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CLASSIFICATION OF HOUSEHOLDS INTO FOOD SECURITY STATUS IN THE NORTH-CENTRAL NIGERIA: AN APPLICATION OF RASCH MEASUREMENT MODEL

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ABSTRACT

The main objective of the study was to classify households in the North-Central Nigeria (NCN) into food security status based on certain demographical characteristics with Rasch model. Data for the study were generated from a cross-sectional survey of 396 household heads from the two selected states (Kogi and Kwara) in October 2006 to January 2007. The results of the analysis show that, only 23.7 percent households are food secure (FS) in the study area. Further analysis revealed that 15.5 percent and 37.4 percent adults and children respectively are food secure. While 18 percent households are FS in the urban areas, only 13.7percent are FS in the rural areas of the NCN. In addition, female-headed households are found as been FS (21.9 percent) compare to 14 percent male-headed. There appears to be an inverse relationship between household size and food security in the study area. Households with small sizes of ≤ 3 members are also more FS (25 percent) compared to 15.1percent by those with larger sizes of 8-11 members. However, contrary to the adults' food security status in the NCN, the proportions of children who are FS in both rural and urban are nearly the same. In all the cases, there is a direct relationship between employment status of household heads and the household food security status. To transit from food insecure to food secure status, it is important to pursue policy on birth control and gender empowerments in the study area which was found to have the mean household size of 5.89 and standard deviation of 2.24.

Keywords: household, food secure, food insecure, infit, outfit, Rasch model.

1. INTRODUCTION

Food security is a complex and multi-dimensional phenomenon with poverty. It is an access by all people at all times to enough food for an active, healthy life (Nord and Hopwood, 2007). Food security has long been used as an important macro-level indicator of agricultural stability and progress for both agricultural and economic researchers. But little work has been done to operationalise the concept at the household level. We view household food security as a concept that integrates environmental, economic, and cultural factors in a manner that can provide a useful tool for predicting dietary patterns within the household. The main goal of food security is for individuals to be able to obtain adequate food needed at all times, and to be able to utilise the food to meet the body's needs.

The generation of household food security is dependent on the physical availability of food at the market or community level, the ability of the household to access the available food, the ability of individuals particularly those especially susceptible to food deficits such as women, infants, and children to eat the food, and finally the body's ability to process the nutrients consumed. The physical availability of food is a function of productive agriculture, effective trade infrastructure, and efficient food aid logistics, if necessary. Agriculture, trade, and aid policies are important in influencing the availability of staple and non-staple foods. The promotion of staple crops that are high in micronutrient status can increase calorie and micronutrient availability simultaneously. Economic access is a function of prices (food and others) and incomes (not only the level of income, but who earns it).

Measurement of food security has proven to be a difficult task (Abuelhaj, 2007). This is a clear result of the wide definition of the concept to include multiple dimensions ("physical, social and economic") along with a temporal aspect and a hierarchical nature. Measurement of food security entails combination of both "qualitative-subjective" and "quantitative-objective" indicators (Migotto *et al*., 2005). Individuals are nested within households, households within communities and communities within countries. Intra and inter household equality in access to food is a function of availability of food at the national level among other influences as well. Accounting for the complexity in measuring such a construct, analysts have turned to measure distinct facets of food security rather than the whole. A number of indicators developed that are limited to measuring distinct aspects of food security such as quantity or quality of consumed food or the psychological, social and cultural aspects of food insecurity. In Nigeria, household food insecurity is one of the topmost developmental problems; the level has continued to rise steadily since the 1980s. It rose from about 18% in 1986 to 41% in 2004 (Sanusi *et al*., 2006).

The household-based food insecurity (FI) measures have become the standard tool for measuring food security. But this approach has not always been useful for guiding food security polices at the national, regional, or local level (Pelletier *et al.,* 1995 and Muder-Sibanda *et al*., 2002). Thus, researchers recognized the need to also measure this phenomenon through more direct

experiential approaches at the household level. During the 1990s, the USDA led the effort to develop a valid scale that was capable of measuring household food insecurity in the United States (Carlson *et al*., 1999 and Rose *et a*., 1995). This work built heavily on the Radimer/Cornell hunger scale (Radimer *et al*., 1992 and Radimer 2002) and the Childhood Hunger Identification Project scale (Wehler 1992). In almost all cases, only the head of household is surveyed with respect to his or her impression of household food security. This response is then used to categorize the entire household's food security status. In the process, the impressions of other household members notably those of the children are not considered due to limited information. Neglecting other household members' assessment of their food security status may well skew our estimates of overall food security, food security within different groups, and the determinants of food security (Gundersen, *et al*., 2007).

