International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Determining Factors that Influence Household Food Insecurity in Uganda: A Case Study of Tororo and Busia Districts

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Abstract

Addressing the national food insecurity problem requires an understanding and measurement of food insecurity at micro-level using a wide range of explanatory variables. Measurement of food insecurity is a challenge because it is a multi-faceted latent and continuous phenomenon explained by many variables. This paper examines these variables and applies exploratory factor analysis to identify variables which significantly influence household food insecurity and how they uniquely associate with specific food insecurity factors. Primary data on food availability, access, utilization and coping strategies were collected from 1175 randomly selected rural households in Tororo and Busia Districts of Uganda. Feasibility of exploratory factor analysis was analyzed using Pearson's correlation coefficient.

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Bartlett's test of sphericity tested for existence of relationships between variables and Kaiser-Meyer-Olkin Measure of Sampling Adequacy tested appropriateness of factor analysis. Factor extraction was done using Principle Component Analysis technique. Factor rotation was applied to achieve distinct associations of each variable with a factor. Twenty six (60%) of the 43 variables were retained and seven factors extracted. Determining key food insecurity factors and their associated variables is a crucial step in development of models that are effective in reliably measuring household food insecurity.

Key words: Food availability, access, utilization, coping strategies, factor analysis

1. Introduction

Food insecurity is a situation in which individuals do not have physical or economic access to the nourishment they need and no access to cash or resources for producing food. Food insecurity, if prolonged, leads to hunger, that is, the recurrent and involuntary lack of access to food [1, 2] [3-5]. In the World Summit on Social Development of 1995 nations committed themselves, under the Millennium Development Goals (MDGs), to reduce by half extreme poverty and hunger by 2015 [6]. Two-thirds (30 out of 44) of countries with the world's 800 million food insecure people are in Africa. Food insecurity was reportedly worsening because the world's population growth was faster than its food stocks [7]. Consequent to the persistent gap between Africa's population growth (2.8% between 1965 – 1990) and its food production growth (1.7 %), Africa depends increasingly on food imports and food aid which in 1994 represented about 10% of food consumed in Africa [8]. The number of chronically undernourished in Sub-Saharan Africa was predicted to rise from 180 million in the 1990s to 300 million by the year 2010.

In Uganda, population pressure on land due to population increasing faster (by 42.9%) than food production (by 18.8%), poor climate due to reduction in forest cover, poor food crop yield due to soil degradation resulting from soil erosion and poor crop management all reportedly contributed to significant reduction in Uganda's food surpluses and in some areas resulted in food insecurity. One in every three (31%) of Uganda's population are absolutely poor. This increases to 60% in the Northern region. Poverty and food insecurity are strong correlates which are experienced by such a significant proportion of the population because of a number of factors which include, among others, limited use of appropriate agricultural technology, over-dependence on rain-fed agriculture, declining soil fertility, pests, stress food sales and inadequate buffer stocks, civil strife, low incomes, poverty and diseases [9-13]. Uganda Government therefore set up a food and nutrition policy programme to ensure good health, social and economic well-being, food security and adequate nutrition for all people in Uganda. Meeting this goal requires that government establish current health, social-economic, food security and nutrition status of the population [9, 14-16]. For food insecurity, which is the focus of this paper, establishing such status meets a number of challenges because food insecurity is a multi-faceted latent phenomenon explained by many different variables which contribute to the phenomenon different proportions of influence.

Several efforts from global to household levels have been made to measure and establish food security status using qualitative and quantitative methodologies. The subjective nature of the qualitative methods means that results cannot be reliably inferred to other similar food security situations. The quantitative methodologies though reliable because of their objective nature, miss out on some key influences that are qualitative in nature. Some of the quantitative approaches have tended to concentrate on aspects of food security while ignoring others. For instance, using food production as a measure of food security excludes vital aspects of food access and food utilization and only addresses food availability. The use of household income or expenditure on food as a proxy of food security may miss-represent those who produce much of the food they consume. This paper suggests that a quantitative method for measurement of food security should incorporate as many measurable variables of all food security components – food availability, food access, food utilization and coping strategies as possible. A list of indicator variables for each of the components was therefore generated and analyzed.

