! TECHNICAL GUIDE #7 !

CHOOSING OUTCOME INDICATORS OF HOUSEHOLD FOOD SECURITY

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CONTENTS

1. INTRODUCTION[1]

Many development agencies regard the concept of household food security—often defined as adequate access to food at all times, throughout the year and from year to year—as a guiding principle for designing interventions in rural areas. A commitment to household food security carries with it an important implication for development practitioners, namely the need to measure food security outcomes at the household and individual level.[1] Measurement is necessary at the outset of any development project to identify the food insecure, to assess the severity of their food shortfall and to characterize the nature of their insecurity (seasonal versus chronic). Further, it provides the basis for monitoring progress and assessing the impact of these projects on the beneficiaries' food security.

Food security is a concept that has evolved considerably over time and there is much literature on potential household food security indicators. There are approximately 200 definitions and 450 indicators of food security. One volume on household food security by Maxwell and Frankenberger (1992) lists 25 broadly defined indicators. Riely and Moock (1995) list 73 such indicators, somewhat more disaggregated than those found in Maxwell and Frankenberger. Chung et al. (1997) note that even a simple indicator such as a dependency ratio can come with many different permutations. They list some 450 indicators. Consequently, an important methodological problem for development practitioners is to determine which indicators are appropriate, given the project being proposed. Hence the title of this guide, choosing household food security indicators.

In the work by Maxwell and Frankenberger, a distinction is made between "process indicators"—those that describe food supply and food access—and "outcome indicators" that describe food consumption. This guide focuses only on the latter for two reasons. However, process indicators are insufficient to characterize food security outcomes. Chung et al. (1997) found that there is little correlation between a very large set of process indicators and measures of food security outcomes. This finding echoes the conclusion of some development agencies,

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namely that there is little correlation between area-level food production and household food security (IFAD 1997, p. 13).[2]

The guide also recognizes that development agencies, and their local collaborators, face significant financial and time constraints. Undertaking very detailed household and individual surveys on an ongoing basis to characterize, monitor, and measure impact is infeasible—either because the time spent on these activities does not fit into the standard project cycle, the skills to implement and analyze such data are not available, or because purchasing these skills—say by contracting to outside consultants—is prohibitively costly. Mindful of this constraint, an objective of this guide is to show how simple measures of food security outcomes can be constructed and compared. These methods have been chosen so as to be accessible to anyone with a very basic grounding in statistics and access to a spreadsheet software program such as Microsoft Excel.

The next section outlines four ways of measuring household food security outcomes: individual intakes, household caloric acquisition, dietary diversity, and indices of household coping strategies.[3] In each case, an explanation is given regarding what this indicator measures; how the data is collected; and how indicators of food security are calculated. Each description ends with a commentary on the strengths and weaknesses of the method. This is followed by an explanation of how these different measures can be compared, illustrated using data collected in the Zone Lacustre region of Mali where a development project is currently active. The final section proposes a possible sequence of activities that would use these indicators at different stages of a project cycle.

2. OUTCOME MEASURE OF HOUSEHOLD AND INDIVIDUAL FOOD SECURITY

This section outlines four ways of measuring household and individual food security: individual intakes (either directly measured or 24-hour recall), household caloric acquisition, dietary diversity, and indices of household coping strategies. This ordering of methods is deliberate, moving from methods that are very time- and skill-intensive, but are regarded as being more accurate, to those that can be implemented quickly, are relatively undemanding in terms of the skills required by the implementors, but are more impressionistic.

Individual Food Intake Data

Description

This is a measure of the amount of calories, or nutrients, consumed by an individual in a given time period, usually 24 hours.

Method for generating these data

There are two basic approaches used to collect these data. The first is observational. An enumerator resides in the household throughout the entire day, measuring the amount of food served to each person, and the amount of food prepared but not consumed ("plate waste") is also measured. In addition, the enumerator notes the type and quantity of food eaten as snacks between meals as well as food consumed outside the household. The second method is recall. The enumerator interviews each household member regarding the food they consumed in the previous 24-hour period. This covers the type of food consumed, the amount consumed, food eaten as snacks and meals outside the household.