In order to address this research lacuna, this study determines household food security status using the same standard method with United States Department of Agriculture (USDA) where four categories were used to describe the food security situation experienced by adults and children. The 18 items in the household food security scale include: 3 items that ask about experiences of the entire household, 7 items that ask about experiences and behaviors of the adult members of the household as a group, or of the adult respondent individually, and 8 items that ask about experiences and conditions of the children in the household as a group (see Table-1). The central problem however in using the Household Food Security Scale, which includes both adult-referenced and child-referenced items to assess children's food insecurity is that the relation between the food security of adults and children in the same household depends critically upon the ages of the children. Young children are generally protected from disrupted eating patterns and reduced food intakes at much greater levels of adult food insecurity than older teenaged children. The "severe hunger range" of the household scale was found to overestimate, by 48%, the prevalence of children's hunger in households with no child >5 years of age, and to underestimate, by 33% and 20%, the prevalence of children's hunger in the 2 older age groups (6-14 years and 15-17 years, respectively)(Nord and Bickel, 2002). The 18 items in the Household Food Security Scale do not, in fact, measure a single dimension of food insecurity, but rather 2 dimensions, adult food insecurity and children's food insecurity, which are correlated, but not collinear (Nord and Bickel, 2001, 2002). The bi-dimensionality of the adult and child items in the Household Food Security Scale also generally causes it to underestimate the food insecurity of adults in households with only very young children compared with adults in households without children.).

This study has its basic objective at analyzing households in the North-Central of Nigeria into food security status using Rasch measurement approach despite its shortcomings. Rasch model is still superior to other tools like the consumption expenditure on food energy as an indicator of food security (Smith, *et al*., 2006; Smith and Wiesmann, 2007); Basic Calorie Requirement Approach (such as Obamiro *et al*, 2003, Agbola, 2004, Babatunde *et al*., 2007) and Discriminant Analysis (Olayemi, 1996) in classifying households into food security status. Rasch models can be estimated for households with incomplete sets of answers, whether this is due to (random) item nonresponse or to forced skip patterns in the questionnaire. With the Rash model, one can estimate food security status of children and adults separately. Rasch model has ability to classify households to food secure (FS), food insecure without hunger (FSWH); food insecure with moderate hunger (FSWMH) and food insecure with severe hunger (FSWSH) based on the number of their affirmative responses to the 18 survey items (USDA, 2000). In most of the analyses used in the past, households are either classified as been food secure or insecure. Households are classified as food secure, if their daily food intake from different sources combined is found to be greater than or equal to the recommended daily intake requirements. The use of calorie requirement have therefore been faulted based some empirical evidence (Delisle et.al. 1991, and Behrman and Deolalikar, 1988) that caloric sufficiency does not translate into sufficiency of the nutrients.

2. METHODS OF DATA COLLECTION AND EMPIRICAL MODEL SELECTION

Kogi and Kwara states were purposively selected from the North-Central Nigeria. Kogi lies on latitude7.75^{o} N and longitude 6.75^{o}E with a transitional zone between grassland and forest of North and South of Nigeria respectively while Kwara state extends from latitude 7.45^{o}N in the southern end, latitude 2.45^{0} E to the west and longitude 6.40^{0} to South-East.

A total of 396 households were selected through multi-stage sampling procedure from Kogi (215) and Kwara State (181) proportionate to the size of these states. The data used came from two kinds of households, those with children and those without children. Households with children received 18 questions, whereas households without children received only 10, representing a subset of the 18 questions (Table-1). This strategy inevitably yields missing data on the 8 questions not asked of the households without children. Data were collected by interviewing the household head (the major decision maker) with questions ranging from food production, food demand as well as on food consumption. The qualitative method of assessing food security examines people's perceptions about energy inadequacy and food deprivation and provides a simple, direct measure of food insecurity and hunger that is country- and context-specific (Kennedy, 2002). The food security questions used to determine adult and child food security status and to derive household status were adapted from food security measurement methods developed in the United States (Bickel, Nord, Price *et al*., 2000; Hamilton, Cook, Thompson *et al*., 1997a, 1997b; Nord and Bickel 2002). These measurement methods have been used to monitor household food

security in the U.S. annually since 1995 through the Current Population Survey (CPS)(Nord, Andrews, and Carlson 2006) and for a wide range of monitoring and research on food insecurity in the United States, Canada and internationally(Broughton, Janssen, and Hertzman 2006; Lawn and Harvey 2003, 2004a, 2004b; Melgar-Quinonez, Zubieta, and MkNelly 2006; Stuff, Casey, and Szeto 2004; Tarasuk 2001; Tarasuk and Beaton 1999; and Whitaker and Orzol 2006).

The Household Food Security Survey Module (HFSSM) included in the focuses on self-reports of uncertain, insufficient or inadequate food access, availability and utilization due to limited financial resources, and the compromised eating patterns and food consumption that may result. The module is not designed to capture other possible reasons for compromised food consumption, for example, voluntary dieting or fasting. The HFSSM is a household measure; it assesses the food security situation of adults as a group and children as a group within a household, but does not determine the food security status of each individual member residing in the household.

In the U.S. standard method, the food security status of households with children is determined by considering all 18 items combined, not the two scales separately (Nord, Andrews, and Carlson 2006). But research has shown that the single scale can be problematic because the relationship between the food security of adults and of children in the same household depends critically on the ages of the children (Nord and Bickel 2002). The approach of considering the food security situation of adults and of children in the household separately therefore become necessary though similar to that employed in the analysis of the 18-item food security module in the baseline surveys for the Canadian Food Mail Program Pilot Projects, undertaken in three isolated northern communities (Lawn and Harvey 2003, 2004a, 2004b). The 18 items include 10 adults-referenced food items and 8 child-referenced food items (Tables 2 and 3).

