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ASSESSMENT OF FOOD SECURITY AND DIETARY DIVERSITY OF FONIO (*Digitaria spp.*) FARMING HOUSEHOLDS IN PLATEAU STATE, NIGERIA

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ABSTRACT

The study assessed the food security and dietary diversity among Fonio farming households in Jos-South LGA, Plateau state, Nigeria. A multi-stage sampling technique was used to select 157respondents for the study. Primary data was used for this study through the administration of a well-structured questionnaire aided by interview schedule. The analytical techniques used include descriptive statistics, USDA Food Security model, Dietary Diversity score and Logit Regression model. The results of the socioeconomic characteristics; age, marital status, household size, education, farming experience, farm size, membership of cooperative societies, access to credit and access to extension services were identified and described. The result of household food dietary diversity indicates that 64% of the respondents' households had high food dietary diversity while 36% accounted for low household food dietary diversity. The result further indicates that 14% of the households consumed cereals, followed by legumes (14.49%), milk had 1.75%, and eggs had 2.47%. Oil/fats, Meats, Vegetables and Roots and Tubers accounted for 13.13%, 9.99%, 7.66% and 6.59% of the respondents' households respectively. The result of logit regression indicated that the coefficients of age, household size, farm size, cooperative membership, and access to credit were significant. The study recommend that government should make credit accessible through the anchor borrower's scheme, inputs heavily subsidized easily through the anchor borrower's scheme and there should be education of farming households on different classes of food for healthy living through the National Orientation Agency.

Keywords: Food Security Status, Dietary Diversity, Fonio Farming Households, Jos South LGA, Plateau State

INTRODUCTION

Dietary diversity became a global concern in improving health conditions through the habit of food group consumption by adding health dimension to the issue of food calorie consumption. Access to nutritionally adequate and good quality diet is essential to human health, productivity and work output (Savy, Martin-Prevel, Sawadogo, Kameli, and Delpeuch, 2005). Diverse diets refer to a variety of foods from different food groups (vegetables, fruits, grains, and animal source foods), which provide a balance of nutrients that promote healthy growth and development. The increase in the variety of foods across and within food groups has the potential in ensuring adequate intake of essential nutrients to promote good health (Savy *et al*., 2005). Similarly, Kennedy, Gina, Nadia Fanou, Chiara Seghieri, Inge and Brouwer (2009) maintained that a diet, which is sufficiently diverse, could reflect nutrient adequacy as well as preventing the cases of food insecurity. Arimond and Ruel, (2004) reported that the diets of many households in Africa are predominantly plant-based, consisting largely of starchy staples (which contain low number of micro-nutrients that are often not easily absorbed) with little or no proteins of animal origin and few fresh fruits and vegetables. Understanding diversity in food consumption is crucial in various areas. A varied diet is generally conceived by nutritionists as an essential component of high-quality diet; having high correlation with adequate of intake of protein and micro-nutrients as well as prevention of excessive intake of other nutrients such as fat and chronic diseases (Ruel, 2002; Johns and Sthapit, 2004).

Among the development problems facing Nigeria, food insecurity ranks topmost. The national per capita food growth is 19.57% in the production of major food items in Nigeria has not been sufficient to satisfy the demand for an increasing population of 212,907,083. Nigeria alone accounts for 42% of the region's total number of acutely food-insecure people. In terms of absolute numbers, Nigeria ranked among the world's 10 worst food crises in 2019, with 5 million food insecure people (Acute Food Insecurity Hotspot, (2020). Food insecurity therefore remains a fundamental challenge in Nigeria (Hall, 2002). Idachaba (2006) also reported that many households and individuals in Nigeria merely eat for Survival. The fight against food insecurity therefore demands an integrated set of actions (Food Security Magazine (FSM), 2006). Food security which added a dimension "stability" as the short-term indicator of the ability of food systems to withstand shocks, whether natural or man-made (FAO, 2009). The quantity of food available must not only be proportionate on the aggregate but there must also be per-capita adequacy at all times. The main goal of food security for individuals is the ability to obtain adequate food needed at all times, and be able to utilize the food to meet the body's needs. Agriculture is an important tool and vehicle for reducing the effects of household food insecurity, unemployment and poverty which are major problems in urban areas in Nigeria (Moore, 2000). FAO (2020) projected the global trend in food insecurity and estimated the prevalence and number of people undernourished for the period 2000-2002, 2017-2019 and reproduced the FAO projection estimates for 2028-2030 period. It also opined that by 2050, the planet is expected to have about 9 billion people, many of whom will live in cities far from where food is grown which will require a global food system that can feed all of them in a sustainable way.

