Testing Food-Security Scales for Low-Cost Poverty Assessment

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EXECUTIVE SUMMARY

Freedom from Hunger is an international non-governmental organization located in Davis, California. Since 1946, it has been offering innovative strategies to help families around the world suffering from chronic hunger and poverty. In 1990, Freedom from Hunger developed the first integrated microcredit/health and nutrition education programs. Its Credit with Education program currently serves approximately 330,000 families.

Freedom from Hunger has continually valued and emphasized client assessment and the monitoring and evaluation of impacts of Credit with Education on the families it serves. Thus, in 2002, Freedom from Hunger initiated one of the first multi-country studies in the microfinance industry to identify reliable, low-cost, and management-oriented tools to assess and track the changes in the poverty levels of its clients. Freedom from Hunger has used household food security as a key variable in several in-depth impact evaluations and discovered it was suitable as a standard indicator of Credit with Education program impact at the client and household level. Freedom from Hunger then chose and adapted the United States Department of Agriculture's Food Security Scale because of its simplicity in assessing household food security and conducted a study to test the correlation between Freedom from Hunger's modified USDA Food Security Scale and the consumption module from the Living Standards Measurement Survey (LSMS) developed by the World Bank. The goal was to determine whether the food-security scale could also serve as a proxy indicator for poverty.

The study was conducted in partnership with the following local Credit with Education partners and research institutes: Bolivia – CRECER and AGRODATA; Burkina Faso –Réseau des Caisses Populaires du Burkina Faso (RCPB), Centre d'Innovations Financières (CIF) and Research Center of University of Ouagadougou (CEDRES); Ghana - FFH Ghana, the Akoti Rural Bank, and the Noguchi Memorial Institute for Medical Research (NMIMR); Philippines – Center for Agricultural and Rural Development (CARD).

Over 300 households were sampled in each country, comprising both Credit with Education clients and non-clients. Survey data was analyzed with various statistical tests to evaluate the performance of the food-security scale itself, to determine the correlation among the food-security scale, the consumption module data, and the U.S. dollar-per-day per capita poverty line which is used as a global benchmark. The analyses indicated the following (and excludes the data from Ghana due to data-quality issues):

- All of the items (questions) in the food-security scale measure a common phenomenon and do so with approximately equal sensitivity. *This indicates that the food-security scale accurately measures food security and measures it accurately across the three countries.* Where there are differences among the countries, it could be due to how well interviewees interpreted various questions in the survey. It is recommended that additional qualitative studies should be undertaken to gain additional perceptions of food security in different contexts.
- In the three countries included in the analysis, statistically significant relationships between the consumption module and the food-security scale were found. This signifies that as a household becomes more food-insecure, its consumption per capita per day decreases. It also indicates that *household food security may serve as a high-quality proxy for expenditure as a predictor of household "income poverty."*
- Although the tests also indicate that the average consumption per capita per day is significantly higher in the food-secure group, it does not differ significantly between the two food-insecure

groups (food-insecure without hunger and food-insecure with hunger). This indicates that *the food-security scale works well when comparing food-secure households to all food-insecure households and doesn't work as well when differentiating between the two levels of food insecurity* as designed in the survey tool.

- Additionally, when the food-security scale and consumption levels are compared to the dollar-per-day benchmark, food-insecure households primarily fall below the dollar-per-day benchmark, and food-secure families are located above the benchmark. However, this finding is based on a dollar-per-day benchmark that has not been adjusted for purchasing power parity (PPP) because of inconclusive results. This report suggests that perhaps the dollar-per-day adjusted for PPP does not provide relevant and accurate measurements for the countries analyzed in this study. Several other organizations testing poverty assessment tools have also encountered this limitation.
- *The food-security scale will correctly predict whether a household is poor and food-insecure or non-poor and food-secure on an average of 67 percent.* This is an acceptable threshold for Freedom from Hunger's purposes, although the IRIS Poverty Assessment Tools Project has set a goal of 80 percent correct classification for the tools that will be certified by USAID for microfinance institutions. However, the IRIS project has not yet completed its research and analysis and it is yet to be seen whether or not 80 percent correct classification can easily be achieved. Indications thus far suggest that this is barely achievable with even the best and most promising five indicators, of which some are quite time-consuming and expensive to measure.
- This research does indicate that *before the scale can be used, it must be adapted to the local context.* The survey must be correctly translated and tested locally to ensure that respondents understand the questions. More qualitative research conducted with Freedom from Hunger's partners will be important to help reveal local understandings and perceptions of food insecurity. Additionally, the thresholds for indicating whether a household is food-secure or food-insecure (where a household fits on the 0-9 scale) needs to be determined with the help of local health officials or policymakers.

Freedom from Hunger concludes from these findings that the food-security scale provides a valid measure of household food security and poverty levels. Freedom from Hunger will continue to use the food-security scale as an indicator and measurement method for assessing program impact for clients of Credit with Education providers. However, it is recognized that as this tool is implemented and integrated into our partners' social performance systems and monitoring and evaluation processes, we will learn more about how well the scale works in other countries and contexts. Additionally, it will improve our ability to understand how sensitive this instrument might be to changes and interventions affecting people's food-security status.

Other methods and indicators developed and tested by the IRIS project may prove superior to food security measured by the food-security scale, in which case Freedom from Hunger will adopt one or more of the superior methods for making international comparisons of the poverty profiles of Credit with Education and other development programs. On the other hand, food security measured by the food-security scale seems to be a serious contender to become one of the more low-cost, meaningful and valid indicators/measures of household poverty available.

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I. INTRODUCTION

As Freedom from Hunger's work focuses on eliminating chronic hunger and poverty, assessing food security of its clients is central to its mission. For the past two years, Freedom from Hunger has been working to develop and implement a process to track the change in food security and poverty levels of its clients over time. Building on the the U.S. Department of Agriculture (USDA) food-security scales and experiences, Freedom from Hunger made adaptations to these scales so that they could serve two purposes: to measure the changes in food security of a family over time and to have this measurement serve as a proxy indicator for poverty.

The food-security scale (FSS) was developed in 1995 by USDA to measure food access problems and food deprivation of low-income families in the United States. Items in the scale are based upon a respondent's self-report of behaviors, conditions or experiences commonly associated with resource-constrained hunger (skipping meals, reducing variety and quality of foods consumed, anxiety about having enough food to meet the family's needs, etc.). Respondents' responses were used to classify households into three categories—food-secure, food-insecure but not hungry, food-insecure and hungry.

Extensive research by the USDA Economic Research Service has shown that the FSS can be both a simple and reliable way to accurately predict the nutritional status of households--a proxy for anthropometric measures of nutritional status. Freedom from Hunger was attracted to the FSS as a simple way to assess household food security, which Freedom from Hunger's in-depth impact evaluation research in Bolivia, Ghana and Mali had shown was highly sensitive to client participation in a well-implemented Credit with Education program (MkNelly and Dunford, 1998, 1999; MkNelly and Lippold, 1999; MkNelly and Nteziyaremye 2001) and therefore suitable as a standard indicator of Credit with Education program impact at the client and household levels. This is a particularly important finding for Freedom from Hunger because of its mission to promote self-help to overcome chronic hunger, a.k.a. food insecurity, and the more general importance of food security as a major component of poverty, especially at the lower extreme.

The FSS had been modified and tested successfully by the University of California, Davis, Program in International Nutrition for use in Mexico, which led Freedom from Hunger to decide in late 2002 to further test the validity of the FSS for use in a variety of developing countries where Freedom from Hunger works. Freedom from Hunger hypothesized that the FSS, appropriately modified for each country, could become a low-cost but valid and reliable method for measuring household food security along a scale from most food-secure to most food-insecure. Over a relatively short time, as a woman client participated in Credit with Education, her household's score on the FSS could be expected to improve appreciably and thereby be an indicator of general improvement of household welfare due to the client's participation in the program.

In addition to offering this potential as a social impact indicator, the FSS was hypothesized to be a low-cost and acceptably accurate method for predicting the total consumption, or expenditure, of a household and thereby serve as a proxy for the results of the much more extensive and expensive LSMS consumption module. In short, the FSS method of measuring household food security could also be an acceptable, valid and low-cost proxy measure of household poverty level, in terms of expenditure per capita per day. If so, there should be a strong correlation between the FSS score for a household and the daily per-capita expenditure for the same household.

It was further hypothesized that the FSS score, in relation to a locally meaningful cut-off along the scale (allowing conversion from a "continuous" scale score to a binomial yes/no decision as to whether or not the household is food-secure), could predict whether or not the daily per-capita expenditure is above or below the international poverty line of US$1.08. If so, the dichotomous FSS score should have high odds of correctly classifying a household as above or below the international poverty line.

In 2002, Freedom from Hunger initiated a study to test these hypotheses in four countries: Bolivia, Burkina Faso, Ghana, and the Philippines. This report presents the results from the FSS study completed in 2004. It outlines the methods used to conduct the study, the processes utilized to adapt the surveys to the various local contexts, a quantitative and qualitative analysis of the data collected, and a presentation of conclusions and recommendations for further research.

