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ASSESSING FOOD SECURITY PROFILE OF BENEFICIARY AND NON-BENEFICIARY FARMING HOUSEHOLDS UNDER GURARA IRRIGATION SCHEME IN KADUNA STATE, NIGERIA

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ABSTRACT

Globally, food security has been one of the major focuses of discussion particularly in developing country. This study analyzed and assesses the food security profile of beneficiary and non-beneficiary farm households under Gurara dam irrigation scheme in Kaduna State, Nigeria. Specifically, the study examined food security status, coping strategies and its determinants among the two categories of farming households. A cross-sectional survey which involved a multistage sampling procedure was employed to opt for 340 farming households made up of 170 for each category. Information on food security profile was collected using structured questionnaire during the 2019 cropping season. The analytical tools include descriptive statistics, t-statistics and logit regression models. The mean food security index implied that average food-secure individuals used up 127% above their day-to-day calorie needed while food-insecure individuals expended 26% below when compared to 2,260 needed per capita per day. About 74 and 52% of the beneficiaries and non-beneficiaries were food secure. The beneficiary mean household dietary diversity score of 6.12 falls under high dietary score compared to 4.57 of medium dietary for non-beneficiaries. Logit regression results showed that the odd ratios of marital status ($p > 0.05$), educational level ($p > 0.01$), family status ($p > 0.10$), farming knowledge ($p > 0.01$), irrigation income ($p > 0.01$), farmland ($p > 0.01$) and dependency ratio ($p > 0.01$) were the major determining factors influencing the food security status of the farming individuals' beneficiary. The study concluded that farming households should take advantage of the proximity of the dam facilities, for increase farm yield, to enhance income and improve their standard of living.

Key words: Logit regression, food security, irrigation, coping strategies

INTRODUCTION

Food security is foremost in the arrays of welfare desires of every family. Food is one of the most essential requirements, and its satisfactory consumption including its magnitude and value, is germane for vigorous and active living (Ejiga and Omede, 2016). In spite of the importance of food to mankind in terms of availability, accessibility and affordability, it is still regrettable that more than half of the world's population still go to bed half-hungry or completely hungry; the problem is more acute in the so-called developing countries of Africa, including Nigeria (Aiyedun, 2015). FAO (2003) opined that for individuals in a nation to be food secure, there must be always access to satisfactory, safe, and balanced diets. Specifically, the major indicators of food security are availability, access, stability and utilization which will not negates the care-related features of balance nutrition and the inadequacy of any of the key indicators is portend as insecurity which are core goals mentioned in the first three sustainable development goals to escape food insecurity (Obi and Ogunkunle, 2022). According to FAO, IFAD, and WFP (2013), Nigeria has a calorie consumption of 1,730 kCal and a mean protein which amount to 0.064 kg per head per day, far less than the 2,500-3,400 kCal least possible FAO endorsed day-to-day energy consumption per head per day. Though, the 0.064 kg protein per adult per day reported by FAO is more than the 56-60 g per day as it varies by age and gender. This implies that the nation is threatened with the problem of under-nourishment resulting to numerous nutritional deficiencies and health issues. The Global Food Security Index (GFSI, 2018), positioned Nigeria as 96th out of 113 nations with 38 overall points using food security indicators such as budget constraints, attainability, value and safety of food. Therefore, adequate food availability in required amount and quality is a pointer to improved gross domestic product (GDP), as well as basic precondition for social and political stability and a means to alleviate suffering among populace in any nation (Abu and Soom, 2016).

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The primary condition for food security to exist at the state, regional and local levels is that it must be within the reach of the populace, easily accessed and correctly consumed by all strata of the populace. These necessities of easily obtaining, accessing and proper consumption of food in a real term, embraces the supply and demand, and appropriateness of food constantly. As a result, at the individual level a food secure farmer is a farmer that has guaranteed arrays of privileges from food harvest, money, saved food stuffs or investments, remittance and/or government aids and grants to the extent that such farmer canal ways have adequately balanced food consumption to ensure his well-being and active life (Adamu and Idisi, 2014).

