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SOCIO-ECONOMIC DETERMINANTS AND THEIR EFFECTS ON THE FOOD SECURITY STATUS OF SMALLHOLDER MILLET FARMERS IN JIGAWA STATE, NIGERIA

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ABSTRACT

This study examined the socio-economic determinants of food security among smallholder millet farmers in Jigawa State, Nigeria. The objectives were to profile the farmers' socio-economic characteristics, assess their household food security status, and examine how selected socio-economic variables affect food security outcomes. Data were collected from 262 respondents through a multistage sampling technique using structured questionnaires. Descriptive statistics, the Household Food Insecurity Access Scale (HFIAS), and binary logistic regression were employed for analysis. Results revealed that all respondents were male, with an average age of 41 years and mean household size of 8 persons. About 59.9% had attained some level of formal education, though most cultivated small farm plots averaging 1.65 hectares. Findings further showed that 53.8% of households were food insecure, while 46.2% were food secure. Regression analysis indicated that total household income exerted a positive and highly significant influence on food security ($p < 0.01$). In contrast, dependence solely on millet income, longer years of millet farming experience, and limited access to extension services had negative and significant effects ($p < 0.05$). Farm size exhibited a weak positive influence, whereas education, household size, age, and credit access were not significant. The study concludes that income diversification and institutional support, especially agricultural extension, are crucial in enhancing food security among millet farming households. It recommends targeted policies to improve rural incomes, strengthen extension delivery, and promote innovative practices and technologies that can boost millet productivity and ensure sustainable household food security.

Keywords: Socio-economic determinants, Food security, Smallholder farmers, Millet production, Jigawa State

INTRODUCTION

Agriculture is a cornerstone of food security and economic stability, particularly in developing nations. It serves as a critical source of employment, income, and sustenance for millions. In Nigeria, the agricultural sector supports both impoverished and non-impoverished rural households, drives national economic growth, and can serve as a vital route out of poverty—especially when productivity improves (FAO, 2021). Food security extends beyond mere food availability; it encompasses consistent access, affordability, stable supply, and the proper nutritional utilization of food (Bilali et al., 2018; Barthel et al., 2019).

In northern Nigeria, millet (Pennisetum glaucum) stands out as a key staple crop. Its resilience to extreme conditions—such as poor soil quality, low rainfall, and high temperatures—makes it particularly well-suited to the agro-ecological conditions of Jigawa State (ICRISAT, 2020; Ndiaye et al., 2021). Despite its agricultural potential, Nigeria continues to grapple with widespread food insecurity. In 2020, approximately 21.4% of households experienced severe food shortages, while half of the population lived on less than USD 1.90 per day (Osabohien et al., 2020a; Erokhin & Gao, 2020). The Global Food Security Index ranked Nigeria 94th out of 113 countries in 2019, with a score of 48.4 placing it behind neighboring nations such as Niger, Ethiopia, and Cameroon (Ayinde et al., 2020). Compounding these challenges, rapid population growth is projected to increase Nigeria's population to 400 million by 2050, significantly escalating food demand (Otekunrin et al., 2019; Amzat & Aminu, 2020). According to the FAO (2021), food security exists when all individuals, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to lead healthy, active lives. However, achieving this goal is increasingly threatened by climate change, which undermines agricultural productivity and disrupts food systems (IPCC, 2019).

Smallholder farmers those who cultivate small plots of land primarily using family labour are central to food production in developing countries. They produce up to 80% of the food supply in many regions (IFAD, 2016), and in Nigeria, they constitute about 70% of the agricultural workforce (FAO, 2021). Nevertheless, these farmers face numerous constraints, including limited access to credit, improved seed varieties, modern technologies, and extension services, all of which hinder their productivity and capacity to adapt to shocks (Obi et al., 2020; World Bank, 2018). In Jigawa State, millet plays a crucial role in household food security, serving as a staple in local diets (e.g., tuwo and kunu), livestock feed, and income generation. Nutritionally, millet is rich in protein, dietary fiber, and essential minerals such as iron, zinc, and magnesium (Gupta et al., 2022; Amadou et al., 2019). Despite these advantages, millet farmers confront persistent challenges, including a shortage of improved seed varieties, inadequate access to credit, weak post-harvest infrastructure, and significant post-harvest losses (Bello et al., 2021; Obi et al., 2020). Recent initiatives aim to address these constraints. The Jigawa State government has distributed climate-resilient and bio-fortified millet seeds to approximately 30,000 farmers to enhance both nutritional outcomes and climate resilience (Premium Times, 2025; Vanguard, 2025).

