ISSN: 18158129 E-ISSN: 18151027
Volume 18, Issue 07, July, 2022

Gender Differentials of Empowerment and Levels of Food Security Status of Arable Crop Farmers in Osun State, Nigeria

Olawuyi, T.D.[1], Alao, O.T.[1], Kehinde, A.L.[2], Olawuyi, S.O.[3,4*]

Department of Agricultural Extension & Rural Development, Osun State University, Nigeria[1]
Department of Agricultural Economics, Osun State University, Nigeria[2]
Department of Agricultural Economics & Extension, University of Fort Hare, South Africa[3]
Department of Agricultural Economics, Ladoke Akintola University of Technology, Nigeria[4]

Corresponding Author: 3,4*

ABSTRACT— The discourse on gender-based discrimination and imbalances is gaining tractions among policy and development experts because gender equality is central to achieving the vision of zero hunger for all. Despite the important roles of women in the food systems, they face systemic disadvantage in accessing productive resources, services and information. Therefore, this study examined the effect of gender inequality on the arable crop farmers' food security status in Osun State, Nigeria. Cross-sectional data were elicited from a sample of 252 arable crop farmers selected through multistage sampling processes. The data collected were analyzed using descriptive statistics to describe the farmers' socio-economic characteristics; while principal component analysis and composite score technique were used to generate the women empowerment index, and categorize the farmers into levels of empowerment, respectively. Cross-tabulation technique was applied to achieve gender disaggregation of the empowerment status, and food security categories, while the World Food Programme approach was applied to estimate and categorize the farmers into the different continuums of food security status. Ordered logistic regression was also used to examine the effect of gender inequality on the farmers' food security status. The results also indicated that both male and female farmers are disproportionately lacking in the empowerment indicators, while majority of the farmers were in the chronic food insecurity category. The ordered logistic regression estimates indicated that gender of the farmers, years of formal education, number of employed household members, primary occupation, years of farming experience, institutional engagements, and importantly, women empowerment status were significant factors influencing the probability of arable farmers falling into each of the food security categories. The study concluded that most of the farmers were in the chronic food insecurity category. Therefore, the study recommended integration of gender-just policy in the national food security strategies and policy framework by the government. Equally, the study advocated for revitalization of agricultural extension service delivery system in Osun state, Nigeria.

KEYWORDS: arable crop farmers, gender inequality, women empowerment, food security, proportional odds model, Nigeria

1. INTRODUCTION

Gender is a major concern, an issue of importance, and it is central to improving agricultural productivity [27]. Gender equality and women's empowerment are central to achieving the food security vision for the purpose of achieving food security for all, by raising levels of nutrition, improving agricultural productivity and natural resource management, and improving the lives of people in rural areas with full and equitable

participation in decision-making [27]. Without gender equality and rural women's economic, social and political empowerment, food security may be difficult to achieve, both in the short and long run. A strong relationship exists between gender-based discrimination and the different channels by which individuals access food, which could be through own-production, waged employment, and/or social protection [24]. Growth in the agricultural sector remains fundamental for food and nutrition security, employment creation, and poverty reduction. However, productivity in the sector is far below its potential with respect to the staple food and/or arable crops [12], and this threatens food availability and distribution among the population. Owing to this situation, there is a greater need to ensure the achievement of zero hunger as enshrined in the United Nations' (UN) Sustainable Development Goal 2 (SDG 2), shown in Figure 1 [29]. Not just only that, but ensuring sustained responsible consumption and production (SDG 12), no poverty (SDG 1), as well as maintaining good health and well-being (SDG 3) which are all critical to the socio-economic development of the nation through improved productivity in the agri-food and allied sectors.

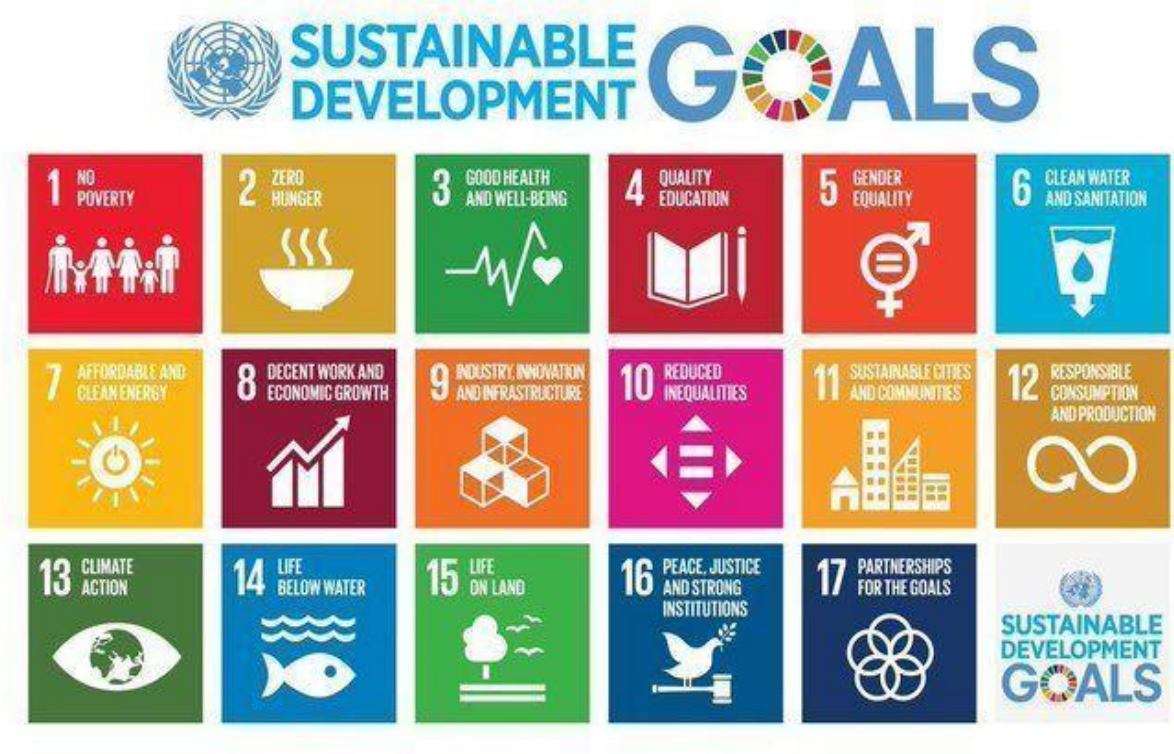

Figure 1. Sustainable Development Goals (SDGs)