Irrigation practice across the world is vital to successful green revolution all year round to achieving sustainable development goals in food security, socio-economic and rural development (Serageldin, 1995; Loucks, 2000; Svendsen *et al.,* 2009; Awulachew *et al.*, 2010). Of course, rivers through irrigation are one of the major drivers in the attainment of sustainable development goals (SDGs) targets of improving agricultural productivity, while conserving and enhancing natural resources; it is an essential requirement for Nigerian rural households to be food secure and increase global food supplies on a sustainable basis (Oladimeji *et al.,* 2019). However, irrigation practice in Nigeria has not achieved the set goals despite the huge investment involved. Moreover, the level of investment and abundant water resources ought to have expedited the goals of food self-sufficiency and socio-economic development in the country. In Nigeria, poverty gap is widening, and a greater percentage of the nation is becoming food insecure since household food security depends substantially on household income and asset (or wealth) status. A number of empirical studies across the world have shown that irrigation has a positive influence on household incomes, food security and poverty (Oladimeji and Abdulsalam, 2014; Ogunniyi *et al.*, 2018).

According to Ulsido and Alemu (2014), irrigated agriculture can reduce poverty through increased production and income, and reduction of food prices; this will help very poor households to meet the basic needs by improving their overall economic welfare, protect them against risks of crop loss due to insufficient rain water supplies and promote their use of yield enhancing farm inputs which in the long run enable them to move out of the poverty trap. Therefore, it is vital to examine the level of contribution of Gurara irrigation scheme to food security status of farm households in Kachia and Kagarko Local Government Areas (LGAs) of Kaduna State, where the dam is situated, and identify coping strategies adopted by the farming households to reduce food security in the study area, and Nigeria at large.

MATERIALS AND METHODS

Description of Study Area

The research was conducted in Kaduna State, in the North-West zone of Nigeria. It has 23 Local Councils with Kaduna as its capital. The state lies between Latitudes 11° 32″ and 09° 02″ north and longitudes 08° 50″ and 06° 15″ east. It covers an area of about 48,473.30 km^2 and has a population of 6,066,512 persons in 2006 (NPC, 2006) resulting in an estimated people adding up to 10,041,861 persons in 2022 at a growth rate of 3.2% per annum. The terrain is made up of undulating raised grounds with many rivers including Rivers Kaduna, Wonderful, Kagom, Gurara and Gaima. The Gurara irrigation project located at Azara-Jere in Kagarko LGA of Kaduna State is an important water project initiated by the Federal government with potential of nourishing 20,000 hectares when completely established and will be useful for smallholder and commercial farmers. The water delivery structure for the dam comprised 29 km of 1,400 mm steel pipeline, 100000 m^3 flexible water basin, with tributary supply scheme, and an on-farm supply method.

Sampling Procedure and Sampling Size

A multi-stage sampling procedure was employed to select the beneficiary and non-beneficiary farmers for the purpose of this research as demonstrated in Table 1. The foremost stage involves the purposive selection of Kachia and Kagarko LGAs of Kaduna State where Gurara irrigation facility is domiciled. Secondly, random selection of two districts each from the two LGAs to select one district each randomly with high level of dependence on the irrigation facilities of the dam. These were Bishini and Kushe districts in Kachia and Kagarko LGAs, respectively. Similarly, two districts, Ariko and Janjala were randomly selected among non-beneficiary's districts of the dam in each LGA where the beneficiaries were selected. Three villages from each of the four districts were randomly selected in the third stage, which makes twelve villages in all.

In the fourth stage, with the help of the village heads and extension personnel, the total number of farming households in each village was compiled; 16.70 and 14.29% of the total beneficiary and non-beneficiary's sample frame which amounted to 170 respondents each were randomly selected. A total of 340 farming households were randomly sampled for this research (Table 1). Equal number of beneficiary and non-beneficiary were randomly selected for the purpose of the study which required using the equal variance *t*-test which is used when the number of samples in each group is the same or the variance of each data set is similar and also satisfying certain conditions of propensity score matching (PSM) such as the balancing property and conditional independence assumption (CIA).