II. METHODS

With the goal of contributing to the identification of easy-to-apply, non-expensive indicators of poverty estimation, a study to test the correlation between a modified USDA Food Security Module and per capita consumption expenditures was conducted in four developing countries (Bolivia, Burkina Faso, Ghana, and the Philippines). The study was conducted by Freedom from Hunger in partnership with local Credit with Education institutions and local research firms: Bolivia – CRECER and AGRODATA; Burkina Faso –Réseau des Caisses Populaires du Burkina Faso (RCPB), Centre d'Innovations Financières (CIF) and Research Center of University of Ouagadougou (CEDRES); Ghana - FFH Ghana, the Akoti Rural Bank, and the Noguchi Memorial Institute for Medical Research (NMIMR); Philippines – Center for Agricultural and Rural Development (CARD). Field work and data collection was conducted between April 2003 and January 2004. Parallel to the field work, the statistical analysis took place between June 2003 and June 2004. Given that the dataset from Ghana confronted some data-quality issues, the analysis for this country is still pending. Therefore, the following report essentially presents the results on Bolivia, Burkina Faso and the Philippines.

A cross-sectional survey study was conducted to assess the correlation between food security, determined by a 17-item Household Food Security Scale, and consumption expenditure per capita per day, measured by the consumption module of the Living Standards Measurement Survey (LSMS) developed and used by The World Bank. A full description of the three survey tools, of partner institutions, the time frame, subjects, study sites, interviewing teams, the field-testing of the surveys, the completion of the final survey tool, and data-analysis methods are covered in this section.

A. Survey Tools

The survey instrument for Bolivia, Burkina Faso, and Ghana incorporated two modules: the Household Food Security Scale and the LSMS Consumption Module. In the case of the Philippines, a third group of indicators was added to the original two modules. These indicators were provided by the Center for Institutional Reform and the Informal Sector (IRIS) of the University of Maryland. IRIS has been funded by USAID to facilitate the task of developing and testing poverty-assessment

tools that will be used by microfinance institutions. Although the IRIS composite tool is described in this report, the analysis of these indicators is not provided.

1. Household Food-Security Scale

Freedom from Hunger adapted the 18-item USDA household food-security scale to include only the items related to household and adult food insecurity, leaving out eight items related to the food insecurity of children. In addition, a major change from the USDA module was to ask each question in a "yes/no" response format, and then follow up with, "How often did this occur: often, sometimes, or rarely?" The intent of this approach was to support the calculation of two scales, one registering *occurrence* of specific measured levels of food insecurity at any time (other than rarely) during the year, the second measuring *the frequency or chronic occurrence* of these conditions. A strength of this measurement approach is that frequent or chronic food insecurity is likely to be more strongly associated with undernutrition and related health and development outcomes.

The only question without a follow-up question was the one related to weight loss. A second important change was to split the question about adults cutting the size of meals or skipping meals into two questions (C6 and C7). These behaviors are quite distinct and indicate substantially different levels of severity of food insecurity. Therefore, we had a total of 17 items in the scale. The adapted Food Security Survey instrument is located in the Appendix.

2. Consumption Module

Although costly and time-consuming, the LSMS surveys provide robust measurements for multiple aspects of household welfare (covering topics such as housing, education, health, agriculture, expenditures, income, etc.) and have been widely used in developing countries as a means to measure poverty. They have also been used to construct the $1 per-day and $2 per-day poverty lines used by the World Bank. For the purpose of this study, only the LSMS modules for household expenditures and income are used as a benchmark for assessing the food-security scale and the indicators from the IRIS composite tool.

Being that Bolivia was the first country where the study was conducted, the LSMS consumption module was initially translated into Spanish. This instrument was adapted to the Bolivian context using the consumption module from the National Statistics Institute's (INE) National Household Survey (Encuesta Nacional de Hogares - ENH) as a reference. This adapted version of the LSMS consumption module was back-translated into English and subsequently was used in the other three countries. As with Bolivia, the survey was also adapted by local research groups in order to reflect the local context in the other countries. Nevertheless, the adaptations made to the survey in each country did not alter the type of information that was gathered in each of the countries.

The consumption module in the survey included the following sections:

Section	**Items**
1. Household roster	Number of household members, age, relationship to interviewee, marital status of interviewee, head of household, relatives mentioned by interviewee but living out of the household
2. Education (for each household member)	Currently enrolled at school, educational level, expenditures in tuition, textbooks, transportation, school uniforms
3. Food and cooking fuel	Bread and cereals, meats, fruits, vegetables, legumes, tubers, dairy

	products, sugar, spices, beverages, oils and fats, and cooking fuel (wood, gas, etc.).
4. Food as payment for employment	
5. Food consumed from own business	
7. Non-food items	Items for housecleaning, personal items and services, clothing and shoes, household equipment, others (books, automobile and bicycle repairs, gasoline, sports equipment, tourism, etc.)
8. Daily expenses	Transportation, newspapers, meals consumed out of home, tobacco, alms and offerings
9. Health	Expenses on public and private health services (including traditional medicine), drugs, remedies, laboratory tests
10. Dwelling expenses and services	Rent payments in cash or goods and services; own house: estimated payment if rented; electricity, phone, water, installations
11. Remittances	Cash and goods
12. Durable goods	Furniture, domestic and electrical devices, automobile, truck, tractor

3. IRIS Composite Tool

The IRIS composite tool consists of various approaches to measuring poverty provided by microfinance institutions (MFIs) that receive USAID funding. The IRIS composite tool was also tested against the LSMS data to determine levels of correlation between the indicators and to determine which indicators would best serve as proxy indicators for poverty. This tool consists of 6 sections and for this study was only used with CARD in the Philippines:

Section	**Items**
A) Household Expenditures	Typical month: Expenditures for all goods and services; Value of self-produced goods consumed; Expenditures on food, school, health, home, utilities, transport, fuel, clothing, savings, others.
B) Food Security	Modified US food-security module – the same tool tested by Freedom from Hunger in Bolivia, Ghana, and Burkina Faso.
C) Household Structure, Income and Expenditures by Household Members	By household member: Income; Expenditures on clothing and footwear; Savings; School attendance
D) Food-Related Indicators	Number of daily and weekly meals; Consumption of less affordable foods; Consumption of "inferior" foods; Storage of staple foods
E) Housing Indicators	Home property; rent; own home value; construction materials; Utilities; number of rooms; Roofing, flooring, and walls materials; Enumerator self-assessment; Cooking fuel; Water connection
F) Asset-Based Indicators	Agricultural assets; Animals; Transportation; Appliances; Furniture; Financial

B. Partner Institutions

In each country, Freedom from Hunger collaborated with local Credit with Education (CwE) partner institutions: CRECER in Bolivia; Réseau des Caisses Populaires du Burkina Faso (RCPB) and Centre d'Innovations Financières (CIF) in Burkina Faso; Freedom from Hunger-Ghana and the Akoti Rural Bank in Ghana; and the Center for Agriculture and Rural Development (CARD) in the Philippines. These institutions provided the research teams with logistic support to help define the

study sites and to access the Credit Associations within the study site. Besides our partner institutions, Freedom from Hunger hired local research firms (Agrodata in Bolivia, the Research Center of University of Ouagadougou (CEDRES) in Burkina Faso, and Noguchi Memorial Institute for Medical Research). Freedom from Hunger also hired one study supervisor in Davis, who had research and work experience in one of the participating countries. In the Philippines, however, CARD put together its own research group to conduct the study.

C. Time Frames

The fieldwork phase of this study took place between April 2003 and January 2004. In Bolivia, data were gathered in April; in Burkina, the data collection took place in June; in Ghana, the survey was administered in August; and finally, in the Philippines data-gathering was carried out between December 2003 and January 2004. In each of the countries this phase of the study took between 1.5 and 3 weeks.

In regards to the survey instrument, there were several different time frames that were used to have a respondent recall periods of food insecurity. The time frame that the food-security questions referred to included the 12 months prior to the interview. The consumption module included different time frames of reference, depending on the item. For example, for daily expenses, the time of reference was the last week, but for clothing the time of reference was during the past 12 months, and for the rent, we asked about the monthly expense. Given the differences in purchasing behavior for food items, the interviewee was asked about how often she/he purchases or consumes a specific item from own production. Subsequently, the subject was asked about the amount purchased or consumed from own production every time, and the value of the item purchased or consumed. Therefore, for items like bread, we found mostly daily expenses, whereas for items like meat, the expenditures showed more a weekly or even monthly pattern.

D. Subjects

In each country our goal was to gather data on 300 households. The sample was a convenience sample of Credit with Education (CwE) clients (2/3 of the sample) and non-clients (1/3 of the sample) . The samples included subjects residing in both urban and rural sites. After defining the study site, we randomly selected a number of Credit Associations within that area. Based on the number of clients in each Credit Association, we generated a list of random numbers. Before the interview, we used the number on the list of clients in each Credit Association to select 8-10 CwE subjects. Corresponding to each Credit Association, 4-5 non-client-subjects were selected in the area. The main criterion of inclusion of non-clients was that candidates did not participate in any micro-credit program, even outside CwE. Interviewers looked for subjects who could be wealthier or poorer than the CwE subjects. Wealthier non-client subjects in the rural locations had income-generating activities other than agriculture, especially trading. In the urban sites they were owners of provision stores, small hotels or restaurants. Poorer non-client subjects in the rural areas were subsistence farmers or farm workers, who worked for others and relied on what they were paid. In the urban area, we recruited poorer non-client subjects mainly in the surroundings of the central plaza who were working in services such as shoe shining, or had very small businesses to sell bread, fruits, or vegetables.

