			
Married	40 (93.0)	57(91.9)	97(92.4)
Single	1(2.3)	2(3.3)	3(2.9)
Widowed	1(2.3)	1(1.6)	2(1.9)
Divorced	1(2.3)	2(4.8)	3(2.9)
Total	43(100)	62(100)	105(100)
Household size (person)			
1-3	2(2.6)	1(1.5)	3(2.9)
4-8	41(96.2)	58(90.1)	99(94.3)
>8	1(1.2)	2(5.4)	3(2.9)
Total	43(100)	62(100)	105(100)
Mean	5.4	5.1	5.2
Standard deviation	1.3	1.2	1.2
Minimum	1	1	1
Maximum	8	8	8
Level of education			

No formal education	10(23.5)	11(17.7)	21(20.0)
Primary education	28(41.8)	30 (48.4)	58(55.2)
Secondary education	4 (9.3)	17(27.4)	21(20.0)
Tertiary education	1(2.3)	4 (6.5)	5(4.8)
Total	43(100)	62(100)	105(100)
Experience in maize farming (year)			
<5	10(23.3)	15 (24.2)	25 (23.8)
6-10	9 (20.9)	40 (64.5)	49 (46.7)
>10	24 (55.8)	7 (11.3)	31(29.5)
Total	43(100)	62(100)	105(100)
Access to extension service			
Yes	3 (6.7)	9 (14.5)	12 (11.4)
No	40 (93.0)	53 (85.5)	93 (88.6)
Total	43(100)	62(100)	105(100)
Membership of farmers cooperatives			
Yes	33(76.7)	40 (64.5)	73(69.5)
No	10 (23.3)	22 (35.5)	32(30.5)
Total	43(100)	62(100)	105(100)
Farm size (hectare)			
< 1	25(58.2)	29 (46.8)	54(51.4)
1-3	12 (27.9)	32 (51.6)	45(42.9)
> 4	5 (11.9)	1(1.6)	6 (5.7)
Total	43(100)	62(100)	105(100)

Source: Computed from field survey, 2017

Table 1 presents detailed socio-economic characteristics of the respondents, including sex, age, primary occupation, marital status, household size, level of education, experience in maize farming, access to extension services, membership in cooperatives, and farm size. In terms of gender distribution, 75 (71.4%) of the rural maize farmers were male, while 30 (28.6%) were female. Regarding the use of labor, 29 (67.4%) male and 14 (35.6%) female maize farmers reported using family labor, while 46 (74.2%) male and 16 (25.8%) female farmers utilized hired labor.

In terms of age distribution, the majority of respondents, 70 (66.7%), were below 30 years old, with 28 (26.9%) aged between 31-40 years, and smaller proportions in higher age brackets. The mean age of respondents was 29.1 years, indicating a predominantly youthful population among maize farmers in the study area.

Regarding primary occupation, 99 (94.3%) respondents identified farming as their main occupation, highlighting agriculture's central role in their livelihoods. Marital status analysis revealed that 97 (92.4%) of the respondents were married, indicating a predominantly married population within the farming community.

Household size distribution showed that 99 (94.3%) respondents had between 4-8 persons in their households, with an average household size of 5.2 persons. In terms of education, the majority of respondents, 58 (55.2%), had completed primary education, while smaller proportions had no formal education, secondary education, or tertiary education.

Experience in maize farming varied, with 49 (46.7%) respondents having between 6-10 years of experience, indicating a moderate level of expertise among farmers. Access to extension services was reported by only 12 (11.4%) respondents, suggesting limited engagement with agricultural extension support.

Regarding membership in farmers' cooperatives, 73 (69.5%) respondents were members, underscoring the importance of cooperative associations in agricultural activities. Farm size distribution indicated that 54 (51.4%) respondents cultivated less than 1 hectare of land, while 45 (42.9%) managed between 1-3 hectares, reflecting predominantly small-scale farming operations among maize farmers in the study area.