Fonio (*Digitaria Spp)* is probably the oldest African cereal with cultivation history dating back to 7000 years (Cruz, 2004). There are two cultivated species, viz.; *Digitaria exilis*, known as white Fonio, and *Digitaria iburua* known as black Fonio. White Fonio is mainly cultivated from Senegal to Chad and black Fonio is grown mainly in Nigeria as well as the Northern regions of Togo and Benin (Kalaisekar., Padmaja, Bhagwat and Patil (2017). According to Gyang and Wuyep (2005), the herbaceous plant is known by different

names in various African communities: Acha in Nigeria, Findi in Senegal, Findo in Gambia, Fonio in Sierra–leone, Founde in Mali, Foni in Burkina Faso, Kpendo in Guinea, Podgi in Benin Republic, Pom/Polin in Cote-d'voire and Hungry Rice in English. Although, the English name hungry rice, believed to be coined by the Europeans is considered misleading because at that time the Europeans knew little of the crop and the lives of those who used it. The high nutritional content of Fonio and the economic importance makes it a high demand crop especially in urban areas where its nutritional value is understood. However, the production and supply of Fonio remains low and falls short of its demand because of the tediousness in the production process. Fonio has tiny seed of 0.4 - 0.5 mm, and this makes the cultivation and processing of the grain difficult and unfortunately all its operations are still done manually (zero mechanization). The processing is done in the traditional way which involves dehulling by beating or pounding in a mortar using pestle. Due to the small size of the seed, winnowing is hard to do as sand tends to remain with the seeds. This crop is now mainly produced and processed by women. Given the difficulty faced in the production and processing of the crop, many producers have reduced the quantity of the Fonio that they produce, and some have substituted the cultivation of the crop with other crops.

The choice of Fonio for this study lies in the fact that it is a crop which has been neglected in the past by researchers and scientists. Also known as Hungry rice as coined by the Europeans, it is an orphan crop which is said to be one of the oldest cereals grown and originated from West Africa. The production trend in the last 10 years has no significant marginal increase. In fact, according to the FAOSTAT (2020), in 2010, the yield (ton/hectares) is 5211 and in 2019, it is approximately 5000. This is a clear indication there is a decline in terms of productivity. Production is said to be swindling. However, due to its increasing awareness of high nutritional value, it has of recent, started receiving attention by researchers (such as Jideani & Podgorski, 2009; Musa *et al., 2008;* Morales-Payan, 2003; Cuz, 2004). Recent studies (Jideani, 2012) have also shown an increasing importance of the crop amidst growing utilization as food. However, there is no research, to the best of the researcher's knowledge, carried out in the study area in a bid to analyze the food security status of Fonio farmers. The following objectives of the study were to; i. describe the socio-economic characteristic of Fonio farmers in the study area, ii. determine the food security status of Fonio farmers in the study area, iii. determine dietary diversity of Fonio farming households and iv. estimate the determinants of food security among Fonio farming households

METHODOLOGY

Study Area

Jos South Local Government Area is situated between latitudes 9° 48'00"N of the equator and longitude 8° 52'00" E of the Greenwich meridian. It is positioned at the north western part of the state with its headquarters at Bukuru, which is about 15 km from the state capital, Jos. It shares boundary with Jos-North Local Government Area in the North, Riyom Local Government Area to the South, Barkin Ladi Local Government Area to the East and Bassa Local Government Area to the west. The Local Government Area has four districts. They include: Du, Gyel, Kuru and Vwang districts. The Local Government Area has total land mass of about 1,037 km^2 with a population of 306,716 in 2006 and a projected population of 451,482 in 2020 based on 2.8% growth rate (National Population Census (NPC), 2006).