Table 1: Distribution of selected farming households in the study area

LGAs	District	Villages	Sample frame	Sample size
Beneficiary				(16.70%)
Kachia	Bishini	Kigwali	162	27
		Saminaka	186	31
		Atara	162	27
Kagarko	Kushe	Kushe Makaranta	222	37
		Kasangwe	150	25
		Dogwa	138	23
Sub-total			1020	170
Non-beneficiary				(14.29%)
Kachia	Ariko	Dutse	238	34
		Anfani	161	23
		Koronsofua	196	28
Kagarko	Janjala	Iddo	203	29
		Gidan Sani	161	23
		Sabon janjala	231	33
			1190	170
Total			2210	340

Field Survey (2019). LGAs - local government areas

Data Collection and Analytical Tools

Cross sectional data was obtained with the use of a structured questionnaire, and the data were collected in 2019 cropping season. Data on crop production, income, expenditure and consumption of the farming household in the study area were collected.

Food security index (FSI) and household dietary diversity score (HDDS) were used to classify the food security status of farming households into food-secure and food-insecure households. Using FSI, a food secured household is one whose per capita monthly food expenditure falls above or is equal to two-third of the mean per capita food expenditure. However, food insecure households are those whose per capita food expenditure falls below two-third of the mean monthly per capita food expenditure (Omonona and Agoi, 2007; Demi and Kuwornu, 2013). The HDDS is calculated by adding quantity of foods or food groups consumed in a particular period. Twelve food groups were included in the HDDS by adopting FAO (2007) and (2010); these were: (*i*) cereals, (*ii*) roots and tubers, (*iii*) vegetables and fruits (*iv*) meat from ruminants, (*v*) poultry meat and eggs, (*vi*) fish and sea foods, (*vii*) legumes, nuts and seeds, (*viii*) milk and milk products, (*ix*) oils and fat, (*x*) sugar/honey, (*xi*) condiments, and (*xii*) beverages.

The food groups in the HDDS checklist are pooled into a single food group to construct the HDDS by creating two alternative variables that bear two dummy values: 1 is yes, which implied that the individual consumed that particular food group; and zero is otherwise. Thereafter, the dummies of all alternative variables were added to construct the HDDS, and the estimated variable will have a range of 0-12 through the maximum number of food groups obtained. Finally, the individual will be ranked based on conventional HDDS scores thus into high dietary diversity (9-12), medium dietary diversity (6-8.99) and low dietary diversity (0-5.99) (Arimond and Ruel 2004; Ruel and Garrett, 2004; FAO, 2007; Wineman, 2014).

In order to determine the factors affecting food security level of the Gurara farming households in the study area, Logit regression model was fitted. The model was developed based on the cumulative logistic probability function which entails that the odds of the Gurara farming households being food secured (*Pi*) is given to be:

$$Y_i = \mathrm{F}\,(\mathrm{w_i}) = \frac{1}{1 + e{-}wi} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1);$$

yi ranges between zero and one and it is non-linearly related to W_i. W_i is the stimulus index which ranges from minus infinity ($-\infty$) to plus infinity ($+\infty$) and it is operationalized as:

$$wi = ln \frac{\mathrm{yi}}{1 - \mathrm{yi}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2).$$

To find the value of w_i, a binary response variable was incorporated to get the likelihoods of observing the sample (Idi *et al.,* 2019). The regression model was estimated using equation 3 as:

$$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3);$$

where Y is food security status of the households (food secure = 1, food insecure = 0), X_1 is age of the farmers (years), X_2 is marital status (married = 1 and single = 0), X_3 = educational level (years), X_4 is family status (number), X_5 is experience in farming (years), X_6 is irrigation income including crop and fishery production (₦), X_7 is farm size (ha), X_8 is off farm income from non-farm activities (₦), X_9 is remittances from family and friends as a gift and government interventions (₦), X_{10} is dependency ratio (index), βo is constant term, β_1-β_{10} is coefficients, and u is error term. A four-point Likert rating was employed to ascertain the coping mechanisms by respondents' farming households in mitigating household food insecurity status. The feedback alternatives and ratings were allotted thus, not satisfactory = 1, slightly satisfactory = 2, satisfactory = 3, and very satisfactory = 4.