E. Study Site

In each of the countries, the local Freedom from Hunger partner institutions helped us define the study site, which included the following conditions: central urban location surrounded by rural villages. We looked for a town that had good access to the capital city and with enough services to establish the fieldwork team headquarters, and from where we had access to smaller rural villages. In Bolivia, the study took place in the province of Achacachi. In Burkina, the survey was conducted in Ouagadogou, and in Ghana, we worked in Abura Dunkwa. In the Philippines, the study site selected was located in the province of Occidental Mindoro. Most of the study communities were located around a central urban area, where the study headquarters were located.

F. Interview Team

Given that the interviews in Burkina, Ghana, and the Philippines were partially or totally conducted in the local language (Moré, Fanti, and Tagalog, respectively), the interviewers were selected based on their ability to speak the local language, as well as on their previous research experience, writing legibility, and availability for the duration of the study. Most of the interviewers had a Bachelor's degree in economics, social work or linguistics, among other fields. In Bolivia, the survey tool was written in Spanish, but the interviewers and the interviewees spoke the local language and Spanish. In each of the countries, a group of enumerator candidates was selected for a prior training workshop of 3-5 days. The workshop included the following topics: purpose of the study, food security, consumption and poverty measurement, validation of measurement instruments, the role of the interviewer in research studies, and interviewer skill, abilities and responsibilities. Final enumerators were selected based on their performance during the training.

G. Cognitive Testing and Field-Testing of the Survey Tool

Each of the sections in the survey instrument was discussed with the enumerators and CwE staff members in order to identify understanding, cognitive or perception problems. Wording of specific questions was reviewed and adapted based on suggestions made by the enumerators. Given that most of the enumerators were acquainted with local cultural values, they provided big support in adapting the instrument to the local conditions. Subsequently, focus groups consisting of CwE clients that had characteristics similar to the selected sample of subjects were conducted in locations similar to the selected study sites with the goal of examining the understanding of the questions in the tool. Wording of the questions was discussed, and focus group participants were asked if they found the questions and the way they were worded as offensive. This also allowed the enumerators to identify any other issues that would prohibit the survey from being effective. Based on those discussions, changes were introduced into the tool.

H. Final Survey Tool

The modified survey tool was copied and distributed daily to the interviewers, depending on the number of scheduled interviews per day. Initially, each interview took on average 1 hour and 15 minutes. This time was rapidly improved after the first couple of days in the field. During the rest of the data collection phase the average duration per interview was 50-60 minutes.

Data quality was controlled by the supervisors in the field and in the work-team headquarters every day. Problems were discussed with interviewers, who went back to the interviewees to correct identified errors or to clarify any questions on their responses. Completed surveys were gathered every day, stored by the field supervisor, and then were carried in boxes to the research firm headquarters, where the data entry took place.

I. Data Analysis

The local research team conducted data cleaning and the datasets were sent to Freedom from Hunger after the cleaning procedure was completed. Questionnaires were sent by the research firms to Freedom from Hunger in the U.S. in order to double-check for outliers and other problems identified during the initial phases of the statistical analysis.

Data analysis was conducted using the software STATA version 8.0, as well as SPSS version 12.0. An initial procedure to identify outliers and missing data was conducted by the analysts. Where missing data were found, and in case the specific questionnaire review didn't provide any additional information, we used median values from subjects with similar characteristics (client/non-client; urban/rural; age of interviewee; amount of the item consumed; frequency of consumption; etc).

Descriptive statistics were generated for each country sample. Consumption per capita per day as a continuous variable was correlated with the raw food-insecurity score (Pearson correlation), as well as with the categorical variables of food insecurity (one-way ANOVA). The food-security score as a continuous variable was correlated also with a dichotomous variable of consumption of one dollar or less per capita per day (one-way ANOVA). Categorical variables of food insecurity and of poverty based on consumption were also correlated using Chi-square analysis. Multivariate regression analysis was conducted to control for some of the characteristics of the household and the interviewee. Rasch modeling, which was the same statistical method used to develop the food-security scale, is also utilized to assess household data. Further description of Rasch modeling is included in Section Three. Finally, reliability of the scale was measured using Cronbach's Alpha.

1. Food-Security Scale

Responses to questions in the food-security scale can be "often," "sometimes," "rarely," and "yes" or "no." A set of dichotomous variables was coded 1 (affirmative) for responses of "often" or "sometimes," and 0 for responses of "no" to the base question or for response of "rarely" to the follow-up if the response to the base question was "yes." We then summed the responses to the items to calculate the raw score for the scale, registering the most severe food insecurity that occurred at any time during the year (other than very rarely). Since there was no "how often did this occur?" follow-up to the question about losing weight, we included it in the "ever in the year" scale with "yes" responses coded as 1 and "no" responses coded as 0. Using this procedure we generated a raw food security score between 0 and 9 points, with 0 corresponding to the most food-secure households and 9 to the households most severely affected by food insecurity. Three food-security levels were generated with the following cut-off points: Food-secure households (0-2 points); Food insecure households without hunger (3-5 points); Food-insecure households with hunger (6-9 points). A dichotomous variable was also generated with two levels of food insecurity: Food-secure households (0-2 points in the score) and Food-insecure households (3 or more points).

2. Consumption module

Aggregates for each of the sections in the consumption module were calculated, as well as a total aggregate of consumption per household. The total aggregates were calculated for one year, taking into account the different times of reference for the items in the tool. The total consumption aggregate was divided by the number of household members (all those who shared consumption for at least 3 months during the last 12 months). Finally, annual consumption per capita was divided by 365 days. That way we generated a variable of consumption per capita per day. The PPP adjustment for the poverty line resulted in very few households under the poverty line (e.g. Bolivia – 5 households; Philippines – 1 household). In order to be able to perform bivariate and multivariate analysis, we decided to use convert the national currency to the 1 US dollar (USD) as benchmarks. In some cases, this was also equivalent to the national poverty line.

3. IRIS Composite Tool Indicators

Other IRIS poverty indicators were treated as continuous as well as categorical variables, depending on the nature of the questions, where the relationship of these indicators with expenditure (LSMS-consumption) both as a continuous variable (total household expenditure and expenditure per capita per day) and as a categorical variable (< 1 USD/capita/day) was assessed. Results are not included in this document.

III. ANALYSIS

The following analysis includes descriptive statistics of the datasets, bivariate and multivariate statistical analyses. Additionally, the FSS is analyzed using Chronbach's Alpha and Rasch modeling. The Rasch modeling analysis was conducted with the expertise and assistance of Mark Nord from the USDA.

A. Descriptive Statistics

Given the problems we had with the quality of the Ghana dataset, the following results in some places reflect only the analysis of the datasets for Bolivia, Burkina Faso, and the Philippines:

Characteristics of the sample (See Table 1).

- The total sample size in each of the countries was higher than our initial goal of interviewing 300 households in each study setting. The final sample size was: Bolivia=327 households (HH); Burkina Faso=330 HH; Ghana=336 HH; and the Philippines=349 HH. Total sample size = 1,342 households.
- In the four countries, the sample of interviewees included 2/3 CwE program clients and 1/3 non-clients.
- Excluding the Ghana sample, over 2/3 of the interviewees lived in the rural communities. 50% were rural households in the Ghana data set.
- The average age of interviewees for all four samples ranged from 38-41 years.
- The majority of interviewees were female (83 – 96%) and the majority of them reported to be married or living with a partner.

- School attendance of interviewees was low in the four samples. More than 2/3 of the interviewees had a formal educational level of elementary school or less.
- With the exemption of the Burkina sample, the average household size was about 5 household members. The average household size in Burkina was 11.
- The Bolivian sample has some characteristics that suggest that this group is wealthier than the Burkinabe and the Philippine subjects. The mean consumption/capita/day was higher in Bolivia than in Burkina and the Philippines (US $1.74 vs. $0.66 and $1.15, respectively).
- However, the mean food-security score was lower in the Philippines (2.3) than in Bolivia and Burkina (4.5 and 5.2, respectively). Consequently, the percentage of food-secure HH was higher in the Philippines than in Bolivia and Burkina (65% vs. 30% and 27%, respectively).

B. Bivariate Analysis

Relationship between poverty (by consumption) and food insecurity (by food-security scale) (See Table 2).

In the three countries, statistically significant relationships between consumption and the food-security scale were found.

- The correlation between both measurements seems to be stronger in Bolivia than in Burkina and the Philippines.
- In the three countries, the group with the lowest food-security score (0 points) shows the highest mean consumption/capita/day in United States dollars.
- A trend towards a lower consumption/capita/day is observed as food-insecurity scores deteriorate, with a clearer, stronger trend in the Bolivia sample.
- Once the mean score has a certain level, it remains low but stable.

- *Mean consumption per capita per day is significantly higher in the food-secure group* (score: 0-2) *in the three countries*, *but it does not differ significantly between the two food-insecurity groups* [food-insecure without hunger (score: 3-5) and food-insecure with hunger (score: 6-9)]. Thus, the mean consumption per capita per day is significantly higher among food-secure households (score: 0-2) when compared with food-insecure households all together (score: 3-9).

- The mean food-security score is lower among those households with consumption > 1 USD per day. The difference is statistically significant ($p = 0.0000$) only for Bolivia and the Philippines; but it is marginally significant for Burkina ($p = 0.07$).