It has a cool climatic condition due to its altitude. The coldest period is between November and February with an average daily temperature of 18°C, while it gets warm between March and April before the onset of rain. The rainy season, which is between the months of May and October, has its peak in August. The mean annual rainfall varies between 1347.5 and 1460 mm per annum. The major inhabitants of the area are the Beroms. However, as a result of the mining activities and other opportunities, there has been influx of people of the other ethnic backgrounds such as the Hausa, Igbo, Yoruba among others. As staple food, the people grow crops like Fonio, Maize (corn), Guinea corn, Irish potato, Cassava, etc. With the nature of the weather, a lot of vegetable and fruits are also grown (Dung-Gwom, 2008). The livestock reared by the residents include cattle, goats, sheep, poultry, pigs and rabbit (DLC, 2019; Kosshak *et al.,* 2020) By implication, majority of the people of Jos South are predominantly farmers (crop and livestock farmers). Some are civil servants, while others engage in mining activities as occupation.

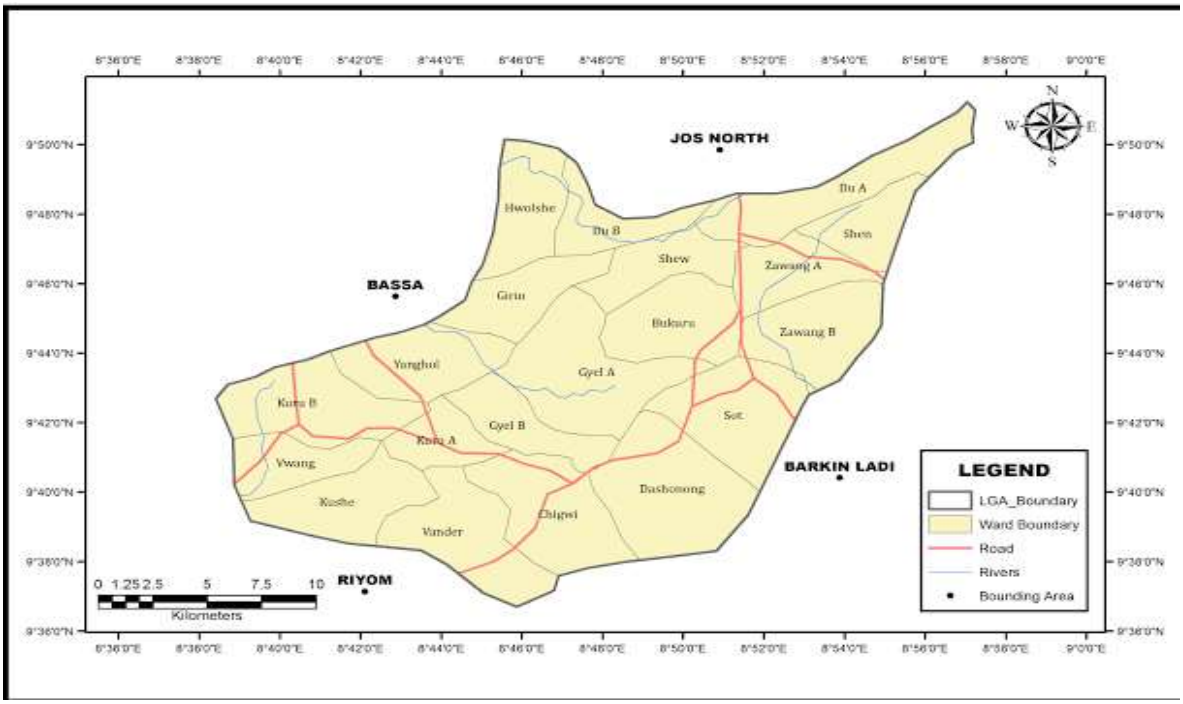

Figure 3.1: Map of Plateau State showing Jos-South Source: Google Map (2020).

Sample Size and Sampling Procedures

A multi-stage sampling technique was employed in the selection of Fonio farmers for the study. The first stage involved a purposive selection of Jos-South Local Government Area owing to the preponderance of Fonio production in the area. In the second stage, three districts (Du, Gyel and Vwang) out of the four (Du, Gyel, Kuru and Vwang) districts were randomly selected. In the third stage, a proportionate sampling of two villages each from the three districts were randomly selected. In the final stage, a total number of 155 (comprised 62 from Du, 47 from Gyel and 46 from Vwang) respondents were randomly drawn from the sample frame of 5241 farmers as obtained from the Plateau Agricultural Development Programme (PADP).