Food insecurity remains a major challenge in Nigeria, where several studies have investigated the socio-economic factors influencing household food security, particularly among rural households and producers of crops such as maize (Alim et al.,

2022; Ibrahim et al., 2019; Ogunniyi et al., 2021). However, most of these studies have not focused specifically on millet farmers in Jigawa State, despite millet being a key staple in the region. (Chiaka et al., 2022; Yusuf et al., 2024; Abubakar et al., 2021). Existing research on millet in northern Nigeria has largely concentrated on issues such as adoption of improved varieties, training needs, and value-chain constraints, rather than directly analyzing the food security status of millet-farming households and its socio-economic determinants In addition, many earlier studies have measured food security using calorie intake or expenditure-based approaches (Wudil et al., 2023), which may not fully capture household-level experiences of food access and insecurity. Although the Household Food Insecurity Access Scale (HFIAS) has been applied in some contexts, its use in analyzing millet-farming households in Jigawa State remains limited.

Broadly the study aim to examine the effects of socio-economic determinants on the food security status of smallholder millet farmers in Jigawa State, Nigeria. While specific objectives are to: describe the socio-economic characteristics of smallholder millet farmers in the study area, assess the food security status of smallholder millet farmers in the study area and to determine the influence of socio-economic determinants on the food security status of smallholder millet farmers.

MATERIALS AND METHODS

The Study Area

The study was carried out in Jigawa State, situated in the north-western region of Nigeria. Spanning approximately 22,410 km², the state lies between latitudes 11°N and 13°N, and longitudes 8°E and 10.15°E. It shares borders with Kano and Bauchi states to the south, Yobe to the east, and the Republic of Niger to the north and west. With an estimated annual population growth rate of 3%, the state's population was projected to reach 6.7 million by 2023 (NPC, 2006). Elevated at around 750 meters above sea level, Jigawa boasts fertile soils conducive to a wide variety of agricultural activities. The region experiences a tropical climate marked by a distinct rainy season from June to October and a dry season extending from November to May. Average annual rainfall ranges from 700 to 1,000 mm, while temperatures fluctuate from 35°C in October to peaks of about 50°C in May (JARDA, 2005). Agriculture is the primary livelihood for over 80% of the population, encompassing the cultivation of staple crops such as millet, sorghum, cowpea, groundnut, vegetables, and sugarcane, as well as livestock production including cattle, sheep, goats, and poultry (MTSS, 2016). For agricultural administrative purposes in agriculture, Jigawa State is divided into four Agricultural Development Programme (ADP) zones: Zone 1 (Birnin Kudu), Zone 2 (Gumel), Zone 3 (Hadejia), and Zone 4 (Kazaure). These zones collectively cover all 27 local government areas in the state (JARDA, 2005).

Sampling Procedure and Sample Size

A multi-stage sampling technique was employed to ensure a representative and comprehensive selection of smallholder millet farmers across Jigawa State. This approach was designed to account for variations in farming systems, adoption of climate-smart agricultural practices, and food security outcomes across the state's four Agricultural Development Programme (ADP) zones: Birnin Kudu, Gumel, Hadejia, and Kazaure. In the first stage, all four ADP zones were purposively included in the study. This decision was based on the need to capture the diverse agro-ecological, climatic, and socio-economic conditions across the state. Research indicates that factors such as soil type, rainfall patterns, access to resources, and institutional support can significantly affect farmers' adoption of innovative agricultural practices (Adebisi et al., 2022). By covering all zones, the study enhances the representativeness and generalizability of its findings, enabling broader policy relevance.