Method of calculation

Data collected on quantities of food are expressed in terms of their caloric content, using factors that convert quantities of edible portions into calories. These are provided for a range of foods in Appendix 1. These intake data are compared against a definition of food needs. It should be noted that "food needs" is a contested concept. Individual caloric requirements reflect individual characteristics such as age, sex, weight, body composition, disease states, genetic traits, pregnancy and lactation status, and activity levels, as well as other factors such as climate. A typical approach is to begin with a reference person, say a 60-kilogram man aged somewhere between 30 and 60 years undertaking "moderate activity." This yields a caloric requirement of approximately 2,900 kilocalories per day. Individual requirements for children are made on the basis of their age and sex to yield "adult equivalents." These are reported in Appendix 2. A minimum requirement for a low-activity existence—8 hours sleeping, 1 hour walking, 15 hours standing or sitting quietly—is 2,030 kilocalories or 70 percent of that required in order to undertake moderate activity. For this reason, this lower figure is often used as a cutoff to determine whether an individual is consuming enough to meet their food needs, although it does

seem rather odd to describe "minimal" food needs as a percentage of "minimal" requirements! However, it should be stressed again that there is no universal agreement on these figures, and estimates of "basic requirements to meet food needs" range from 1,885 to 2,500 kilocalories (James and Schofield 1990; Smil 1994).

Advantages and disadvantages of this method

This method has two principal advantages: implemented correctly, it produces the most accurate measures of individual caloric intake (and other nutrients) and therefore the most accurate measure of food security status of an individual. Second, because the data are collected on an individual basis, it is possible to determine whether food security status differs within the household. Indeed, it may be the case that sufficient calories are being consumed at the household level, but inequalities within the household result in some members consuming in excess of their requirements while others do not obtain sufficient food to eat.

Set against these significant advantages are a large number of disadvantages. These measures of intakes need to be made repeatedly—ideally for seven nonconsecutive days—in order to account for within person and within household day-to-day variations in nutrient intake (for example, those resulting from religious prohibitions on the consumption of certain foods on certain days of the week or seasonal changes in diet). It requires highly skilled enumerators who can observe and measure quantities quickly and accurately—and in such a fashion that does not cause households to alter typical levels of food consumption and distribution within the household. The recall method requires enumerators to interview carefully every household member until they have established the exact make-up (food types, ingredients, and quantities) of every meal and snack, an extremely difficult task. This method generates an enormous amount of data that needs to be entered, checked, and aggregated before being usable.

The feasibility of implementing this method was considered in three different locations: western Honduras, northern Mali, and central Malawi. In all three locales, implementation proved infeasible under relatively straightforward survey conditions. Consequently, despite its clear advantages in terms of accuracy, it is unlikely to be an indicator that can be feasiblely collected as part of many development projects.

Household Caloric Acquisition

This is the number of calories, or nutrients, available for consumption by household members over a defined period of time.

Description

The principal person responsible for preparing meals is asked how much food she prepared over a period of time. After accounting for processing, this is turned into a measure of the calories available for consumption by the household.

Method for generating these data

A set of questions regarding food prepared for meals over a specified period of time, usually either 7 or 14 days, is asked to the person in the household most knowledgeable about this activity.[4] In constructing these questions, the following considerations should be borne in mind: it is extremely important that the list of foods specified in the questionnaire is detailed and exhaustive. Experience has shown that using short lists typically leads to an understatement of consumption on the order of 25 to 75 percent (Deaton and Grosh 1998); the phrasing of the questions needs to be unambiguous in the sense of distinguishing between the amount of food purchased and the amount prepared for consumption and the amount of food served; and it is not uncommon for individuals to report consumption in units other than kilograms or liters. In such cases, it is necessary to obtain information on the size of a "heap" or the quantity contained in a "sawal" or whatever units are used locally.

Below is an *excerpt* from the questionnaire used in northern Mali to obtain information on food consumption in the last seven days (Table 1).

Method of calculation

Converting these data into calories requires three steps:

- converting all quantities into a common unit such as a kilogram;

Table 1 Excerpt from questionnaire on food consumption

We would like to ask you some questions about food consumption in this household in the last seven days. These questions pertain to the quantity of foods prepared for consumption.		
Food	Quantity	Unit
Millet		
Sorghum		
Rice		
Maize		
Bread		

Units: 1 bowl 2 sack 3 "sawal" 4 pot 5 calebash 6 kilogram

- converting these into edible portions by adjusting for processing; and
- converting these quantities into kilograms using the standard caloric conversions (these are found in Appendix 1).

Sample data for five household consuming millet are reported below (Table 2). Measurements undertaken as part of this survey work determined that millet was typically measured in "sawal" and "pots." Both were obtained and the amount stored in these weighed. One sawal contained 6½ pots and a pot was approximately 0.77 kilos, implying that a sawal was 5 kilos. The ratio of unground to processed millet, 0.61, was obtained by providing several women with 1 kilo measures of millet, having them crushed by local women using local technologies, and measuring what was left. The number of calories available was computed by taking this quantity and multiplying it by the number of calories (3,390 kilocalories) in 1 kilo of edible millet.