Method of Data Collection

Primary data was used for this study via the administration of a well-structured questionnaire aided by interview schedule to the respondents based on the objectives of the study. Sequel to the administration, the questionnaire was validated by experts in the Department of Agricultural Economics and Extension, University of Jos. Trained enumerators was also used to facilitate the collection of data from the respondents.

Analytical Techniques

Descriptive and Inferential statistics were both employed in the analyses of data collected.

For descriptive statistics; this include included frequency distribution, percentages and arithmetic means which was all used in achieving objective 1.

The inferential statistical tools used in this study include: USDA Food Security Approach, Dietary Diversity Index and logit regression models were used to achieve objectives 2, 3 and 4

Household's Dietary Diversity Score

Dietary diversity was measured by summing the number of foods or food groups consumed over a reference period. The Household dietary diversity score which ranges between 0-12 was ranked accordingly into high dietary diversity (6-12) and low dietary diversity (0-5) (FAO, 2008). HDDS indicator for sample population was also measured by the sum of HDDS of households divided by the total number of households. The twelve (12) food groups that was included in the HDDS include: Cereals, roots and tubers, Vegetables, Fruits, Meat, poultry, offal, Eggs, Fish and sea foods, Legumes, nuts and seeds, Milk and milk products, Oil and Fat, Sugar/honey, condiments, Beverages (FAO, 2007). This was used to achieve objective 3.

Household Dietary Diversity Score

Food Dietary Diversity was employed as a qualitative measure of food consumption. High Food Diversity which ranges between (6-12) result of 95% was obtained while Low Dietary Diversity which ranges between (0-5) of 5% was obtained among the agro pastoralists in the study area. Ruel (2006) have shown that households that engage in farming may have access to relatively cheaper food, and to a wider variety of particularly nutritious foods, such as vegetables and products of animal origin (milk, eggs, meat). Also, direct access to food may allow households to consume greater amounts of food and a more diversified diet, richer in valuable micro nutrients. This ultimately have a positive impact on the food security and poverty situation of the households.

The food diversity of their household is then classified into three levels: lowest dietary diversity (≤3 food group), medium dietary diversity (4 and 5 food groups) and highest dietary diversity (≥6 food groups).

Table: 3 Distribution of household Dietary Diversity

High diversity	Medium diversity	Lowest-diversity
(≥6 food groups)	(4 and 5 food groups)	(≤3 food groups)
Spices	Spices	Spices
Seeds	Seeds	Seeds
Oil and Butter	Oil and Butter	Oil and Butter
Vegetables	**Vegetables**	
Beans	**Beans**	
Milk		

Binary Logit Regression Model

Binary logit regression model was used to ascertain the relationship between food price volatility and household food security in the study area (objective 4). The relationship between food security Status, and food price volatility of the households, was determined using the logit (Logistic) regression model as applied by Omonona and Agoi (2007).

It is expressed as:

$Ln\ (i) = \ln (Pi/1- Pi) = Zi$ - (1)

From the general model as specified in (4) above,

$Zi = \beta 0 + \beta i\ Xi + \mu i$ - (2)

Where i = 1, 2, 3 … 10.

The equation (5) above can thus be rewritten as;

$Ln\ (i) = \ln (Pi/1- Pi) = \beta 0+\beta iXi + \mu i$ - - - - - - - - - - - - - - (3)

The explicit Logit model is expressed as: $Y = \beta 0 + \beta 1X1 + \beta 2X2 + \ldots\ldots\ldots + \beta nXn + \mu$ --------(8) Where; Y = Food security status (0 if food insecure and 1 if food secure).

X_1 = Gender of Household head (Male or Female).

X_2 = Age of Respondent (years).

X_3 = Marital status (Male = 1; Female = 0years).

X_4 = Educational level of Household head (years).

X_5 = Farming Experience(Years).

X_6 = Household Size (numbers).

X_7 = Farm size (Ha).

X_8 = Cooperative Membership (membership = 1; non-membership – 0)

X_9 = Access to credit (Access = 1; No access = 0)

μ = Error term.

β_0 = Constant term i.e. the value of Y when all independent variables equal zero. $\beta 1$ - $\beta 8$ = Coefficients to be estimated. This was used to achieve objective 4 of the study.