RESULTS AND DISCUSSION

Food Security Status of Beneficiary and Non-Beneficiary Farm Households

Results of food security status of the respondents in Table 2 depicted the cost of calories regression which showed that the slope coefficient is –0.201 and –0.007 for beneficiaries and non-beneficiaries, statistically significant at 1 and 10% probability levels, respectively. This suggests that as the cost of calories required to be food secured increases by a unit, the food security level decreases for both beneficiary and non-beneficiary by their respective coefficients. Considering the threshold energy levels (*L*) per day of 2,260 kCal, the food security benchmark (*S*) calculated to be ₦22,507.50 per month per adult equivalent for beneficiary, translate to ₦5,251.75 per week and ₦750.25 per day. However, the food security line per month per adult equivalent was ₦19,171.50 per month per adult equivalent for non-beneficiary which amounted to ₦4,473.35 per week and ₦639.05 per day. This implied that the Gurara dam beneficiary households had higher food expenditure compared to the non-beneficiary households.

Table 2 also shows the headcount (*H*) to be 0.306 and 0.511 for beneficiary and non-beneficiary respectively. This suggests that 30.6 and 51.1% of the beneficiaries and non-beneficiaries sampled rural farming households were below the food security line. The average food security indexes (FSI) of food-secure and food-insecure Gurara dam beneficiary farming households were 2.27 and 0.74, respectively. The food surplus index of 1.27 and food insecurity gap of 0.26 of the beneficiaries implied that the average respondents that were food-secure used up (1.27) 127% above their per day energy daily calorie necessities, while food-insecure households had 26% below the day-to-day calorie benchmark of 2,260 kCal per capita per day. This further implied that the total dependence of beneficiaries on the Gurara dam yielded increased output from their farm activities because of exposure to more advanced or mechanized way of farming and input, particularly irrigation facilities; 118 households (69.41%) were able to meet up with and had excess of the daily calorie requirement for all members of their household. Only 52 households (30.59%) were food deficient by consuming 26% less than expected daily calories requirement.

Conversely, the average FSI of food security and food insecurity of non-beneficiary respondents were 1.21 and 0.52, respectively. The food surplus index of 0.21 (21%) and food insecurity gap of 0.48 (48%) of the non-beneficiary implies that on average the food secured households expended only 21% above their day-to-day energy needs compared to food-insecure households that spent 48% below the expected energy threshold needs considering the standard benchmark estimated to be 2,260 kCal per day. The non-beneficiaries had 83 households (48.82%) that are food secured and have excess daily energy requirement, while 87 households (51.18%) were food-insecure with the consumption of 48% less of the required daily calorie intake. It can be inferred that the beneficiaries thrived better in FSI portfolios compared to their counterfactual, the non-beneficiary of Gurara dam farming households. This could be because of the total dependence of beneficiaries on the Gurara irrigation facilities, and exposure to more advanced or mechanized way of farming, which yielded increased output from their farm activities, unlike the non-beneficiaries who depended on rainfall, streams, and rivers to irrigate their farms, with less exposure to more advanced irrigation facilities. Shani and Musa (2021) opined that most farming households in Nigeria do not possess adequate wealth to own irrigation machinery hence the nation's mechanization rate of 0.27 horsepower per hectare is well below the international recommended rate of 1.5 horsepower per hectare.

Table 2: Summary of food security status of Gurara dam farming households

Item description	Beneficiary	Non-beneficiary
Cost of calories equation	$\ln X = a + bc$	$\ln X = a + bc$
Constant	0.109 (1.497)	0.083 (0.552)
Slope coefficient	–0.201 (3.03)	–0.007 (1.76)
FAO recommended daily energy levels (*L*)	2260.00 kCal	2260.00 kCal
Per day (₦)	750.25	639.05
Per week (₦)	5251.75	4473.35
Per month (₦)	22507.50	19171.50
Per year (₦)	273841.30	233253.30
Head count (*H*)	0.306	0.511
Mean food security index (food-secure)	2.27	1.21
Mean food security index (food-insecure)	0.74	0.52
Food insecurity gap/surplus index (food-secure)	1.27	0.21
Food insecurity gap/surplus index (food-insecure)	0.26	0.48
Food-secure (number)	118.00	83.00
Food-insecure (number)	52.00	87.00
Aggregate income gap (AIG)	–31.06	–172.00
Food-secure (percentage)	69.41	48.82
Food-insecure (percentage)	30.59	51.12

Data Analysis (2019)