Table 2 Distribution of Respondents according to Labour Types in the Study Area

Variable	Frequency	Percentage
Labour Type in Current Season		
Family	43	41.0%
Hired	62	59.0%
Total	105	100.0%
Labour Type Last Season		
Family	53	50.5%
Hired	52	49.5%
Total	105	100.0%
Difficulty in getting Labour		
Yes	52	49.5%
No	53	50.5%
Total	105	100.0%

Source: Computed from field survey, 2017

Table 2 presents the distribution of respondents based on types of labor utilized in the study area. In the current season, 43 (41.0%) respondents reported using family labor, while 62 (59.0%) used hired labor. This indicates a greater reliance on hired labor compared to family labor during the current season.

In the previous season, 53 (50.5%) respondents utilized family labor, whereas 52 (49.5%) employed hired labor. This suggests that farmers relied more on family labor than hired labor in the last season.

Furthermore, 52 (49.5%) respondents expressed difficulty in acquiring labor, while the remaining 53 (50.5%) reported no difficulty in accessing labor resources

Table 3 Distribution of Respondents according to Labour Types, disaggregated by Farm Operations in the Study Area

Farm Operations	Labour Type	Frequency (%)
Land Preparation	Family	42 (40.0)
	Hired	63 (60.0)
Planting	Family	56 (53.3)
	Hired	49 (46.7)
Weeding	Family	38 (36.2)
	Hired	67 (63.8)
Agrochemical Application	Family	79 (75.2)
	Hired	26 (24.8)
Harvesting	Family	44 (41.9)
	Hired	61 (58.1)

Irrigation	Family	6 (5.7)
	Not Applicable	99 (94.3)
Transportation	Family	24 (22.9)
	Hired	81 (77.1)

Source: Computed from field survey, 2017

Table 3 illustrates the distribution of respondents categorized by labor types across various farm operations in the study area. For land preparation, 42 (40.0%) respondents utilized family labor, while 63 (60.0%) employed hired labor, indicating a predominant use of hired labor for this activity.

In planting, 56 (53.3%) respondents relied on family labor, whereas 49 (46.7%) utilized hired labor, suggesting a higher reliance on family labor for planting tasks.

During weeding, 38 (36.2%) respondents used family labor, while 67 (63.8%) utilized hired labor, highlighting a greater reliance on hired labor for weeding activities.

For agrochemical application, 79 (75.2%) respondents employed family labor, compared to 26 (24.8%) who used hired labor, indicating a predominant use of family labor for applying agrochemicals.

In harvesting, 44 (41.9%) respondents used family labor, while 61 (58.1%) used hired labor, showing a higher utilization of hired labor for harvesting.

Regarding irrigation, 6 (5.7%) respondents utilized family labor, whereas 99 (94.3%) employed hired labor, indicating a significant reliance on hired labor for irrigation tasks.

In transportation, 24 (22.9%) respondents used family labor, while 81 (77.1%) used hired labor, indicating a predominant use of hired labor for transportation activities.

Table 4 Distribution of Food Security Status of Maize-Based Farmers

Food Security Status	**Frequency**	**Percentage**
Food Secure	65	61.9%
Food Unsecure	40	38.1%
Total	105	100.0%

Source: Computed from field survey, 2017

Table 4 presents the distribution of food security status among maize-based farmers. The majority of respondents, 65 (61.9%), reported being food secure, while 40 (38.1%) indicated that they are food insecure.

Table 5 Food security profile of maize farmers in the study area

No.	**Calculation of food security status**	**Unit**	**Value**
1	Total household size	Number	105
2	Mean per capita household food expenditure(MPCHHFE)	₦	11924.24
3	Food security line (i.e. 2/3 of MPCHHFE)	₦	7949.49
4	Moderate food secure line (i.e. > 1/3 of MPCHHFE)	₦	>7949.49
5	Core food security line (i.e. 1/3 of MPCHHFE)	₦	3974.74

Source: Computed from field survey, 2017

Table 5 presents the food security profile of maize farmers. The mean per capita household food expenditure is N11,924.24. The food security line, which is 2/3 of the mean per capita household food expenditure, stands at

N7,949.49. Additionally, the core food security line, which is 1/3 of the mean per capita household food expenditure, stands at N3,974.74.