Table 2 Sample conversions from reported consumption of millet in local units to calories

Household	Quantity	Unit		Conversion into kilos	Adjustment for processing	Number of calories available for consumption
1	15	sawal		15 x 5 = 75	75 x 0.61 =45.75	45.75 x 3390 = 155093
2	10	sawal		10 x 5 = 50	50 x 0.61 =30.5	30.5 x 3390 = 103395
3	14	sawal		14 x 5 = 70	70 x 0.61 =42.7	42.7 x 3390 = 144753
4	12	pot		12 x 0.77 = 9.24	9.24 x 0.61 =5.63	5.63 x 3390 = 19086
5	20	pot		20 x 0.77 = 15.4	15.4 x 0.61 = 9.39	9.39 x 3390 = 31832

Advantages and disadvantages

This measure produces a crude estimate of the number of calories available for consumption in the household. It is not obvious to respondents how they could manipulate their answers. Because the questions are retrospective, rather than prospective, the possibility that individuals will change their behavior as a consequence of being observed is lessened. The level of skill required by enumerators is less than that needed to obtain information on individual intakes. On average, it took around 30 minutes per household to obtain these data, an amount of time considerably less than that required to obtain information on individual intakes.

Set against these advantages are a number of disadvantages. This method generates a large quantity of numerical data that needs to be carefully checked both in the field and during data entry. Relative to the methods described below, data processing requirements are also higher. It is not as accurate as dietary intake data. The use of a recall period puts considerable reliance on memories of events that may not be well-remembered, with respondents either forgetting about particular foods or "telescoping"—including foods that had been used in a period prior to the preceding seven days. It does not capture especially accurately any food eaten outside of the household. It does not incorporate considerations of wastage, nor is it possible to uncover differential allocations of food among household members. Just as with the dietary intake method, it is necessary to convert quantities into calories and compare these against some standard, which, as already discussed, remain controversial.

Dietary Diversity

Description

This is the sum of the number of *different* foods consumed by an individual over a specified time period. It may be a simple arithmetic sum, the sum of the number of different food groups consumed, sums of the number of different foods within a food group, or a weighted sum—where additional weight is given to the frequency by which different foods are consumed.

Method for generating these data

One or more persons within the household are asked about different items that they have consumed in a specified period. These questions can be asked to different household members where it is suspected that there may be differences in food consumption among household members. Experience implementing this method has shown that comprehensive lists, 100-120 different food items, perform better than shorter lists in distinguishing better-off from poorer households. Determining which items should appear on these lists can be done via rapid appraisal exercises, discussions with key informants, and references to previous survey work. Table 3, an *excerpt* from a questionnaire used in northern Mali, is used to illustrate this approach.[5]

Method of calculation

There are two possible methods of calculation:

- the first is a simple sum of the number of different foods eaten by that person over the specified time period; and
- the second is to calculate a weighted sum, where the weights reflect the frequency of consumption, and not merely the number of different foods. Here, the following weights are assigned: J: 24; S: 10; M: 3; and R ; 0.

Sample data for five households, together with these two measures, are presented in Table 4 below.

Table 3 Sample questions on dietary diversity

I would like to ask you about all the different foods that you have eaten in the last 30 days. Could you please tell me whether you ate the following foods: 16 to 30 days in the last month (J) - that is, at least every other day if not more frequently than that; 4 to 15 days in the last month - that is, once or twice a week (S); 1 to 3 days in the last month (M); 0 days - not at all (R).

Item	Frequency			
	J	S	M	R
Cereals				
Millet				
Sorghum				
Rice				
Maize				
Bread				
Wheat				
Other cereals				
Tubers				
Sweet Potato				
Manioc				
Groundnuts				
Other tubers				
Vegetables				
Tomatoes				
Onions				
Beans				
Carrots				
Okra				
Other vegetables				

Item	Frequency			
	J	S	M	R
Fruits				
Bananas				
Mangoes				
Lemons				
Pineapple				
Other fruits				
Meat				
Beef				
Chicken				
Sheep/goat				
Fish				
Dried				
Smoked				
Milk products				
Cows milk				
Goats milk				
Other items				
Butter				
Tea				
Salt				

Table 4 Sample data and measures of dietary diversity

Household	Millet	Sorghum	Rice	Beef	Salt	Tea		Simple Sum	Weighted Sum
1	J	J	R	M	J	J		5	99
2	J	J	M	M	R	S		5	64
3	S	R	J	R	R	R		2	34
4	S	R	R	R	S	R		2	20
5	J	R	R	R	M	J		3	51