Methods of data analysis

Rasch model as employed for this study assumes that the log of the odds of a household affirming an item is proportional to the difference between the "true" severity level of the household and the "true" severity level of the item. This is stated below

$$\ln \{Pt(\theta) / [1- pt(\theta)]\} = \theta - \beta t \quad \text{--------- (1)}$$

Where Pt (θ) is the probability of an affirmative response to item "t" for a household that has a food-insecurity score of θ. The index "t" runs over the 10 adult-referenced items for childless households and over all 18 items for households with children. The probability of an affirmative response rises as the household food-insecurity score rises and falls as the item severity calibration rises.

In the simple Rasch model, the probability of a correct response is modeled as a logistic function of the difference between the person and item parameter. In the Rasch model, the probability of a specified response (e.g. right/wrong answer) is modeled as a function of person and item parameters. The Rasch analysis transforms ordinal scores to the logit scale and thus to an interval-level measurement (Wright *et al*., 1982). Infit and outfit statistics were used to evaluate the model-data fit for each item in the Rasch analysis. Infit statistics represent the information-weighted mean square residuals between observed and expected responses; outfit statistics are similar to infit statistics but are more sensitive to the outliers. Infit and outfit statistics values that were close to 1 were considered satisfactory model-data fit, whereas values that were more than 1.5 or less than 0.5 were considered a misfit of the model. Values that were more than 1.5 indicated inconsistent performance and values that were less than 0.5 showed too little variation (Wright *et al.*, 1982 and Rasch 1960). Outfit statistics are more sensitive to extreme scores. In analyzing Rasch data, users typically are concerned when the mean square (MNSQ) fit statistics exceed 1.5. The higher the statistic, the more questionable the information. Through the use of fit statistics, the Rasch model helps the user identify any items that are not fitting the model (thereby decreasing both the validity and reliability of the test), and any respondent whose scores do not appear to be consistent with the model.

This item response models were fitted using the BILOG-MG program from Scientific Software International using joint maximum likelihood methods. The discrimination parameter was set at unity, and mean item score was set at the mean of the eight child items in the standard scale as described in Bickel and Nord (2000). Initially a one-parameter logistic model (1PL) was fitted to the data for all subjects as a single group (Embretson and Reise, 2000). In order to evaluate how well this model fitted the data, the constraints of the 1PL model were then relaxed in each of two ways. First, a two-parameter logistic model (2PL) was fitted in which the slope, or discrimination parameter, of the item characteristic curves was allowed to vary between items (Hambleton, *et al*., 1991). Fitting the 2PL model allowed us to evaluate whether the estimation of food security status was sensitive to varying the assumption of equal discrimination for all items (Embretson and Reise, 2000). In the 1PL model, subject scores are a function of the number of affirmatives or raw score and all subjects in a raw score category receive the same 1PL score. In the 2PL model subject scores depend not only on the number of affirmatives but also on which items are affirmed with a range of subject scores possible at a given raw score. Subject scores were compared for the 2PL and 1PL models by means of a box and whisker plot.

Secondly, a differential item functioning (DIF) model was fitted in which the item calibrations were allowed to vary between groups of subjects defined by the state (region) and geographical location of the child. Only the mean of the item calibrations was held constant across groups. Item calibrations were estimated after adjusting for variation in the average level of food insecurity

between groups. Fitting the DIF model allowed us to evaluate whether it was reasonable to assume that calibrations of individual items were the same across groups of subjects defined by region and geographical location. The change in goodness of fit from DIF model as compared to the 1PL model was evaluated by means of likelihood ratio tests. Differences in item calibrations (95% confidence intervals) were estimated using the Afro-Caribbean group for reference with the evaluation of differences between groups using the ordinal logistic model where the food security status was used as dependent variable.

3. RESULTS AND DISCUSSIONS

We first examined the goodness-of-fit of the items to the expectations of the Rasch model with the Mean square residuals (MnSq). The results of findings indicate that an adapted version of the USDA 18 HFSS items is a valid tool to classify households' into food security status of adults or children in the area. The use of the means square criterion shows that many items of the 18 food security items in this study were redundant and were therefore removed from the scale because of their failure to demonstrate goodness-of-fit to the Rasch model. Only the 8 "basic" adult and household items by excluding questions relating to "how often" which are follow-up questions were used. Incomplete responses (That is, responses with any missing values on the basic 8 items) and extreme responses (those that said "no" to all 8 items or "yes" to all 8 items) were also omitted. This reduced the sample size from 396 to 249 in line with standard practice in Rasch analysis. This is very essential since such responses do not provide any information about the relative severity of items. The items were only omitted from measurement analysis but were used in the classification of households into food security status. A single Parameter Logistic model (IPL) was therefore fitted to the data for all 249 non-extreme no-missing cases as a single form. This gave rise to two Logs Likelihood (2LL) model which is the measure of entropy in categorical analysis. The difference between the entropy (measured by 2LL) in a constrained and unconstrained model is referred to as the likelihood ratio (Table-4). The zero value in Table-4 is the severity calibration for the least-severe item ("worried food would run out"). For each of the remaining items, the calibration parameter represents the relative severity for that item in comparison with the least-severe. The Log Likelihood ratio, given by the Chi-square statistic test was highly significant at both 1% and 5% levels indicating that the chosen independent variables fit the data reasonably well.

