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Can Gender Disparities in Resource Empowerment Affect Food Security? Evidence from Cassava Farmers in Osogbo ADP Zone, Osun State, Nigeria.

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Abstract: Background: Sustainable food security may not be attained unless the wide gender gap inherent in agricultural productivity is significantly reduced. This study examines how gender disparities in resource empowerment among cassava farmers in Osogbo Adp Zone, Osun State, Nigeria affects their food security. **Methods:** Using a multi-stage sampling procedure, controlling for endogeneity, 100 matched pairs of 200 male and female cassava farming households were randomly selected and interviewed. Data for the study were obtained using a structured questionnaire and analyzed using descriptive statistics, Gini inequality index, and probit regression models. **Results:** Following the Feminist Political Ecology theory, the study discovered unequal gendered access to productive resources, particularly farmland. Furthermore, the males' and females' Gini indices (0.422 vs 0.49) respectively compared to the overall population (0.45) indicated moderately more equitable resource accessibility among men than women. Additionally, women had a higher mean HFIAS score (10.0 vs 8.5) than men, and a greater variation within women's gender (std. dev. 3.0 vs 1.5), indicating women households are experiencing greater food insecurity with wider variations. Among the major significant factors influencing food security are gender and access to farmland ($p<1\%$), independence in agricultural decision-making ($p<5\%$). **Conclusion:** A land reform policy addressing women's land ownership rights is recommended.

Keywords: gender disparities; resource empowerment; feminist political ecology; gini inequality; probit model; food security.

Received for publication on January 18, 2025

Accepted for publication on July 17, 2025

1. Introduction

Attainment of food security and agricultural sustainability as contained in the United Nations 2030 Sustainable Development Goals (SDG), Agenda 2, may not be achieved unless the wide gender gap inherent in agricultural Productivity is significantly reduced. Gender dynamics within the agricultural sector in Nigeria, particularly in cassava production, have become a subject of increasing significance (Nwaobiala et al., 2019). Despite their substantial involvement in agricultural production, women encounter barriers to accessing resources and opportunities due to cultural,

religious, and institutional factors (Amadi et al., 2020). Meanwhile, literature identifies a historical shift in the division of labor, with women assuming more responsibilities in response to an acute dearth of male labor (Olaoye, 2014). Despite this shift, gender differentials still manifested in land holdings, resource empowerment, and participation in agricultural production (Agarwal, 2017). Furthermore, while women dominate "menial" tasks like food crop processing (Jimoh et al., 2024b), men control critical resources such as finance and marketing avenues, resulting in an unequal distribution of benefits (Oyugi et al., 2015). The resultant effect could be the endemic poverty and recurrent food shortages experienced in the country (Olaoye, 2014).

The agricultural sector employs about 70% of the population (Kassali and Jimoh, 2018), contributes significantly to a sustained reduction in food and nutritional insecurity, as well as poverty (Ajayi and Ross, 2020) and in Nigeria, cassava is one of the major crops grown by the smallholder farmers in the southern and eastern part of the country. In developing countries like Nigeria, agricultural resource acquisition, access, and control are pivotal in shaping improved livelihood outcomes (Ankrah et al., 2020). Therefore, realizing favorable livelihood outcomes for smallholder cassava farmers hinges on their ability to exercise control over productive agricultural assets without gender consideration. The effectiveness of this is crucial for farmers to leverage advanced technologies and make strategic investments (Diechman et al., 2016). However, it is observed that technological advancements in cassava production, developed by institutions such as the International Institute for Tropical Agriculture, Ibadan, among others, further complicate the gender dynamics. Nwaobiala et al. (2019) highlight differences in functions, decision-making power, and access to finance, land, and other agricultural endowments constituting empowerment. For instance, land ownership, a pivotal factor in agricultural success, favors men globally (Yisa et al., 2020), leaving women with smaller, degraded plots. In addition, Quan (2007) states that women in patrilineal societies have little control and are less accessible to land than women in matrilineal communities. These, however, limit their potential for optimal production and expose them to food inadequacy. Additionally, unequal access to financial resources and agricultural inputs perpetuates poverty and food insecurity cycles among women (Lemke and Bellows, 2015).