Advantages and disadvantages

The use of this measure stems from the observation made in many parts of the developing world that as households become better-off, they consume a wider variety of foods. It is easy to train enumerators to ask these questions and individuals generally found them easy questions to answer. Asking these questions typically takes about 10 minutes per respondent. Field testing indicates that it is correlated with levels of caloric acquisition; tracks seasonal changes in food security—measures of dietary diversity are highest just after harvesttime and lowest during the hungry season; and also appears to capture differences in distribution within the household. In northern Mali, for example, women reported that they were more likely than their husbands to reduce their own food consumption during periods of stress and this was reflected in lower scores for women than men on measures of dietary diversity. Finally, a diverse diet is a valid welfare outcome in its own right—the nutritional literature is placing increasing emphasis on the importance of consuming a wide variety of foods so as to enhance dietary quality in addition to longer-standing concerns regarding quantities of consumption.

The disadvantage of this measure is that the simple form of this measure does not record quantities. If it is not possible to ask about frequency of consumption of particular quantities—see footnote #5, it is not possible to estimate the extent to which diets are inadequate in terms of caloric availability.

Indices of Household Coping Strategies

Description

This is an index based on how households adapt to the presence or threat of food shortages. The person within the household who has primary responsibility for preparing and serving meals is asked a series of questions regarding how households are responding to food shortages. In the nutrition literature, these first appeared in Radimer, Olson, and Campbell (1990). Coping strategies themselves are discussed in Maxwell and Frankenberger (1992) and Maxwell (1996) proposed a method for taking consumption-related strategies and constructing a numerical index.

Method for generating these data

The most knowledgeable woman in the household regarding food preparation and distribution within the household is asked a series of questions of the following form (French versions of these are found in Appendix 4).

In the last seven days:

1. Has the household consumed less preferred foods? (Circle the best response.)
   1. Never 2. Rarely (once) 3. From time to time (2 or 3 times) 4. Often (5 or more times)

2. Have you reduced the quantity of food served to men in this household?
   1. Never 2. Rarely (once) 3. From time to time (2 or 3 times) 4. Often (5 or more times)

3. Have you reduced your own consumption of food?
   1. Never 2. Rarely (once) 3. From time to time (2 or 3 times) 4. Often (5 or more times)

4. Have you reduced the quantity of food served to children in this household in the last seven days?
   1. Never 2. Rarely (once) 3. From time to time (2 or 3 times) 4. Often (5 or more times)

5. Have members of this household skipped meals in the last seven days?
   1. Never 2. Rarely (once) 3. From time to time (2 or 3 times) 4. Often (5 or more times)

6. Have members of this household skipped meals for a whole day?
   1. Never 2. Rarely (once) 3. From time to time (2 or 3 times) 4. Often (5 or more times)

Method of calculation

A sample of responses to these questions, taken from a survey of households in the Zone Lacustre region of Mali are reproduced in Table 5.

Table 5 Sample responses to questions on coping strategies

	Question					
Household	#1	#2	#3	#4	#5	#6
1	3	3	3	3	1	1
2	3	3	3	3	2	2
3	2	2	2	2	2	2
4	3	3	4	3	3	3
5	2	1	2	2	1	1

There are several ways of summarizing the information obtained from these questionnaires into a single number (Table 6):

- counting the number of different coping strategies used by the household. Here, this is the number of strategies that the household used often, from time to time, or rarely. The higher the sum, the more food-insecure the household.
- calculating a weighted sum of these different coping strategies, where the weights reflect the frequency of use by the household. A simple way of doing so is to make the weights consecutive, so that "often" is counted as a 4, "from time to time" is counted as a 3, "rarely" is counted as a 2, and "never" is counted as a 1. The higher the sum, the more food-insecure the household.
- calculating a weighted sum of these different coping strategies, where the weights reflect the frequency of use—as described above—and the severity of the household's response. A simple way of doing so is to ascribe a weight of 1 to the use of strategies such as eating less preferred foods (question #1) and reducing portion sizes served to men, children, and women (questions #2, 3, and 4), a weight

of 2 to skipping meals (question #5) and a weight of 3 to skipping eating all day (question #6). So for the first household on this list, we would obtain a score of $17 = 1 \cdot (3 + 3 + 3 + 3) + 2 \cdot (1) + 3 \cdot (1)$. Again, the higher the sum, the more food-insecure the household.

