

BOOSTING MODEL PERFORMANCE THROUGH INCLUSION OF RELEVANT PREDICTOR: AN ILLUSTRATION OF FOOD SECURITY STATUS MODEL USING DIMENSION OF FOOD SECURITY

ALIMI HALIMAH M.

Department of General Studies, Federal College of Agricultural Produce Technology Kano.

Corresponding Author: alimihalimah@gmail.com

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ABSTRACT

The study attempt to illustrate the influence the dimension of food security as additional predictors has on explanation of variation in the outcome variable (Food Security Status) as well as the usefulness of the model for predictability. A total of 120 respondents were selected from Kura local government area using a multistage sampling technique for the illustration. and data collected using a schedule questionnaire. The Reliability of items used for dimension of food security was done using Cronach's Alpha Reliability test. Binary Logistics Regression analysis was

Introduction

Food insecurity exists when there is poor or no access to enough food, which may be linked to certain physical, social, and economic factors (Onoja et al., 2022). Several factors such as continuous decline in budgetary allocation for agricultural sector (Ike, 2024), poor production output of farmers (Onyemekonwu et al., 2023), fear of herdsmen attack, flooding, poor extension contact, fear of kidnappers, and limited knowledge of the application of improved agricultural practices

carried out using socio-demographic variables as predictors in the first model while the second model has the dimensions of food security added to the predictor. Comparism was done using test statistics such as omnibus test of significance, Cox & Snell R-square, Nagelkerke R-square and Hosmer-Lemeshow goodness of fit test. The compared result showed that each of the dimension of food security satisfied reliability test with an overall Alpha value of 0.74. The Cox & Snell R-square and Nagelkerke R-square for including dimension of food security ranged from 0.174 to 0.588 compared to that of 0.094-0.319 when the conventional socio-demographic variables were used as predictors. The Omnibus Test was also significant at pvalue of 0.03. It is therefore recommended that model should look beyond conventional predictors and include more variables of relevance in explaining variation and increasing power of predictability of outcome (Dependent) variables

Key Words: *Model performance, Relevant predictors, Dimension of food security, Model predictability.*

(Ehiwario et al., 2023) have been blamed for the current food insecurity situation in Nigeria. Although Nigeria has the manpower and large favourable arable land required for the advancement of food production and boosting of livestock, but there exist limited modern technology, infrastructure, training and education necessary to increase agriculture yield in order to meet natural demands (Blessing Adedotun 2021) The quantity and quality of secure food status has been found to be greatly influenced by socio –demographic factors of farmers and are therefore significant indicators in food security analysis. The age of household head is expected to impact on his or her labour supply for food production. Young and energetic household heads are expected to cultivate larger farms compared to the older and weaker ones. It also determines the ability to seek and obtain off farm jobs and income which can be done better by younger household

head. In contrary to this claim, Arene and Anyaeji (2010) found older household head to be more food secure than the younger household head in their study. The expected effects can either be positive or negative.

According to FAO (2012), female headed household tends to be older and have fewer years of education than male heads of household, education is a social capital which positively influence food security by enabling access to information on agricultural production and new technology as well as making economic farm decision, while the hereditary system in the country allows men more access to farmland by the male gender. This is buttressed by Pionce-Gutierrez (2016 as cited in Olagunju, 2022) which asserted that household head in the rural area are majorly male gender. Positive relationship has been established between farm size and improvement in household income and food security, the larger the farm size, the more the production, income and food security. (Wudil et al 2023)

According to Jrad *et al.*, (2010), food security can be viewed in terms of food availability, food accessibility, food utilization, stability of food supply and food and nutrition safety. He stated that food availability *can be* referred to the physical presence of food which might be sourced from own production, purchases from internal market or import from overseas. Food accessibility is the ability to obtain sufficient food of guaranteed quality and quantity to meet nutritional requirements of all household members. Here, the food should be at right place at the right time and people should have economic freedom or purchasing power to buy adequate and nutritious food. Kuwornu *et al.*, (2011) clarified that the determinant of food accessibility is based on physical resources, social and political factors including financial resources.

They defined food utilization as the proper biological use of food, which provides a diet that contains sufficient energy and essential nutrients, as well as knowledge of food storage, processing, basic nutrition for proper growth, child care and illness management. This refers to ingestion and digestion of adequate and quality food for maintenance of good health. Stability of food

supply is another dimension which is the continuous supply of adequate food all through the year devoid of shortages.

Having said this, several statistical methods have been used by researchers to discover the relationship between the conventional predictors of food security (socio- demographic characteristics of household head) and food security status. One of the best method for prediction is Logistic regression (binary). Logistic regression is performed when the outcome variable is a categorical variable either dichotomous, polychotomous or ordinal variable. As outlined by Muhammed et al 2021, the purposes of multivariate logistic regression analysis are

- to adjust the estimate of risk (odd ratio) for a number of factors set in the model,
- determine the relevant contribution of factors to a single outcome.
- Predict the probability of an outcome for number of independent variable of the model.
- Assess interaction of multiple variables for the outcome.