Source: UN, 2015

'Food' is a rights issue, and with women constituting a significant proportion (about 50%) of the agricultural labour force in Africa, they evidently become a good candidate and compelling target for support in terms of improving food productivity [27] doing this will evidently advance the development experts' crusade for gender equality (SDG 5), and reduced inequality in the society (SDG 10). The case for enhancing women's productivity is made stronger against the background which several extant studies (for instance, [10], [6], [12], [21], [7], [27] have all observed a wide gender gap in food security status vis-à-vis crop productivity in Africa.

In lieu of the aforementioned, this study investigated the gender inequality (proxy by women empowerment components and indicators) and food security status of the arable crop farmers in the study area, from the gender disaggregation perspective. The study also examined how the empowerment inequality status impact on different levels of food security status among the arable crop farmers in the study area.

2. Description of the study area

The study was carried out in Osun State, Nigeria, located in the south-west geopolitical zone of Nigeria. This is an inland state with its capital in Osogbo city and lies on latitude of 8010' N and longitude of 605'S on the south [3]. The state falls within the rain forest ecological zone of the country. The state shares boundary with Oyo, Ekiti, Kwara and Ondo states. The state enjoys luxuriant vegetation with vast rainforest found in the south while the northern fringe in mostly sub-savanna forest. The state is divided into three Agricultural Development Zones (ADPs) based on the agro-ecological zones (AEZs) they fall into, namely: rain forest (Ife/Ijesa ADP), derived savannah (Osogbo ADP), and savannah (Iwo ADP) [1], [2]. The climate is tropical and characterized by a bi-modal rainfall pattern (that is, the wet and dry seasons). The annual rainfall also ranges from 800 mm in the derived savannah to 1500 mm in the rain forest while the mean annual temperature varies from 21.1°C to 31.1°C [2]. All these attributes support agricultural activities in this state.

2.1 Sampling Frame and Data

All the arable crop farmers in Osun State, Nigeria constitute the population of the study. And, a multi-stage sampling procedure was used to select the respondents. The first stage involved a purposive selection of two (2) Local Government Areas (LGAs) each from the three ADP zones in the state, making six (6) LGAs that were chosen out of the thirty (30) LGAs in Osun State. In the second stage, random proportionate to size sampling technique was used to select two (2) villages each from the LGAs selected, to arrive at twelve (12) villages that were selected across the 6 LGAs. Random proportionate to size and simple random sampling were jointly used in the third stage to select a total of 256 arable crop farmers in the study area.

According to [22], the three main criteria which are usually considered in the determination of a suitable sample size for any study are: the level of precision, confidence level and the degree of variability. Since a reliable list of registered farmers in each of the LGAs could not be guaranteed, this research selected the study's representative sample (sample size) using sample size determination procedure for unknown population (confidence level technique of Z-score table) as described in [28]. This is expressed as:

$$n_0 = \frac{z^2 \times p(q)}{e^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$ where:

$\boldsymbol{n_0}$= sample size to be estimated, $\boldsymbol{z^2}$ = selected critical value of desired level of confidence or risk

$\boldsymbol{p}$ = estimated proportion of an attribute that is present in the population or maximum variability of the population

$$\boldsymbol{q} = 1 - p$$

$\boldsymbol{e}$ = error margin.

Therefore, at the standard and recommended 5% (0.05) error margin (which is 95% confidence interval), the sample size is:

$$\boldsymbol{n_0} = \frac{(\mathbf{1.96})^2 \times \mathbf{0.5}(\mathbf{1} - \mathbf{0.5})}{(\mathbf{0.05})^2} = \mathbf{384.16}$$

Two-third of this estimated value were eventually selected due to financial constraints, to arrive at the 256 arable crop farmers used for this research. Meanwhile data from 252 farmers entered the final analyses due to incomplete responses.

Cross-sectional research design was adopted for this study. In specific term, cross-sectional data (primary data) were collected from the respondents through the use of a well-structured interview schedule which was designed in line with the research objectives.

3. Methodological Literature

Food security is a multidimensional phenomenon; which is difficult to assess with the use of a single measure [8]. Suffice it to say that food security is considered to be a latent trait, meaning that it cannot be observed directly [4]. Part of several techniques for measuring food security vis-à-vis food insecurity is the Food Insecurity Experienced-based Scale (FIES) [4], [23], [31]. The food insecurity experience scale (FIES) is especially useful because it is very reliable, valid, affordable to use, and can be applied in a relatively short period of time [8].

3.1 Food insecurity experience-based scale (FIES)

The food insecurity experience-based scale (FIES) is used to assess direct experiences of food insecurity at the individual or household level (USDA, 2012; [4]. It thus measures the access dimension that captures the range of experiences of food insecurity. Furthermore, FIES incorporates a 12 months, 3 months or 1 month reference period, and takes into consideration eight questions which are used to measure the severity of food insecurity [4]. This measurement tool uses a theoretical construct of food insecurity based on ethnographic research that showed the universality of food insecurity experiences, ranging from worrying about obtaining food (mildly food insecure) to skipping meals or going hungry for a whole day (severely food insecure) [4]. The respondents usually provide a yes/no answer to the questions, and the sum of the answers provide an indication of the level of severity [4].