Table 6 Sample calculations of measures of coping strategies

Household	Number of different strategies used	Weighted sum reflecting frequency of use	Weighted sum reflecting frequency and severity of use
1	4	14	17
2	6	16	22
3	6	12	18
4	6	18	25
5	3	9	12

Advantages and disadvantages of this measure

There are three attractive features of this measure. First, it is easy to implement, typically taking less than three minutes per household. Second, it directly captures notions of adequacy and vulnerability: currently, is there enough food to eat in this household?; and also the vulnerability of households—those households using a larger number of coping strategies, or using more severe strategies are more likely to be poor and more vulnerable to destitution. Third, the questions asked are easy to understand both by respondents and by analysts and project designers.

There are also several disadvantages. As it is a subjective measure—different people have different ideas as to what is meant by "eating smaller portions"—comparison across households or localities is problematic. In particular, as part of the field tests for these measures, men and women were asked what constituted a "food secure" diet. Poorer households tend to report smaller quantities of food than richer households. This has two implications. First, that this measure can be somewhat misleading—a richer and poorer household may both report eating

smaller quantities, but this does not imply an equal increase in food insecurity. Second, evaluating the impact of an intervention solely in terms of this measure risks setting a lower target for poorer households than for richer ones.

Second, its simplicity makes it relatively straightforward to misreport a household's circumstances. For example, households might perceive that they are more likely to receive assistance when they report greater use of these coping strategies. Finally, it is necessary to decide what weights should be applied to different questions, and to different levels of response. The rapid appraisal techniques described in Technical Guide #6 could be used to obtain this information.

A Comparison of Methods

Table 7 provides a summary table that qualitatively compares these four methods in terms of costs, time and skill requirements, and susceptibility to misreporting.

Table 7 Comparison of methods in terms of costs, time and skill requirements, and susceptibility to misreporting

	Individual intake	Household caloric acquisition	Dietary diversity	Index of coping strategies
Data collection costs	High	Moderate	Low	Low
Time required for analysis	High	Moderate	Low	Low
Skill level required	High	Moderately high	Moderately low	Low
Susceptibility to misreporting	Low	Moderate	Low	High

3. TESTING THE CORRELATIONS BETWEEN DIFFERENT OUTCOME MEASURES OF FOOD SECURITY

Each of the four measures described above are valid indicators of different dimensions of food security. However, indicators such as dietary diversity and indices of coping strategies are easier and less expensive to collect and analyze than measures of caloric acquisition and dietary

intake. If it is the case that this simply measures "track" or "correlate" these more complex and expensive measures, then for purposes such as project monitoring, they would suffice. Examining this possibility requires the use of statistical techniques that provide this information, but are also feasible, given the resources available to project staff.

Below, three methods are discussed: correlation coefficients, contingency tables, and regression-predictive methods.[6] All are illustrated using data collected in a project in northern Mali. These techniques presented below are those that could be implemented by anyone who had competently completed a basic undergraduate course (*not degree*) in statistics and had access to a spreadsheet computer package such as Excel or Quattro.

Correlation Coefficients

A simple approach to examining the validity of alternative measures of food security is to calculate measures of correlation such as Pearson or Spearman correlation coefficients. These are index numbers that show to what extent two variables are linearly related. They can take on values that range from -1 to 1. A priori, it is expected that the dietary diversity index and per capita calorie consumption are positively related, that is, both increase in value together. By contrast, the indices of coping strategies and per capita caloric availability should be negatively related. One would expect that increased reliance on coping strategies is associated with lower food availability.

Examples of these are reported in Table 8. The measure of dietary diversity is the weighted measure based on data provided by women in these Malian households. The index of coping strategies is doubly weighted by the frequency of use of this strategy and the severity of the strategy.

Note that prior expectations are borne out: there is a positive correlation between dietary diversity and caloric availability and a negative correlation between the coping index and caloric availability. All four correlation coefficients are statistically significant at the 1 percent level. A more difficult question is how to interpret the magnitudes of these coefficients, which are all roughly the same. It would appear that there is little to choose between these two measures. Both provide some correlation with the bench mark, but not at an especially high level.

Table 8 Pearson and Spearman correlation coefficient between caloric availability and two alternatives

	Correlation between calories available per person and	
	weighted female dietary diversity	doubly weighted coping strategy index
Pearson	0.17**	-0.17**
Spearman	0.22**	-0.17**

Note: ** statistically significant at 1 percent level; * statistically significant at the 5 percent level.

It is worth noting that a drawback to the use of correlation coefficients is that the correlation could be driven by just one part of the distribution of joint variables. Suppose that for most households, there is little correlation between dietary diversity and calorie consumption. But for very rich households, the correlation is quite high. As a consequence, the calculated coefficient might just prove to be statistically significant. An additional problem is that of false correlation where some other variable is correlated with both measures, producing a false correlation between the two variables that are observed. A reasonable conclusion, therefore is that these correlation coefficients are a good exploratory tool, but should not be the only method used.