RESULTS AND DISCUSSION

Socioeconomic characteristics of Fonio Farming Households

The result in Table 1 shows that 65% of the respondents were male while 35% are female. This means that male Fonio farmers were more in number than their female counterpart thereby implying that most of the respondents are men who are naturally endowed with the strength and energy to embark on farming. Also, male dominance in farming activities may be due to the drudgery nature of agriculture. This result is consistent with the findings of Philip and Isaac (2012) who worked on demographic characteristics, agricultural and technological profile of Acha Farmers in Nigeria. They observed that the male dominated response could be attributed to interaction, cultural, traditional or religious reasons. The result also shows that 41% of the respondents were between the ages of 40 and 49 years, while 1% was below 20 years, representing the least percentage. Also. the age brackets within 20 – 29; 30 – 39 and 50 – 59 years accounted for 13%, 21% and 16% respectively while 8% of the respondents were above 60 years. The mean age of the respondents is 43 years, indicative of a youthful age group which is often regarded as being economically active, innovative and productive. The findings of Wilma *et al.* (2018) on prospects and constraints to acha production and processing in Bogoro Local Government Area of Bauchi State: implication to relevant technology transfer, agrees with this result as it further implied that the youth had enough energy, were healthier and stronger to be engaged in a tedious work of the production and processing of Acha which is labour intensive.

The result shown in Table 1 further indicate that 71% of the respondents were married, 18% and 10% were single and widowed respectively while divorced status accounted for only 1%. This suggest that agricultural activities are mostly carried out in the study area by married people. This result corroborates that of Sani & Silas (2012) in their work on the socio-economic determinants and production constraints in adoption of new variety of acha (*Digitaria spp*) in Plateau state, Nigeria. Also, the greater proportion of married respondents is a clear indication that family labour could be available for the farming households in the study area. In addition, this could suggest stability and societal cohesion, attributes that can easily translate to socially responsible behaviour capable of enhancing the identified goals of development (Emokaro and Oyoboh, 2016). However, for these married respondents, there could be the likelihood of too many a mouth to feed, and as a result, food insecurity may threaten to occur, particularly if the farmers have no access to factors of production *ceteris paribus.* The results as depicted in Table 1 shows the total households size of the respondents. It revealed that the farmers were dominated by household size of between 6 and 10 persons with 59% followed by 1-5 persons with 35%. Those households between 11 and 15 persons had the lowest with 6%. The average household size in the study area was 7 persons. This implies that majority of the respondents have a fairly large family size and may not have to augment their family labour with hired labour if they engage in subsistent farming. However, this relatively large household size also means more mouths to feed, which can bring about food insecurity, especially if these mouths being are non-productive class. This reasoning is consistent with the view of Omonona and Agoi (2007) as they reported an increase in food insecurity incidence as household size increases.

The result in Table 1 further shows that 30% of the respondents attained tertiary educational level, followed by secondary education level accounting for 29%. Primary level had 27%, while respondents with no formal education had 14%. The implication of this result is that most of the respondents are able to read and write. Their level of education not only connote a possible increase in farm productivity but also may enhance their ability to understand and evaluate new production technologies which may improve their food security status. The result is in consonance with the findings of Sani and Silas (2012) who

reported a majority of educated farmers to the extent in which the rate of adoption of improved farm technology will not be a problem for them, unlike the illiterates who are likely to be conservative and not willing to take risk. The result in Table 1 depict the farming experience of the respondents. It shows that 34% of the respondents had less than 11 years of farming experience, 44% had 11-20 years of experience, while 15% had farming experience between 21 and 30 years. Also, the ranges 31 – 40 years and above 40 years constituted 6% and 1% respectively. The mean farming experience was 16 years. This implies that Fonio farmers are well experienced to increase their output and secure enough food for family consumption. Thus the more the years of farming experience, the more the likelihood of the farmers to acquire more practical knowledge and possess the ability to efficiently utilize farm inputs as well as handle production problems, thereby increasing output. This may consequently impact positively on their food security status. This finding corroborates that of Mohammed *et al*. (2016) in their work on analysis of food security among smallholder farming households in arid areas of Borno State, Nigeria.