Table 6 Food Security Profile of Maize Farmers and Selected Socio-economic Variables

Household characteristic	Family labour			Hired labour		
	P_0	P_1	P_2	P_0	P_1	P_2
Sex						
Male	0.721	0.111	0.204	0.551	0.002	0.011
Female	0.333	0.103	0.015	0.121	0.000	0.000
Age (years)						
< 30	0.444	0.021	0.000	0.001	0.000	0.000
31-40	0.702	0.202	0.022	0.027	0.032	0.010
41-50	0.812	0.334	0.031	0.171	0.051	0.021
51-60	0.333	0.119	0.127	0.111	0.032	0.010
> 60	0.254	0.211	0.032	0.010	0.000	0.000
Marital status						
Married	0.560	0.224	0.051	0.700	0.030	0.053
Single	0.312	0.105	0.011	0.482	0.011	0.036
Divorced	0.211	0.153	0.010	0.601	0.000	0.043
Widowed	0.100	0.139	0.010	0.501	0.000	0.032
Level of education						
No formal education	0.111	0.000	0.001	0.000	0.003	0.000
Primary education	0.442	0.082	0.022	0.461	0.030	0.100
Secondary education	0.521	0.091	0.035	0.600	0.04	0.121
Tertiary education	0.540	0.100	0.042	0.680	0.051	0.220
Household size (person)						
1-3	0.862	0.331	0.142	0.661	0.231	0.112
4-8	0.323	0.071	0.051	0.423	0.199	0.001
>8	0.014	0.000	0.011	0.104	0.110	0.00
Primary occupation						
Farming	0.211	0.000	0.001	0.000	0.011	0.104
Otherwise	0.777	0.111	0.000	0.333	0.000	0.000

P_0, P_1 and P_2 represent poverty incidence, depth and severity respectively. Source: Field survey, 2017.

Table 6 presents the food security profile of maize farmers based on various socio-economic variables using the FGT poverty index. It assesses poverty incidence (P0), poverty depth (P1), and severity (P2) among maize-based farmers in the study area. The analysis shows that male maize farmers using both family and hired labour tend to be more food secure compared to their female counterparts. Farmers aged between 41-50 years exhibit higher levels of food security. Married farmers using family and hired labour also demonstrate greater food security. Additionally, maize farmers with tertiary education and those with smaller household sizes (1-3 persons) are more likely to be food secure. Interestingly, farmers primarily engaged in occupations other than farming show higher food security compared to those solely reliant on farming.

Table 7 Factors influencing the Food security status of Maize-based Farmers

Covariates	Coefficient	Standard Error	T-ratio	Marginal Effects
Sex of Household Head	0.20294***	0.06094	3.33	0.040807
Marital Status	0.70541	0.85567	0.82	0.073961
Membership of Cooperation	-0.8774	0.67599	-1.30	-0.12208
Years of Schooling	-0.03983	0.05877	-0.68	-0.0066203
Farm Size	0.28175**	0.1299	2.17	0.0078977
Age of Household Head	0.09758**	0.04511	2.16	0.00092857
Years of Experience	-0.04056	0.04217	-0.96	-0.0013243
Household Size	-1.0893***	0.26616	-4.09	-0.0037980
Family Labour	0.6051	0.6280	0.96	0.018936
Hired labour	-0.1890	0.65736	-0.29	0.003514
Constant	1.4396	1.5331	0.94	0.555555
Pseudo R^2= 0.3633 Prob> Chi^2 = 0.0000				
Log-likelihood = -49.202				

Source: Computed from field survey, 2017; Asterisk signs of; *, **, *** imply significance at 10%, 5% and 1% respectively

Based on the findings from Table 7, which utilized the probit regression model to analyze determinants of food security status among maize farmers, several key insights emerge. The x2 statistics (49.202) indicate high significance ($p<0.01$), affirming the model's robustness. However, the coefficient of determination (R-squared) of 0.36 suggests that the explanatory variables explain only 36% of the variation in food security status, indicating other unmeasured factors play a significant role.

The analysis reveals that variables such as sex of the household head, marital status, farm size, age of the household head, and use of family labour positively influence food security among maize farmers. Conversely, factors like membership in cooperatives, years of schooling, years of experience, household size, and reliance on hired labour have a negative impact on food security.