The primary focus of this paper was to identify variables that significantly influence food availability, food access, food utilization and coping strategies. Exploratory factor analysis was used to determine the factors that each of the identified variables uniquely associated with. The main purpose of using factor analysis was to perform data reduction. Exploratory factor analysis was used instead of confirmatory factor analysis because there was no prior information available on the data. Factors were therefore identified and their association with the observed variables determined in the course of analysis. The assumption here was that each variable may be associated with any factor. No prior theory was required; instead factor loadings were used to explain the factor structure. Confirmatory factor analysis (CFA) is used when one would like to set the number of factors and relationship patterns between the measured variables and the common factors *apriori*. A theory is preset based on which the measured variables are evaluated to see whether their association with the factors is as predicted in the theory [17, 18]. An application of the confirmatory factor analysis in a study of food security in the Philippines reduced a set of 77 variables to 55 by predetermining four factors that they associated with [19, 20]. In this paper, 43 explanatory variables of food insecurity were analyzed using exploratory factor analysis after placing them into three major groupings: 10 for food availability, 22 for food access/coping strategy variables and 11 for food utilization. The data set used was 2009 food security data collected from 1175 households. The 43 variables were reduced to 26 (60%), 5 for food availability, 14 for food access/coping strategies and 7 for food utilization. The 26 variables distinctly associated with 7 factors.

2. Materials and methodology

The study area was Tororo and Busia districts in Eastern Uganda which largely survive on crop farming, animal farming and fishing for those who live near rivers or by the shores of Lake Victoria. They experience two rainy seasons March/April and August/October. Typical food crops grown are millet, sorghum, maize, sweet potatoes, cassava, rice, beans, and ground nuts. Fruits are not common and are grown by a few households and they include

Jackfruit, oranges, passion fruits and some sweet bananas. The soils are generally poor in most parts of the districts as they have been over used and yields are low unless manure is applied.

A two-stage stratified sampling design was used where districts were strata, first stage units were local council ones (LC1's) and second stage units were households. Within each district a systematic sample of 18 LC1's were selected. LC1 registers were used to select a simple random sample of 36 households and an extra 4 to be used in case of non-response. The sample size was computed on the assumption that the study area could be divided into four livelihood zones: Two crop farming zones (Tororo, Busia), a fishing and crop farming zone (Busia); and a cattle keeping and crop farming zone (Tororo). The sample size *n* for each zone was computed as:

$$n = D\left[\frac{z_\alpha{}^2 pq}{\ell^2}\right] = 333 \qquad (1)$$

Therefore, the overall sample size was 1332 households. Where p the proportion of food insecure households is assumed to be 0.5 given we do not have data on p from previous studies. At 95% confidence level $Z_\alpha = 1.96$, $q = 1 - p$, the permissible error $\ell =$ 8% for the district and 4% for overall estimates. The maximum permissible value of ℓ for socio-economic studies is 10%. D = 2 was the assumed design effect given that we did not have information on design effect from previous studies. Non response rate was 10%.

Personal interviews using structured questionnaires were used to collect primary data from household heads or their spouses. Focus group discussions and Key informants interviews were conducted to validate information on prices of food crops, local measures used for crop sales like basket sizes, tin sizes and their corresponding prices, existing markets and the food situation in the area. Four enumerators under close supervision of the researcher each collected data from an average of nine households per day for 36 days. Information on quantities of food and non food items were recorded in local measures then converted to standard measures of shillings, kilograms and litres before analysis. The questionnaires had a number of consistency and validity checks which helped in validation and verifying reliability of collected information. Spot checks were conducted to ensure enumerators were doing their assignments according to the study guidelines. Breaks were made in between data collection weeks for brief discussion of field challenges, local measures and conversion procedures used. Coding of open ended responses was also done.