Table 1 shows the distribution of the respondents according to their farm size. The result reveals that 81% of the respondents had 0.25-1.95 hectares of farm land, followed by 10% which had 1.96-3.66 hectares. 6% had 3.67-5.37 hectares, while 3% had 5.38 – 7.08 hectares of farmland. The mean farmland was 1.59 hectares. This is a clear indication that most of the farmers in the study area are small scale famers, which implies that small farm size will require less input and therefore less output. This small farm size could be attributed to the subsistent farming being practiced and the difficulty in accessing land and credit facilities which may likely contribute to food insecurity. This result agrees with the findings of Wilma, Emeses and Rambo (2018) as they stressed that small farm size impedes productivity, crop diversification and consequently food security status of farm households. The result of Table 1 also shows that 58% of the respondents were not members of any cooperative society while 42% were members of a cooperative societies. Their non-membership status could be attributed to the insignificant benefits the cooperatives within the study area bring to the members. The result further revealed that 61% of the farmers had no access to credit while 39% had access to credit. This shows that majority of the farmers have no access to credit. This could be as a result of farmers' attitude towards risk. Farmers who view credit as very risky will not take it up even when available. As a result, scaling up in their business will be slow and may pose great threat to their food security status. This agrees with the findings of Kloeppinger-Todd and Sharma (2010). who stated that package of financial services available to small scale farmers is severely limited. The result in Table 1 reveals that 57% of the respondents had no access to extension services while 43% had access to extension services. This result implies that most of the famers had no opportunity to express their opinion about innovations and constraints faced in their farming businesses. This may result in continuous use of crude cultivation methods in Fonio production, consequently posing food insecurity threats especially when these said farmers have large households.

Table 1: Socioeconomic characteristics of fonio farming households

Variables	Frequency	Percentage
Sex		
Female	54	35
Male	101	65
Total	**155**	**100**
Age		
<20	1	1
20-29	20	13
30-39	33	21
40-49	63	41
50-59	25	16
>60	13	8
Mean	**42.63**	
Standard Deviation	**10.924**	
Marital status		
Married	110	71
Single	28	18
Widow	15	10
Divorced	2	1
Household size range		
1-5	55	35.5
6-10	91	58.7
11-15	9	5.8
Mean	**6.5**	
Standard Deviation	**2.472**	
Educational level		
No formal education	2	1.3
Primary level	41	27
Secondary level	45	29
Tertiary level	12	7.7
Farming experience		
1-10	53	34.2
11-20	68	43.9
21-30	23	14.8
31-40	9	5.8

41-50	1	0.6
51-60	1	0.6
Mean	**16**	
Standard Deviation	**9.417**	
Farm size		
0.25-1.95	125	80.6
1.96-3.66	16	10.3
3.67-5.37	10	6.5
5.38-7.08	4	2.6
Total	**155**	**100**
Mean	**1.59**	
Standard Deviation	**2.688**	
Membership of cooperative		
Non-membership	90	58.1
Membership	65	41.9
Access to credit		
No access	94	60.6
Access	61	39.4
Access to extension service		
No access	88	56.8
Access	67	43.2
Total	**155**	**100**

Source Field Survey, 2021

Food Security Status of Fonio Farming Households

Table 2 shows the estimates of food security status of Fonio farmers in the study area. From the result shown, only 3% of the respondents attained the food secure status. The remaining (97%) respondents were food insecure with 74% insecure without hunger, 17% insecure with moderate hunger, while 5% are insecure with severe hunger. This implies that virtually the entire sampled households in the study area were food insecure, although at varying degree of severity. This could be attributed to the small scale of Fonio production despite it being a rewarding venture in the study area. Also, the current spate of Farmer-Herder clashes may not be left out of the equation as insecurity could, more often than not, be a clog in the wheel of every farmer's progress. This result is consistent with that of Mohammed *et al*. (2016) in their work on the analysis of food security among smallholder farming households in arid areas of Borno State, Nigeria as they reported over two-third of the smallholder farming households sampled were food insecure.

Table 2: Food security status of Fonio farmers in the study area

Food Security status of respondents	Frequency	Percentages
Food secure	5	3
Food insecure without hunger	115	74
Food insecure with hunger (moderate)	27	17
Food insecure with hunger (severe)	8	5
Total	**155**	**100**

Source: Field Survey, 2021.