Statistically significant determinants include the sex of the household head ($p<0.01$), farm size ($p<0.05$), age of the household head ($p<0.05$), and household size ($p<0.01$). Specifically, male household heads are associated with higher food security probabilities, likely due to cultural roles in food provision. Larger farm sizes contribute positively to food security, as do older household heads. Conversely, larger household sizes tend to decrease food security probabilities, possibly due to increased mouths to feed within the household.

3. Discussion of Findings

The study focused on analyzing labor use and food security among maize-based farmers in Abuja Metropolis State. It employed a 2-stage sampling technique to select 105 farmers, gathering data through a well-structured questionnaire and utilizing descriptive statistics, food security index, and probit regression for analysis. Key findings include:

The average age of respondents was 29.1 years, with an average household size of 5.2 persons.

A significant portion (59%) of farmers used hired labor in the current season, while 50.5% relied on family labor last season, and 50.5% faced challenges in securing labor.

Hired labor was predominantly used for land preparation, weeding, harvesting, irrigation, and transportation, whereas family labor was more common for planting and agrochemical application.

The majority (61.9%) of farmers reported being food secure, with an average per capita food expenditure of N11,924.24.

Food security varied significantly based on gender, age, marital status, educational level, household size, and primary occupation of farmers.

Significant determinants of food security status included the sex of household heads, farm size, age of the household head, and household size.

These findings underscore the complex interplay between labor dynamics, socio-economic factors, and food security outcomes among maize farmers in the study area, highlighting areas for targeted interventions and policy measures to enhance agricultural productivity and food security.

4. Conclusion

Based on the research findings, it can be concluded that maize farmers in Abuja Metropolis State employ both hired and family labor in different proportions. The study suggests that increased reliance on family labor tends to enhance the food security of rural maize farming households. In contrast, higher dependence on hired labor appears to diminish the food security status of these households. This underscores the importance of household-based labor contributions in enhancing agricultural productivity and food security outcomes among maize farmers in the region.

Recommendations

Recommended solutions to enhance food security in both Nigeria and the United States:

- **Nigeria**
  - **Investment in Agriculture:** Increase public and private sector investment in agriculture, particularly small-scale farming and rural infrastructure development.
  - **Improved Access to Credit:** Provide easier access to credit and financial services for smallholder farmers to invest in better seeds, fertilizers, and equipment.
  - **Enhanced Extension Services:** Strengthen agricultural extension services to provide farmers with knowledge on modern farming techniques, pest management, and climate-resilient practices.
  - **Infrastructure Development:** Improve rural infrastructure such as roads, irrigation systems, and storage facilities to reduce post-harvest losses and enhance market access.
  - **Promotion of Crop Diversification:** Encourage diversification of crops beyond staples like maize and cassava to include nutritious crops and cash crops for income generation.
  - **Support for Research and Innovation:** Invest in agricultural research and innovation to develop drought-resistant crops, improve soil fertility, and adapt to climate change challenges.
  - **Women and Youth Empowerment:** Support women and youth in agriculture through training, access to land, and technologies to increase productivity and income.
  - **Food Distribution Networks:** Establish efficient food distribution networks to ensure that surplus food reaches vulnerable populations, especially in remote areas.
  - **Policy Support:** Develop and implement supportive policies that prioritize food security, including subsidies for inputs, price stabilization mechanisms, and market regulations.
  - **Community-Based Initiatives:** Promote community-based initiatives such as cooperatives and farmers' associations to strengthen resilience and collective action in food production and distribution.
- **United States:**
  - **Support for Small-Scale Farmers:** Provide financial support, technical assistance, and market access for small-scale and family farmers.
  - **Nutrition Programs:** Strengthen and expand nutrition assistance programs like SNAP (Supplemental Nutrition Assistance Program) to ensure food access for vulnerable populations.
  - **Urban Agriculture Initiatives:** Promote urban agriculture and community gardens to increase local food production and access to fresh produce in urban areas.
  - **Sustainable Agriculture Practices:** Encourage adoption of sustainable farming practices that reduce environmental impact, conserve water, and improve soil health.
  - **Food Waste Reduction:** Implement measures to reduce food waste throughout the food supply chain, including improved storage, transportation, and consumer education.
  - **Research and Development:** Invest in research and development of new agricultural technologies, including GMOs and precision farming, to boost productivity and resilience.