- 86% of the Bolivian HH living on 1 USD or less per capita per day were classified as food-insecure; the same applies for 75% of the HH in Burkina living with US$1 or less per capita per day. On the other hand, only 45% of those households living in the Philippines with 1 USD or less per capita per day were classified as food-insecure. Nevertheless, 79% of those classified as food-insecure in the Philippines were under the 1 USD cutoff point, and 80% of those over 1 USD per capita per day were classified as food-secure.

- 90% of the HH classified as food-insecure in Burkina were living with 1 USD or less per capita per day.

In conclusion, the comparison of the FSS scores and LSMS consumption module data for expenditure per capita per day showed a statistically significant, though not large correlation coefficient, over the range of poverty represented in the convenience samples (about 300 for each site). This result is hardly surprising, but reassuring given the intuitively strong relationship between daily household expenditure and access to adequate quantity and quality of food throughout the year. The slope of the Pearson correlation is important, as it is the statistical significance of the correlation, but even a sharper slope means no more than a hint that the association exists. Finding statistically significant correlations enabled further explorations into this relationship: multivariate models, where the association was adjusted by other variables, sensitivity and specificity analysis, and Rasch modeling were utilized as additional research models and the results are described below.

C. Multivariate Analysis (Tables 3 and 4)

- **The association found in the bivariate analysis remained statistically significant ($p < 0.05$) or marginally significant ($p < 0.10$) in the multivariate regression and logistic analysis, adjusting by several HH and interviewee characteristics.**

- By each point of increase in the food-security score (meaning they are more food-insecure), the consumption per capita per day went down significantly in the three samples: Bolivia (8 cents), Burkina (4 cents) and the Philippines (4 cents), ($p < 0.05$).

- In Bolivia, the probability of living with 1 USD or less per capita per day was significantly higher ($p= 0.03$) in the food-insecure group than in the food-secure group (2.8 times).

- In Burkina's whole sample, the probability of living with 1 USD or less per capita per day was higher in the food-insecure group than in the food-secure group (1.8 times), but the difference between the groups was only marginally significant ($p = 0.1$). Nevertheless, when analyzing the Burkinabe dataset separately by location of the household (urban/rural), the urban food-insecure households showed a much higher probability of been categorized as poor (4 times) than food-secure households. The odds ratio coefficient in this case was statistically significant in the multivariate analysis (0.02). In the rural area, however, food-insecure households didn't show a higher likelihood of being categorized as poor. (See Table 5.)

- In the Philippines, the probability of living with 1 USD or less per capita per day was significantly higher (2.8 times; $p = 0.000$) in the food-insecure group than in the food-secure group**.**

D. Sensitivity and Specificity (Tables 5-8)

Tables 5 through 8 show accuracy of the FSS data in classifying households as poor or non-poor. Table 5 summarizes all three sites, using USDA's standard cut-off on the 0 to 9 scale between the scores 2 and 3, so that scores 0-2 represent "food-secure = non-poor" households, and scores 3-9 represent "food-insecure = poor" households. The Burkina Faso data are disaggregated into rural

and urban data sets, because clearly the two combined give insignificant results, whereas the urban data set by itself shows statistically significantly elevated likelihood (4.1 times more likely) of a household in fact being poor (by expenditure data) when it is determined to be food-insecure (score 3-9) than when it is determined to be food-secure (score 0-2). The rural data set in Burkina Faso seems to lack sufficient variability in poverty levels of households to produce statistically significant odds results. Alternatively, the questions in the FSS were not sufficiently adapted in the rural sample, through cognitive testing, to ensure that the respondents had reasonable understanding of the meaning of the questions.

In contrast, the full data sets from Bolivia and the Philippines offer highly significant odds of accurate classification. However, in both countries higher odds are found at other cut-offs along the FSS. Tables 6-8 show the same data points as Table 5, but for every possible cut-off point along the FSS. Somewhat higher odds are found at higher cut-off points in both countries. Taking into consideration the data for sensitivity and specificity (probabilities of classifying poor households as food-insecure and non-poor households as food-secure), the data for positive predictive value and negative predictive value (probabilities of classifying food-insecure households as poor and food secure-households as non-poor), maximizing the statistical significance of the odds ratio, and avoiding cut-off points too high or low to be intuitively reasonable, it may be more reasonable to choose an FSS cut-off between 3 and 4 in Bolivia and the Philippines, rather than the cut-off point between 2 and 3 that works best in urban Burkina Faso. This variability from country to country indicates the importance of engaging local experts in food security or nutrition research to choose the cut-off point that seems the most meaningful in the local context (given the similarity or difference between the questions--and resulting answers--immediately above and below the cut-off).

It is interesting that specificity is nearly the same (in Bolivia) or slightly higher (in urban Burkina and in the Philippines) as the sensitivity. In contrast, the positive and negative predictive values are very different in all three cases—positive predictive values are much lower than negative predictive values in Bolivia, but much higher in urban Burkina and the Philippines. This illustrates the sensitivity of the data to the site and the importance of adaptation to local situations. One interpretation of these data would be that the Burkina and Philippine situations lend themselves to high frequency of "false positives" (relatively low *negative* predictive values) because there are many food-secure households clustered near the international poverty line, where a very slight variation in per-capita daily expenditure will push a household above or below the poverty line, even though the household is food-secure. In Bolivia, the opposite may be true--clustering of food-insecure households around the poverty line--leading to many false negatives in the other direction (relatively low *positive* predictive values), with many food-insecure households appearing to be non-poor due to a few pennies difference in daily expenditures.

Sensitivity and specificity data are not subject to the same volatility from country to country, it seems. The average of these two percentages yields the percentage of poor or non-poor households correctly classified as food-secure or food-insecure. For all FSS cut-off points in Bolivia, the range is from 65.1 to 67.9 percent correctly classified (omitting the two extremes at each end of the scale). For urban Burkina, the range is 67.6 to 69.6, and for the Philippines, 64.5 to 67.7. Taken all together the range is 64.5 to 69.6. The mid-point value is about 67 percent correctly classified, or a two in three chance of getting the classification right. This would indicate that the food-security scale will correctly classify a household status correctly 67 percent of the time. Thus, food-insecure houses will be classified as poor and poor households will be classified as food-insecure 67 percent of the time (and vice versa for non-poor and food-secure households).

E. Rasch modeling

In order to learn about the performance of the food-security tool in various settings and samples of subjects, we examined the food-security tool using Rasch modeling. Rasch modeling helps us to assess survey items for scale construction, create a survey from those items, and evaluate the performance of the scale in any given sample of individuals. Additionally, it helps identify poorly functioning items in the scale as well as unexpected responses.

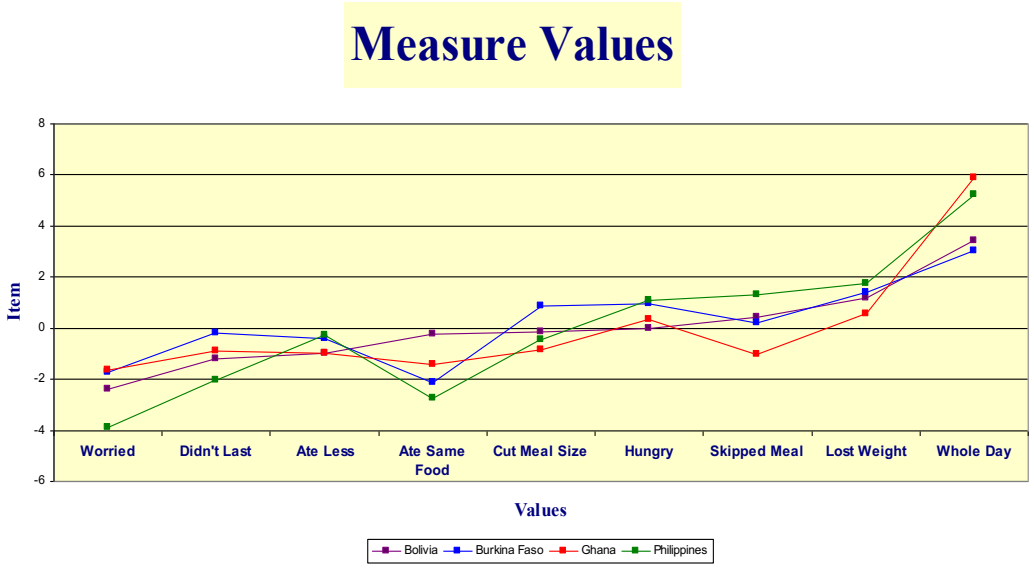
We fit the nine items (the main nine questions, excluding their follow-up questions on how often, i.e. often, sometimes, rarely) to the single-parameter Rasch model. The scale was assessed by examining item-fit statistics and the measurable range of household scores (compared with measurement error). The fit values help us determine how well each of the items in the scale fits in the model. Dimensionality was assessed by conducting a linear factor analysis of the item-household residuals from the Rasch model, normalized by expected variance. Relative item severities[1] were compared with those of corresponding items (considered to be equivalent in meaning) in the original USDA scale. The comparison of relative item severities to the U.S. scale was intended primarily to assess the comparability of measured severity levels and prevalence statistics between the countries.