Ajayi (2009) found that half of the agricultural labor force in Nigeria is practically represented by adult females and youths; still, farm credit, loans, extension services, and others are more directed to benefit males than female farmers. Using primary data obtained through a sample of 78 farmers with the aid of a questionnaire, Henri-Ukoha and Ikpe (2018) examined the cassava value chain in Obio/Akpor Local Government Area of Rivers State, Nigeria. They discovered that while both males and females were active in the farming operation, female farmers were more involved in processing and production than male farmers, who were more engaged in marketing. Sampling 120 cassava farmers—60 men and 60 women—Nwaobiala et al. (2019) evaluated gender differences in cassava production activities in Abia State, Nigeria. The findings indicated more involvement of women in cassava production activities (2.0) than male cassava farmers (1.8). Additionally, factors that influenced men's involvement in cassava production activities included farm income, farm size, and household size, while farming experience, marital status, and education were significant to women's involvement. Investigating gender differences in technical efficiency among small-scale cassava farmers in Abia State, Nigeria, Yisa et al. (2020) gathered primary data from 147 female and 133 male cassava farmers. The study found a gross margin per hectare of ₦140,978.28 and ₦131,070.27 for male and female farmers, respectively, indicating that cassava production was profitable. Additionally,

estimates from maximum likelihood indicated that male farmers were more technically efficient, with a mean efficiency score (0.82 vs 0.78) than female.

Meanwhile, an overview of the gender dimension in resource access and decision-making is poorly documented in the Osogbo ADP zone, Osun State, Nigeria. There is no certainty on the cassava production level of involvement by gender, and it is also not known how various socio-economic, demographic, and institutional variables intersect in influencing resource empowerment and decision-making power to predict food security of the area from a gender dimension. This study is more important now that women's involvement in agricultural production has already dwindled, hindering their productivity and hence, the perceived food insecurity. Therefore, it is pertinent to examine the relationship that exists between gender differentials in resource empowerment and food security among cassava farmers in the area to ensure the effective allocation of productive resources and food security. Data that will be collected will serve as a benchmark for policymakers on which solutions to SDGs 2 and 5 of gender equality and the eradication of hunger by 2030 stand.

1.1. Theoretical and conceptual considerations

1.1.1. Theory of feminist political ecology (FPE)

Recognizing the shortcomings of conventional methods that frequently ignored the vital role of gender in influencing human-environment interactions, feminist political ecology (FPE) arose as a critical lens within environmental studies. According to Shiva (1988), women, especially in the Global South, bear a disproportionate amount of the burden of environmental degradation while also having significant information about ecological sustainability. This early work argued that social and economic inequality, especially that faced by women, is closely linked to environmental problems, challenging prevailing narratives that portrayed these challenges as the product of human exploitation of nature. This approach explores how power dynamics and gender relations interact to affect environmental consequences. It looks at how social, economic, and political frameworks influence women's traditional ecological knowledge, their accessibility and control over resources, and their involvement in making decisions.

According to Rocheleau et al. (1996), despite their vital contributions to environmental sustainability and food security, women's responsibilities in agricultural production and natural resource management are frequently ignored and underappreciated. This acknowledgment draws attention to the disproportionate costs that women frequently experience because of environmental deterioration, including higher workloads brought on by a lack of resources and the effects of climate change. FPE theory has expanded over time to include a wider range of topics and viewpoints. It now acknowledges women's agency and resilience in the face of environmental challenges, moving past the idea that they are passive victims of environmental issues. Escobar (1999) stresses the significance of comprehending the varied experiences of women and their active involvement in environmental movements, which is critical to understanding the intersection of gender with other social categories like class, race, and ethnicity in shaping perceptions of environmental injustice.

This intersectional approach acknowledges that not all women experience the effects of environmental degradation equally and that resolving environmental injustice necessitates a sophisticated comprehension of the various and intertwining forms of oppression that women experience. By centering gender in environmental analysis, it provides a framework for developing

more just and equitable solutions to environmental challenges, making sure that the needs and perspectives of women are fully considered in decision-making.

Our conceptual framework follows the direction of the FPE theory, an interdisciplinary model that investigates how gender relations intersect with power dynamics to predict food security outcomes. It shows the complex interplay between genders, agricultural decision-making, and land access, including examining how the interwoven effect of socio-demographic and institutional factors jointly predicts women's accessibility to productive endowments, decision-making power, and their ability to influence food security through the lens of gender dynamics significantly.

2. Materials and Methods

2.1. The Study Area

The study was carried out in the Osogbo ADP zone of Osun State, Nigeria (Figure 1). The area is one of the three (3) Agricultural Development Program (ADP) zones, namely, Osogbo, Iwo, and Ife/ Ijesha. Osogbo ADP zone is located around Latitude 6.07ºN and Longitude 4.014ºE (Adapted from Osun State Local Government Council's Dividend of Democracy 2016). According to the 2016 National Population Census, the zone had an estimated population of 1,143,144 persons. Osogbo ADP zone is made up of thirteen Local Government areas, namely Ifedayo, Ila Orangun, Boluwaduro, Boripe, Ifelodun, Osogbo, Olorunda, Orolu, Irepodun, Ede-south, Ede-north, Odo Otin, and Egbedore. The area enjoys a tropical climate with prominent wet and dry seasons. The rainy season generally occurs between April and October, while the dry season occurs between November and March. Agboola et al. (2021).