The aggregate income gap (AIG) of Gurara dam beneficiaries and non-beneficiaries was –31.06 and ₦172.00, respectively. This indicated a wider income gap for non-beneficiaries compared to the beneficiaries. Differences in income levels between the two groups may arise largely due to opportunities of engagement in irrigation by the beneficiary. This predisposes the two groups of rural farming households to diverse food expenditure arrangement sowing to the amount of income set aside for food items. Gurara dam farming households are predominantly subsistence in food production in both rain and dry seasons. This enabled the Gurara dam beneficiaries to achieve a sustainable food production through irrigation in line with the report of Oladimeji and Abdulsalam (2014). In addition, most of the beneficiaries engage in a variety of diverse production of crops such as maize, sorghum, cowpea, soybean, and yams as well as vegetables for home consumption. Practicing artisanal fishing by more than 64.7% of beneficiaries due to Gurara dam and rivers' resources enhanced their protein consumption and additional opportunity to supplement the working capital for their primary occupation through purchase of farm inputs. This finding corroborates the report of Abdulrahman *et al.* (2018) on expenditure differential of International Fertilizer Development Center (IFDC) project participants and non-participants in Sahel farming households of Nigeria.

Food Security Status and Cost Implications of Beneficiary and Non-Beneficiary Farmers

Table 3 presents the results of the food security status and cost implications of Gurara dam beneficiary and non-beneficiary farming households. The energy consumed deficits were calculated based on food threshold level of 2,260 kCals per adult per day according to FAO. The calorie consumption estimates the level of food insecurity directly by categorizing the extent of food deficit. The result indicated that the minimum benchmark to be food secured is nine hundred and fifty naira and eight kobo (₦950.08) per farmer per day. About 44.12% of Gurara dam beneficiaries were food secured while only 12.94% of non-beneficiaries were within this threshold. The results suggest that farmers who benefitted from Gurara dam were more food secured even though the two groups of respondents showed zero or minimal evidence of food insecurity.

Results also established that 31.76% of the beneficiaries were marginally food insecure which indicated a border line to migrate to food secure status. On the contrary, only 20% of non-beneficiaries were marginally food secure which implied consumption of between 1,800 and 2,250 kCal with average cost of ₦807.00 per farmer per day. About 18.82% of Gurara dam beneficiaries fell between 1,500 and 1,799 kCal with an average cost of ₦731.12 compared to 24.12% non-beneficiaries in this threshold line. Only 5.29% of the beneficiaries were chronically food insecure compared to about 42.94% of non-beneficiaries that were severely food insecure. It is pertinent to mention that the Gurara dam beneficiary farming households had a mean of 3,059.90 kCal consumption per adult per day. This translated to better food security level compared to the non-beneficiary farming households with a mean of 2,403.10 kCal consumption per adult per day.

The results in Table 3 suggest that the bulk of the Gurara beneficiaries farming households were food secure while the bulk of non-beneficiaries were food insecure. The average calorie intake of beneficiaries was adequate by international standards. This could be as a result of exposure to all year-round farming activities, resulting from relatively higher output from crops translating into increase in household income, which enabled beneficiaries purchase more nutritional foods (cereals and protein-based). This finding is similar to the report of Saleh and Mustafa (2018), which showed that the average daily per capita calorie intake of the households was about 3,175 calories in Kaduna State.

Table 3: Food security status and cost implications of beneficiary and non-beneficiary farmers

Food security status	Calorie consumption/farmer/day (kCal)	Food price equivalent (₦)	Beneficiaries *F*	(%)	Non-beneficiaries *F*	(%)
Food secure*	Above 2,260.00	950.08	75.00	44.12	22.00	12.94
Marginally food insecure	Between 1,800.00 and 2,260.00	807.00	54.00	31.76	34.00	20.00
Moderately food insecure	Between 1,500.00 and 1,800.00	731.12	32.00	18.82	41.00	24.12
Severely food insecure	Below 1,500.00	525.05	9.00	5.29	73.00	42.94
Total			170.00	100.00	170.00	100.00
Summary			kCal	₦	kCal	₦
Mean			3,059.90	821.00	2,403.10	543.07
Minimum			1,398.70	498.90	1,321.60	297.03
Maximum			4,123.50	2,590.00	2,730.40	1,200.00
Standard deviation			58.50	21.08	112.90	78.04