- **Climate Change Adaptation:** Develop strategies to mitigate the impact of climate change on agriculture, such as drought-resistant crops and water management techniques.
- **Public-Private Partnerships:** Foster partnerships between government, private sector, and NGOs to address food security challenges through innovative solutions and investments.
- **Education and Training:** Provide education and training for farmers on best practices, market trends, and technological advancements to improve efficiency and profitability.
- **Food Policy Councils:** Establish food policy councils at local and state levels to coordinate efforts, set priorities, and advocate for policies that enhance food security and sustainability.

These recommendations aim to address various aspects of food security, from production and distribution to policy support and community engagement, tailored to the specific contexts of Nigeria and the United States.

To implement a comprehensive strategy addressing both food security and the enhancement of banking services through a marketing information system, it is essential to recognize the interconnected nature of these issues. Food security involves ensuring that all individuals have consistent access to sufficient, safe, and nutritious food, which relies heavily on effective agricultural practices, robust infrastructure, and efficient distribution systems. Similarly, improving banking services requires a strategic approach that leverages marketing information systems to gather, analyze, and utilize data for better decision-making and customer service. By integrating these approaches, banks can play a crucial role in enhancing food security by providing financial services tailored to the agricultural sector, supporting farmers with loans, insurance, and investment opportunities that enable them to adopt sustainable practices and improve productivity. Moreover, a well-developed marketing information system can help banks identify and address the specific financial needs of rural communities, facilitating better access to credit and financial literacy programs. This dual focus not only strengthens the agricultural value chain but also fosters economic growth and stability, ultimately contributing to both food security and enhanced banking services for customers (Oshireku, 2023 a & b)

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflicts of interest.

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5. Appendix

Questionnaire

Table 1 Socio-economic characteristics of maize farmers and labour use in the study area

Household characteristics	**Family labour (%)**	**Hired labour (%)**	**All (%)**
Sex			
Male	29(67.4)	46(74.2)	75(71.4)
Female	14(35.6)	16 (25.8)	50(28.6)
Total	43(100)	62(100)	105(100)
Age (years)			
< 30	26(60.5)	44(70.9)	70 (66.7)
31-40	10(23.3)	18(29.1)	28(26.9)
41-50	4(9.3)	0	4(3.8)
51-60	1(2.3)	0	1(1.0)
> 60	2(4.7)	0	2 (1.9)
Total	43(100)	62(100)	105(100)
Mean	28.9	29.8	29.1
Standard deviation	9.1	8.5	8.9
Minimum	21	20	20
Maximum	64	40	64
Primary occupation			
Farming	41(95.3)	58 (93.5)	99 (94.3)

Otherwise	2 (4.7)	4 (6.5)	6 (5.7)
Total	43(100)	62(100)	105(100)
Marital status			
Married	40 (93.0)	57(91.9)	97(92.4)
Single	1(2.3)	2(3.3)	3(2.9)
Widowed	1(2.3)	1(1.6)	2(1.9)
Divorced	1(2.3)	2(4.8)	3(2.9)
Total	43(100)	62(100)	105(100)
Household size (person)			
1-3	2(2.6)	1(1.5)	3(2.9)
4-8	41(96.2)	58(90.1)	99(94.3)
>8	1(1.2)	2(5.4)	3(2.9)
Total	43(100)	62(100)	105(100)
Mean	5.4	5.1	5.2
Standard deviation	1.3	1.2	1.2
Minimum	1	1	1
Maximum	8	8	8
Level of education			
No formal education	10(23.5)	11(17.7)	21(20.0)
Primary education	28(41.8)	30 (48.4)	58(55.2)
Secondary education	4 (9.3)	17(27.4)	21(20.0)
Tertiary education	1(2.3)	4 (6.5)	5(4.8)
Total	43(100)	62(100)	105(100)
Experience in maize farming (year)			
<5	10(23.3)	15 (24.2)	25 (23.8)
6-10	9 (20.9)	40 (64.5)	49 (46.7)
>10	24 (55.8)	7 (11.3)	31(29.5)
Total	43(100)	62(100)	105(100)
Access to extension service			
Yes	3 (6.7)	9 (14.5)	12 (11.4)
No	40 (93.0)	53 (85.5)	93 (88.6+
Total	43(100)	62(100)	105(100)
Membership of farmers cooperatives			
Yes	33(76.7)	40 (64.5)	73(69.5)
No	10 (23.3)	22 (35.5)	32(30.5)
Total	43(100)	62(100)	105(100)
Farm size (hectare)			
< 1	25(58.2)	29 (46.8)	54(51.4)