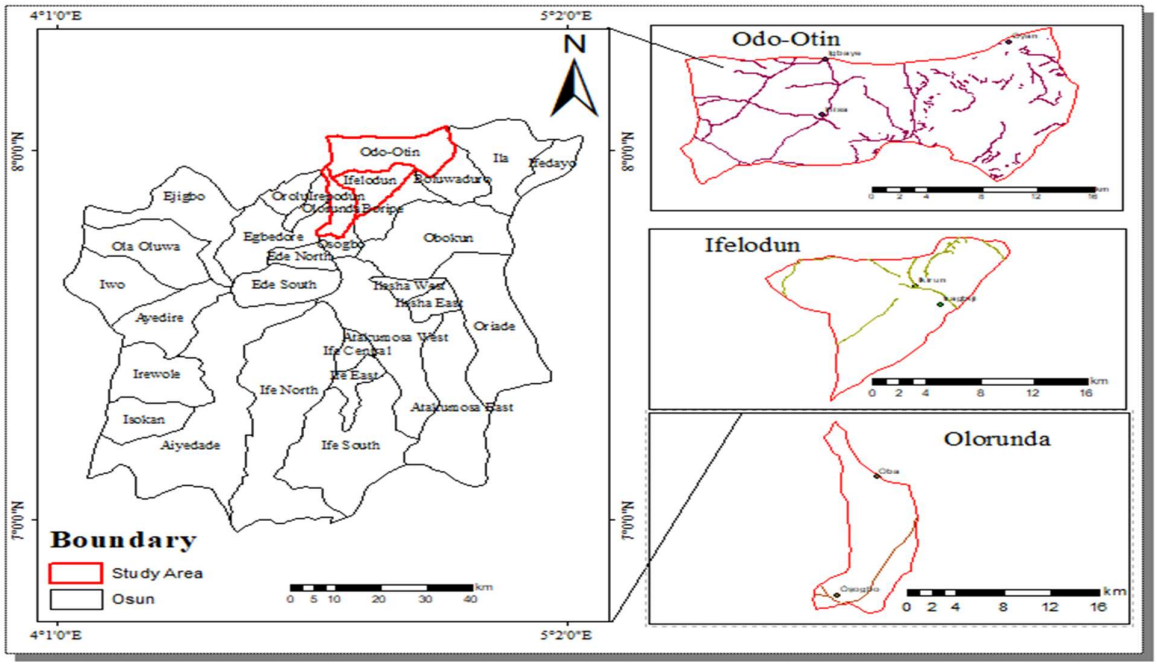

Figure 1: Map of Osun State showing the study area

Source: https://gadm.org/download_country.html#google_vignette

2.2. Sampling procedure and sample size

The study was carried out using a multi-stage sampling procedure. The first stage was a purposive selection of the Osogbo ADP zone among the three ADP zones in Osun state because of its prominence in cassava production. The second stage also entails the purposive selection of three (3) local government areas (LGAs) out of the thirteen (13), which include Olorunda, Ifelodun, and Odo-Otin local governments. The three (3) selected LGAs were chosen to reflect diversity in geography, socio-economic status, varying levels of food insecurity and livelihoods, and urban-rural distributive dynamics in the study area. At the last stage, adopting a propensity score matching sampling frame to avoid sampling selection bias, based on the census of households in each community as identified by the community heads, thirty households (30) were randomly selected from each community giving a total of three hundred (300) households, consisting of 150 males and 150 females' households.

A propensity score matching technique was used to be more confident in attributing differences in food security to gender. We tried to control for endogeneity, resulting in sample selection bias that may influence food security. A logistic regression model was used to estimate the probability of a household being male/female based on their collected socioeconomic variables. Then, a propensity score was estimated. Using the nearest neighbor matching method to pair each male household with the female that has the closest propensity score, we then randomly select 100 matched pairs to form our final sample size of 200 households for the study. The sample size is justified considering its power for sub-group comparisons, and statistical adequacy which allows for 95% confidence levels and acceptable margin of error.

2.3. Method of Data Collection

For this study, primary data were collected with well-structured questionnaires administered, collated, and analyzed. Field officers, who were undergraduate students of Agricultural Economics, were trained in the local context of the study area, and questionnaire administration, were used to elicit information through the focus group discussions and interview schedules. We conducted a pilot test using a group of twenty-five households, and the questionnaire was then adjusted to remove ambiguity, limited answer choices, ordering, and flow issues, and then validated. Households involved in the pre-test were removed from the survey. No incentive was given to the consented non-minor respondents who were assured of the safety of their information for academic publication. The questionnaire captures the socio-economic characteristics of the cassava farmers, the activities carried out, and the food expenditure by the farmers' gender.