According to [4], [8], two methods, namely: Item-Response Theory and Rasch Modelling, were used to develop and validate FIES. As mentioned earlier, food insecurity is recognized as a latent trait, which means that it cannot be observed [23]. The Item Response Theory works with the assumption that in a series of questions, an unobservable construct can be measured with the use of yes/no answers [4], [23]. According to this theory, if a question results in a high number of positive responses, then the question is correlated with a less severe state of food security. On the other hand, if a question results in a high number of negative responses, then the question is associated with a more severe state of food insecurity.

Responses are measured as a raw score in order to assess how questions are associated with a certain level of severity. Rasch modeling is used to determine the probability that a question will generate a positive response [4], [23]. These probabilities are used to determine the severity of food insecurity associated with each question. Importantly, the severity of each question is measured independently of the other questions. In line with [18] [31], the scores generated from the FIES survey are scaled into the following continuums, depicting the respondents' food security and/or food insecurity status: Food surplus (FS), Food break-even (FB), Chronic food insecurity (CF), and Transitory food insecurity (TF).

3.2 Gender Inequality

Measuring gender inequalities is important for many reasons. In the first instance, women and girls have been historically more disadvantaged compared to the male counterparts, a trend found in both developed and developing nations [26], [18]. As a result, men folks tend to have better access to resources and opportunities,

which can increase their well-being, as well as their social, economic, and political power in their societies. Second, there is a need for a comprehensive gender-disaggregated data to identify the main forms of gender inequalities and learn how to address these inequalities [16]. Finally, this measurement approach like many others can also be used to monitor targets and determine the impact of national-level policies on addressing gender inequalities [11], [16], [18]. It is good to reiterate there are quite a number of gender inequality measurement tools with varying purposes, strengths and limitations, however women empowerment approach adopted by this study appears to be an appropriate measurement tool.

For an index to be constructed and serve as a synthetic measure of gender disparity or inequality there must be a conceptual clarity and it must meet some basic globally acceptable methodological standards [11]. Conceptualizing women empowerment (as gender inequality designate) is designed to capture women's disadvantages (men inclusive) in some important dimensions of empowerment- agriculture, economic, social/health, and civic, which also have components [11]. Further, gender inequality depicts loss in human development due to inequality between female and male achievements in these dimensions. Importantly, when choosing the dimensions and indicators to construct women empowerment, and given the severe limitations to gathering some quality data on some indicators, there are important trade-offs between data relevance as well as importance and geographical coverage which have to be kept in mind for dimensions and indicators selection [26]. This is particularly applicable to Nigerian situation and this research.

3.3 Description and Measurement of variables

The choice of variables for this research study is guided by the economic theory of human behavior, and the theory is also a representation of people's actions. This theory is based on the traditional economics where human behavior is believed to stem from absolute rationality. The variables are highlighted in the description and measurements of variables shown in Table 1.

Table 1: Description and measurement of variables

Variable	Description and Measurement
Food surplus	If a farmer experiences food surplus (yes = 1, 0, otherwise)
Food break-even	If a farmer experiences food break-even (yes = 1, 0, otherwise)
Transitory-FIS	If a farmer suffers from transitory-FIS (yes = 1, 0, otherwise)
Chronic-FIS	If a farmers suffers from chronic-FIS (yes = 1, 0, otherwise)
Women empowerment	If a farmer is empowered in the following dimensions: social, civic, economic and agricultural (yes = 1, 0, otherwise)
Gender	Sex of the farmers (male = 1, 0, otherwise)
Age	Age of the farmers (actual number)
Marital status	Marriage status of the farmer (married = 1, 0, otherwise)
Household size	Number of persons within a household (actual number)
Years of formal education	Number of years spent in formal school (actual number)
Number of working members	Number of working members in a household (actual number)
Farming experience	Number of years of farming activities (actual number)
Nativity	If a farmer is a native of the village (native = 1, 0, otherwise)

Land acquisition	If a farmer owns land-inheritance (inheritance = 1, 0, otherwise)
Primary occupation	If the main occupation is farming (farming = 1, 0, otherwise)
Secondary occupation	Participation in other occupation (participate = 1, 0, otherwise)
Social organization membership	Member of a social organization (member = 1, 0, otherwise)
Source of labour	Source of labour-use (family = 1, hired = 2, both = 3)
Source of livelihood information	Information source (ext. agent = 1, friends = 2, social org. = 3)
Access to extension services	Access to extension delivery services (access = 1, 0, otherwise)
Frequency of extension access	Frequency of access to extension services (actual number)
Type of extension services	Types of extension services accessed (soil management = 1, farming technique = 2, pest control & fertilizer application = 3)

Source: Authors' compilation

3.4 Analytical Approach

Descriptive statistics such as frequency counts, percentages, mean value, standard deviation, cross tabulation techniques and chats were used to describe and profile the respondents' personal and socio-economic characteristics. Similarly, World Food Programme [31] categorization technique based on the Food Insecurity Experienced-Based Scale (FIES) developed by FAO's experts- [4], and used by [18] was applied to estimate the respondents' food security status, and categorize them into the following continuums or levels of food security status (0 = Chronic food insecurity (CFIS); 1 = Transitory food insecurity (TFIS), 2 = Food break-even (FBE); 3 = Food surplus (FS)).

In addition, the UNDP's approach of measuring gender inequality through various dimensions and indicators of women empowerment was used to generate the women empowerment index (WEI) (which is used as a proxy for capturing gender inequality). According to [31], this approach is reliable and valid for the calculation of gender disparity/inequality among individuals. Thereafter, ordered logistic regression model (proportional odds model) was applied to examine the effect of gender inequality (using women empowerment aggregate) on the levels of food security status of the arable crop farmers in the study area. Complimentarily, appropriate post estimation test (measures of fit tests) was also called, to establish the validity and reliability of the model's estimates.