After item calibrations and household scores have been estimated, we also assess how well responses to items correspond to the Rasch-model assumptions by calculating "infit" and "outfit" through the infit and outfit statistics. The results implied that nearly all the item Infit and Outfit mean-squares are within usual fit criteria (0.8-1.2) corresponding to the Rasch-model assumptions. The differences in discrimination can be attributed to random variation, rather than enduring effects (Table-5).

Differential response patterns of household to food security items

Table-6 revealed that, in the North Central Nigeria, about 73.8 percent households with children and 55.2 percent of households without children responded affirmatively to being worried about food running out. About 63.8 percent of household with children and 48.0 percent of households without children also responded affirmatively to threshold item for food insecurity about "balanced meals. An average of 30.0 percent of the household heads in the study area reported that their children are always hungry with difficulty in feeding them, while 35.7 percent reported that they often cut the size of their children's meal. This empirical finding is consistent with a limited body of previous research (for instance, USDA (2000). The least severe item, asking whether the household heads "worried whether food would run out," was answered affirmatively by 73.8percent of households with children and 55.2 percent of households without children in the study area. Furthermore, about 53.7 percent of households with children in the study area responded affirmatively to threshold item for food insecurity about "balanced meals". The threshold item for food insecurity with hunger about "cutting or skipping meals in three or more times per month," was answered affirmatively by 47.4 percent of households with children and 31.0 percent of households without children in the study area. All these results show that households with children exhibited more frequent indications of food-related problems in this study area. This finding is consistent with the situation in United States of America in 2000 (USDA Technical Report, 2000). It implies that, children are more food demanding compared to adults and have high tendency of making household food insecure. It is therefore imperative for any government that wants to ensure household food security to look into how to reduce number of children in the households through birth control policy.

Classification of adults, children and household food security status

Data from the HFSSM were analysed to determine food security status among adults in the household and among children in the household. The 10 adult-referenced items (Adult Food Security Scale) were used to determine the food security situation among adults. The eight child-referenced items (Child Food Security Scale) were used to determine the food security situation among children. Among households without children, adult food security status was also household food security status. Among households with children, the results of the analysis of both the adult and child scales were considered in determining the food security status of the household. In situation where both adults and children in the household were food secure, the household was considered food secure. Where either adults or children, or both adults and children, in the household were

moderately food insecure, and neither were severely food insecure, the household was considered moderately food insecure. When either adults or children in the household were severely food insecure, the household was considered severely food insecure.

The results of the analysis of households food security (18 household food security questions) presented in Table-7 shows that, 18 percent of those that are food secure were found in urban areas while 13.7 percent were in the rural areas. About 21.9 percent households headed by female were food secure while the percentage of the male-headed who were food secure was only 14 percent. In addition, 24.6 percent of respondent with a small household size (0-3 members) were food secure, with only 15.1 percent of those with a larger size (8-11 members) food secure. About 31.3 percent of those who were employed (either privately or publicly) were food secure with 16.4 percent of the unemployed probably through remittances found to be food secure. On household nature of primary occupation, those who were involved in agricultural practices were more food secure (16.5 percent) than those who were not involved (15.2 percent). The singles (unmarried) contrary to some empirical findings in the study area were more food secure than the married (15.7 percent) possibly as a result of limited number of people that such have to feed.

Analysis of the adult food security status through the use of adult-reference items presented in Table-8 revealed that, 49.9 percent rural and 22.9 percent urban households were food secure in the North Central Nigeria. Further analysis also revealed that 27.1 percent female-headed household were food secure compared to 22.7 percent male-headed households. While 24.6 percent of those having ≤ 3 household members were food secure, 23.3 percent by those with household size of 8-11 percent were food secure. About 55.7 percent of those employed were also food secure compared to only 17.6 percent of the unemployed. While 27.1 percent of those that participate in agriculture were found to food secure in the study area, a lower percent (19.7 percent) of household heads who do not participate in agricultural activities fell into food secure category. Contrary to early finding when the pooled analysis of all households (those with children and those without) were analyzed, the percentage of married household heads were food secure (23.8 percent) and 23.1 percent in the single (unmarried) class were food secure.

Table-9 shows the result of the analysis of children food security (using the children reference items). From the Table-9, 37.0 percent rural and 37.7 percent urban household children were food secure. While 40.6 percent children in female-headed household were food secure, 36.3 percent children in male-headed households were found as being food secure in the North Central Nigeria. About 42.1 percent children found in household having ≤ 3 members were food secure, 37.2 percent children with household size of 8-11 percent were only found as food secure. About 80.6 percent children of employed household heads were food secure compared to only 33.3 percent of children from unemployed household heads. While 43.6 percent children from household heads that were engaged in agriculture were found to be food secure in the study area, a lower percent (29.8 percent) of children found in households who were not engaged in agricultural activities were only being food secure. Children from married respondents were observed to be more food secure (38.5 percent) compared to children from the single class (37.3 percent).

4. CONCLUSIONS AND RECOMMENDATIONS

This study classified household into food security status with the use of Rash Measurement Model. The food security status of adults in each household was assessed by responses to 10 questions about food-related behaviours, experiences, and conditions that are known to characterize households having difficulty meeting their food needs. In households where children are present, the food security status of the children was assessed by an additional 8 questions. The questions cover a wide range of severity of food insecurity, ranging from worrying about running out of food to children not eating for a whole day. Each question specifies lack of money or other resources to obtain food. So the measures are not affected by hunger due to voluntary dieting or fasting. All questions are referenced to the previous 30 days (one month) for good memory recall. Based on the number of indications of food insecurity reported, households are classified into four categories.