Food Dietary Diversity of the Respondents

The result depicted in Table 3 shows the household food dietary diversity of the respondent. Majority of the respondents' households had high (64%) food dietary diversity, while 36% accounted for low household food dietary diversity. This implies that the respondents have assorted varieties of food to choose from and may possess the financial capacity to meeting this food diversity. The high food diversity could be attributed to several agricultural ventures – having its respective produce and products – that are available, easily accessible and/or affordable in the study area.

The high food dietary diversity of the sampled households, all things being equal, should guarantee their food security of the farmers since it is a function of food security. However, it is interesting to note that reverse is the case from the findings of this study as majority of the farming households, despite their high food dietary diversity, are food insecure. In other words, the high food diversity of the farming households is at variance with their food security status. This could be as a result of the continuous farmer – herder clashes in and around the study area. The insecurity of a location may prevent farmers in accessing their farm lands who consider their lives more precious to them, consequently threatening their food security status since they are unable to produce.

Seasonality of food produced could be another reasoning for the variance. The high food dietary diversity of the farming households may be dependent on 'in-seasons' of agricultural commodities (glut periods) only. That is when agricultural commodities are more than available, they tend to diversify their food diets, feigning temporal food security. However, after the glut, they boomerang to their default state of food insecurity owing to out of season of these agricultural produce.

Further revelations in Table 3 show the kinds of food consumed daily by the respondents. About 14% of the households consumed cereals which is closely followed by legumes/grains (14.49%) while milk had the least (1.75%) succeeded by eggs (2.47%). Oil/fats, Meats, Vegetables and Roots and Tubers accounted for 13.13%, 9.99%, 7.66% and 6.59% of the respondents' household respectively. Other kinds of food consumed daily include sugar/honey (5.08%), fish (5.61%) and fruits (4.31%). However, 14.19% of the respondents had one food or the other consumed that are not

captured – This is due to their non-reoccurring decimal across the respondents.

Table 3: The food dietary diversity of Fonio farming households

Household food dietary diversity	Frequency	Percentage
High household food dietary diversity	99	64
Low household food dietary diversity	56	36
Total	**155**	**100**
Kinds of food consume daily		
Cereals	164	14.73
Roots and tubers	73	6.59
Fruits	48	4.31
Sugar/honey	56	5.08
Eggs	28	2.47
Legumes/grains	161	14.49
Vegetables	85	7.66
Oils/fats	146	13.13
Milks	20	1.75
Meats	111	9.99
Fish	62	5.61
Others	158	14.19
Total	**1112***	**100**

*Multiple responses allowed.

Determinants of food security status of the respondents

Table 4 shows the Logit regression estimates of the determinants of food security status of Fonio farmers in the study area. The entire model was statistically significant at 1% probability level with a log pseudo likelihood of -77.754, Wald chi^2(10) of 30.67 was found to be significant at 1% level of probability and Pseudo R^2 of 0.317.

The log pseudo likelihood of -77.754 represents a high negative value that maximizes the joint densities in the estimated model, altogether describing a model displaying a good fit and normal distribution of the error term. The Wald chi^2(10) of 30.67 suggest a strong explanatory power of the individual variables for the sampled Fonio farmers in the study area. This also indicates that variation in the food security status was explained by the (maximum likelihood) estimates of the specified explanatory variables, suggesting that the model as specified, explained significant non-zero variations in the determinants of food security status of the Fonio farmers in the study area.

The Pseudo R^2 of 0.317 shows that the independent variables explain a larger part (31.7 per cent) of the variation in food security status. An important part of the model is the role of the different types of variables in explaining food security status.

The result also showed that Age, household size, farm size, cooperative membership and access to credit, among other variables regressed were the determinants of food security status among the sampled Fonio farmers in the study area.

The coefficient of age was positive (0.0453) and significant at 10% probability level. The positive estimate for the coefficient of age implies that a unit increase in the age of the respondents will likely increase their chances of being food secure. This could be possible because it is expected that as one grows in age, one's sense of responsibility and experience also grows, all things being equal. This may in turn contribute immensely to their food security status. This finding contradicts the finding of Osuji, Ehirim, Balogun and Onyebinama (2017) in their study on analysis of food security among farming households in Imo State, Nigeria who reported an inverse effects of age of household heads on their food security. The findings of Godwin and Aondonenge (2016) also contradict that of this study.