Field Survey (2019). * - FAO recommended, *F* - frequency

Household Dietary Diversity Score (HDDS)

Table 4 shows the classification of respondents by HDDS index with 18.24% of sampled beneficiaries under low dietary diversity level. About half of the non-beneficiaries (47.65 %) had low dietary diversity level. Under medium dietary diversity score, 35.88 and 32.35% of beneficiaries and non-beneficiaries were in this category. Furthermore, 45.88% of beneficiaries had high dietary score compared to only 20% for non-beneficiaries. The implications of HDDS level were that majority of the Gurara dam farming households consume more varieties of food crops such as carbohydrates, legumes, and vegetables. The households with high dietary diversity had better access to food and a slightly more diversified food intake; although the different foods were consumed with varying frequency in line with Fashina (2019). According to FAO (2008), the low dietary score leads to malnutrition, hunger and food insecurity.

Food Security Determinants of Gurara Dam Beneficiary and Non-Beneficiary Farming Households

To examine the factors determining food security profile of the Gurara dam farming households' beneficiaries and non-beneficiaries, logit regression estimate results are presented in Table 5. The result showed that the log likelihood ratio test of 310.75 and 407.76 with eight degrees of freedom were statistically significant at 1% probability level each for both beneficiaries and non-beneficiaries. The log likelihood function was –17.112 and –32.481, respectively, which suggests that the variables incorporated in the two models were collectively essential in explaining the households` level of food security. The estimate showed that the odd ratios of marital status, educational level, family status, experience in farming, irrigation income and dependency ratio were significantly determining the food security status of the Gurara dam farming households' beneficiaries as well as the non-beneficiaries. In addition, the odd ratio for farm size was also statistically significant for beneficiaries. The marginal effects showed the probable effect of an individual status of food security with respect to a unit change in an exogenous variable.

The odds ratio for marital status has direct relationship for beneficiaries (16.874) and non-beneficiaries (5.636) and significant at $p > 0.05$ and $p > 0.01$ levels of probability, respectively. The results signify that the household food security status increased as one migrates from single to married households. This implied that married household heads are less prone to food insecurity compared to unmarried households in the study area. This can be attributed to the fact that farming generally requires labour which the married households could easily supply through their household size *ceteris paribus*. Larger farm sizes point towards increased harvest and more food availability to the married-individual headed households. This result is in conformity with the findings of Akadiri *et al.* (2018), which showed that married households were more food secured than the single households.

Table 4: Distribution of household dietary diversity score (HDDS)

HDDS classification	HDDS index	Beneficiaries		Non-beneficiaries	
		F	(%)	*F*	(%)
Low dietary	0.00-3.00	31.00	18.24	81.00	47.65
Medium dietary	3.10-6.00	61.00	35.88	55.00	32.35
High dietary	6.10-12.00	78.00	45.88	34.00	20.00
Total		170.00	100.00	170.00	100.00
Mean		6.12		4.57	
Standard deviation		0.47		0.62	

Field Survey (2019), *F* - frequency

Table 5: Determinants of food security level of the Gurara dam beneficiary and non-beneficiaries farming households

Variables	Beneficiaries			Non-beneficiaries		
	Odd ratio	SE	$p > \lvert z \rvert$	Odd ratio	SE	$p > \lvert z \rvert$
Age	0.975	0.396	0.534	1.008	0.037	0.835
Marital status	16.874**	23.089	0.039	5.636*	5.451	0.074
Educational level	–0.457***	0.121	0.003	–0 .696**	0.116	0.029
Family status	–0.769*	0.102	0.047	–0.854*	0.071	0.058
Farm experience	1.432***	0.164	0.002	1.199***	0.066	0.001
Irrigation income	1.000***	0.00003	0.006	na	na	na
Farm size	1.956***	0.449	0.003	1.188	0.169	0.224
Off-farm income	0.007**	0.003	0.031	0.654	0.732	0.175
Remittance	0.001	0.304	0.421	0.532	0.712	0.205
Dependency ratio	–0 .006***	0.008	0.000	–0.022***	0.016	0.000
Constant	0.014	0.044	0.175	–0 .214	0.472	0.485
Diagnostic statistics						
LLF		–17.112			–32.481	
LR Chi^2		310.75			407.76	
LR test		0.00***			0.00***	
Probability > Chi^2		0.000			0.000	
Pseudo R^2		0.390			0.362	
Number of observations		170.00			170	