At the second stage, key Local Government Areas (LGAs) within each ADP zone were purposively selected based on their significance in millet production. Millet is a major staple crop in Jigawa, especially in semi-arid regions where drought-tolerant crops are critical for sustaining food security. The selection of LGAs was guided by agricultural production data and reports from the Jigawa State Agricultural and Rural Development Authority (JARDA, 2024), ensuring that the study focused on high-production areas. In the third stage, two farming communities were randomly selected from each of the chosen LGAs. This randomization helped ensure balanced geographic representation and minimized selection bias, thereby improving the accuracy and reliability of the data. In the final stage, individual smallholder millet farmers were randomly selected from the list of registered farmers in each community. The total sample size of 262 respondents was determined using the Raosoft sample size calculator, based on a 90% confidence level and a 5% margin of error. To ensure proportional representation across communities, Bowley's proportional allocation formula was applied:

Bowley's Proportional Allocation Formula:

$$ni = Ni\frac{Ni}{N} \times n \qquad (1)$$

Where ni is the sample size for each community, Ni is the total number of millet farmers in each community, N is the overall population of millet farmers across the six communities, and n is the total sample size of 262.

This systematic and stratified approach ensured that the sample accurately reflected the distribution and diversity of millet farming households in Jigawa State, strengthening the validity and policy relevance of the study's outcomes.

Method of Data Collection

The data for this study were collected from primary sources, focusing on socioeconomic characteristics and food security status of small holder millet farmers. Data were gathered through the use of structured questionnaires, which contained a combination of closed-ended and open-ended questions to allow for both quantitative analysis and qualitative insights.

Method of Data Analysis

The study employed both descriptive and inferential statistical methods. Descriptive statistics including means, standard deviations, percentages, and frequency distributions were used to address Objectives i. To assess Objective ii, the Household Food Insecurity Access Scale (HFIAS) was applied. For Objective iii, which aimed to determine the influence of socio-economic determinants on the food security status of smallholder millet farmers, inferential statistics specifically a Logit regression model were utilized.

Logit Regression Model

The binary logistic regression method has been widely applied in various agricultural, economic, and extension studies that require the analysis and prediction of a binary outcome, such as Access vs. No access, Use of extension services Use vs. Non-use, adoption versus non-adoption and participation versus non-participation. The logistic probability model (Bogale and Shimelis, 2009).

The model specification is as follows;

$logit\ (P) = \ln\left(\frac{P(Y=1)}{1-P(Y=1)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k X_k$ (2)

Where:

Logit (P) is the log-odds of being food secure. P(Y=1) is the probability of being food secure (Y = 1). 1- P(Y=0) is the probability of being food insecure (Y = 0). β0: Intercept (constant term). X_1, X_2….. X_k, represent the independent variables (socio economic variables). β_1, β_2….. β_k: Coefficients for each socio economic variables. X_1 = Age (in years), X_2 = gender of respondent (1=male, 0= female), X_3 = Size of household (number of people in household), X_4 = Level of education (years of formal education), X_5 = Income (naira), X_6 = Farm Size (hectares), X_7 = Access to Credit (1=access, 0=otherwise) and X_8 = Extension contact (1=access, 0= otherwise).

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

As shown in Table 1, the age distribution of respondents indicates that the largest proportions (43.1%) were between 31 and 43 years old, with an average age of 41 years. This suggests that millet farming in Jigawa State is primarily carried out by individuals in their economically active years, who are likely to possess the physical capacity and motivation to maintain high agricultural productivity. These findings are consistent with studies by Ibrahim et al. (2019), Ali et al. (2018), and Anamayi & Anamayi (2024), who also found that smallholder farmers in northern Nigeria are predominantly within the productive age range, enhancing their ability to adopt new technologies and contribute to improved household food security. In terms of gender, the data reveal complete male dominance in millet farming, with 100% of respondents being male. This reflects prevailing cultural and religious norms in the region, where agricultural fieldwork is largely assigned to men, while women are typically engaged in domestic duties and post-harvest processing. This pattern is supported by Inuwa et al. (2025), Ojoko (2021), and Orifah et al. (2024), who attributed male dominance in crop production to traditional social structures and inheritance systems that favour male ownership and management of farmland. Results on marital status revealed that 71.0% of the respondents were married, indicating that millet farming is largely undertaken by individuals with family obligations. Marriage often brings access to family-based labour, which can reduce reliance on hired labour and lower production costs. This observation is in line with Ali et al. (2018) and Ibrahim et al. (2019), who reported a high prevalence of married farmers in rural farming communities. An analysis of household size shows that 35.1% of respondents had between 6 and 10 household members, with an average household size of 8 persons. While larger households can provide a ready source of labour for farm operations, they also entail greater food consumption demands, which may strain food availability and increase vulnerability to food insecurity—especially when agricultural output is insufficient. These findings resonate with those of Ibrahim et al. (2019) and Bello et al. (2018), who highlighted the dual role of large households as both a labour asset and a potential burden on food resources. In terms of educational attainment, nearly 60% (59.9%) of the respondents had some level of formal education. This educational background likely enhances their ability to access, understand, and apply agricultural extension information and adopt innovative farming practices. This is consistent with Ali et al. (2018) and Bello et al. (2018), who emphasized that educated farmers are more inclined to embrace improved technologies and management practices, thereby improving productivity and strengthening household food security.