2.4. Data Analysis

Descriptive statistics such as frequency counts, percentages, and mean scores were used to present the data of the study. A Likert-type scale was used to measure the level of involvement of cassava farmers in production. The Gini inequality index was used to measure inequality in access to agricultural productive resources. Food expenditure pattern was measured by household food

expenditure, household food security was measured by the Household Food Insecurity Access Scale, while factors influencing gender food security were tested with a probit regression model.

2.5. Measurement of Variables

A three-point Likert-type rating scale with always = 3, occasionally = 2, and never = 1 was used to determine the farmers' levels of participation in cassava production activities by gender. By summing 3+2+1 = 6 and dividing by 3, the mean cut-off mark was determined to be 2.0. The decision rule was as follows: 2.0 and higher (high), 1.51–1.99 (moderate), and 1.00–1.50 (low).

2.6. The Gini inequality index

The Gini inequality index measures the degree of wealth inequality within a population. Its numerical value lies between 0 and 1; 0 indicates perfect equality, whereas 1 indicates perfect inequality, meaning one person has all the wealth. A higher value represents greater income inequality, while a lower value represents a more ideal income distribution.

2.7. Household Food Insecurity Access Scale (HFIAS)

The Household Food Insecurity Access Scale (HFIAS) model was employed to measure the degree of food insecurity during the month before the survey. It is calculated for each household based on the household's answers to nine questions about the frequency of occurrence. The scale shows households with different food security levels based on their position on a scale of 0 – 27 (Coates *et al*., 2007). Food insecurity increases as positive responses increase; zero (0) is the most food secure, and 27 is the most food insecure.

2.8. Probit regression model

Following (Washington et al., 2020), a probit analysis was employed as an analytical model for computing maximum likelihood estimates. The rationale of probit analysis is that our target variable (food security) is binary, having two values: food secure = 1 and 0 if otherwise. In exploring the predictor variables of food security in the context of gender dimension, we performed the analysis to provide insights into the relationship between access to farmland, independence in agricultural decision-making, and food security. Socio-demographic factors, including gender, access to information, age, education, and income, were also included.

2.8.1. Model specification as follows:

$$Pr(Y = 1/X) = \emptyset(X^i\boldsymbol{\beta}), \quad (1)$$

where Pr denotes probability and Ø is the cumulative distribution function (CDF) of the standard normal distribution. $\boldsymbol{\beta}$ are the coefficients of the explanatory values, which here are estimated using the maximum likelihood function. X is a vector of the explanatory variables, i.e. access to farmland, independence in agricultural decision-making, gender, access to information, age, education, and income. Our study envisages multiple determinants that influence farmers' gendered food security, such that $\{Y_i, X_i\}i = 1^n$. Hence, their joint log-likelihood function is;

$$\ln L(\boldsymbol{\beta}) = \sum_{i=1}^{n}(y_i \ln \emptyset (\sum_i^1 \beta) + (1 - y_1) \ln(1 - \emptyset ((x_i^1\beta) \quad (2)$$

The estimator β follows the regression assumptions of consistency, asymptotically normal distributed and efficient if $E[XX1]$ exists and it is not singular. The log-likelihood function ensures that β is concave, and hence, standard numerical algorithms for optimization will converge rapidly to the unique maximum, asymptotically normally distributed and efficient if E $[XX1]$ exists and it is not singular. The log-likelihood function ensures that $\beta$is concave, and hence, standard numerical algorithms for optimization will converge rapidly to the unique maximum.

2.9. Hypothesis of the study

The hypotheses of the study were that; i) cassava farmers' food security at a given time was influenced by socioeconomic, institutional, and environmental dimensions and, ii) The dichotomous dependent variable; farmers' food security indicated whether farmers had access to agricultural productive resource of farmland in the last six months that preceded the survey. For the independent variables, the selection was based on the theoretical consideration from literature, experiences gained from local farmers, and expert consultations (Djangmah, 2016; Nwaobiala et al., 2019; Dwomoh et al., 2023).

3. Results and Discussion

3.1. Socio-economic characteristics of cassava farming households by gender

The socio-economic statistics in Table 1 reveal that 58 % of the sampled households in the study area are male-headed. This evidence shows the dominance of male farmers in cassava farming activities, as many studies (Kassali and Jimoh, 2018; Amadi et al., 2020) opined that heavy labor demands in farming operations are intrinsically linked to male domination. Furthermore, the majority (88 vs 89%) of males and females sampled households were married, and the mean age was approximately 44.5 and 38.56 years, respectively. This indicates farmers' ability to be involved in productive activities, enhancing their investment potential for improved technological utilization. Oyetoro et al. (2022) consistently reported a mean age of 35 years among farming households, underscoring the preponderance of farmers in their active age. In addition, the minimum years of education is 4 years. Nwaobiala et al. (2019) reported high primary education among rural household heads. Development partners can take advantage of young educated farmers by investing in farmers' education for sustainable agriculture.