EPIDATA, statistical application software was used for data entry and data cleaning. Exploratory factor analysis was done separately for food availability, food access/coping strategies and food utilization using the Statistical Package for Social Scientists, SPSS. Results generated included: (1) Descriptive statistics of the variables indicating number of cases analyzed and enabled identifying variables with at least 200 cases for factor analysis. (2) R-Matrices showing Pearson's correlation coefficient between all pairs of questions (variables) and probability of these coefficients. In order for factor analysis to be feasible, three requirements were to be fulfilled: First, for any pair of

variables whose correlation was greater than 0.9, one of the two variables was removed to prevent the problem of singularity in the data. Secondly, the determinant of the R matrix was to be greater than 0.00001 in order to avoid the problem of multi-collinearity. Thirdly, any variable that showed no correlation or a weak correlation with most of the other variables was dropped from the set of variables to be included in factor analysis. (3) Bartlett's test of sphericity based on the hypothesis that the original correlation matrix was an identity matrix was to be rejected showing that some relationships existed between variables which could be included in factor analysis.

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value close to one implied that correlations patterns were relatively compact and distinct and reliable factors could be obtained using factor analysis. Acceptable minimum KMO value used was 0.5. If values were less than 0.5 other variables were explored and included so as to attain the acceptable minimum value of 0.5. The condition of having at least 200 records for each analyzed variable in order to use Kaiser's criterion was satisfied. (4) The diagonal values of the Anti-image correlation matrix which were the KMO values for the individual variables were also to be above 0.5 [21, 22]. The off-diagonal elements of the Anti-image correlation matrix, which represent the partial correlations of the variables, were to be very small for a good factor analysis to be feasible. (5) Factor extraction was done using Principle Component Analysis technique that identified which linear components were within the data and how a variable contributed to a given linear component [23]. The linear components (factors or variables) were computed by determining the Eigen values. Eigen values associated with each factor represented the variance explained by the factor. A condition was given to extract components whose Eigen values are greater than one. Factor loadings less than 0.4 were excluded and those equal to or greater than 0.4 were recommended for interpretation. (6) For all the food security components, the factor analysis did not yield distinct association with each of the factors until rotation was applied.

3. Results

3.1 Descriptive statistics

A set of 10 food availability variables, 22 food access and coping strategy variables, and 11 food utilization proxy variables were identified. For food availability the variables were: age and sex of respondent, number of household members, whether other members of the household contributed food or money for food, total land area in acres, total cultivated area, food production trends over last five years, whether crop harvest was less or more than expected or as expected, total value of food harvested and total value of food stored. For food access the variables were: total household members, whether they worried that (1) food would run out before they got money to buy more, (2) the food they harvested or bought did not last and they did not have money to get more, (3) they could not afford to eat balanced meals, (4) they relied on only a few kinds of low-cost food to feed their children because food and money to buy food was running out, (5) they could not feed their children a balanced meal because they could not afford, (6) they ate less than they felt they should because there was not enough money to buy food, (7) they were hungry but did not eat because they could not afford enough food, (8) they would lose weight because they did not have enough money for food, (9) they would not eat for a whole day because food or money for food was not enough.

Other food access variables were: cutting the size of children's meals because food or money for food was not enough, children skipping meals because food or money for food was not enough, children were hungry but they could not afford more food, children not eating for a whole day because food or money for food was not enough, getting food or borrow money for food from friends or relatives, frequency of borrowing from relatives, using borrowing or lending arrangements, sex of person responsible for food expenditure, sex of person who makes decisions about amount of food reserved for the household, the total combined monthly income of all members of the family, percentage of income in the last three months spent on food and whether other members of the household contributed food or money for food for the household. For food utilization variables included: frequency of meals, food commonly eaten as breakfast, lunch and supper for children below 5years, food commonly eaten as breakfast, lunch and supper for children over 5 years and adults, whether they ever ate less than they felt they should because money to buy food was not enough, losing weight because money for food was not enough.