Table 1: Distribution of the Respondents Based on Socio-economic Characteristics (n = 262)

Variable	Frequency	Percentage	Mean	SD
Age (Years)				
18–30	46	17.6	**41**	**12.47**
31–43	113	43.1		
44–56	76	29.0		
57–69	22	8.4		
70–82	5	1.9		
Sex				
Male	262	100.0		
Female	0	0.0		
Marital Status				
Single	67	25.6		
Married	186	71.0		
Divorced	9	3.4		
Household Size				
≤ 5	86	32.8	**8.0**	**4.42**
6–10	92	35.1		
11–15	62	23.7		
16–20	19	7.3		
≥ 20	3	1.1		
Education				
Formal	157	59.9		

Variable	Frequency	Percentage	Mean	SD
Non-formal	105	40.1		

Source: Field Survey Data, 2024

The result in Table 2 outlines the economic characteristics of the respondents. The results show that 46.9% of the farmers primarily engage in arable farming, while others supplement their livelihoods through trading (18.3%), civil service (9.5%), and various other non-farm activities. This highlights that although millet cultivation remains the core occupation, a significant number of farmers rely on diversified income streams to sustain their households. This pattern is consistent with findings by Akamai & Akamai (2024) and Joke (2021), who noted that income diversification plays a critical role in helping rural households manage risks associated with agricultural production. In terms of annual income, the largest proportion (24.8%) earned between ₦600,001 and ₦900,000, with an average annual income of ₦790,717.56. However, a notable 20.6% earned ₦300,000 or less, indicating that a substantial segment of millet farmers remains economically vulnerable and susceptible to financial shocks. This aligns with Akamai & Akamai (2024), who documented similar low-income levels among smallholder farmers, as well as Mwatawala & Nyabiri (2021), who emphasized the role of non-farm income in improving household resilience. When specifically examining income derived from millet farming, over half (52.7%) earned ₦300,000 or less annually, with an average millet-specific income of ₦384,656.49. This suggests that millet production alone may not provide adequate financial returns to ensure a stable livelihood, reinforcing earlier studies by Ojoko (2021) and Anamayi & Anamayi (2024), which underscored the necessity for smallholder farmers to engage in multiple income-generating activities.

With regards to results on farming experience, 31.7% of respondents had been farming for 6–10 years, while 29.0% had 20 years or more of experience, yielding an average general farming experience of 16 years. In terms of millet-specific experience, the average was 15 years, with 34.0% having cultivated millet for 6–10 years. This indicates a balanced mix of experienced and moderately experienced farmers within the sample. According to Adebisi et al. (2022) and Orifah et al. (2024), farmers with mid-level experience are often more receptive to adopting new agricultural technologies and practices, which can positively influence productivity and food security outcomes.