The result further shows that 75% of male and only 20% of female households have farming as their primary occupation and the mean household size is 4 persons. Occupation and family size are factors that influence household income and determine households' food security status. Furthermore, it is interesting to note that male farmers reported a higher mean land holding size of 3.69 hectares compared to 1.24 hectares for females. The wide gap in landholding among the genders is an indication of the prevalence of a patriarchal land tenure system in the study area that exclusively confers land-holding rights to men, as discovered by Amadi et al. (2020), Jimoh et al. (2024b) and Jimoh et al. (2025).

As for the institutional profile, again, Table 1 shows that the average farming experience was approximately 25 years. The extensive farming experience suggests a wealth of practical knowledge

that can be used in adapting to agricultural innovations (Akintunde et al., 2021). Furthermore, only a few male farmers (38, 18, and 8%) had access to credit facilities, and extension services and were members of cooperative societies, respectively, during the farming season. The scenario is even worse for female cassava farmers. This indicates that farmers are not enjoying the essential ingredients of agricultural transformation and income generation.

Table 1. Socio-economic characteristics of cassava farming households

	Male-headed households (n=70)				**Female-headed households (n=50)**			
	Min.	Max.	Mean	S. D.	Min	Max.	Mean	S. D.
Marital status (1 if married, otherwise 0)	0	1	0.88	0.24	0	1	0.89	0.09
Age (years)	19	82	48.40	11.55	24	56	38.56	5.22
Education (years)	5	16	6.75	6.52	4	11	5.55	3.98
Main occupation (1 if the occupation is farming, otherwise 0)	0	1	0.75	0.46	0	1	0.20	0.09
Family size (persons)	0	9	5	1.63	0	6	4	1.25
Farm size (hectares)	0.0057	6	3.69	1.27	0.0040	2	1.24	0.0020
Farming experience (years)	1	58	26.28	13.39	1	32	25	5.25
Access to credits (1 if access, otherwise 0)	0	1	0.27	0.38	0	1	0.08	0.02
Distance to major markets (km)	0	21	11.41	7.38	0	21	11.41	7.38
Access to extension services (1 if access, otherwise 0)	0	1	0.38	0.18	0	1	0.20	0.11
Membership of cooperative society (1 if the farmer is a member, otherwise 0)	0	1	0.25	0.08	0	1	0.18	0.05

Source: Data analysis, 2024

3.2. Level of involvement in cassava production activities by gender

A Likert-type scale was used to measure the level of involvement of farmers by gender in cassava production. Although Fuzzy Rating Scale allowed for a better capture of the variability of individual responses, but on the other hand, Likert Scale were more valuable considering its satisfaction, comparative potential, ease of comprehension and response (Castano et al., 2020). Table 2 shows that both men and women were involved in cassava production activities with grand mean scores of 2.12 and 2.05, respectively. Meanwhile, men were more involved in some activities than women. For instance, men were more engaged in the labor-intensive stages of cassava production. This asserts traditional gender roles in agriculture. Awotona et al. (2022) and Amadi et al. (2020) found that men were highly involved in activities such as planting, fertilizer application, site selection, and farmland preparation.

Furthermore, men were more engaged in site selection than women, probably because of the African patriarchal tradition of inheritance that conferred land ownership on men. Amadi et al. (2020) and Jimoh et al. (2024a) noted that the patriarchal land tenure system in their study area is intrinsically linked to the male domination of site selection for farming. The person who owns the land decides how to use it. As a productive resource, the land needs a reform policy that will allow women equal access. Similarly, food preparation or carrying roots to market are known tasks for women in African tradition; not surprisingly, women were more engaged in those activities than men. These findings conform to Amadi et al. (2020) who reported that women were more engaged in activities such as providing food for laborers and carrying stuff. It should be noted that gender disparities could challenge the food security dynamics of the women gender given that the imbalance restricts accessibility to productive resources Djangmah, 2016.

Table 2. Level of gender involvement in cassava production

Activities	**MALE**	**FEMALE**
	WMS	**WMS**
Site selection	2.32	1.00
Land clearing	2.35	1.05
Gathering of cleared bushes	2.22	2.50
Burning of cleared land	2.25	2.22
Making ridges	2.32	2.00
Selection of varieties	2.26	2.25
Planting	2.32	2.21
Weeding	2.25	2.20
Fertilizer application	2.26	2.35
Harvesting roots	2.24	2.24
Carrying roots to house/markets	1.25	2.35
Prepare food and bring water for labour	1.34	2.35
Average total	2.12	2.05

Note: weighted mean scores were added and divided by the number of activities scored (12) to arrive at the average total; Source: Field Survey, (2024).