The primary aim of this study is to examine the effect of the inclusion of elements of food security in the model for determining the food security status of farming household in the study area.. Specifically the study will determine the reliability of items of food security dimension used in the study and examine its effect along with socio- economic characteristics on food security status using binary logistic regression.

METHODOLOGY

Study Area:

The study was carried out in Kura Local Government area of Kano State. It is a state in the Northern region of Nigeria. Kura has a population size of 144601 as at the 2006 census (NPC 2006) with the Headquarters in the town of Kura. It has an area of 206m². The average annual temperature fluctuate between

54°F and 101°F and centers on the famous river known as Rafin in the southern part of the town used for farming and drinking site for animals. Kura Local Government Area is located between latitude 8° 25' 49"N and 8° 49' 09"N of Greenwich Meridian and Longitude 11° 07'E and 11° 54' 17"E of the equator covering an area of about 206km². It shares common boundaries with Garun Malam LGA from the West, Madobi LGA from the North, Dawakin kudu LGA from the East and Bunkure LGA from the South. It is geographically located in the southern part of the state along the Zaria-Kano express way

Sampling Procedure and Data Collection:

A multistage sampling technique was used to select 120 respondents for the study. Kano state comprises of three agricultural zones (Zone I, II AND III) managed by the Kano State Agricultural and Development Authority (KNARDA). A zone is randomly selected out of the three zones (Zone I), Zone I consists of 14 local government area with Kura LGA emerging as a result of simple random sampling(Stage 2).Two villages namely Karfi, Imawa and Butalawa were randomly selected. The final stage witnessed collection of data from each village by staff of KNARDA from extension and monitoring unit using the list frame of the farmers in the area. Random selection of 40 farming household each from the areas resulted in 120 farming household.

Measurement of Variables

The factors (dimension of food security) responsible for food security in the household were measured with three point rating scale of major factor, minor factor and not a factor coded as 3, 2 and 1 respectively. They were later recorded into binary variables. The same was done for food security status and socio-demographic variables. Questions were asked to discover their food security status, responses with often and sometimes were tagged positive response and graded as 1. Those with never was tagged negative response and tagged as 0 to arrive at the range of score for food security status.

Data Analysis

Two binary logistic regression model was used, the first is given as

$\text{Prob}(Y=1/X) = \ln(P_i/1P_i) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \dots + \beta_8X_8$ where

P_i = Probability that farming household are food secure

$Y=1$ if household is food secure, 0 if household is food insecure

β_0 = Constant

X_1 = Sex of Household head/respondents

X_2 = Marital Status of respondent

X_3 = Educational Level of respondent

X_4 = Age of respondent

X_5 = Income of Household head

X_6 = Household Size

X_7 = Farm Size

X_8 = Farming Experience.

The second model included the dimension of food security which are given as food availability

lity, food sustainability, food accessibility and food utility.

$\text{Prob}(Y=1/X) = \ln(P_i/1P_i) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \dots + \beta_{12}X_{12}$ where

P_i = Probability that farming household are food secure

$Y=1$ if household is food secure, 0 if household is food insecure

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X_2 = Marital Status of respondent

X_3 = Educational Level of respondent

X_4 = Age of respondent

X_5 = Income of Household head

X_6 = Household Size

X_7 = Farm Size

X_8 = Farming Experience.

X_9 = Food availability

X_{10} =Food sustainability

X_{11} =Food accessibility

X_{12} =Food Utility

RESULT AND DISCUSSION

Cronbach's Alpha Reliability for Elements/Dimension of food security.

Indexes are constructed by combining two or more variables which are employed as indicators and referred to as item. It provides quantitative measures that are amenable to more precise statistical manipulation and increases the reliability of measurement. The items are constructed based on literature review on elements of food security. The dimensions are listed below with their items.

Food availability

1. Unavailability of local production of food consumed in the community
2. Lack of storage of food during surplus harvest
3. Lack of food assistance provided during food inadequacy
4. Non availability of regular supply of food items in the community.

Food sustainability

1. Variability in weather does not support agricultural production
2. High changes in the price of food items
3. Unfavourable policies for food production, preservation and storage
4. Harsh economic factor on the trade of food item

Food Accessibility

1. Low household income of the farmer
2. Lack of transport and market infrastructure for food supply system
3. Lack of purchasing power of rural household

Food utility

1. 1 .Poor orientation of rural people on the importance of certain food item
2. Poor food processing practices
3. Poor hygiene and manufacturing practices
4. Poor diet quality and diversity

From table1, Cranach's Alpha ranges from 0 to 1, from the above table, the value ranges from 0.52 to 0.66 with an overall Alpha value of 0.74. The result indicates that all construct of the dimension of food security are reliable, therefore the internal consistency of the instrument is acceptable.