Table 2: Distribution of the Respondents Based on Socio-economic Characteristics (n = 262)

Variable	Frequency	Percentage	Mean	SD
Occupation				
Arable farming	123	46.9		
Fishing	16	6.1		
Livestock farming	4	1.5		
Traders	48	18.3		
Civil servant	25	9.5		
Artisan	15	5.7		
Transport services	15	5.7		
Annual Income (₦)				
≤ 300,000	54	20.6	790,717.56	580,945.98
300,001–600,000	59	22.5		
600,001–900,000	65	24.8		
900,001–1,500,000	63	24.0		
≥ 1,500,001	21	8.0		
Income from Millet (₦)				
≤ 300,000	138	52.7	384,656.49	331,777.54
300,001–600,000	87	33.2		
600,001–900,000	24	9.1		
900,001–1,200,000	5	1.9		
1,200,001–1,500,000	4	1.5		
≥ 1,500,001	4	1.5		
Farming Experience (Years)				
≤ 5	27	10.3	16.2	10.98

Variable	Frequency	Percentage	Mean	SD
6–10	83	31.7		
11–15	47	17.9		
16–20	29	11.1		
≥ 20	76	29.0		
Millet Farming Experience (Years)				
≤ 5	30	11.5	15.3	10.50
6–10	89	34.0		
11–15	47	17.9		
16–20	29	11.1		
≥ 21	67	25.6		

Source: Field Survey Data, 2024

The data presented in Table 3 highlight key institutional factors influencing millet farming. In terms of farm size, 50.8% of respondents cultivated between 1.6 and 2.5 hectares, while 47.7% managed farms ranging from 0.5 to 1.5 hectares, with an average farm size of 1.65 hectares. This confirms that millet farming in the study area is predominantly small-scale, which may constrain agricultural output and, by extension, household food security. Adebisi et al. (2022) have similarly observed that farmers cultivating less than 2 hectares are more susceptible to food insecurity due to limited production capacity. A significant majority (68.7%) of respondents reported being members of farmers' organizations. This high level of participation indicates that collective engagement is valued among farmers, as such groups often facilitate access to information, inputs, and support systems. Studies by Ali et al. (2018) and Adebisi et al. (2022) have linked membership in farmer groups with enhanced productivity and greater resilience to shocks. Regarding access to credit, 65.3% of respondents had some form of credit access, but the source of financing was largely informal: 63.0% depended on loans from friends and family, while only 0.8% obtained credit from commercial banks. This underscores the underdevelopment of formal financial services in rural areas and suggests that most farmers lack reliable capital to invest in farm expansion or improved technologies. Adebisi et al. (2022) have noted that reliance on informal credit systems often limits the scale and sustainability of agricultural production. Extension service access was reported by 51.9% of respondents; however, nearly half (48.1%) had not received any extension visits. Among those who were visited, 27.5% had rare contact and 24.4% only occasional interaction with extension agents. This indicates inadequate outreach and weak extension coverage, which can impede the adoption of modern farming techniques and climate-smart practices. As emphasized by Adebisi et al. (2022), limited access to agricultural extension services hampers knowledge transfer and reduces the likelihood of technology adoption, ultimately affecting productivity and food security outcomes.

Table 3: Distribution of the Respondents Based on Socio-economic Characteristics (n = 262)

Variable	Frequency	Percentage	Mean	SD
Farm Size (Ha)				
0.5–1.5	125	47.7	**1.65**	**0.78**
1.6–2.5	133	50.8		
2.6–3.5	3	1.1		
>3.5	1	0.4		
Membership of Farmers' Organisation				
Yes	180	68.7		
No	82	31.3		
Access to Credit				
Yes	171	65.3		
No	91	34.7		
Source of Credit				
None	91	34.7		
Commercial banks	2	0.8		
Friends & relatives	165	63.0		
Cooperatives	4	1.5		
Extension Access				

Variable	Frequency	Percentage	Mean	SD
Yes	136	51.9		
No	126	48.1		
Frequency of Extension Visit				
No visit	126	48.1		
Rarely	72	27.5		
Occasionally	64	24.4		

Source: Field Survey Data, 2024

Food Security Status of Smallholder Millet Farmers

The findings presented in Table 4 reveal that a majority of smallholder millet farmers in Jigawa State experience food insecurity. Specifically, 53.8% of the respondents were classified as food insecure, while 46.2% were categorized as food secure. This classification was based on the Household Food Insecurity Access Scale (HFIAS), a widely used tool for assessing food access challenges. Respondents with a total HFIAS score ranging from 0 to 9 were considered food secure, indicating minimal or no difficulties in accessing adequate food. In contrast, those with scores between 10 and 27 were deemed food insecure, reflecting frequent and/or severe limitations in food availability and access over the four weeks preceding the survey. These results are consistent with earlier studies conducted in other agricultural regions of Nigeria. Adebisi et al. (2022) found that 41.1% of farming households in Kwara State remained food insecure, attributing this to small farm sizes, insufficient extension support, and irregular income streams. Similarly, Opeyemi et al. (2021) reported that although 71% of farming households in Delta State achieved food security following CSAP adoption, 29% continued to experience food shortages due to infrastructural deficits and economic barriers. Their study highlighted the importance of access to improved technologies and agricultural inputs in improving food security outcomes.