3.3. Inequality in Accessibility to agricultural productive endowments

3.3.1. Inequality in Access to productive resources

Table 3 presents the Gini inequality index, showing access to productive resources disparity among male and female cassava farmers. The Gini coefficient was chosen for its flexibility, decomposability, anonymity principle, and intuitive interpretability concerning measuring inequality (Lau, 2021). The Gini coefficient for the entire sampled population is 0.46. This implies a moderate inequality in productive resource access among the overall population. On the other hand, among men, the lower Gini coefficient, 0.422, compared to the overall population, indicates moderately more equitable accessibility. This might result from men having greater control over household income or better access to production resources that will affect their food security. Dwomoh et al. (2023) evidenced that the accessibility of agricultural production resources increased food security by 7% in their study. For women, the higher 0.49 Gini coefficient indicates more unequal access than the sampled population.

3.3.2. Inequality in income, access to land, and independent agricultural decision-making

Furthermore, Table 3 clearly shows that women who have no control over household income have a higher degree of inequality (0.369) compared to those who have control over their household income (0.321). Similarly, women who had no autonomy to make agricultural decisions had a higher level of inequality (0.321) than men with agricultural decision-making autonomy (0.272). Women who had no access to land had the highest degree of inequality (0.482). This indicates that women, compared to men, had unequal access to land, less decision-making autonomy, and low-income levels. Our findings are in agreement with reported evidence in previous studies relating to food insecurity-gender dynamics in Nigeria, SSA, and beyond (Leroy et al., 2015; Asitik and Abu 2020; Awotona et al., 2022 and Dwomoh et al., 2023). Many factors could be responsible for this evidence; the discriminatory land laws that restrict women from land ownership Adamon and Adeleke (2016), the men's control of critical resources such as finance and marketing avenues, resulting in an unequal distribution of benefits (Oyugi et al., 2015), the women gender dominating only menial food crop processing (Jimoh et al., 2024b), among others. This disparity has implications for food and nutrition inequality, poverty, and sustainable agricultural development.

Table 3. Gini inequality indices for gender accessibility to agricultural productive resource

Indicators	**Group**	**Gini inequality index**
Pooled		0.461
Gender	Men	0.422
	Women	0.471
Access to land	Men with access to land	0.362
	Women without access to land	0.482

Control over household income	men who have control over household income	0.261
	Women who have control over household income	0.321
	Women who have no control over household income	0.369
Interaction between agricultural decision-making and sex	Men who make agricultural decisions freely	0.272
	Women without autonomy to make decision	0.321

Source: Data analysis, 2024

3.4. Food consumption expenditure pattern of the households by gender

Food consumption data indicate the effect of purchasing power on food nutritional vulnerability (Rosen and Shapouri, 2001). Table 4 shows that generally, men allocate more spending on most of the different food categories than women by the average ($\bar{x}$) of N15208.14 per month. Higher food prices have recently been experienced in the country, and men's higher income levels than women could reduce women's purchasing power. Also, men's better access to productive resources than women, could give them an edge to food access, and hence may be more food secure. On the other hand, women spent less, had inadequate food access, may be nutritionally vulnerable, and hence, are less food secured. Furthermore, the result clearly shows that men and women households spent more income on staples (53.49% vs 48.83%) followed by meat, poultry and *wara* (wara is a local cake extract of soya bean fried to replace unaffordable meat). This clearly shows the importance of the staple in the food balance sheet among the sampled households Ndubueze-Ogaraku et al. (2016). This could result from households' vulnerability to price shocks exposing them to limited dietary diversity. Government should work on price stabilization and safety nets to cushion effect of the endemic inflation.

Furthermore, for men, the least expenditure was on fruits and vegetable (7.99%) while it was processed food for women (8.45%). This could result from differences in dietary preferences and health-consciousness as women may prioritize fresh proteinous intake compared to men's whole grain consumption. Furthermore, it can be seen that food procurement alone takes a toll on households' income, as the current inflation and escalating food prices may have eroded their purchasing power. Therefore, the current minimum wage of N18,000.00 per month payable to an employee in the country must be upwardly reviewed for the citizen to have continuous food access and stability, and hence food secured.

Table 4. Average monthly food consumption expenditure pattern by gender

Food category	**Average monthly food expenditure**			
	Male (₦)	**(%)**	**Female (₦)**	**(%)**
Staples (Yam, Gari, maize, beans, rice)	30,575.25	53.49	20,480.50	48.83
Meat, Poultry, *wara*	10,405.70	18.21	4,920.98	11.73
Dairy Products	4,600.00	8.06	5,500.60	13.11
Fruits and Vegetables	4,570.05	7.99	7,500.68	17.88
Processed Foods	7,000.50	12.25	3,540.60	8.45
Ground total	57,151.50	100	41,943.36	100

Source: *Data analysis, 2024; the average exchange rate of naira to one dollar $ was N1500.40.*