The coefficient of household size (0.0148) is positively related to food security status and is statistically significant at 5% probability level ($P<0.05$). This means that the larger the household size, the greater the likelihood fonio farmers are food secure. Household size is likely to play a significant role in Fonio farming, especially when it is subsistent in nature and the household size are made up of capable working members – it is only then these farmers can rely on household size for the supply of farm labour requirements. This is particularly so in view of the increasing cost of hired labour and the inability of the farmers to make use of improved mechanical tools either due to high cost or relative small farm sizes. Babatunde, Omotesho and Sholotan (2007) and Ojogbo (2010) supports this reasoning as they stressed that an increase in household size especially the non-working members put pressure on consumption than production and thus increases food insecurity level of households.

Farm size has a coefficient signed negative (-0.1038) and significant at probability level of 1% ($P<0.01$). This means that farm size and being food secure are inversely related. This implies that as farm size increases, the likelihood for Fonio farmers to become food insecure also increases. All things being equal, increase in farm size should influence output positively, in turn guaranteeing food security status owing to the availability of income. However, this is not the case with the finding of this study and this could be due to the subsistence farming being practiced in the study area that often characterises the use of crude implement and methods. Ahmed (2015), in his study found improved seed to have significant positive effect with the food security status of households. He reported that Households using improved seed are more likely to be food secure than those who did not apply.

Also, a farm land that is not suitable for Fonio production (unproductive), despite the size, it may bring about poor output resulting to food insecurity. This finding disagrees with that of Duniya *et al.* (2013) in their study on analysis of technical efficiency and determinants of Acha (Digitaria exilis) production in Kaduna State, Nigeria, who observed that farm size influenced output positively. Membership of Co-operative is also a determinant of food security status as it had a positive coefficient (0.0909) and is significant at 1% level of probability. This suggests that Fonio farmers' food

security status becomes better when they belong to a cooperative society. This could be attributed to the severance packages (such as credit facilities, new innovations, etc.) every cooperative is often set out to give its members, all in a bid to improve their productivity and quality of life.

Access to credit is seen to also be a determinant of food security status of the respondents in the study area. However, it had a negative coefficient and was significant at 1% probability level. This means that access to credit facilities is likely to make the farmers food insecure. This contradicts *a priori* expectation for access to credit. This may occur when these farmers take bad loans from their creditors or due to production uncertainties that it brought about poor yields of Fonio – This will certainly affect the revenue accrued from acha production. According to Umaru and Hassan (2018) in their study on the determinants of acha productivity and its contribution to income generation and employment, Acha output significantly and positively affect household income which is often used for household purchase amidst other alternative uses.

Table 4: Logit Regression showing the Determinants of Food Security Status

Variables	Coefficient	Standard error	T-value
Constant	-0.4781	0.0769	-6.216
Gender	0.0453	0.2496	0.181
Age	0.0025*	0.0014	1.782
Marital status	-0.0143	0.1846	-0.078
Year of schooling	0.0114	0.0241	0.472
Farming experience	-0.0175	0.0184	-0.956
Household size	0.0148**	0.0060	2.484
Farm size	-0.1038***	0.0232	-4.475
Cooperative membership	0.0909***	0.0294	3.098
Access to credit	-0.0463***	0.0135	-3.430
Access to extension service	0.0233	0.3013	0.077
Wald $chi^2(10)$	30.67		
Prob > chi^2	0.000		
Pseudo r^2	0.317		
Log pseudo likelihood	-77.754		

Note: ***, ** and * significant at 1%, 5% and 10% levels of probability. Y= Food security (food secure=1, otherwise 0)

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it can be concluded that 97% of the Fonio farming households were food insecure while 65% of the Fonio households had high dietary diversity. They also consumed the different classes of food in the study area. It is recommended that government should make credit accessible through the anchor borrower's scheme, inputs heavily subsidized easily through the anchor borrower's scheme and there should be sensitization, orientation and education of farming households on different classes of food for healthy living through the National Orientation Agency. The farmers should take advantage of education to invest on improved technologies for increased production, productivity and household heads should spend more on the family diets and consume more varieties.

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