Contingency Tables

Contingency tables cross classify two variables by two or more attributes. In the tables below, households are classified by whether their per person caloric availability is above or below 2,030 kilocalories per person per day. Approximately one-third of households did not have access to even this minimal amount of food. Households are separately ranked by the alternative indicators and grouped according to whether or not they are in the bottom tercile for that ranking. Having constructed these tables, there are three numbers of interest: *specificity*, the fraction of food-insecure households also classified by the alternative as food-insecure; *sensitivity*, the fraction of food-secure households also classified by the alternative indicator as food-secure; and a chi-squared test of whether there is a statistically significant association

between these attributes. The objective is to achieve high specificity, high sensitivity, and a significant chi-squared statistic.

These contingency tables indicate that there is a statistically significant correlation between these attributes. The dietary diversity measure performs better than the index of coping strategies in identifying food-secure and -insecure households as measured by caloric availability. This can be seen when comparing the measures of specificity and sensitivity in Tables 9a and 9b.

There are, however, two problems associated with using contingency tables. First, there is the issue of choosing the cutoffs for the attributes. Second, the method becomes demanding in a statistical sense when more than a handful of alternatives are considered. Specifically, repeating the exercise several times increases the likelihood of obtaining a significant association that results purely by chance. This can be rectified by setting a higher critical level for the chi-squared statistic (see Chung et al. 1997).

Regression-Prediction Methods

In light of the difficulties associated with correlation coefficients and contingency tables, a third method is outlined here that combines the advantages of each while minimizing their drawbacks. There is no formal name for this approach, which is informally described here as the "regression-prediction" method.

We begin with the observation that the two methods described above do not use all the information available. Specifically, in order to calculate *per capita* caloric consumption, it is necessary to determine how many people are in the household. Additionally, the location of the household will also be known. Consequently, these data can also be added to the analysis at no additional cost. Further, there are good reasons for using this information. First, cross-country studies consistently reveal a negative association between food access and household size, although the reasons for this are not well understood (Deaton and Paxson 1998). Second, consider the following. There are two localities; one centrally located with a weekly food market, the second remote from any markets. One would expect that the more remote village would face higher food prices and less access to a variety of foods. Failing to control for this

Table 9a Contingency table of caloric availability and weighted dietary diversity

	Household is in bottom tercile when ranked by dietary diversity	Household is not in bottom tercile when ranked by dietary diversity	Total
Per capita caloric availability < 2,030 kcal	45	48	93
Per capita caloric availability > 2,030 kcal	39	134	173
Totals	84	182	266
Specificity: 45/93 = 0.48 Sensitivity: 134/173 = 0.77; Chi squared test = 18.70**			

Note: ** statistically significant at 1 percent level; * statistically significant at the 5 percent level

Table 9b Contingency table of caloric availability and weighted coping strategy index

	Household is in bottom tercile when ranked by coping strategy index	Household is not in bottom tercile when ranked by coping strategy index	Total
Per capita caloric availability < 2,030 kcal	26	67	93
Per capita caloric availability > 2,030 kcal	80	93	173
Totals	106	160	266
Specificity: 26/93 = 0.28 Sensitivity: 93/173 = 0.54; Chi squared test = 8.44**			

Note: ** statistically significant at 1 percent level; * statistically significant at the 5 percent level

might lead to a misleadingly strong association between dietary diversity and caloric consumption. The obvious way of incorporating these variables is to use them in a regression where the bench mark indicator is the dependent variable, and household size, location, and the alternative indicator appear as right-hand side or explanatory variables.

The results of doing so for the Mali data, collected at the height of the hungry season, are presented in Table 10 (note that the dependent variable and household size have been transformed into their logarithmic values).

Table 10 The relationship between (log) per capita caloric acquisition and two alternative measure of food security, controlling for (log) household size and location

	Coefficient	t statistic		Coefficient	t statistic
Log household size	-0.403	6.338**		-0.339	5.338**
Dietary diversity	0.002	4.071**		-	-
Coping strategies	-	-		-0.053	1.764
Location					
Tomba	0.045	0.300		0.048	0.308
Mangourou	0.299	1.861		0.229	1.398
Gouaty	0.165	0.738		-0.140	0.656
N'goro	0.115	0.830		0.059	0.422
Tomi	0.092	0.467		-0.040	0.202
Hamakoira	-0.154	-0.872		-0.242	-1.345
Goundam Touskel	0.155	0.836		0.171	0.895
Ouaki	0.286	2.028		0.234	1.621
Anguira	-0.212	-1.283		-0.329	-1.976*
Constant	5.567	8.017**		8.495	42.885**
Adjusted R-squared		0.24			0.17

Note: ** statistically significant at 1 percent level; * statistically significant at the 5 percent level.