The outcome of the analysis shows that only very few proportion of households (23.7 percent) in the North central Nigeria are food secure. Children's food security is correlated with that of adults in the same household, but the relation depends on the ages of children less than 15 years. Households with children were also found to exhibit more frequent indications of food-related problem in the study area. These findings are in consonance with the situation in United State as reported by the USDA Technical Report (2000). The results of households classification based on the demographic characteristics of the household heads implies that for a transition from food insecurity classes (such as FIWH, FIWMH and FIWSH) in the study area to take place, there is the need for gender empowerments since most female-headed households are more food secure. There is the need for employment of the household head in one economic activity or the others as well as birth control to reduce the number of household size from the mean value of 5.89 and standard deviation of 2.22 to at least 3. This becomes necessary as a result of the inverse relationship between household size and household's food security status in the study area.

Further research may become necessary to assess the relationship between food security and children's diet quality as well as the effects of children's food security on their health and development.

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Table-1. Eighteen (18) households' food security items

Number	Questions
Q_1	Adult cut size or skipped meals because there wasn't enough money for food*
Q_2	Adult cut size or skipped meals three or more times in the last 30 days*
Q_3	Adult does not eat whole day because there was no enough food*
Q_4	Adult does not eat whole day three or more times in the last 30 days*
Q_5	Adult eat less than what they felt they should*
Q_6	Adult hungry but did not eat*
Q_7	Adult lost weight because there wasn't enough food*
Q_8	Cut size of child's meals**
Q_9	Child skipped meal because there wasn't enough money for food**
Q_{10}	Child skipped meal, three or more times in the last 30 days**
Q_{11}	Child being hungry but did not eat because we couldn't afford more food **
Q_{12}	Child not eating for a whole day because there wasn't food**
Q_{13}	Worried whether food would run out before getting money to buy more*
Q_{14}	Food bought did not last and no money to get more*
Q_{15}	Adult could not afford to eat balanced meals*
Q_{16}	Could not feed child with balanced meals because we couldn't afford that**
Q_{17}	Child not eating enough because we couldn't afford enough food**
Q_{18}	Adult feed child with low-cost foods because of inability to buy food**

Note: * are the 10 adult referenced food security item and ** are the child referenced items.
Source: USDA (2000): Food security guide

Table-2. Operationalized framework of the core food security questions for households with children[1] (entire 18 food security items).

Category	**Sequence of 18 items answered affirmatively in modal households[2]**	**Expected behaviors**
Food secure (Sum 0-3) [3]	Worried food would run out	Diminished household food resources force economizing in food spending: running short of money, substituting cheaper, dietary monotony
	Food bought didn't last	
Food insecure (Sum: 3-7)	Family couldn't afford balanced meals[4]	Food insecurity short of actual hunger: extreme food acquisition and management coping strategies, use of socially non-normative food resources, nutritional quality of diets and health affected
	Relied on a few low cost foods	
	Cut size of meals/skip meals: adults	
	Could not afford balanced meal: child	
	Adult ate less than felt they should	
Moderate hunger (Sum: 8-12)	Adult cut size or skip meals for three or more days in the last 30 days	Managing insufficient resources; adult hunger in household, for at least some members, sometimes
	Child not eating enough	
	Adult hungry but didn't eat	
	Adult lost weight	
	Cut size of child's meals	
Severe hunger (Sum: 13-18)	Adult didn't eat for whole day	Severe hunger in household and hunger among children
	Child hungry	
	Adult didn't eat for whole day (3 times or more in the last 30 days)	
	Child skip meals: short term	
	Child skip meals (3 times or more in the last 30 days)	
	Child didn't eat for a whole day	

[1] Adapted from Bickel *et al*., 1996
[2] "Modal" households are those whose responses to the 18 items exactly fit the common pattern determined by the rasch measurement model to the (Hamilton *et al.*, 1997).
[3] Items in italics represent threshold scale items.
[4] Sum refers to the total number of affirmative responses of the CFSM for households with children.

Table-3. Operationalized framework for 10 Adult -referenced and 8 child-referenced food security items.

Category labels	**Category description**	
	10-Item adult food security scale	**8-Item child food security scale**
Food secure	No, or one, indication of difficulty with income-related food access 0 or 2 affirmed responses	no, or one, indication of difficulty with income-related food access 0 or 2 affirmed responses
Food secure without hunger	Food Insecurity is reducing the quality of food and an increase in unusual coping patterns with little or no reduction in household member's intake. 3-5 affirmed responses	Food Insecurity is reducing the quality of food and an increase in unusual coping patterns with little or no reduction in household member's intake. 3-5 affirmed responses
Food insecure, moderate	indication of compromise in quality and/or quantity of food consumed by adult with repeated experiences and physical sensation of hunger 6 to 8 affirmed responses	indication of compromise in quality and/or quantity of food consumed by adult with repeated experiences and physical sensation of hunger 6 to 8 affirmed responses
Food insecure, severe	Indication of reduced food intake and disrupted eating patterns. The children have repeated experiences with the physical sensation of hunger. For households without children and for some adults living in households with children 9 to10 affirmed responses	-

Table-4. Analysis of maximum likelihood estimation of households on food security.