3.5 Empirical model specification: Ordered Logistic Regression

This is a regression model built on logit regression which permits more than two discrete outcomes which must be ranked or ordered [14]. This suggests that, ordered or ordinal logit regression is used to model relationships between more than two ordered or ranked response variables and a set of explanatory variables. According to [17], an appealing way of computing the ordinal categorized response variable is through the categorization of an underlying continuous variable. In line with [14], ordered model is built around a latent regression or an underlying random utility model of the following expression: $y_i^* = \beta' X_i + \varepsilon_i$, ($i$ = 1,..2,…., n) ….....(2) where:

X and β are standard variable and parameter matrices, and ε is a vector matrix of normally distributed error terms. The predicted grades (y_i*), according to [14] is observed in discrete form through censoring. This is expressed as:

$$\text{“}y_i = 0 \text{ if } \mu_{-1} < y_i^* \leq \mu_0 \quad \text{..... (3)}$$

= 1 if $\mu_0 < y_i^* \leq \mu_1$ ……..... (4)

= 2 if $\mu_1 < y_i^* \leq \mu_2$ ……... (5)

= 3 if $\mu_2 < y_i^* \leq \mu_3$" ……... (6)

….

= J if $\mu_{J-1} < y_i^* \leq \mu_J$ where:

μ_1, μ_2 and μ_3 are the cut off points or the threshold variables, and are also known as the intercept shifters in the logit model. They indicate the discrete category that the latent variable falls into, and are determined through the maximum likelihood estimation procedure for the ordered logit.

Following Liu (2009), the likelihood function of the ordered logistic regression to model the effect of gender inequality (women empowerment) and other hypothesize factors on the level of food security status of the arable crop farmers, is expressed as:

$$FSS = \left[\Phi(0 - X_i\beta)\right]^{z_{i1}} \left[\Phi(\mu_1 - X_i\beta) - \Phi(0 - X_i\beta)\right]^{z_{i2}} \left[1 - \Phi(X_i\beta - \mu_1)\right]^{z_{i3}} \quad \text{…….....} (7)$$

$$z_{ij} = \begin{Bmatrix} 1., if ... y_i = j \\ 0, otherwise.. for ... j = 0..1,..2..and...3 \end{Bmatrix} \quad \text{.....} (8)$$

where: for i^{th} individual;
FSS_L = observed outcome, the levels of farmers' food security status (CFIS, TFIS, FBE, and FS).
X_i = a vector of hypothesized explanatory variables including women empowerment aggregate; while the unknown parameters; and β_i is estimated through maximum likelihood estimation.

4. Results and Discussion of Findings

This section presents the results and discussion of findings from the statistical analyses carried out on the data collected from the sampled farmers in the study area. This is structured to highlight the findings in line with the research objectives, which are arranged sequentially.

4.1 Women Empowerment (Gender inequality)

Internal consistency test (Cronbach's alpha) on the women empowerment indicators

As common to many empirical researches, Cronbach's alpha is estimated to obtain a measure of reliability of some statements items [5]. [9] emphasized on the internal consistency as the "proportion of the test variance that can be attributed to a group of items, which measures the reliability coefficient alpha."

Internal consistency test (reliability analysis) was carried out using Cronbach's alpha for the women empowerment components and indicators in respect of the statement items on gender inequality (as proxy by women empowerment) in the study area. This was done to assess how well these statement items can form a single index or scale measuring the same concept, and to ensure that the statements are in good shape to measure what they are developed for. Consequent on this, and in line with [30], the higher the cronbach's alpha value, the better, and by extension, an indication that the correlation between the observed value and the true value should be as high as possible. A rule of thumb suggests that cronbach's alpha value of 0.60 and above is considered appropriate and acceptable, and the higher the better. The resulting alpha-coefficient of

reliability obtained ranges from 0 to 1, which is helpful in providing the overall assessment of a measure's reliability [13], and in this case, women empowerment measure. The overall *cronbach's alpha* coefficient value as shown in Table 2 was reasonably high and strong with the value of 0.6794, suggesting that the statements items measuring the women empowerment hang together pretty well.

Importantly, if all of the scale items are entirely independent from one another (that is, are not correlated or share no covariance), then alpha will be zero (0), but, if all of the items have high covariances, then alpha will tend towards one (1), as the number of items in the scale approaches infinity. In line with [13], the higher the alpha-coefficient the more the items have shared covariance and/or correlated, and perhaps measures the same underlying concept (such as women empowerment). In this case, the item-test correlation shows how highly correlated each item is with the overall scale-index. Then, the item-rest correlation pointed out that the items statements are correlated with the scale-index computed. The implication of all these results is that the statements items on women empowerment exhibit strong face validity and constructs validity for women empowerment concept. This agrees with the submission of [13], as well as [5] that cronbach's alpha is an appropriate reliability test measure that is useful to evaluate constructed scale with homogeneous statements items loadings.

Table 2: Reliability analysis for the women empowerment components and indicators

Item	**Obs**	**Sign**	**item-test correlation**	**item-rest correlation**	**Average inter-item covariance**	**Alpha**
Did you have income that you could use without asking for permission from anyone?	252	+	0.2671	0.1783	0.0165	0.6750
Can you make your own decisions on what to do with money you receive from other source?	252	+	0.0252	-0.0696	0.0177	0.6929
Did anyone in your household take money you earned, received, or had saved, without your permission?	252	+	0.3900	0.2280	0.0153	0.6729
Are you the person who spends the most time doing housework, such as cleaning, cooking, and/or caring for children?	252	+	0.7339	0.6450	0.0124	0.6153
Do you have your own account with a bank or other financial institution, such as a savings, current/transaction, or checking account?	252	+	0.1965	0.0232	0.0172	0.7000
Do you, personally, have any money saved that you could use if you needed it?	252	+	0.1897	0.1126	0.0169	0.6792