1-3	12 (27.9)	32 (51.6)	45(42.9)
> 4	5 (11.9)	1(1.6)	6 (5.7)
Total	43(100)	62(100)	105(100)

Source: Computed from field survey, 2017

Table 2 Distribution of Respondents according to Labour Types in the Study Area

Variable	**Frequency**	**Percentage**
Labour Type in Current Season		
Family	43	41.0
Hired	62	59.0
Total	105	100.0
Labour Type Last Season		
Family	53	50.5
Hired	52	49.5
Total	105	100.0
Difficulty in getting Labour		
Yes	52	49.5
No	53	50.5
Total	105	100.0

Source: Computed from field survey, 2017

Table 3 Distribution of Respondents according to Labour Types, disaggregated by Farm Operations in the Study Area

Farm Operations	**Labour Type**	**Freq (%)**
Land Preparation	Family	42 (40.0)
	Hired	63 (60.0)
Planting	Family	56 (53.3)
	Hired	49 (46.7)
Weeding	Family	38 (36.2)
	Hired	67 (63.8)
Agrochemical Application	Family	79 (75.2)
	Hired	26 (24.8)
Harvesting	Family	44 (41.9)
	Hired	61 (58.1)
Irrigation	Family	6 (5.7)
	Not Applicable	99 (94.3)
Transportation	Family	24 (22.9)
	Hired	81 (77.1)

Source: Computed from field survey, 2017

Table 4 Distribution of Food Security Status of Maize-Based Farmers

Food Security Status	Frequency	Percentage
Food Secure	65	61.9
Food Unsecure	40	38.1
Total	105	100.0

Table 5 Food security profile of maize farmers in the study area

No.	Calculation of food security status	Unit	Value
1	Total household size	Number	105
2	Mean per capita household food expenditure(MPCHHFE)	₦	11924.24
3	Food security line (i.e. 2/3 of MPCHHFE)	₦	7949.49
4	Moderate food secure line (i.e. > 1/3 of MPCHHFE)	₦	>7949.49
5	Core food security line (i.e. 1/3 of MPCHHFE)	₦	3974.74

Table 5 Food security profile of maize farmers and selected socio-economic variables

Household characteristic	Family labour			Hired labour		
	P0	P1	P2	P0	P1	P2
Sex						
Male	0.721	0.111	0.204	0.551	0.002	0.011
Female	0.333	0.103	0.015	0.121	0.000	0.000
Age (years)						
< 30	0.444	0.021	0.000	0.001	0.000	0.000
31-40	0.702	0.202	0.022	0.027	0.032	0.010
41-50	0.812	0.334	0.031	0.171	0.051	0.021
51-60	0.333	0.119	0.127	0.111	0.032	0.010
> 60	0.254	0.211	0.032	0.010	0.000	0.000
Marital status						
Married	0.560	0.224	0.051	0.700	0.030	0.053
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Level of education						
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Primary occupation						
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P_o, P_1 and P_2 represent poverty incidence, depth and severity respectively; Source: Field survey, 2017.

Table 6 Factors influencing the Food security status of Maize-based Farmers

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Hired labour	-0.1890	0.65736	-0.29	0.003514
Constant	1.4396	1.5331	0.94	0.555555
Pseudo R^2 = 0.3633 Prob > Chi^2 = 0.0000				
Log-likelihood = -49.202				

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