3.5. Measuring households' food security by gender

Following Coates et al. (2007), as adopted by Crush (2013), using Household Food Insecurity Access Scale (HFIAS) indices, the households' food security was measured. The model was selected as it distinctively reports the household food insecurity status, its validity, strong reliability, and contextual relevance among respondents (Natamba et al., 2015). Table 5 reveals that the general pattern for all households is widespread food insecurity. Households headed by women had a higher mean HFIAS score (10.0) compared to men (8.5). This indicates that female-headed households are experiencing greater food insecurity. The higher the HFIAS score, the greater the food insecurity and vice versa. This could be the result of the female-headed households having less access to agricultural resource endowment, less independence in agricultural decisions (Ankrah et al. (2020), suffering from discriminatory land laws, hence low productivity and so, are less food secured. The finding agrees with Dwomoh et al. (2023), but runs contrary to Akter et al. (2017) who found that women were more empowered than men in informed decisions on agricultural productive resources. This finding is a testament to the difficulty being experienced in the attainment of both SDG 5 which targets gender equality and SDG 2 targeting ending all forms of hunger and malnutrition by 2030. Land reform policy addressing land ownership, access, and administration must be pursued rigorously. This will reduce women's access denial to productive agricultural endowments. Targeted interventions are necessary in income support, food support, and skill training addressing women's vulnerabilities to food insecurity.

Furthermore, there is more variation in the HFIAS score among female-headed (standard deviation = 3.0) compared to male-headed (standard deviation = 1.5) households. This suggests greater variability in food insecurity dynamics among female-headed households. It highlights a wider range of experiences, meaning some households are facing severe food insecurity, while others face little or no food insecurity. Many factors could be responsible for this evidence. In some households, women

have control over income or access to credit and have some independence in agricultural decision-making while this runs contrary in other women-headed households. Also, in some societies, women could inherit or purchase agricultural land (Ankrah et al., 2020), while it is impossible or unaffordable to others. To address this, there must be identification of the vulnerable subgroups among women for tailored intervention as one-size-fits- all method may not be well effective to address the wide range of food insecurity experienced among the women gender.

Table 5. Food security status of male and female-headed sampled households

Food security	Count	Mean	Std	Min	Max
Male-headed	70	8.5	1.5	7.0	11.0
Female-headed	50	10.0	3.0	9.0	15.0

Note: The food scores were obtained using a point-based system ranging from 0 (food secure) to 27 (severely food insecure); **Source:** Data analysis, 2024

3.6. Factors influencing gender food security among sampled households

Following (Washington et al., 2020), a probit analysis was employed as an analytical model for computing maximum likelihood estimates. The rationale of probit analysis is that our target variable (food security) is binary, having two values: food secure = 1 and 0 if otherwise. In exploring the predictor variables of food security in the context of gender dimension, we performed the analysis to provide insights into the relationship between access to farmland, independence in agricultural decision-making, and food security. Results in Table 6 show that gender, age, education, income, access to land, access to information, and freedom in agricultural decision–making are the significant variables predicting the food security of the households. Gender was positive and significant at 1%, indicating a higher likelihood of men having greater food security than the female respondents. The marginal effect shows that a 1% increase in men's cassava farming population is associated with a 0.33 unit increase in households' food security. This suggests a gender-based disparity in food security outcomes. The finding can be linked to several factors; men's access to productive endowments, credit access, and the labor-intensive nature of cassava farming. Meanwhile, Dery (2015) opined that gender disparities must be addressed for agricultural-dominated economies to expand quickly in other to ensure agricultural productivity and food security. We propose the abolishment of discriminatory land laws against women to allow easy access to farmland and a gender-sensitive scaling up of agricultural mechanization through farmers' cooperatives to reduce gender-based hardships encountered in cassava farming operations.

Furthermore, the marginal effect of the age of the farmer has a negative correlation with food security. This indicates that there is a likelihood of a downward trend in household food security as farmers get older. It is possible that factors, like reduced physical capabilities, retirement, and increased

healthcare costs, could be responsible for the negative correlation. Older farmers may face challenges in food access, meal preparation, and affording nutritious food, particularly in a scenario of limited finance. Li and Li, (2019) confirm that the aging of the agricultural labor force reduces the physical strength, which leads to the abandonment of cultivated acreage with resultant limited production output. We propose an early enrolment of farmers in a pension scheme at their productive age, and provision of safety nets that could help ameliorate food insecurity resulting from aging. Furthermore, the marginal effects of farmers' education, income and, access to information were positively correlated and significant at 5%, 10%, and, 10% respectively to the food security of the farmers' households. Education has a positive impact on the likelihood of households' being food-secured as highly educated household heads are more likely to embrace better farming techniques, can make independent agricultural decisions, are accessible to and able to utilize extension information, would be more productive, and likely have a better income than the less educated, and hence, more food secure. Leroy et al. (2015) and Dwomoh et al. (2023) found income, and education as determinants of food security, and Jimoh et al. (2024b) discovered that education leveraged better productivity.