***, **, * - significant at 1, 5, and 10% probability, respectively. LLF - log likelihood function, LR - log ratio, SE - standard error, na - not available

The estimated odds ratio for years of formal education was negative (–0.457) for beneficiaries as well as non-beneficiaries (–0.696) and had significant effect at 99 and 95% confidence interval to farmers' food security status, respectively. The results suggest that deficiency of education in both respondents decreased farmers' propensity to be food secured. This is anticipated because level of education may directly affect the household income and ability to manage the household's food resources. Hence, households whose heads are educated tend to be food secured compared to non-educated household heads. Haile (2005) posited that access to education and training could lead to more knowledge about modern inputs adoption and improve the quality of labour.

The odds ratio of family status has negative relationship with food security status among the beneficiaries (–0.769) and the non-beneficiaries (–0.854) and 90% confident interval in the groups. This shows an opposite relationship with household food security. The negative odd ratios of –0.769 and –0.854 shows that increase in the number of household members diminished the likelihood of being above the food threshold line. This result is expected because increase in the household size especially when majority are teenagers or young females (who may be less active and less productive) implied that more people are eating from the same resources; hence, the household members may have less food to go round when compared with a smaller household size or bigger households with active and more productive members. Even if large households have relatively large consumption expenditure, this will be compensated for if reasonable members of the family are productive. This result is in contrast to the reports of Oyewole (2012) and Fashina (2019), who observed household size to be positively related to the probability of a household being food secured.

The odds ratio obtained for years of farming experience was positive for both beneficiaries (1.432) and non-beneficiaries (1.199) and statistically significant at 1 and 5% levels of probability, respectively. A unit increase in farming experience led to corresponding increase in the probability of level of food security of the households increase. This is because such households must have accumulated skills or knowledge and are expected to be better managers in resource utilization which will improve their harvest and probability of being food secured.

The odds ratio of income from irrigation was positive for beneficiaries (1.00) at $p > 0.01$ and not available for non-beneficiaries (1.00). A unit increase that accrued from irrigation activities led to probability of the respondents being above the food threshold line by 100%. Irrigation income will enable the farmers to have enhanced food security status. Furthermore, irrigation income generating activities are of utmost importance in sustaining on farm households' livelihoods. It enables farmers to equip their production and procure modern inputs by giving them the prospect to alleviate the risks of food deficit during periods of unexpected crop failures. Income from irrigation activities is also invested in off-farm agriculture such as livestock rearing to increase agricultural production and protein food availability at the household level.

Farm size odd ratio (1.956) of the Gurara dam beneficiary households was positive and statistically significant at 1% but not significant for non-beneficiaries. This connotes that a unit increase in farm size is expected to increase the probability of increased food security status of beneficiaries by 1.956 units. Farm size represents an important production input determining a farm household's food security status because increase in farm size portends increase harvest which invariably reduces food insecurity status. The results suggest that the larger the farm size of the household, the higher the probability of their food security in line with findings of Oladimeji and Abdulsalam (2014).

The estimated odd ratios of household's dependency ratio for beneficiaries (–0.006) and non-beneficiaries (–0.022) were found to be negative and had opposite relationship with food security with $p > 0.01$ level of probability. This suggests that if the dependency ratio was high, i.e., the number of unproductive members of the household were large, the food desires of households will be equally large, thus decreasing the probability of food security in line with the findings of Orewa and Iyangbe (2009) as well as Ojogho (2010), which showed that dependency ratio increased food insecurity level among their respondents.