Can you make your own decisions about seeking medical or healthcare services?	252	+	0.1308	-0.0217	0.0176	0.7003
Do you, by yourself or with someone else, own property, such as land, and/or dwelling?	252	-	0.3398	0.1635	0.0158	0.6831
Has a house chore such as cleaning, cooking, and/or caring for children or other household members prevented you from doing paid work, if you wanted to?	252	+	0.6468	0.5516	0.0135	0.6328
Has house chores, such as cleaning, cooking, and/or caring for children or other household members prevented you from participating in education or training, if you wanted to?	252	+	0.7118	0.6330	0.0131	0.6244
Do you, by yourself, own a mobile phone?	252	+	0.1509	0.0616	0.0171	0.6831
Who decides whether you can work for pay outside of the home, if you wanted to?	252	+	0.0759	-0.0323	0.0176	0.6924
Are you able to decide on your own whether to use any methods to prevent pregnancy or sexually-transmitted illnesses, such as birth control or condoms?	252	-	0.1188	-0.0023	0.0174	0.6921
Would you have to get permission from anyone in your household before you could go to a local event by yourself, such as a community or neighborhood celebration or meeting?	252	+	0.7282	0.6343	0.0123	0.6152
Would you have to get permission from anyone in your household before you could go to the market or shops by yourself?	252	+	0.7298	0.6460	0.0126	0.6181
Can you make your own decisions about spending time with relatives/friends who do not live with you?	252	-	0.5246	0.3713	0.0140	0.6524
Can you make your own decisions about voting or being voted for?	252	-	0.5859	0.4634	0.0136	0.6406

Has anyone in your household threatened to harm you or someone you care about?	252	-	0.0823	-0.0021	0.0174	0.6868
Test scale					0.0154	**0.6794**

Source: Data analysis, 2022

4.2 Gender Disaggregation of Empowerment and Food Security status of arable crop farmers

4.2.1 Empowerment status (categories) of the arable crop farmers (by gender)

The results shown in Table 3 revealed the cross-tabulation analysis of women empowerment status disaggregated by gender. Given their respective population, the findings revealed higher proportion (93.1%) of the male arable crop farmers are in the low empowerment category compared to the female (23.4%) counterparts with, while reverse was the case in favour of female (38.9%) arable crop farmers compared to the male (6.9%) counterparts, in the moderate empowerment category. However, female (37.7%) arable crop farmers were found to occupy the high empowerment category alone, with no male (0.0%) counterpart in that category.

The implication of this result is that women are more empowered than the male counterparts across all the components of empowerments. This is interesting, although against a-priori expectations because women are generally believed to be highly marginalized and disempowered. Apparently, this is a welcome development as the finding pointed to the reality that women are beginning to show emancipation in the society, and also a good pointer to the efforts by governments, policy and developments experts, channeled towards achieving gender-just society in line with the UN's SDG 5. This finding disagrees with [19] who reported empowerment in support of men compared to the female counterparts in their study among smallholder rice farmers across the six geo-political zones in Nigeria.

In a similar manner, the finding disagrees with [25] who also found that men were more empowered than the female counterparts in their national survey research. A point of note for this observed departure is that the likelihood of obtaining a differential result is high using national survey data and a unitary disaggregated survey data. And, this position has been affirmed by the findings from this study.

4.2.2 Food security status (categories) of the arable crop farmers (by gender)

The results shown in Table 3 revealed the cross-tabulation analysis of food security status (in categories) disaggregated by gender. Given their respective population, proportion of male (59.4%) is greater than that of the female counterparts (38.9%) in the chronic food insecurity category. In terms of the transitory food insecurity category, female (44.2%) arable crop farmers were more in this category than the male (23.4%) counterparts. Conversely, the proportion of male (14.3%) in the food break-even category is marginally higher than the female (11.7%) counterparts, while 2.9 percent of the male arable crop farmers were in the food surplus category, compared to the of female (5.2%) arable crop farmers who were in the food surplus category. Compared to previous similar studies, the findings from this study are with mixed feelings; first, the result on chronic food insecurity and food surplus disagree with the findings of [18], as well as [24], while, the result on the transitory food insecurity and food break-even categories is in agreement with [18].

A critical look at the findings indicated that there is a possibility of transition of more female arable crop farmers from the transitory food insecurity category to either of the food break-even category given appropriate institutional supports, or chronic food insecurity category with poor institutional engagements and supports.

Table 3: Gender disaggregation of farmers by empowerment and food security status

Variables	Gender		Total
	Male	Female	
Empowerment status			
Low	163 (93.1)	18 (23.4)	181
Moderate	12 (6.9)	30 (38.9)	42
High	0 (0.0)	29 (37.7)	29
Food security status (categories)			
Chronic food insecurity	104 (59.4)	30 (38.9)	134
Transitory food insecurity	41 (23.4)	34 (44.2)	75
Food break-even	25 (14.3)	9 (11.7)	34
Food surplus	5 (2.9)	4 (5.2)	9
Total	**175 (100.0)**	**77 (100.0)**	**252**

Figures in parentheses are percentage values
Source: Field survey, 2022

4.2.3 Gender disaggregation of food security status and women empowerment status

The results indicated in Table 4 showed the cross-tabulation analysis of the food security status (categories) and empowerment status (categories) of the female arable crop farmers. The findings indicated that majority (63.3%) of the female arable crop farmers who fall within the moderate empowerment category were vulnerable to chronic food insecurity, while 75.9 percent of the female arable crop farmers who fall within the high empowerment category were in the transitory food insecurity category.

Meanwhile, same proportions (16.7%) of the female arable crop farmers who fall within the low and moderate empowerment categories respectively were found in the food break-even category. More so, few (22.2%) of the female arable crop farmers who were also in the low empowerment class were found in the food surplus category. By implication, most of the female arable crop farmers fall within the moderate and high empowerment categories, and were also found to be in the transitory food insecurity continuum. This finding agrees also with [20] who reported differentials in resources endowments vis-à-vis empowerment and food security categories of individuals in the South-West Nigeria.