The inter correlation matrix all displayed positive values while corrected item total under item total statistics are also positive with non-recording a value less than 0.3. Under summary item statistics, the mean ranges between 0.194 and 0.445, and the mean is 0.324. All indices indicate a strong relationship between the items used for elements/dimension of food security in the study.

Table1: Cronbach's Alpha Reliability of Dimension of food security

Dimension	Items	Alpha
Food availability	4	0.52
Food Sustainability	4	0.61
Food accessibility	3	0.66
Food Utilization	4	0.58
Total	15	0.74

Source: Field Survey 2024.

Table 2 showed that 95.8% of the farming household were food insecure while an insignificant 4.2% were found to be food secure. There is an alarming rate of food insecurity in the study area. Food insecurity can lead to malnutrition and leaves children weak, vulnerable and unable to fight

childhood like malaria, measles, infection and so on. According to Nafees et al (2021) food insecurity can result in reduced life expectancy, low birth weight among pregnant women, feeling of alienation and anger

Table 2: Distribution of Food Security Status among the Respondents

Variables	Range of Score	Frequency (%)
Food Secure	0-7	5 (4.2)
Food Insecure	8-16	95(95.8)

Source: Field Survey 2024

From table 3, The overall classification at bloc 0 is an indicate the overall percentage of correctly classified cases, an increase at bloc 1 means that the addition of independent variables improves the ability of the model to predict the dependent variable. In this scenario, the overall classification in Model 1 remains unchanged at block 1 while Model 2 which include the dimension of food security as stated by literature review increases in bloc 1(97.5%). This shows that the addition of dimension of food security to the socio-demographic variables has impacted positively on the model

The omnibus test of coefficient indicates whether the overall performance of the model is improved when independent variables are included in the model compared to the model without any independent variables (given under Block0). For this test to be significant p-value must be less than 0.05. In this illustration, Omnibus test for Model 1 and Model 2 are 0.16 and 0.03 respectively. The p value for Model 1 is greater than 0.05 ($p > 0.05$) while that of Model 2 is less than 0.05 ($p\text{-value} < 0.05$). This implies that Model 2 is significant and much better compared to Model 1.

Cox & Snell R-square and Nagelkerke R-square (called pseudo R-square) values provide an indication about the amount of variation in the outcome variable that can be explained by the independent variables in the model. In this illustration, the values of the pseudo R-square are 0.094 (Cox & Snell R-

square) and 0.174 (Nagelkerke R-square) for Model 1 , 0.319 and 0.588 for Model 2 respectively. This implies that between 9.4% and 17.4% variation in the outcome variable (Food security Status) was explained by the independent variables in model 1 while Model 2 was able to account for a range of variation between 31.9% and 58,8% in the outcome variable. This has further shown that Model 2, that is inclusion of other variables of relevance has a better explanation of variation of the dependent variable.

Hosmer-Lemeshow goodness-of-fit test (Table 3) judges whether the Model is useful for prediction. It indicates how well the observed and predicted values fit with each other (i.e., observed and predicted probabilities match with each other). The null hypothesis is “the model fits” and the p-value is expected to be >0.05 (non-significant). If the p-value is not significant, it means that the model is a good fit for prediction (i.e., the observed and predicted values are close together). In this case, the p-value for Model 1 is 0.617, while that of Model 2 is 1.000. Both Models shows prediction power but that of Model 2 indicate a perfect prediction ability of Food security status (Outcome) in the study.

Table 3: Result of Logistic regression Models for Food Security Status Of Farming Household

S/N	Test Statistics	Model 1	Model 2
1.	Overall classification at block 0	95.8	95.8
2	Overall classification at block 1	95.8	97.5
3	Omnibus Test (Does addition of independent variables makes the model better?)	Pvalue 0.161 $p>0.05$	Pvalue 0.03 $P<0.05$
4	Cox & Snell R-square Negelerke R-square	0.094 0.319	0.174 0.588
5	Hosmer-Lemeshow goodness of fit test	Pvalue 0.617 $p>0.05$	Pvalue 1.000 $p>0.05$

Conclusion and Recommendation

The findings have shown that the reliability test of items used in the study for items of food security dimension are favourable thereby by making them good predictors/ independent variables to be added for the second Logistic model. The second model has revealed more usefulness in terms of variation explanation of dependent variable as well as a better predicting ability when compared to a model with only socio-demographic variables as predictors/independent variables. It is hereby recommended that studies should include important variables based on theoretical proof and Literature review so as to have a better and more result oriented Model for their studies.

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