Controlling for household size and location, increased dietary diversity is associated with higher per capita caloric availability. Every additional point on the dietary diversity index is associated with an increase of 0.2 percent in caloric availability. This association is statistically significant at the 1 percent level. By contrast, once these other factors are taken into account, there is no statistically significant association between the coping index and the bench mark.

Also note that the adjusted R-squared, which indicates to what extent the variance in the dependent variable is explained by the regression, is considerably higher for the regression using dietary diversity as an explanatory variable.

These estimated coefficients can be used to predict levels of log per person caloric availability. For example, for households residing in the village of Tomba, these predicted levels are

$$\text{predicted log caloric availability per person} = 5.567 + 0.045 - 0.403 \cdot \log \text{hh size} + 0.002 \cdot \text{dietary diversity}.$$

Taking anti-logs yields predicted values in terms of caloric availability per person. These can be used to construct the following contingency tables in which the bench mark (actual caloric availability) and predicted caloric availability are divided into three categories: less than 2030 calories per day (indicating severe food insecurity); 2,030-2,900 calories per day (indicating some degree of food insecurity); and greater than 2,900 calories per day. The results of this exercise for the Mali data set are reported in Tables 11a and 11b, with summary statistics reported in Table 11c.

The chi-squared tests indicate that the match between the actual distribution of food acquisition and that predicted by both alternative indicators is greater than what would have occurred if these alternatives had randomly assigned households to these different groups. Both correctly classify about half the households in the sample. Whereas the actual distribution across food security status is fairly constant, both alternatives predict that it is more concentrated among households experiencing moderate food insecurity. This is particularly marked in the case of the coping strategies index, which appears to especially underreport the number of severely food-insecure households.

Table 11a Contingency table of actual per person caloric availability and predicted availability using household size, location, and dietary diversity as regressors

		Predicted per person caloric availability based on regression			Total
		< 2,030	2,030-2,900	> 2,900	
Actual per person caloric availability	< 2,030	50	34	9	93
	2,030-2,900	16	25	23	64
	> 2,900	12	39	58	109
Total		78	98	90	266

Table 11b Contingency table of actual per person caloric availability and predicted availability using household size, location and a measure of coping strategies as regressors

		Predicted per person caloric availability based on regression			Total
		< 2,030	2,030-2,900	> 2,900	
Actual per person caloric availability	<2,030	46	33	14	93
	2,030-2,900	12	34	18	64
	>2,900	10	47	53	110
Total		68	114	85	267

Table 11c Comparison of predictive power of dietary diversity and coping index

	Dietary diversity	Coping index
Chi-squared test of association	60.16**	54.24**
Percent of households correctly categorized	50	50
Percent of severely food-insecure households classified as food secure	9.7	15.1
Predicted distribution by food security status:		
< 2,030 (actual = 35%)	29	25
2,030-2,900 (actual = 24%)	37	43
> 2,900 (actual = 41%)	34	32

Note: ** significant at the 1 percent level.

Summary

This section has presented three methods for examining the associations among different outcome measures of food security. All these can be implemented using a standard spreadsheet package. In the example considered here, it would appear that an index of dietary diversity is reasonably well-correlated with per capita caloric availability and does reasonably well in terms of predicting the level and distribution of food security in the sample.

4. DEVELOPING AND USING OUTCOME INDICATORS OF HOUSEHOLD FOOD SECURITY IN DEVELOPMENT PROJECTS

The material presented thus far has outlined possible outcome measures of food security and methods for evaluating these. This section outlines a possible sequence of events by which development practitioners and consultants can implement these methods. In what follows, it is assumed that the area in which the project will operate has been identified.

1. The first step is to review existing secondary literature on the types of foods consumed in this area. In addition, rapid appraisal techniques and discussions with key informants can be used to establish a list of foods eaten in the area and coping strategies used by these households during periods of food stress.
2. The next step is to develop a household questionnaire to capture data on a variety of outcome measures of varying degrees of complexity. Although the measures chosen will need to take into account local conditions and resources available for this work, experience gained under this TAG suggests that despite the attractions of the greater accuracy of intake data, implementing this measure is simply infeasible. Work on this TAG has also suggested that certain alternative indicators are problematic as bench marks. Specifically, community rankings of households by degree of food insecurity (discussed in Technical Guide #6) would appear to suffer from three problems: in a group setting, villagers have a strong incentive to misreport the status of individual households; there is relatively low correlation between the rankings assigned by different subgroups within the locality (see Research Paper #4); and because these rankings are based on village criteria, differences in

criteria across villages make it impossible to compare these rankings spatially. Use of household-level coping strategies suffers from similar limitations: what is described as limiting portion size can have a radically different meaning in a rich and poor household and the rather loaded nature of the question can encourage misreporting.