In the same vein, the results shown in Table 4 revealed the cross-tabulation analysis of the food security status (categories) and empowerment status (categories) of the male arable crop farmers. The findings indicated that 60.7% of the male arable crop farmers who fall within the low empowerment category or continuum were vulnerable to chronic food insecurity, while above average (58.3%) of the male arable crop farmers who fall within the moderate empowerment category were in the transitory food insecurity category. However, few (15.3%) and only very few (3.1%) of the male arable crop farmers who also fall within the low empowerment category were found to be in the food break-even and food surplus category, respectively. By implication, these results suggest that most of the male arable crop farmers fall within the low empowerment category, and were chronically food insecure. This result is in tandem with [20] who shared the same view on the unequal endowments of resources which defines the differentials in the empowerment and food security status of individuals in South-West Nigeria.

Table 4: Gender disaggregation of food security and empowerment status (categories)

Variables	Empowerment categories			Total
	Low	Moderate	High	
Food security status (Female)				
Chronic food insecurity	5 (27.8)	19 (63.3)	6 (20.7)	30
Transitory food insecurity	6 (33.3)	6 (20.0)	22 (75.9)	34
Food break-even	3 (16.7)	5 (16.7)	1 (3.4)	9
Food surplus	4 (22.2)	0 (0.0)	0 (0.0)	4
Total	**18 (100.0)**	**30 (100.0)**	**29 (100.0)**	**77**
Food security status (Male)				
Chronic food insecurity	99 (60.7)	5 (41.7)	-	104
Transitory food insecurity	34 (20.9)	7 (58.3)	-	41
Food break-even	25 (15.3)	0 (0.0)	-	25
Food surplus	5 (3.1)	0 (0.0)	-	5
Total	**163 (100.0)**	**12 (100.0)**	-	**175**

Figures in parentheses are percentage values
Source: Field survey, 2022

4.3 Effect of gender inequality (women empowerment) on the farmers' food security status

4.3.1 Ordered Logistic Regression (proportional odds model)

The margins estimates of the proportional odds model otherwise known as the ordered logistic regression model are presented in Table 5. However, an important assumption or caveat of the ordered outcome model is that the coefficient estimates are the same for all categories (parallel regression assumption). To address this, the study relaxes the assumption by computing the average marginal effects (AME) through the same data generating process used for the ordered logistic regression, to obtain different coefficient estimates for each of the categories (that is, chronic food insecurity (CFIS), transitory food insecurity (TFIS), food break-even (FBE), and food surplus (FS)) of food security status of the arable crop farmers. Therefore, the interpretation henceforth is based on the margins estimates obtained from the ordered logistic regression analysis.

The estimates shown in Table 5 indicated that the average marginal effect for gender in terms of CFIS and FS were 10.6% and 2.5%, respectively. All else equal, this result implies that the probability of the female arable crop farmers falling into CFIS and FS is lower by 10.6% points and higher by 2.5% points respectively, compared to the male counterparts. This result is in tandem with earlier discussion on the arable crop farmers' food security status disaggregated by gender that the transition of more female farmers from the transitory food insecurity category to either of food break-even category, or chronic food insecurity category is promising subject to appropriate institutional supports and engagements.

Similarly, and as expected, the estimates of the years of formal education suggests that on the average, the probability of the arable crop farmers with higher years of formal education falling into CFIS, FBE, and FS is 1.06% points lesser, 0.59% points higher and 0.25% points higher, respectively, than those with less years of formal education, *ceteris paribus*. By implication, highly educated individuals are more exposed to opportunities and can perhaps make timely informed decision that can boost better food security status than

those with low or no education.

In the same vein, the estimates for the number of working members in an household indicated that on the average, the probability of falling into CFIS and FBE by the arable crop farmers who have more members of the household engaged in income generating activities were 2.6% points higher, and 1.5% points lower respectively. This result disagrees with a-priori expectation owing to the fact that higher number of working members in a household is expected to induce more supports (financially and morally) that can drive better food security status.

In terms of primary occupation, the results revealed that, on the average, the probability of falling into CFIS and FBE by the arable crop farmers who are involved in farming as primary occupation is higher by 5.9% points and lower by 3.3% points, respectively, compared to those whose primary occupation is not farming. This result completely deviates from expectations, and this could perhaps be as a result of smallholding nature of farming in the study area.

The estimates of the years of farming experience indicated that on the average, the probability of the arable crop farmers with higher years of farming experience falling into CFIS, TFIS, FBE, and FS is 1.6% points lesser, 0.32% points higher, 0.93% points higher, and 0.39% points higher, respectively, than those with less years of farming experience, which is in line with a-priori expectations. By these findings, individuals with higher years of farming experience have less chances of being vulnerable to CFIS, and higher chances of falling into the TFIS, FBE, and FS categories.

With reference to access to extension services, the results revealed that on the average, the probability of falling into CFIS, TFIS, FBE, and FS by the arable crop farmers with more access to extension delivery services is 79.1% points lesser, 15.5% points higher, 44.6% points higher, and 18.9% points higher, respectively, than those with less access to extension delivery services. This result is as expected because of the potential positive impact of extension delivery services on the performance of farmers, which is also capable of driving better food security status.

Further, estimates of the types of extension services revealed that, on the average, the probability of falling into CFIS, TFIS, FBE, and FS by the arable crop farmers who are exposed to modern farming techniques and trainings on soil management, pest control and fertilizer application is 31.6% points higher, 6.2% points lesser, 17.8% points lesser, and 7.6% points lesser, respectively, than those who are not exposed to any type of extension services. This result agrees with a-priori expectation for all the categories of food security status except for the CFIS category. All else equal, farmers' exposure to various types of extension services is expected to drive increased food production output, farmers' income, and ultimately boost food security status, but this is not the case for the relationship between types of extension service and CFIS category, and a possible reason for this deviation could be attributed to many (more than half) of the arable crop farmers who fall within the CFIS category, as shown in the earlier discussion.