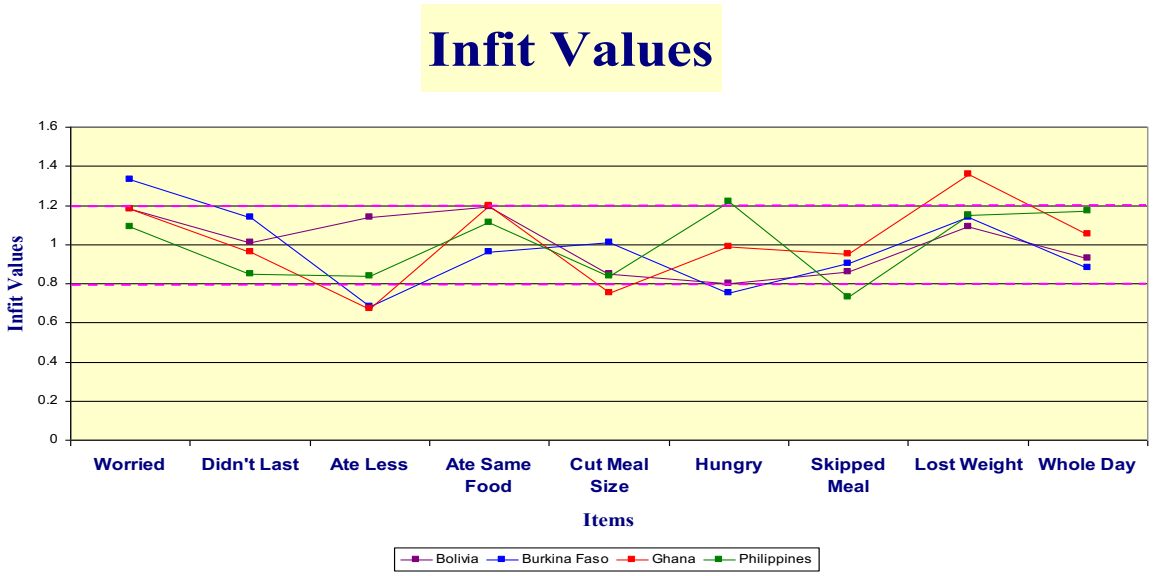
This procedure also allows comparison of average item discrimination of the country surveys with that of the U.S. survey. Average item discrimination is a measure of the consistency of ordering of responses to questions that measure different levels of severity of food insecurity. For example, if an item has low discrimination, this indicates that the item in the scale is less consistently related to the common underlying phenomenon of food insecurity. This, in turn, provides information on how consistently questions are understood and the behaviors and conditions are related to an underlying phenomenon of resource-constrained difficulty in accessing enough food.

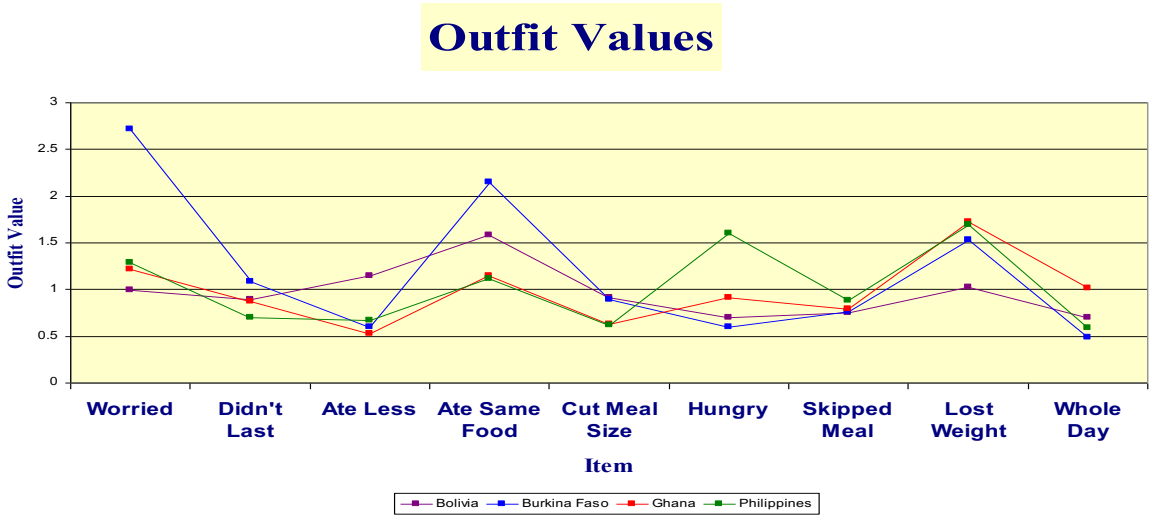
Item-fit statistics were quite good (near unity) for all items, *indicating that they measure a common phenomenon and do so with approximately equal sensitivity*. Infit statistics ranged from 0.70 to 1.35. See the graphs below. The Rasch model assumes that all items discriminate equally. Under this assumption, all infit and outfit statistics would be 1.00. Among other considerations, this assumption is required to assure that the raw score is an ordinal measure of the severity of food insecurity and that each raw score maps to a unique scale score regardless of which specific items are affirmed to achieve the raw score. However, a range of 0.8 to 1.2 is generally considered to be quite good. Outfit statistics are sensitive to highly unusual or improbable responses. Some items had a high infit and/or outfit, especially in Burkina and Ghana. Given that the food-security tool is based on people's perception of their food-insecurity situation, the differences in data between the countries could be determinant in how well the respondents interpreted the questions in the surveys. Where these high measurements occur, the question in the survey is most likely less clearly understood than the other questions or the behavior is less consistently related to food insecurity than are the behaviors reported in response to the other questions.

[1] Item Severity: The items in the food-security scale vary across a wide range of severity levels of food insecurity. For example, a person who is worried about lacking enough money for food is less severe than a person not eating all day long because they can't afford to purchase food. Not eating during the day indicates a more severe level of food insecurity than the former. In response patterns, you'd most likely see that the more severe items are less frequently affirmed than less severe items and that a person who affirms a severe item will also most likely affirm all less severe items.

Differences between rural and urban areas, especially in Burkina, illustrate how important it is to identify how differences in location might affect the results of administering the questionnaire to diverse population groups. For example, average item discrimination in Burkina Faso was 15 percent higher for urban respondents than rural respondents. This may indicate respondents from urban areas understood the questions better due to higher education and literacy or it may indicate that this scale, which was originally developed in the U.S., is more appropriate for urban populations than rural populations in Burkina Faso. Scaling analysis, especially outfit values, need to be further explored in detail to see if outlier respondents might be affecting the significance of the explored relationship between food insecurity and hunger. In some cases, one or two households might be determining the observed misfit of some of the items. The misfit of these items is in most cases not excessive. It is definitely recommended to include them in the scale at least until it can be assessed in a much larger survey.







F. Reliability

Cronbach's alpha measures how well a set of items (or variables) measures a single unidimensional concept. It is a coefficient of reliability (or consistency). A reliability coefficient of **.80** or higher is considered "acceptable" in the field of social science.

Reliability as assessed by Cronbach Alpha was over 0.82 in the four countries. This indicates that the items in the scale are highly correlated to each other and that they are measuring the same underlying concept. This further indicates that the food-security scale has high or good reliability as a scale.

Country	Cronbach α
Bolivia	0.82
Burkina Faso	0.89
Ghana	0.85
Philippines	0.86

IV. CHALLENGES AND LIMITATIONS

This study represents the first time that the proposed food-security tool was tested simultaneously in four countries located throughout three continents. This effort itself represents a very important achievement in the search for valid and reliable indicators to assess household food insecurity and its underlying causes. On the other hand, the resources and time available to conduct the study, as well as the particular needs of the institutions carrying out the research, posed a number of challenges and limitations constituting the framework for the interpretation of the results. Therefore, awareness of the limitations faced by the researchers and the supporting micro-credit institutions is essential to better understand the findings.

As mentioned above, the data collection phase of this study took place between April 2003 and January 2004. In February 2003, Freedom from Hunger officers and researchers prepared the initial survey draft and coordinated and set up the needed collaboration network.

A. Sampling

The first challenge faced by our research team was to decide on the type of sample to be included in the study. From a technical point of view, it was essential to have a sample with the adequate size and variability to guarantee enough power and confidentiality. Given that CwE institutions focus their efforts in the poorest population groups, having a sample with a good balance and distribution between very poor and wealthier households (food-insecure and food-secure households) represented a constant worry. Because of the nature of CwE programs also, the study was usually conducted in more rural than urban-poor regions of the four countries, which again represented an impediment to have a sample with a good variability.

In order to decrease the effects of this situation, we decided to include at least 100 households (1/3 of the sample) that were non-clients in any micro-credit initiative. Those households were meant to be wealthier (because the majority of CwE clients are poor) as well as poorer than CwE participating households, which in addition to being poor also needed to have the ability to pay any loans they had received. Our attempt to have a more variable sample was limited by the type of population living in the chosen study sites, but all field-work teams made the best effort to include non-clients with the characteristics that were needed in the survey.

To illustrate this problem, Table 1 shows the percentage of households under the poverty cut-off point of 1 USD per capita per day expenditure. Although we achieved our goal of having 1/3 of the sample from non-CwE client households, approximately 60% of the participants in the Philippines

and almost 90% of the Burkinabe households were under the chosen poverty line. In Bolivia, although ¼ of the households were classified as poor, the mean expenditure per capita per day was under US $1.75. Additionally, less than 30% of the interviewed households spent more than 2 dollars per capita per day, and less than 4% reported expenditures higher than US $4 per capita per day.