Furthermore, the study found access to farmland and independence in agricultural decision-making positive and significant at 1% and 5% respectively. The marginal effect shows that a 1% increase in acreage accessibility will increase the households' food security by about 0.43 units. This indicates that land accessibility is a strong and gender-biased indicator with male farmers having a likelihood of easier access to farmlands and predicts a substantial impact on their likelihood of being more food secure than women. At the same time, women were likely more disadvantaged in making informed independent agricultural decisions compared to men. This could stem from the African traditional patriarchal land ownership (Doss et al., 2014; Ankrah et al., 2020; Jimoh et al., 2024a), which cedes land ownership rights to men as is prevalent in the study area. More so, women's over-dependency on men after marriage could betray their land ownership rights (Buabeng et al., 2024) and power to make informed decisions. Meanwhile, it is said that, if given equal access to the agricultural productive endowment, female managers could be as efficient as males (Kilic et al., 2013). The findings confirm recent gender-related studies (Kieran et al., 2015; Doss et al., 2014; Dwomoh et al., 2023 and Adams et al., 2024) which assert that men were more endowed with productive agricultural resources and had independence of agricultural decision-making than women in some SSA countries and beyond. There is a need to prioritize women's education and credit accessibility (Kendel *et al.*, 2024) for the necessary enlightenment otherwise, women in SSA will continue to be less productive and, hence their vulnerability to nutritional and food insecurity

Table 6. Factors influencing gender food security among the households

Food security	Marginal effect	Std. Error	z-score	Sig. levels
Gender (male)	0.332	0.113	2.93	0.00338***
Age	-0.045	0.021	-2.11	0.03485**
Education	0.317	0.133	2.35	0.01877**

Income	0.113	0.063	1.77	0.07672
Farm size	0.029	0.022	1.17	0.24200
Access to land	0.424	0.157	2.69	0.00714***
Access to Information	0.018	0.007	2.27	0.02321**
Freedom of decision-making (male)	0.251	0.108	2.32	0.02034**
Mean dependent var	0.758	SD dependent var		0.428
Pseudo r-squared	0.852	Number of obs.		200
Chi-square	15.857	Prob > chi2		0.0000
Akaike crit. (AIC)	36.125	Bayesian crit. (BIC)		26.237

Source: Data analysis, 2024; *** p<.01, ** p<.05, * p<.1

4. Conclusion and recommendations

Given that resource empowerment provides the basis for agricultural productivity, our study investigates how gender disparities in resource empowerment affect food security among cassava farming households. Taking the direction of the FPE theory to explore the problems confronting women's gender in the attainment of food security, it was discovered that there exists a gender disparity between males and females in the level of involvement in cassava production activities, expenditure pattern, and access to productive resources. From our findings, among men, the lower Gini coefficient (0.422), compared to the overall population (0.45) indicates a moderately more equitable resource accessibility as opposed to the women (0.49) indicating a more unequal endowment. It was also discovered that women had no independence in agricultural decision-making compared to men which affected their resource empowerment.

Furthermore, households headed by women had a higher mean HFIAS score (10.0) than households headed by men (8.5), indicating that female-headed households are experiencing greater food insecurity. Also, there is more variation in the HFIAS score within the female-headed (standard deviation = 3.0) compared to the male-headed (standard deviation = 1.5) households indicating a wider variation in food insecurity within the women gender. Among the positive and significant factors influencing food security are access to farmland and information, independence in agricultural decision-making, education, among others which indicates male-headed households' likelihood of being more food secure compared to female.

Based on the findings, the following policy outlines are recommended;

For the attainment of SDG 2 targeting ending all forms of hunger and malnutrition by 2030, the land reform policy underway in Nigeria aiming to address land ownership, access, and administration must be rigorously pursued. Issues relating to women's access must be addressed. This will reduce women's access denial to productive agricultural endowments. Also, targeted interventions are necessary in the forms of food support, and skill training addressing women's vulnerabilities to food insecurity. These should be implemented synergistically for a complementary advantage, Jimoh et al. (2024a).

The wider food insecurity discovered within the women gender should be addressed through the identification of the vulnerable subgroups among women for a tailored intervention as a one-size-

fits-all method may not be well effective in countering the wide range of food insecurity experienced within them. Development partners should also prioritize women's education to help them in agricultural decision-making.

Author Contributions: L.O Jimoh: Conceptualization, Data curation, Writing – original draft, Writing – review & editing, Visualization, Investigation, Formal analysis, Methodology, Supervision, Resources, Project administration. Titiloye Elizabeth Abimbola: Data curation, Writing – review & editing.

Funding: This research received no external funding
Acknowledgments: The authors would like to thank all those who made this work successful.

Conflicts of Interest: The authors declare no conflict of interest

Data availability statement: Data are within the files or are available on request

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