Empowerment is a mix of capabilities and intensions, and in terms of women empowerment, the findings indicated that on the average, the probability of falling into CFIS, FBE, and FS by the arable crop farmers who are empowered is 3.5% points higher, 1.98% points lesser and 0.84% points lesser, respectively, than those who are disempowered. From the findings, women empowerment was revealed to be a significant predictor of food security status, but its nature of relationships with the categories of food security status completely disagrees with the tenets of literature and it represents a total deviation from a-priori expectations. This could also be attributed to a significant proportion of the arable crop farmers who were found to be

disempowered, while at the same time fall within the chronic and transitory food insecurity categories; and, it could perhaps be an indication of a reverse causal effect situation of women empowerment and food security status.

In conclusion, the findings have revealed important and significant predictors of food security status of the arable crop farmers in the study area. Importantly, the significant contribution of women empowerment aggregates across all the levels of food security status. Even though the direction of relationship of women empowerment is perpendicular to the levels of food security status, which is against the expectation. A plausible explanation for this deviation could be as a result of gender inequality among the arable crop farmers because a higher proportion of the arable crop farmers falling into low and moderate empowerment status (disempowered), while a very small number of the arable crop farmers (female) fall into the high empowerment continuum (empowered).

All in all, all the results agree with [15] who found heterogeneous associations between gender equity and food security status in the low income countries such as Nigeria, and a disproportionate differential in the empowerment and food security status of both male and female farmers. The findings also agree with Kasie et al. (2015) who also established differences in resources endowment, lack of: decision making ability, economic and/or financial self sufficiency, reproductive freedom, civic duties, and freedom from violence, as well as the prevalence of time poverty, which hitherto contributed to the food security gap among both male and female population.

Table 5: Ordered logistic regression: Effect of gender inequality (women empowerment) on the farmers' food security status

ables	dy/dx-Chronic FIS	dy/dx-Transitory FIS	dy/dx-Food break-even	dy/dx-Food surp
der	-0.1063 (-2.22)**	0.0208 (1.55)	0.0599 (-2.16)	0.0255 (1.93)*
	0.0043 (1.30)	-0.0008 (-1.13)	-0.0024 (-1.28)	-0.0010 (-1.21
rs of formal education	-0.0106 (-2.11)**	0.0020 (1.54)	0.0059 (2.06)**	0.0025 (1.80)*
ital status	-0.1449 (-1.26)	0.0284 (1.09)	0.0817 (1.25)	0.0347 (1.22)
ve	0.0840 (1.10)	-0.0164 (-1.01)	-0.0473 (-1.08)	-0.0201 (-1.05
sehold size	0.0145 (1.26)	-0.0028 (-1.06)	-0.0082 (-1.26)	-0.0034 (-1.22
nber of working members	0.0266 (1.79)**	-0.0052 (-1.41)	-0.0150 (-1.77)***	-0.0063 (-1.58
nary occupation	0.0593 (1.67)***	-0.0116 (-1.33)	-0.0334 (1.68)***	-0.0142 (1.47
ondary occupation	0.0303 (1.31)	-0.0059 (-1.14)	-0.0171 (-1.30)	-0.0072 (1.20
rs of farming experience	-0.0166 (-5.24)*	0.0032 (2.01)**	0.0093 (4.71)*	0.0039 (3.02)
al organization membership	-0.0208 (-0.71)	0.0040 (0.66)	0.0117 (0.71)	0.0049 (0.71)
d acquisition (inheritance)	-0.0004 (-0.01)	0.0001 (-0.01)	0.0002 (-0.01)	0.0001 (0.01)
ess to extension	-0.7917 (-7.64)*	0.1553 (2.46)**	0.4464 (4.92)*	0.1898 (3.07)
e of extension services	0.3169 (8.75)*	-0.0621 (-2.54)*	-0.1787 (-5.04)*	-0.0760 (-3.13

men empowerment index	0.0352 (1.92)**	-0.0069 (-1.42)	-0.0198 (-1.89)***	-0.0084 (-1.72)

dy/dx – Average Marginal Effects (AME) estimates, Figures in parentheses are z-values
* - $p<0.01$; ** - $p<0.05$; *** - $p<0.1$ probability levels respectively,
Prob>chi^2 = 0.0000; *Pseudo-R*^{2} = 0.3234, Number of observations = 252
Source: Data analysis, 2022

4.3.2 Goodness of fit tests

Information measures criteria: The akaike's information criterion (AIC) and the bayesian information criterion (BIC), as well as the McFadden's R2 represent the basic focus in the fit test statistics for ordered response models [30]. The information measures are usually applied to compare either nested and/or non-nested models, and the relative plausibility of two models [30]. It is important to stress that, the best model is usually designated with a smaller value of the test statistics and/or a more negative value generated (Liu, 2009; [30]. Suffice it to say that, the smaller the value of the statistics and/or the more negative the value is, the better the model fits well. On this premise, the information measures generated from the results presented in Table 6 presented a clear indication that the decision favors the full model as against the model with intercept only (null model having no predictors); hence, the fitted model is technically good.

Table 6: Measures of fit tests for ordered logistic regression model

Null model (intercept only)		**Full model**	
Log-Lik Intercept Only:	-273.623	Log-Lik Full Model:	-185.142
D (343):	370.284	LR (23):	176.961
-		Prob > LR:	0.000
McFadden's R^2:	0.323	McFadden's Adj. R^2:	0.258
ML (Cox-Snell) R^2:	0.505	Cragg-Uhler (Nagelkerke) R^2:	0.569
McKelvey and Zavoina's R^2:	0.607	-	
Variance of y*:	8.378	Variance of error:	3.290
Count R^2:	0.734	Adj Count R^2:	0.432
AIC:	1.612	AIC*n:	406.284
BIC:	-923.602	BIC':	-94.020
BIC used by Stata:	469.814	AIC used by Stata:	406.284

Source: Data analysis, 2022

4.3.3 Test of hypotheses

Hypothesis 1 (H_{01}): The null hypothesis stipulates that there is no significant relationship between the socio-economic characteristics of the arable crop farmers and their food security status. By default, since the results in Table 5 revealed a significant relationship between the arable crop farmers' socio-economic characteristics (gender, years of formal education, numbers of working members, primary occupation, years of farming experience, and extension delivery services), and the food security status, the null hypothesis is not accepted, while the alternative hypothesis is hereby accepted.