Model	**Binary Logit**														
	Rural area			**Urban area**			**Kogi state**			**Kwara state**			**Pooled**		
Parameter	**Coeff.**	**S.E**	**p>chisq**	**Coeff.**	**S.E**	**p>chisq**	**Coeff.**	**S.E**	**p>chisq**	**Coeff.**	**S.E**	**p>chiq**	**Coeff.**	**S.E**	**p>chisq**
1 Worries whether food will run out before buying	0***	0	0	0***	0	0	0***	0	0	0***	0	0	0***	0	0
2 Food bought did not last and no money to buy new one	-0.5764**	0.2792	0.0390	-0.2881	0.3400	0.3968	-0.6375**	0.3041	0.0360	-0.2784	0.3052	0.3615	-4.4573***	0.2147	0.0332
3 Can not eat balanced meal	-0.5403	0.2796	0.0533	-0.5090	0.379	0.1319	-0.4182	0.3059	0.1716	-0.6266**	0.3015	0.0377	-0.5225**	0.2143	0.0148
4 Cut/ skip meals due to lack of money to buy food	-1.3209***	0.2758	<0.0001	-1.3871***	0.3370	<0.0001	-1.4080***	0.3019	<0.0001	-1.2766***	0.3002	<0.001	-1.3365**	0.2124	<0.0001
5 Eat less than what we should	-0.6834**	0.2783	0.0141	0.3018	0.3481	0.3859	-0.2361	0.3071	0.4428	-0.3677	0.3040	0.2265	-0.3020	0.2159	0.1620
6 Hungry but did not eat due to lack of food	-1.2886***	0.2758	<0.0001	-1.1852***	0.3360	0.0004	-.5631***	0.3025	<0.0001	-0.9162***	0.3000	0.0023	-1.2385***	0.2122	<0.0001
7 Lose weight due to lack of enough food to eat	-1.8322***	0.2781	<0.0001	-1.4376***	0.3374	<0.0001	-0.9103***	0.3051	<0.0001	-1.4352***	0.3010	<0.001	-1.6679***	0.2137	<0.0001
8 Not eaten for a whole day because of not having enough money for food	-2.3579***	0.2854	<0.0001	-2.4432***	0.3575	<0.0001	-2.7236***	0.3206	<0.0001	-2.0434***	0.3090	<0.001	-2.3753***	0.2218	<0.0001
Number of strata	149			100			130			119			249		
Likelihood ratio	118.0796			101.3701			142.6875			76.5315			210.1399		
Score	113.8511			96.0305			135.2545			74.4139			202.1638		
Wald	103.2141			84.0578			117.3141			68.7587			181.6877		
Akaike info criterion	886.477			563.140			720.263			729.584			1444.926		
Schwarz criterion	922.060			549.932			754.892			763.594			1484.104		
2 Log likelihood	872.477			549.140			705.263			715.584			1430.926		

*, ** and *** are significant levels at 10%, 5% and 1% level respectively.
Source: Calculated from field survey, 2006/2007

Table-5. Logistic conditional analysis of odds ratio estimates.

	Kogi								Kwara											
	Rural				Urban				Rural				Urban				Combine			
Parameter	**P.E**	95% **confidence**	**Infit**	**outfit**	**P.E**	**95 % conf.**	**infit**	**outfit**	**P.E**	**95 % conf.**	**infit**	**outfit**	**P.E**	**95 % conf.**	**infit**	**outfit**	**P.E**	**95 % conf.**	**infit**	**outfit**
worried	0	0	0.7658	0.5741	0	0	0.9444	0.7713	0	0	0.7767	0.6110	0	0	0.8780	0.6918	0	0	0.8303	0.7713
fnotlast	0.562	0.325	0.9689	0.9584	0.750	0.385	0.6153	0.4886	0.528	0.291	0.8964	0.9109	0.757	0.416	0.7771	0.6592	0.633	0.416	0.8307	0.7820
balmeal	0.583	0.337	1.2273	1.2802	0.601	0.310	1.0803	0.9485	0658	0.361	1.2110	1.0625	0.534	0.296	1.1333	1.1278	0.593	0.390	0.1658	1.1300
cutskip	0.267	0.155	0.9223	0.8503	0.250	0.129	1.0351	1.0372	0.245	0.135	1.0625	1.1304	0.279	0.155	0.8611	0.7407	0.263	0.173	0.9618	0.9167
eatless	0.505	0.293	1.1628	1.3311	1.352	0.684	1.3444	1.8318	0.790	0.432	1.1769	1.2675	0.692	0.382	1.3609	1.6385	0.739	0.484	1.2696	1.4826
hungry	0.276	0.161	0.9725	0.9716	0.306	0.158	0.9963	0.9877	0.209	0.116	0.8184	0.7664	0.400	0.222	1.1175	1.1800	0.290	0.191	0.9756	0.9748
losewt	0.160	0.093	0.9188	0.9015	0.237	0.123	1.0985	0.9639	0.148	0.081	1.0740	0.0919	0.238	0.132	0.9028	0.7858	0.189	0.124	0.9946	0.9218
whlday	0.095	0.054	1.0919	0.9100	0.087	0.043	0.9887	0.7505	0.066	0.035	1.0431	0.8488	0.130	0.071	1.0508	0.8613	0.093	0.060	1.0526	0.8515

Source: Calculated from field survey, 2006/2007
P.E = Point Estimate

Table-6. Distribution of households' affirmative response to the 18 food security items (households with and without children).