B. Time and Resource Limitations

A second very important limitation faced by this study is the time and resources that remained available after the quantitative research to conduct qualitative research and to explore more in-depth the items included in the proposed food-security tool, as well as the local concept of food insecurity and hunger. A series of no more than two focus groups per country was carried out to conduct cognitive testing of the questions. During those focus groups, we also very briefly discussed with the participants the issues that related to the consumption module, which allowed for some modifications on the questionnaire.

C. Using the International Poverty Line Adjusted by PPP as the Benchmark

The data analysis ran into a serious problem with the Purchasing Power Parity (PPP) adjustment, in that once expenditure data were adjusted for conversion to US dollars, only one household of about 300 in the Philippines qualified as "poor" in relation to the (adjusted) international poverty line. In Bolivia, only three households of about 300 qualified. The problem is not likely due to the samples, because special effort was made to ensure that a good number of very poor households, as well as wealthier households, were included at each site. More likely, the problem relates to the PPP adjustment method's relevance to the sites chosen for this research (USAID's Don Sillers, personal communication regarding commentary of PPP experts -- letter from Angus Deaton). Data analysis reverted to use of the prevailing market exchange rate in each site to convert expenditure data in local currency to US dollars. This is an unsatisfactory solution for comparison with research by IRIS and others who have done PPP adjustments to the expenditure data. But it was the best solution at the time of writing this report.

V. CONCLUSIONS

As mentioned above, understanding the limitations allows us to contextualize the results of the study. Although the decrease in expenditure didn't show a totally linear pattern as the food-security score increased, in all cases the more food-secure households (those with 0 points in the score) had the highest expenditure per capita per day. Food-secure households, using the cut-off point of 2 or less points in the score, always reported a significantly higher expenditure than the food-insecure groups. The bivariate analysis presented a consistently significant relationship between both the poverty and food-security indicators. The multivariate linear regression and logistic regression analysis confirms this association, adjusting by a number of indicators statistically or theoretically related to poverty. The Rasch modeling from each of the three data sets show that the modified FSS used in these tests functioned as a proper scale, with relatively smooth progress of answers from indicating high food security to high food insecurity.

It was reassuring that the FSS will correctly classify a household as food-secure/non-poor and food-insecure/poor approximately 67 percent of the time. By Freedom from Hunger standards, this threshold is acceptable for our purposes in assessing the food security and poverty of our clients. The IRIS Poverty Assessment Tools Project (www.povertytools.org) has set a goal of 80 percent correct, which its early data from Bangladesh (data from Kazakhstan, Peru and Uganda will be analyzed soon) indicate this goal can be barely achieved with a composite of the five best indicators being tested, some of which are quite time-consuming to measuring (such as expenditure). The single food-security indicator, measured by the FSS (relatively easy to administer in 10 minutes or less), comes acceptably close in accuracy as a predictor of household poverty level. However, the difficulty of comparing the results of this study with those of the IRIS project will be the failure of the PPP adjustment to work properly in this project (as described in the limitations of this study).

The overall results encourage Freedom from Hunger to use the FSS in its programs as a method for estimating household food security as an indicator of general program impact at the household level. And this method is expected to show improvement of the indicator as the client's time in the program increases, especially as the FSS is similar in concept and format to the food-security questions shown in the above-cited impact research studies to be sensitive to length of participation in the program. The use of the proposed household food-security questionnaire in other settings, the further exploration of its validity, as well as the regular application as part of monitoring and evaluation systems by CwE institutions, will improve our ability to understand how sensitive this instrument might be to changes and interventions affecting people's food-security status.

Freedom from Hunger concludes from these findings that the FSS provides a low-cost, meaningful and valid measure of household food security. Freedom from Hunger will use this indicator and measurement method for regularly assessing program impact for clients of Credit with Education providers. Freedom from Hunger will also use the FSS to classify households as very poor (food-insecure) or not-so-poor (food-secure). The utility of this indicator, and method for measuring it, to classify household poverty in relation to an international poverty line, is less certain. Further research is needed to assess the variation in utility from country and to deal with the problem of purchasing power parity adjustment. Other methods and indicators developed and tested by the IRIS project may prove superior to food security measured by the FSS, in which Freedom from Hunger will adopt one or more of the superior methods for making international comparisons of the poverty profiles of Credit with Education and other development programs. On the other hand, food security measured by the FSS seems to be a serious contender to become one of the more low-cost, meaningful and valid indicator/measures of household poverty available.

VI. FUTURE ASSESSMENTS RECOMMENDED

The results of this study represent a major achievement in the search for meaningful, non-expensive, and valid indicators suitable to be applied in a variety of settings and population groups. In addition to the items mentioned above as future research items, two additional recommendations are presented.

The items included in the instrument should be further assessed using qualitative methods to better understand local concepts and perceptions about food insecurity and hunger. The surveys also represent a very important instrument for local agencies to continue the discussion on how to

enhance, modify, and adapt the proposed measurement. The generated datasets represent an important asset that needs to be explored in depth.

Questions on which consumption areas are stronger related to the food-security measurement also remain subject to future assessments. Preliminary analysis of how food expenditure is related to food insecurity is shown in tables 9-11. In the three countries, food expenditure consistently decreased as food-insecurity level became more severe. It is interesting to point out that whereas in Bolivia, where the main staple food is tubers, a significant difference between the food-insecurity levels was found with regards to expenditures on cereals. In the Philippines, where the main staple food is rice, although the food-secure group spent more money in cereals than the food-insecure groups, that difference was not statistically significant. Probably because of the close location to the Titicaca Lake in Bolivia (the same as in the Philippines), no significant differences were found in the expenditures on fish. Nevertheless, in the two countries significant differences were found in the expenditure on meat and dairy products, as well as in fruits and vegetables. Further analysis of food expenditures could therefore highlight some interesting factors that would additionally be very indicative of a household's poverty level in different country or regional contexts.

Finally, additional research should also be conducted to determine whether or not a screening process should be included in the administering of the survey. During the study, all households were asked all questions in the food-security scale. This is advantageous for purposes of scaling analysis, as any screening tends to artificially improve the fit to the Rasch model by eliminating certain improbable response patterns. For later routine monitoring use, especially in a survey that includes less vulnerable populations, a screen after C4 or C5 might be considered. Households that have indicated no food-access problems up to that point could skip over the remaining questions with little loss of information.

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VIII. APPENDIX

A. Food-Security Survey Instrument Example

Now I will ask you questions about the food eaten in your household in the last 12 months, in other words, from August of last year until now.

C1. I will read 4 choices for your response. Please tell me, which of the following best describes the food consumed in your household:

1) Always ate enough of what I wanted
2) I had enough food but not always the kinds I wanted
3) Sometimes I did not have enough food
4) Often I did not have enough food ☐

C2. Please tell me if during the last 12 months, that is from last August until now, were you worried that your food would run out before you had money to buy more?

1) Yes
2) No –*Go to C3* ☐

C2a. How often did this occur?

1) Often
2) Sometimes
3) Rarely ☐

C3. Please tell me if during the last 12 months, that is from last August until now, the food you had was not enough and you did not have enough money to buy more?

1) Yes
2) No – *Go to C4* ☐

C3a. How often did this occur?

1) Often
2) Sometimes
3) Rarely ☐

C4. Please tell me if during the last 12 months, that is from last August until now, you had to eat the same foods daily because you did not have money to buy other foods?

1) Yes
2) No- *Go to C5* ☐

C4a. How often did this occur?

1) Often
2) Sometimes
3) Rarely ☐

C5. Please tell me if during the last 12 months, that is from last August until now, you have served yourself or any other adult in your household less food because you did not have enough money to buy food?

1) Yes
2) No – *Go to C6*

C5a. How often did this occur?

1) Often
2) Sometimes
3) Rarely

C6. Please tell me if during the last 12 months, that is from last August until now, you skipped any meals (breakfast, lunch or supper) because you did not have enough money for food?

1) Yes
2) No –*Go to C7*

C6a. How often did this occur?

1) Often
2) Sometimes
3) Rarely

C7. Please tell me if during the last 12 months, that is from last August until now, you ever ate less than you felt you should because you did not have enough money to buy food?

1) Yes
2) No – *Go to C8*

C7a. How often did this occur?

1) Often
2) Sometimes
3) Rarely

C8. Please tell me if during the last 12 months, that is from last August until now, you were ever hungry and did not eat because you did not have money to buy enough food?

1) Yes
2) No – *Go to C9*

C8a. How often did this occur?

1) Often
2) Sometimes
3) Rarely

C9. Please tell me if during the last 12 months, that is from last August until now, you lost weight because you did not have enough money to buy food? This loss of weight should not be due to stress, hard work or sickness.

1) Yes
2) No

C10. Please tell me if during the last 12 months, that is from last August until now, you or another adult in your household stopped eating for an entire day because you did not have enough money to buy food?

1) Yes
2) No –*Go to D1*

C10a. How often did this occur?