Hypothesis 2 (H_{02}): The null hypothesis stipulates that there is no significant relationship between the gender inequality (proxy by women empowerment) and the arable crop farmers' food security status. And, by default, since the results in Table 5 indicated a significant relationship between women empowerment and the arable crop farmers' food security status, the null hypothesis is not accepted, while the alternative hypothesis is

hereby accepted.

Hypotheses 3 (H_{03}): The null hypothesis stipulates that there is no significant difference between the food security status of the male and female arable crop farmers in the study area.

*Two sample t-test***:** Two-sample t-test was conducted to estimate the mean differences in the food security status of the two groups, and from the results in Table 7, it is evidently clear that there exists a significant difference between the food security status of the male and female arable crop farmers in the study area, given the significant t-test statistics (t = 2.7572 at p<0.01) obtained. More so, the estimated t-statistic of 2.7572 and its p-value of 0.0063 also reject the default null hypothesis of equal means and variance, which further suggests that the food security status between the two groups differ. The study also found that the means between the two groups (male and female arable crop farmers) are statistically different from each other at any level greater than 0.63%.

Table 7: Two-sample t-test

Group	*Observation*	*Mean*	*Std. error*	*Std. dev.*	*[95% Conf. Interval]*	
Male	175	0.5775	0.0265	0.3510	0.5251	0.62990
Female	77	0.4441	0.0410	0.3598	0.3624	0.52580
Combined	252	0.5367	0.0225	0.3583	0.4922	0.5812
Difference		0.1333	0.0483		0.0381	0.2286

diff = mean(0) - mean(1) t = 2.7572
Ho: diff = 0 degrees of freedom = 250
Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.9969 Pr(|T| > |t|) = 0.0063 Pr(T > t) = 0.0031
Source: Data analysis, 2022

5. Conclusion and Recommendations

There are empirical evidences from this study to conclude that both male and female individuals are disproportionately lacking in one area or the other, with respect to the empowerment disaggregated by levels. Besides, larger proportion of individuals (on both count) are food insecure with a skewness towards chronic food insecurity status, while female arable crop farmers stand at an advantageous position of switching from the transitory food insecurity category to either food break-even category, given appropriate institutional supports, or chronic food insecurity category, with poor institutional supports. More importantly, farmers' personal and socio-economic characteristics, as well as gender inequality designate (women empowerment status) have significant influence on the arable crop farmers' food security status in Osun State, Nigeria.

Based on these revelations, the following policy statements are necessary to be considered:

(i) The study revealed the importance of gender and the gender-effect on the food security status of the arable crop farmers as clearly shown in the results presented, hence, the need is necessary for the inclusion of gender-just policy in the food security policy framework of the state. Efforts should be made to include women in the food security discussions and planning, because addressing gender issues is a step closer to achieving the global goal of zero hunger by 2030, and to benefit immensely from various interventions bothering on food security attainment, gender equality should be included, along with other intervention strategies.

(ii) The effect of formal education on the food security status cannot be overemphasized. Since

education has been found to heighten food security status of the arable crop farmers, it is very necessary to build the arable crop farmers' human capital development, and more specifically, access to formal education because lack of education can pose a challenge for interventions at the grassroots or local level, given the fact that majority of the rural people have low level of formal education. Apparently, this calls for the evolution of effective adult literacy policy complimented with good implementation of universal basic education to ensure qualitative education, capable of assisting the farmers in the diffusion and dissemination of important agricultural information which can ultimately result to high productivity.

(iii) The cooperation among homogeneous group of people who interact directly, frequently, and in multifaceted ways, better captures the aspects of good governance which explain the importance of family and kinship ties, because the benefit is on what people do collectively to enhance their quality of life, than what individual does. The need is necessary to encourage connectedness and trust among individuals since the number of working members of households was found to contribute significantly to the arable crop farmers' food security status. This can be helpful when economically active individuals in the households contribute resources to cater for the households' food needs and other non-food responsibilities.

(iv) Involvement in agriculture can be rewarding, but not immediately reaped. Since the results indicated a significant contribution of the arable crop farmers' primary occupation (which is farming) to their food security status, the time is now for government at all levels to appropriate adequate budgetary allocation to the agricultural and allied sectors, as well as providing the farmers with the needed supports. Apparently, doing this can drive individuals' involvement in the agri-food sector, increase farm productivity, and boost food availability.

(v) Accumulation and development of human capital over the years can potentially assist the farmers in the utilization of residual and indigenous knowledge to solve many challenges associated with farming activities. In particular, farmers with many years of farming experience stand better chance to perform very well in the production possibility frontier than the ones with a very few years of farming experience. In lieu of this, promotion of indigenous knowledge should be encouraged among the farmers, while government and research institutes should also pay attention to capacity building for the farmers to bring out the best in them.

(vi) Institutional engagement is good and relevant for rural and agricultural development in terms of information sharing and diffusion of modern farming techniques. Since access to agricultural extension services and types of extension services were found to influence the arable crop farmers' food security status, this study advocates for the revitalization and scaling up of agricultural extension service delivery system. Doing this is likely to boost the effectiveness of extension service delivery system, as well as agricultural productivity and food security situation in the study area.

(vii) Empowerment is a mix of capabilities and intensions to be liberated from all the challenges hindering one's development. In view of the fact that women empowerment vis-à-vis gender inequality was found to heighten food security status of the arable crop farmers, it becomes imperative to lend a voice, and advocate for a gender-just policy efforts in all the aspects of human endeavors. This should not be limited to the food sector alone, but cut across all the empowerment components to bring about a sustained well-being of the people. And, from a policy perspective, gender equality vis-à-vis women empowerment should be integrated into national food security strategies, because increasing investments in gender equality through women empowerment could ultimately advance reduction in the spread of food insecurity.

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