Affirmative response (%)										
Item name	**Description**	**Kogi State**			**Kwara State**			**Pooled**		
		HWC	**HWOC**	**ALL**	**HWC**	**HWOC**	**ALL**	**HWC**	**HWOC**	**ALL**
Worried	Worried food would run out	71.5	57.1	70.7	72.9	56.3	71.1	73.8	55.2	71.0
Fnotlast	Food bought did not last	61.7	50.0	60.9	66.9	53.3	65.7	64.0	51.7	63.1
Balmeal	Could not afford balanced meal	65.2	35.7	63.3	60.0	62.2	61.1	63.8	48.0	61.9
Chfewfd	Fed child with few low cost foods	58.7	-	54.9	52.4	-	48.1	55.9	-	51.8
Chbal	Could not feed child balanced meal	58.7	-	54.9	47.6	-	43.6	53.7	-	49.7
Chenuf	Child not eating enough	40.3	-	37.7	47.0	-	43.1	43.3	-	40.2
Cutskip	Adult cut size or skipped meal	49.3	35.7	48.4	51.2	26.7	49.2	50.1	31.0	48.7
Cutskipf	Adult or skipped meals 3+ /month	47.8	35.7	47.0	47.0	26.7	45.3	47.4	31.0	46.2
Hungry	Adult hungry but could not eat	57.8	47.8	52.5	53.3	53.0	53.0	50.6	50.4	52.8
Losewt	Adult lose weight	36.8	7.1	34.9	42.2	13.3	39.8	39.2	10.3	37.1
Whlday	Adult not eating a whole day	28.6	25.9	27.3	33.3	33.1	33.1	31.0	29.2	29.3
Whldayf	Adult not eating a whole day 3+/month	28.6	19.9	24.3	26.7	20.5	23.6	20.2	24.6	24.0
Chcut	Cut size of child meal	39.3	-	36.7	31.3	-	28.7	35.7	-	33.1
Chskip	Child skipped meal	35.8	-	33.5	30.1	-	27.6	33.2	-	30.8
Chskipf	Child skipped meal 3+/month	26.4	-	24.7	27.7	-	25.4	27.0	-	25.0
Chhungry	Child hungry	35.3	-	33.0	23.5	-	21.5	30.0	-	27.8
Chwhlday	Child not eating for a whole day	26.4	-	24.7	19.3	-	17.7	23.3	-	21.5
Eatless	Adult eat less than felt he/she should.	69.2	50.0	67.9	73.3	61.4	67.4	71.3	55.7	67.7
	Total no of households	201	14	215	166	15	181	367	29	396

Note: HWC= Households with children HWOC = Households without children
Source: Computed from Field survey, 2006/2007

Table-7. Classification of all households (those with children + those without children) in both Kogi and Kwara states (pooled data) into food security status based on the 18HFS items.

Characteristics	Kogi and Kwara combined				
	Sample size	**FS**	**FIWH**	**FIWMH**	**FIWSH**
Location					
Rural	227 (100)	31 (13.7)	82 (36.1)	70 (30.8)	44 (19.4)
Urban	169 (100)	32 (18.9)	59 (34.9)	41 (24.3)	37 (21.9)
Total	**396** (100)	**63** (15.9)	**141** (35.6)	**111** (28.0)	**81** (20.5)
Gender					
Male	300 (100)	42 (14.0)	113 (37.7)	81 (27.0)	64 (21.3)
Female	96 (100)	21 (21.9)	28 (29.2)	30 (31.3)	17 (17.7)
Total	**396** (100)	**63** (15.9)	**141** (35.6)	**111** (28.0)	**81** (20.5)
Household size					
0-3	57 (100)	14 (24.6)	21 (36.8)	13 (22.8)	9 (15.8)
4-7	248 (100)	36 (14.5)	86 (34.7)	76 (30.6)	50 (20.2)
8-11	86 (100)	13 (15.1)	34 (39.5)	19 (22.1)	20 (23.3)
≥12	5 (100)	0 (0.0)	0 (0.0)	3 (60.0)	2 (40.0)
Total	**396 (100)**	**63** (15.9)	**141 (**35.6)	**111** (28.0)	**81** (20.5)
Employment status					
Govt/private employed	107 (100)	18 (16.8)	35 (32.7)	28 (26.2)	26 (24.3)
Self-employed	124 (100)	18 (14.5)	43 (34.7)	36 (29.0)	27 (21.8)
No employment	165 (100)	27 (16.4)	63 (38.2)	47 (28.5)	28 (17.2)
Total	**396** (100)	**63** (15.9)	**141** (35.6)	**111** (28.0)	**81** (20.5)
Participation in agriculture					
Participate	218 (100)	36 (16.5)	74 (33.9)	59 (27.1)	49 (22.5)
Do not participate	178 (100)	27 (15.2)	67 (37.6)	52 (29.2)	32 (18.0)
Total	**396** (100)	**63** (15.9)	**141** (35.6)	**111** (28.0)	**81** (20.5)
Marital status					
Married	370 (100)	58 (15.7)	133 (35.9)	104 (28.1)	75 (20.3)
Single	26 (100)	5 (19.2)	8 (30.8)	7 (26.9)	6 (23.1)
Total	**396** (100)	**63** (15.9)	**141** (35.6)	**111** (28.0)	**81** (20.5)

Source: Calculated from Field survey, 2006/2007
Values in parentheses are in percentages, the single includes the unmarried, Divorce and those that have separated

Table-8. Classification of adults in Kogi and Kwara state to food security status.