3.2 Summary of results on correlations, determinants, singularity and multi-collinearity

The variables were subjected to a series of tests. For the variables that were eventually selected for factor analysis, the determinants of the R-matrices were all greater than the threshold of 0.00001 implying there was no multi-collinearity. There were no correlations greater than 0.9 which meant there was no problem of singularity. Bartlett's tests were all significant implying original matrices were not identity matrices and implying relationships existed between the retained variables. A summary of the test results are given in Table one.

Food Availability Factors: Factor 1 was land area and food harvested (variables included: Total land owned, total area cultivated and total food harvested). Factor 2 was Food Production Trends and Expectations (variables included: Production trends in past 5 years and whether production expectation was achieved). Food Access/Coping Mechanisms Factors: Factor 1 Inability to access food (variables included: Worried food would run out, food did not last, running out of food and money, did not have balanced meals. Factor 2 coping by reducing amount of food eaten (variables included: Cutting meal size, eating less, hungry but not eating). Factor 3 coping by skipping or missing meals (variables included: Not eating whole day children, adults, Skipping meals and weight loss). Food Utilization Factors: Factor 1 was Poor, cheap low quality or less foods (variables included: No balanced meals, Frequency of meals, eating less, losing weight, low cost foods). Factor 2 was commonly eaten foods for lunch or supper (variables included: Lunch, Supper for below 5 years and Lunch, Supper for household members above 5 years).

4. Discussions

4.1 Food availability factors

Data reduction achieved using the exploratory factor analysis was 40% from 43 variables to 26 variables. Food availability to a household in Tororo and Busia is dependent on total crop harvest. This depends on how much land a household owns and how much of it they are utilizing for food production. This constituted factor 1. The data showed that the major livelihood of 90% of the households was crop farming. Those whose major livelihood was

business were 4.3% while those whose major livelihood was fishing were only 2%. Crop farming required enough land for a household to grow sufficient food. Nearly three quarters (70%) of land owned was reported to be customary land. This means as households get more members, land is divided further among them making available land to households smaller and smaller. Households with 3 to 5 acres of land were 58% while those with 5 to 6 acres of land were 38%. Among those who cultivated their land, 80% used at least 3 to 4 acres of land. One would have expected that with that size of land they would be producing reasonable amount of food. However according to factor 2 on trends and expectations, most households (88%) reported decreasing trends in production for the past 5 years and 89% reported getting less than expected yield in the previous season. These trends are pointers beyond land owned or cultivated to other factors that affect food production and therefore food security.

Table 1: Summary of Results on Correlations, Determinants, Singularity and Multi-collinearity

Tests	Food Availability	Food Access and Coping Strategies	Food Utilization
Determinants of the final R-Matrix	0.379> 0.00001 No multi-collinearity	0.035> 0.00001 No multi-collinearity	0.210> 0.00001 No multi-collinearity
Singularity test	All Correlations <0.9	All Correlations <0.9	All Correlations <0.9
Bartlett's test	Chi-square= 1065.8 with df=15, p=0.00 Significant	Chi-square=1349.6 (df=91), p=0.00 Significant	Chi-square=1828.4 with 21df, p=0.00 Significant
KMO test	KMO = 0.585>0.5	KMO = 0.755 >0.5	KMO = 0.602>0.5
Diagonals of Anti-image correlation matrix	Individual KMOs>0.5	Individual KMOs>0.5	Individual KMOs>0.5
Off-Diagonals of Anti-image correlation matrix (Partial correlations)	Very Small	Very Small	Small except partial correlations for: D144 & D18=0.464, D144 &D155=0.686, D12&D17=0.321
Number Variables	10	22	11
Variables dropped that is those with zero correlations or no significant relationships	5 (50%)	8 (36%)	4 (36%)
Variables retained	5 (50%)	14 (64%)	7 (64%)
Factors formed	2	3	2