Food Insecurity Coping Mechanisms Adopted by Gurara Dam Farming Households

Table 6 presents the food insecurity coping strategies adopted by farming households in the study area to lessen effects of food insecurity. The results from the analysis show that, in order of importance, reduced volume and numbers of meals (64.41%),

Table 6: Food coping strategies of the pooled rural farming households

Food coping strategy	F^*	(%)	Rank
Reducing volume and number of meals	219.00	64.41	1st
Restricted consumption of adults to allow children	173.00	50.88	2nd
Borrowed and purchase of food on credits	143.00	42.06	3rd
Sale of livestock and household assets	107.00	31.47	4th
Off-farm and menial jobs	87.00	25.59	5th
Send children elsewhere to eat or beg	68.00	20.00	6th
Others	41.00	12.06	7th

Data Analysis (2019), * - multiple responses were allowed, *F* - frequency restricted consumption of adults to allow children (50.88%), borrow and purchase of food on credits (42.06%), sales of livestock (31.47%), off-farm and menial jobs (25.59%), sending children elsewhere to eat or beg (20%) and others (12.06%) were the coping strategies. According to Orewa and Iyangbe (2009), Demi and Kuwornu (2013) and Keku (2017), eating less preferred food, limiting size of food consumption (rationing) and skipping meals within a day were preferred strategies that households adopted to minimize the impact of food insecurity.

Coping Strategy Index Used by Gurara Dam Farming Households

The results in Table 7 show the index of coping strategies used by farming households. The results showed that the proportion of households who were food-secure and need no coping strategy to mitigate food insecurity was 30.59% for beneficiaries of Gurara dam farming households and only 6.47% for the non-beneficiary group. This is an indication that Gurara dam irrigation scheme impacted positively on the beneficiary farmers, especially during the dry seasons, when there is little or no rainfall. The result also showed that about 40.59% of beneficiaries of Gurara dam fell under low index of coping strategies. On the other hand, 20% of non-beneficiaries of Gurara dam exhibited low index of food coping strategy. Low index category required a small proportion of food to be food secure. While medium and high index of beneficiary farmers were 18.24 and 10.59% that of non-beneficiaries were 15.88 and 57.65% respectively. It can be concluded that a significant percentage of non-beneficiaries showed high degree of being vulnerable to food insecurity, hence required more food strategies to cope with food insecurity compared to Gurara dam beneficiary households. This is comparable to the reports of Kyaw (2009), Keku (2017), and Abdulazeez *et al.* (2018).

Table 7: Index of coping strategies used by respondents as a proxy for degree of food security

Food coping strategy	Beneficiaries		Non-beneficiaries	
	Fre-quency	Per-centage	Fre-quency	Per-centage
No strategies	52.00	30.59	11.00	6.47
Low index	69.00	40.59	34.00	20.00
Medium index	31.00	18.24	27.00	15.88
High index	18.00	10.59	98.00	57.65
Total	170.00	100.00	170.00	100.00

Data Analysis (2019)

CONCLUSION AND RECOMMENDATIONS

The beneficiaries of the Gurara irrigation scheme were food secured than the non-beneficiaries of the scheme. Food security line per month per adult equivalent of Gurara dam beneficiary' households were higher compared to their counterparts, the non-beneficiary households. Logistic regression model result showed that the odd ratios of marital status, educational level, family status, farming experience, irrigation income, farm size and dependency ratio were major determining factors of the food security level of the Gurara dam farming households' beneficiaries and non-beneficiaries. The food insecurity coping strategies adopted by farming households in the study area to mitigate effects of food insecurity revealed that, reducing volume and number of meals, restricted consumption of adults to allow children, borrow and purchase of food on credits, sales of livestock, off-farm and menial jobs, send children to elsewhere to eat or beg and others. Based on the findings of this study the following recommendations are made:

i. Food insecure and poor households should be encouraged to engage in standardized and mechanized irrigation farming to enable increase production of food to improve their food security status. This can be achieved by improving access to irrigable water in Gurara dam, access to farm inputs and provision of infrastructure such as rural electrification, market, good road and buying off the excess produce in the market to prevent glut and stabilize price.

ii. Education was positive and significantly related to food insecurity status of the farmers. Thus, reduction in food security should involve an integrated approach by the Government and private sectors through regular orientation that promotes education among farm households on the need to diversify their sources of income from agriculture to off-farm income generating businesses.

iii. Food insecurity coping strategies adopted by households in the study area can only temporarily minimize the impact of food insecurity. More sustainable strategies should be adopted. Farming households should take advantage of the proximity of the dam and make use of all necessary irrigation facilities and equipment on the dam, for increased farm yield, to enhance income and access to meals in healthy and adequate quantities.

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