Characteristics	**Food security status** (Kogi and Kwara)				
	Sample size	**FS**	**FIWH**	**FIWMH**	**FIWSH**
Location					
Rural	227 (100)	42 (49.9)	54 (32.8)	52 (30.8)	21 (12.4)
Urban	169 (100)	52 (22.9)	80 (35.2)	80 (35.2)	23 (10.1)
Total	**396** (100)	**94** (23.7)	**132** (33.3)	**132** (33.3)	**44** (11.1)
Gender					
Male	300 (100)	68 (22.7)	90 (30.0)	109 (36.3)	33 (11.0)
Female	96 (100)	26 (27.1)	36 (37.5)	23 (24.0)	11 (11.5)
Total	**396** (100)	**94** (23.7)	**132** (33.3)	**132** (33.3)	**44** (11.1)
Household size					
0-3	57 (100)	14 (24.6)	15 (26.3)	19 (33.3)	9 (15.8)
4-7	248 (100)	60 (24.2)	76 (30.6)	85 (34.3)	27 (10.9)
8-11	86 (100)	20 (23.3)	35 (40.7)	24 (27.9)	7 (8.1)
≥12	5 (100)	0 (0.0)	0 (0.0)	4 (80.0)	1 (20.0)
Total	**396** (100)	**94** (23.7)	**132** (33.3)	**132** (33.3)	**44** (11.1)
Employment status					
Govt/private employed	107 (100)	25 (23.4)	34 (31.8)	35 (32.7)	13 (12.1)
Self-employed	124 (100)	40 (32.3)	36 (29.0)	35 (28.2)	13 (10.5)
No employment	165 (100)	29 (17.6)	56 (33.9)	62 (37.6)	18 (10.9)
Total	**396** (100)	**94** (23.7)	**132** (33.3)	**132** (33.3)	**44** (11.1)
Participation in agriculture					
Participate	218 (100)	59 (27.1)	70 (32.1)	67 (30.7)	22 (10.1)
Do not participate	178 (100)	35 (19.7)	56 (31.5)	65 (36.5)	22 (12.4)
Total	**396** (100)	**94** (23.7)	**132** (33.3)	**132** (33.3)	**44** (11.1)
Marital status					
Married	370 (100)	88 (23.8)	115 (31.1)	126 (34.1)	41 (11.1)
Single	26 (100)	6 (23.1)	11 (42.3)	6 (23.1)	3 (11.5)
Total	**396** (100)	**94** (23.7)	**132** (33.3)	**132** (33.3)	**44** (11.1)

Source: Calculated from Field survey, 2006/2007
Values in parentheses are in percentages, the single includes the unmarried, Divorce and those that have separated

Table-9. Classification of children to food security status in Kwara and Kogi (pooled data).

Characteristics	Food security status			
	Sample size	FS	FIWH	FIWMH
Location				
Rural	227(100)	84(37.0)	91(40.1)	52(22.9)
Urban	169(100)	64(37.7)	57(33.7)	48(28.4)
Total	**396 (100)**	**148** (37.4)	**148** (37.4)	**100** (25.3)
Gender				
Male	300(100)	109(36.3)	113(37.7)	78(26.0)
Female	96(100)	39(40.6)	35(36.5)	22(22.9)
Total	**396** (100)	**148** (37.4)	**148** (37.4)	**100** (25.3)
Household size				
0-3	57 (100)	24 (42.1)	17 (29.8)	16 (28.1)
4-7	248 (100)	91 (36.7)	101 (40.7)	56 (22.6)
8-11	86 (100)	32 (37.2)	30 (34.9)	24 (27.9)
≥12	5 (100)	1 (20.0)	0 (0.0)	4 (80.0)
Total	**396** (100)	**148** (37.4)	**148** (37.4)	**100** (25.3)
Employment status				
Govt/private employed	107 (100)	44 (41.1	534 (31.8)	29 (27.1)
Self-employed	124 (100)	49 (39.5)	45 (36.3)	30 (24.2)
No employment	165 (100)	55 (33.3)	69 (41.8)	41 (24.8)
Total	**396** (100)	**148** (37.4)	**148** (37.4)	**100** (25.3)
Participation in agriculture				
Participate	218 (100)	95 (43.6)	76 (34.9)	47 (21.6)
Do not participate	178 (100)	53 (29.8)	72 (40.4)	53 (29.8)
Total	**396** (100)	**148** (37.4)	**148** (37.4)	**100** (25.3)
Marital status				
Married	370 (100)	138 (37.3)	138 (37.3)	94(25.4)
Single	26 (100)	10 (38.5)	10 (38.5)	6(23.0)
Total	**396** (100)	**148** (37.4)	**148** (37.4)	**100** (25.3)

Source: Calculated from field survey, 2006/2007