Furthermore, Ahungwa et al. (2013), in a study of farming households in Benue State, found that only 36.7% were food secure based on caloric intake standards, reinforcing the notion that food insecurity remains a critical issue—even in Nigeria's key agricultural zones. Their research also identified farm size and educational attainment as key determinants of food security, which aligns with the current study's observations where small landholdings and low-income levels contribute significantly to household vulnerability.

Table 4: Distribution of Respondents Based on their Food Security Status

Category	Definition (HFIAS Score Range)	Frequency	Percentage (%)
Food Secure	0–9	121	46.2
Food Insecure	10–27	141	53.8
Total		**262**	**100.0**

Source: Field Survey Data, 2024

Effects of Socio-economic Determinants on the Food Security Status of Smallholder Millet Farmers

The results of the binary logistic regression in Table 4.4 show that the model chi-square (χ^2 = 101.317, df = 9) was significant at 1%, indicating that the explanatory variables jointly improve the prediction of household food security. The Nagelkerke R^2 of 0.428 suggests that about 42.8% of the variation in food security status was explained by the model, while the overall classification accuracy was 76.3%.Total income had a positive and highly significant effect ($\beta = 2.562$, $p < 0.01$), implying that higher household income greatly increased the likelihood of being food secure. In contrast, income from millet was negative and significant ($\beta = -1.463$, $p < 0.01$), showing that dependence solely on millet income reduced food security. Farming experience in millet also had a negative coefficient ($\beta = -0.046$, $p < 0.05$), suggesting that longer years in millet farming slightly lowered the chances of food security. Extension visit was negative and significant ($\beta = -1.039$, $p < 0.01$), indicating that lack of extension support reduced the probability of being food secure. Other variables such as age, farm size, education, household size, and access to credit were not statistically significant in the model. These results are consistent with findings by Ibrahim et al. (2019) and Wudil et al. (2023), who reported that income diversification and access to advisory services are crucial for enhancing food security among rural farming households.

Table 5: Logistic Regression Estimates of the Effect of Socioeconomic Determinants on the Food Security Status of Smallholder Millet Farmers

Variable	B	SE	Wald	Sig.	Exp(B)
Age	0.034	0.018	3.313	0.069	1.034
Total income	2.562	0.456	31.637	0.000***	12.967
Income from millet	-1.463	0.397	13.585	0.000***	0.232
Household size	0.041	0.044	0.868	0.351	1.042
Formal education (yrs)	-0.012	0.027	0.206	0.650	0.988
Millet farming experience	-0.046	0.021	4.722	0.030**	0.955

Variable	B	SE	Wald	Sig.	Exp(B)
Farm size	0.562	0.334	2.829	0.093*	1.754
Access to credit	0.405	0.381	1.130	0.288	1.499
Extension visit	-1.039	0.341	9.298	0.002***	0.354
Constant	-16.512	4.143	15.887	0.000***	0.000
–2 Log likelihood	260.364				
Cox & Snell R^2	0.321				
Nagelkerke R^2	0.428				
Classification accuracy (%)	76.3				

Note: * = Significant at 10%, ** = Significant at 5%, *** = Significant at 1%
Source: Field Survey Data, 2024

CONCLUSION

The findings of this study show that food security among smallholder millet farmers in Jigawa State is strongly influenced by socio-economic factors such as total income, income from millet, millet farming experience, farm size, and extension visit. While total household income improved food security, overreliance on millet income and limited extension contact reduced it. Years of millet farming experience also had a negative effect, suggesting diminishing returns without innovation. Based on the findings and conclusion from this study, the following recommendations are proposed; policies should promote income diversification, strengthen extension services, and enhance farmers' access to resources to improve food security in the study area.

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