1) Often
2) Sometimes
3) Rarely

Observations

_____

_____

B. Tables 1-11

Table 1: Characteristics of the sample

Characteristic	Bolivia (N=327)	Burkina Faso (N=330)	Philippines (N=349)
Membership in CwE			
Clients	66.7% (218)	63.4% (210)	67.9% (237)
Non-clients	33.3% (109)	36.6% (120)	32.1% (112)
Yrs of membership in CwE (if interviewee=client)	2.6 (±3.1)	4.4 (±2.9)	0.3 (±0.1)
Area of residence			
Urban	25.7% (84)	30.9% (102)	13.2% (45)
Rural	74.3% (243)	69.1% (228)	86.8% (296)
Gender of interviewee			
Female	83.2% (272)	96.1% (317)	100% (349)
Male	16.8% (55)	3.9% (13)	
Marital status of interviewee			
Married or living with partner	76.6% (250)	89.7% (296)	91.6% (316)
Single	11.7% (38)		2.0% (7)
Widow	8.3% (27)	8.5% (28)	5.5% (19)
Divorced or separated	3.4% (11)		0.9% (3)
Household size (#of persons)	4.9 (± 2.2)	11.1 (±6.6)	5.3 (±2.1)
Educational level			
Less than elementary	20.1% (66)	85.8% (283)	0.9% (3)
Elementary	51.1% (167)	10.9% (36)	41.0% (143)
Secondary school or high school	26.0% (85)	3.0% (10)	42.7 (149)
> than high school	2.7% (9)	0.3% (1)	14.5% (49)
Food-insecurity raw score	4.5 (±2.7)	5.2(±3.1)	2.3 (±2.5)
Food-security status			
Food-secure (0-2 points)	29.7% (97)	27.0% (89)	64.5% (225)
Food-insecure w/o hunger (3-5)	26.9% (88)	21.5% (71)	21.8% (76)
Food-insecure with hunger (6-9)	43.4% (142)	51.5% (170)	13.7% (48)
Consumption/capita/day (U$*)	1.74 (±1.17)	0.66 (±0.96)	1.15 (±0.88)
Consump./capita/day ≤ 1 U$			
Yes	23.9% (78)	87.9% (290)	60.2% (210)

***U$ = US dollar(s)**

Table 2: Correlation between food insecurity and consumption/capita/day

	Bolivia(N=327)	p-value	Burkina Faso (N=330)	p-value	Philippines (N=349)	p-value
Pearson correlation						
Food insecurity raw score:						
Consumption/capita/day	-0.30	0.0001	-0.17	0.002	-0.30	0.0000
Consumption/capita/day (U$) by food-security score (FdSecSc) – Mean (SD) n						
FdSecSc=0	2.48 (±0.97) 38		1.45 (±2.87) 30		1.50 (±1.07) 105	
FdSecSc=1	2.27 (±1.61) 18		0.71 (±0.47) 33		1.32 (±1.02) 71	
FdSecSc=2	2.08 (±1.93) 41		0.70 (±0.37) 26		0.95 (±0.38) 49	
FdSecSc=3	1.62 (±0.53) 22		0.52 (±0.34) 29		0.96 (±0.78) 34	
FdSecSc=4	1.66 (±1.02) 38		0.52 (±0.22) 14		0.90 (±0.48) 20	
FdSecSc=5	1.60 (±0.77) 28		0.51 (±0.28) 28		0.74 (±0.34) 22	
FdSecSc=6	1.46 (±0.67) 50		0.54 (±0.43) 23		0.66 (± 0.15) 8	
FdSecSc=7	1.55 (±1.17) 48		0.61 (±0.52) 36		0.72 (±0.72) 19	
FdSecSc=8	1.40 (±0.77) 28		0.54 (±0.34) 51		0.72 (±0.29) 16	
FdSecSc=9	1.20 (±0.85) 16	0.0001	0.55 (±0.38) 60	0.004	1.03 (±0.28) 5	0.0000
Consumption/capita/day (U$) by food-security status						
Food-secure (0-2 points)	2.27 (±1.55) [a]		0.96 (±1.72) [a]		1.32 (±0.97) [a]	
Food-insecure w/o hunger (3-5)	1.63 (±0.83) [b]		0.52 (±0.29) [b]		0.88 (±0.61) [b]	
Food-insecure with hunger (6-9)	1.45 (±0.90) [b]	0.0001	0.56 (±0.41) [b]	0.002	0.74 (±0.50) [b]	0.0000
Consumption/cap/day (U$) by food-security status (2 cat.)						
Food-secure (0-2 points)	2.27 (±1.55)		0.96 (±1.72)		1.33 (±0.97)	
Food-insecure (3-9 points)	1.52(±0.88)	0.0001	0.55 (±0.38)	0.0005	0.83 (±0.57)	0.0000
Food-security score by Poverty level						
> 1 USD/capita/day	4.09 (±2.71)		4.33 (±3.41)		2.89 (±2.65)	
≤ 1 USD/capita/day	5.69 (±2.34)	0.0001	5.29 (±3.08)	0.07	1.44 (±1.96)	0.0000

Table 2: Cont…

	Bolivia(N=327)		p-value	Burkina Faso (N=330)		p-value	Philippines (N=349)		p-value
	Food-security status (2 cat.)			Food security status (2 cat.)					
	Food-secure	Food-insecure		Food-secure	Food-insecure		Food-secure	Food-insecure	
Poverty level ≤1U$/cap/d	14.1%	85.9%	0.001	24.8%	75.2%	0.02	53.8%	46.2%	0.000

Nevertheless for the Philippines:

	Philippines (N=330)		p-value
	Poverty level		
Food-security status	≤1U$/cap/d	> 1U$/cap/d	
Food-Insecure	79.0%	21.0%	0.000

Table 3: Adjusted consumption/capita/day (U$ cents) regression coefficients (95% CI) [1]

	Bolivia(N=327) Coefficient (95% CI)	p-value	Burkina Faso (N=330) Coefficient (95% CI)	p-value	Philippines (N=349) Coefficient (95% CI)	p-value
Food-Security Score (0-9 points)	**-0.09 (-0.13- -0.04)**	**0.000**	**-0.04 (-0.23 - -0.02)**	**0.02**	**-0.04 (-0.08 - -0.01)**	**0.07**

[1] Estimates are adjusted for membership in *CwE*, location of residence (urban/rural), gender, age, and marital status of interviewee, interviewee head of household, educational level of interviewee, household size, # of children < 5 yrs of age, # of adults > 70 yrs of age, and # of durable goods.

Table 4: Adjusted Odds Ratio (95% CI) from logistic regression for poor households (≤1 U$/capita/day) [1]

	Bolivia (N=327) O.R. (95% CI)	p-value	Burkina Faso (N=330) O.R. (95% CI)	p-value	Philippines (N=349) O.R. (95% CI)	p-value
Food-Insecure (3-9 points)						
No	**1.0**		**1.0**		**1.0**	
Yes	**2.8 (1.14- 6.78)**	**0.02**	**2.0 (0.93- 4.30)**	**0.08**	**1.7 (0.95- 3.12)**	**0.07**

[1] Estimates are adjusted for membership in *CwE*, location of residence (urban/rural), gender, age, and marital status of interviewee, interviewee head of household, educational level of interviewee, household size, # of children < 5 yrs of age, # of adults > 70 yrs of age, and # of durable goods. Reference is consumption > 1 U$/capita/day.

Table 5: Sensitivity/Specificity of the Food-Security Tool

Food-security score Cut off point	Odds Ratio*	p-value	Sensitivity %	Specificity %	Positive predictive value %	Negative predictive value %	Correctly Classified %
Bolivia							
Secure=0-2 Insecure = 3-9	2.8	0.03	64.1	65.5	36.8	85.3	65.1
Burkina Faso – Whole sample							
Secure=0-2 Insecure = 3-9	1.8	0.1	66.9	70.0	94.2	22.6	67.3
Burkina Faso (urban area)							
Secure=0-2 Insecure = 3-9	4.1	0.02	65.8	82.6	92.9	41.3	69.6
Burkina Faso (rural area)							
Secure=0-2 Insecure = 3-9	1.0	0.99	52.0	64.7	94.6	10.3	53.0
Philippines							
Secure=0-2 Insecure = 3-9	2.8	0.000	64.9	71.3	77.3	57.4	67.5

*Likelihood of being poor (<=$1/capita/day) in comparison with the food secure group

Sensitivity Pr(+| D) Probability of a Household being classified as Food-Insecure given that it is Poor

Specificity Pr(-|~D) Probability of a Household being classified as Food-Secure given that it is Non-Poor

Positive predictive value Pr(D| +) Probability of a Household being classified as Poor given that it is Food-Insecure

Negative predictive value Pr(~D| -) Probability of a Household being classified as Non-Poor given that it is Food-Secure

D defined as Poor <=$1/capita/day

~D defined as Non-Poor > $1/capita/day

+ defined as Food-Insecure

- defined as Food-Secure

Tables 6-10: Sensitivity and Specificity based on different cut-off points by country.