Source: Computations from primary data

One would have expected food stored to significantly contribute to food availability. Although it was a significant variable, it contributed little (0.302) to the communalities and was even excluded in factor allocation. Contribution of other household members to food and money for food was not significant. This could be explained by the fact that only 22% of households had other household members who contributed to their food or money for food. Household size would have also been expected to influence food availability. Households with too many dependants may have inadequate food available because there were many mouths to feed but fewer people making inputs into food production. However, in this analysis, household size was dropped from the set of selected variables because it is a confounding variable depending on the household. A household may have many people who are all active in crop farming and therefore making significant contribution to their livelihood. In that case there are chances that they would harvest enough food to feed the entire household. If another household with same number of people has only one or two people involved in farming or raising money for food and the rest just depend on them, food grown may not be adequate. Interestingly, there were households who could have few people involved in farming but cultivated large gardens because they used ploughs and hired workers. The effect of household size on food insecurity is therefore one that is difficult to distinctly establish. An analysis of household size effect would require a control for a number of other factors such as income categories (income classes) and volume of harvest (also a correlate of income).

4.2 Food access and coping strategies

Two out of every three of the households (66%) have trouble getting access to food. Major reasons given are lack of money (50%), unfavourable weather conditions (19%), disease (15) and no land (12 %). Lack of money is a major factor contributing to inability to access food because although most households have land and try to grow crops and harvest reasonable amounts, most of this food is sold cheaply during harvest season to middlemen who take it to the neighbouring countries including Kenya and South Sudan. This was revealed in the focus group discussions and a discussion with some of the opinion leaders. One old man in Tororo district said, “We are bound to continue having famine unless the old system of compulsory storage of food is re-instituted to force people to have as reserve a granary/store of grains and other dry foods.” In the 1960s and 1970s, each home was supposed to store food in a granary whose seal could only be opened with permission of the local chief when a household ran out of food before being allowed to get some and replace the seal. As a result people always had enough food. Food therefore inevitably runs out and people worry and look for cheaper alternatives to survive once the money they obtained from food sales is over as was represented by Factor one.

Coping in case of inadequate food included either eating less food or eating food less frequently as shown in Factors two and three. Among the variables initially selected were number of other members of household contributing food or money to the household. This turned out insignificant as only a few of the households (23%) had one or two other household members contributing food or money for food for the household. Those who contributed up to half the household food were 61%. Percentage of income spent on food in past three months was also not significant because the majority of the households (90%) reported that crop farming was their main source of livelihood in which case

the food consumed was grown and did not require money to buy. This may also explain why income category representing total combined income of the family and use of borrowing/lending arrangements were not significant. Gender-related variables were not selected as significant factor in food accessibility. Variables explored in this study included; who makes decisions on expenditure on food, who makes decisions on food reserved for households and who makes decisions on sell of food.

4.3 Food utilization

Proxy variables for food utilization including frequency of meals, type of foods eaten for the different meals, whether or not one ate balanced meals and weight loss reported, were used. Factor 1 represented quality and quantity of foods while factor 2 was types of foods eaten during meals. It was expected that common diseases would have featured as significant in affecting food utilization because one's wellness determines how much or the kind of foods they are able to intake. Also sickness could result from poor feeding, that is, feeding on low cost foods which are deficient of important food nutrients. However, the common diseases were dropped as they could not result in meaningful analysis.

5. Conclusion

The variables obtained under food availability, food access and food utilization should be used to develop a model combining all the variables as this would give a comprehensive picture of the facets of food insecurity in a household [24]. When used for classification of households the model could lead to more reliable and accurate classification of households by food insecurity status.

Acknowledgements

We would like to acknowledge the support of Carnegie Corporation for the research grant that enabled this study to be conducted. We also acknowledge the support of the Makerere University Graduate School through which we received the grant as part of facilitation for the research as an initial component of PhD research on models for measurement of household food insecurity.

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