3. Data on these outcome indicators are collected.[7] These can be used to provide a characterization of the locality in terms of the nature of the food security problem (is it lack of calories, poor diversity, a problem of seasonal fluctuations in access, unequal access within the household?), the identity of the food insecure, and the severity of the food insecurity. The methods described above can be used to determine to what extent the simpler measures mimic the more complex indicators.
4. If the association is considered strong, these simpler indicators can be used not only as monitoring measures in their own right, but also as a means of inferring changes in more complex measures.
5. Both simple and more complex outcome indicators can be used as measure of impact.

NOTES

1.Nutritional assessment is discussed in a separate Technical Guide, #5.

2.It should be noted, however, that the discussion on how to choose indicators can also be applied to process indicators.

3.A fifth method, group rating, is described in Technical Guide #6.

4.There is no consensus regarding the optimal recall period between 7 and 14 days. In our experience, 7 days seemed to be the most appropriate. A shorter recall period would have risked missing foods served infrequently, say on Fridays (in Muslim areas) or Sundays (in Christian areas). A longer recall period has proved problematic as difficulties of remembering what was prepared appear to increase. However, other organizations such as the World Bank in its Living Standard Measurement Surveys have used the 14-day recall period.

5.A variant of this approach, called a semi-quantitative measure of dietary diversity, involves showing respondents pictures or models of different serving sizes of these foods. Respondents indicate whether they consumed the item and in what quantity and from this information, it is possible to obtain a rough estimate of caloric intake. For example, in Honduras, respondents were shown five sizes of tortilla and asked how many of each they had consumed.

6.Another, more sophisticated method, classification and regression tree analysis, is found in Technical Guide #3.

7.Technical Guide #8 on sampling provides an introduction to this.

APPENDIX 1
ENERGY CONTENT PER 100 GRAMS OF EDIBLE PORTIONS, SELECTED FOODS

Food	Kilocalories		Food	Kilocalories
Cereals and grains			Grain legumes	
Maize, yellow immature on cob	166		Beans/peas, fresh, shelled	104
Maize, white whole kernel, dried	345		Beans, dried	320
Maize, flour, 60-80% extraction	334		Chickpea, whole seeds, raw, dried	327
Maize meal	341		Cowpea, mature pods, dried	318
Millet, finger, flour	315		Mung bean, dried	322
Millet, bullrush, whole grain	339		Pigeon pea, dried	309
Rice, milled	333		Nuts and seeds	
Sorghum, whole grain	343		Bambara groundnut, fresh	346
Sorghum flour	337		Cashew nut, dried	560
Wheat flour	340		Coconut, mature kernel, fresh	392
White bread	240		Groundnut, dry	572
Brown bread	233		Meat, poultry and eggs	
Starchy roots, tubers			Beef, moderately fat	234
Cassava meal	318		Egg, hen	140
Plantain, ripe, raw	128		Goat, moderately fat	171
Sweet potato, raw	109		Mutton, moderately fat	257
Taro/cocoyam	94		Poultry	138
Yam, fresh	111		Fish, dried	255
Yam, flour	310		Oils and fats	
Sugars			Butter from cow's milk	699
Sugar			Coconut oil	900
Milk and milk products			Ghee, clarified butter	884
Milk, cow, whole	79		Lard/animal fats	891
Milk powder, cow, whole	357		Margarine	747
Milk, goat	84		Red palm oil	892

Source: CTA/ECSA (1987).

APPENDIX 2

RECOMMENDED DAILY CALORIC INTAKES

Young Children	Kcal/day		
<1	820		
1-2	1150		
2-3	1350		
3-5	1550		
Older children	Boys	Girls	
5-7	1850	1750	
7-10	2100	1800	
10-12	2200	1950	
12-14	2400	2100	
14-16	2650	2150	
16-18	2850	2150	
Men	light activity	moderate activity	heavy activity
18-30	2600	3000	3550
30-60	2500	2900	3400
>60	2100	2450	2850
Women	light activity	moderate activity	heavy activity
18-30	2000	2100	2350
30-60	2050	2150	2400
>60	1850	1950	2150

Source: World Health Organization (1985).

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