Tables 6: Bolivia

Food-security score Cut-off point	Odds Ratio*	p-value	Sensitivity %	Specificity %	Positive predictive value %	Negative predictive value %	Correctly Classified %
Secure=0 Insecure = 1-9	5.5	0.13	61.5	67.5	37.2	84.8	66.1
Secure=0-1 Insecure = 2-9	6.6	0.003	68.0	66.3	38.7	86.8	66.7
Secure=0-2 Insecure = 3-9	2.8	0.3	64.1	65.5	36.8	85.3	65.1
Secure=0-3 Insecure = 4-9	3.4	0.002	68.0	64.3	37.3	86.5	65.1
Secure=0-4 Insecure = 5-9	2.5	0.006	66.7	67.1	38.8	86.5	67.0
Secure=0-5 Insecure = 6-9	2.3	0.01	66.7	67.5	39.1	86.6	67.3
Secure=0-6 Insecure = 7-9	2.2	0.01	62.8	69.5	39.2	85.6	67.9
Secure=0-7 Insecure = 8-9	1.1	0.7	57.7	68.3	36.3	83.7	65.8
Secure=0-8 Insecure = 9	1.7	0.2	57.7	71.9	39.1	84.4	68.5

*Likelihood of being poor (<=$1/capita/day) in comparison with the food-secure group
Sensitivity Pr(+| D)
Specificity Pr(-|~D)
Positive predictive value Pr(D| +)
Negative predictive value Pr(~D| -)

D defined as Poor <=$1/capita/day
~D defined as Non-Poor > $1/capita/day
+ defined as Food-Insecure
- defined as Food-Secure

Table 7a: Burkina Faso – Whole sample

Food-security score Cut-off point	Odds Ratio*	p-value	Sensitivity %	Specificity %	Positive predictive value %	Negative predictive value %	Correctly Classified %
Secure=0 Insecure = 1-9	2.4	0.07	67.9	70.0	94.3	23.1	68.2
Secure=0-1 Insecure = 2-9	1.9	0.1	66.6	70.0	94.2	22.4	67.0
Secure=0-2 Insecure = 3-9	1.8	0.1	66.9	70.0	94.2	22.6	67.3
Secure=0-3 Insecure = 4-9	1.5	0.3	67.2	72.5	94.7	23.4	67.9
Secure=0-4 Insecure = 5-9	1.3	0.5	65.5	77.5	95.5	23.7	67.0
Secure=0-5 Insecure = 6-9	1.4	0.4	64.5	77.5	95.4	23.1	66.1
Secure=0-6 Insecure = 7-9	1.4	0.4	63.8	77.5	95.4	22.8	65.5
Secure=0-7 Insecure = 8-9	0.9	0.8	67.9	80.0	96.1	25.6	69.4
Secure=0-8 Insecure = 9	1.6	0.4	66.6	77.5	95.5	24.2	67.9

*Likelihood of being poor (<=$1/capita/day) in comparison with the food-secure group
Sensitivity Pr(+| D)
Specificity Pr(-|~D)
Positive predictive value Pr(D| +)
Negative predictive value Pr(~D| -)

D defined as Poor <=$1/capita/day
~D defined as Non-Poor > $1/capita/day
+ defined as Food-insecure
- defined as Food-secure

Table 7b: Burkina Faso (urban area)

Food-security score Cut-off point	Odds Ratio*	p-value	Sensitivity %	Specificity %	Positive predictive value %	Negative predictive value %	Correctly Classified %
Secure=0 Insecure = 1-9	6.3	0.01	74.7	78.3	92.2	47.4	75.5
Secure=0-1 Insecure = 2-9	3.6	0.04	68.4	73.9	90.0	40.5	69.6
Secure=0-2 Insecure = 3-9	4.1	0.02	65.8	82.6	92.9	41.3	69.6
Secure=0-3 Insecure = 4-9	3.1	0.07	63.3	82.6	92.6	39.6	67.6
Secure=0-4 Insecure = 5-9	2.7	0.1	64.6	82.6	92.7	40.4	68.6
Secure=0-5 Insecure = 6-9	2.8	0.08	64.6	82.6	92.7	40.4	68.6
Secure=0-6 Insecure = 7-9	3.4	0.07	63.3	82.6	92.6	39.6	67.7
Secure=0-7 Insecure = 8-9	1.8	0.4	63.3	82.6	92.6	39.6	67.7
Secure=0-8 Insecure = 9	8.2	0.08	64.6	82.6	92.7	40.4	68.6

*Likelihood of being poor (<=$1/capita/day) in comparison with the food-secure group
Sensitivity Pr(+| D)
Specificity Pr(-|~D)
Positive predictive value Pr(D| +)
Negative predictive value Pr(~D| -)

D defined as Poor <=$1/capita/day
~D defined as Non-Poor > $1/capita/day
+ defined as Food--insecure
- defined as Food-secure

Table 7c: Burkina Faso (rural area)

Food-security score Cut-off point	Odds Ratio*	p-value	Sensitivity %	Specificity %	Positive predictive value %	Negative predictive value %	Correctly Classified %
Secure=0 Insecure = 1-9	0.7	0.8	51.0	64.7	94.4	10.1	52.1
Secure=0-1 Insecure = 2-9	1.0	0.96	52.0	64.7	94.6	10.3	53.0
Secure=0-2 Insecure = 3-9	1.0	0.99	52.0	64.7	94.6	10.3	53.0
Secure=0-3 Insecure = 4-9	0.9	0.8	51.0	64.7	94.4	10.1	52.0
Secure=0-4 Insecure = 5-9	0.7	0.5	54.0	70.6	95.6	11.5	55.0
Secure=0-5 Insecure = 6-9	0.8	0.7	53.5	70.6	95.5	11.4	54.8
Secure=0-6 Insecure = 7-9	0.7	0.6	56.0	70.6	95.7	12.0	57.1
Secure=0-7 Insecure = 8-9	0.6	0.4	55.0	74.5	96.5	12.6	56.7
Secure=0-8 Insecure = 9	0.9	0.8	52.5	70.6	95.5	11.2	53.9

*Likelihood of being poor (<=$1/capita/day) in comparison with the food-secure group
Sensitivity Pr(+| D)
Specificity Pr(-|~D)
Positive predictive value Pr(D| +)
Negative predictive value Pr(~D| -)

D defined as Poor <=$1/capita/day
~D defined as Non-Poor > $1/capita/day
+ defined as Food-insecure
- defined as Food-secure

Table 8: Philippines

Food-security score Cut-off point	Odds Ratio*	p-value	Sensitivity %	Specificity %	Positive predictive value %	Negative predictive value %	Correctly Classified %
Secure=0 Insecure = 1-9	2.1	0.004	62.9	67.7	74.6	54.7	64.8
Secure=0-1 Insecure = 2-9	2.3	0.001	62.0	69.1	75.2	54.7	64.8
Secure=0-2 Insecure = 3-9	2.8	0.000	64.9	71.3	77.3	57.4	67.5
Secure=0-3 Insecure = 4-9	3.2	0.000	67.3	68.4	76.2	58.1	67.7
Secure=0-4 Insecure = 5-9	3.5	0.000	62.9	69.9	75.9	55.6	65.7
Secure=0-5 Insecure = 6-9	4.5	0.001	61.0	72.8	77.2	55.3	65.7
Secure=0-6 Insecure = 7-9	3.4	0.01	58.5	73.5	76.9	54.1	64.5
Secure=0-7 Insecure = 8-9	1.6	0.4	52.7	75.0	76.1	51.3	61.6
Secure=0-8 Insecure = 9	1.0	0.99	50.2	76.5	76.3	50.5	60.7

*Likelihood of being poor (<=$1/capita/day) in comparison with the food-secure group
Sensitivity Pr(+| D)
Specificity Pr(-|~D)
Positive predictive value Pr(D| +)
Negative predictive value Pr(~D| -)

D defined as Poor <=$1/capita/day
~D defined as Non-Poor > $1/capita/day
+ defined as Food-insecure
- defined as Food-secure

Table 9: Mean Food Expenditure- Bolivia (B$ per capita/day) by Food-security Level

Food Group	Food-secure	Food-insecure w/o Hunger	Food-insecure with Hunger	p-value
Cereals	1.6 [a]	1.3 [b]	1.2 [c]	.005
Meat	2.2 [a]	1.5 [b]	1.2 [c]	.003
Fish	0.60	0.37	0.43	.15
Fruits	0.56 [a]	0.41 [b]	0.35 [c]	.001
Vegetables	0.84 [a]	0.80 [a]	0.65 [b]	.03
Dairy	1.1 [a]	0.86 [b]	0.62 [c]	.0001
Total Food	**9.5 [a]**	**7.7 [b]**	**6.3 [c]**	**.0000**

Table 10: Mean Food Expenditure- Philippines (P$ per capita/day) by Food-security Level

Food Group	Food-secure	Food-insecure w/o Hunger	Food-insecure with Hunger	p-value
Cereals	10.8	9.6	8.7	.12
Meat	5.3 [a]	2.7 [b]	1.7 [b]	.0001
Fish	3.7	2.6	2.7	.08
Fruits	2.0 [a]	0.7 [b]	0.7 [b]	.002
Vegetables	3.3 [a]	2.8 [a]	2.3 [b]	.08
Dairy	2.6 [a]	1.4 [a]	1.2 [b]	.0002
Total Food	**39.6 [a]**	**28.1 [b]**	**26.6 [b]**	.0000

Table 11: Burkina F$/1000 per capita/day) by Food-security Level

Item	Food-secure	Food-insecure w/o Hunger	Food-insecure with Hunger	p-value
Total Food	**112.6** [a]	**74.7** [b]	**79.5** [b]	0.003
School	6.1 [a]	2.0 [b]	2.9 [b]	0.003
Non-food	60.3 [a]	20.5 [b]	20.3 [c]	0.04
Durable goods	5.6 [a]	2.4 [b]	2.2 [b]	0.000
Health	4.8 [a]	2.0 [b]	2.2 [b]	0.05
Housing	4.7	3.8	4.3	0.90
Daily Expenses	4.6	3.6	3.4	0.23

[a, b, c] *Superscripts denote statistically significant differences between food-security categories.*