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Abstract

Food security is a complex and multi-dimensional phenomenon. As such, its measurement may entail and benefit from the combination of both "qualitative-subjective" and "quantitative-objective" indicators. Yet, the evidence on the external validity of subjective-type information is scarce, especially using representative household surveys. The aim of this paper is to compare information on self-perceived food consumption adequacy from the subjective modules of household surveys with standard quantitative indicators, namely calorie consumption, dietary diversity and anthropometry. Datasets from four countries are analyzed: Albania, Madagascar, Nepal and Indonesia. Simple descriptive statistics, correlation coefficients, contingency tables and multivariate regression show that the "subjective" indicator is at best poorly correlated with standard quantitative indicators. The paper concludes that while subjective food adequacy indicators may provide insight on the vulnerability dimension of food insecurity, they are too blunt an indicator for food insecurity targeting. An effort towards developing improved subjective food security modules that are contextually sensitive should go hand in hand with research into how to improve household survey data for food security measurement along other dimensions of the phenomenon, particularly calorie consumption.

Key Words: Food security, Qualitative indicators, Quantitative indicators, Household surveys, Subjective perceptions of food adequacy.

JEL: I31, I32, O57, C19, C81.

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I. Introduction

The 1996 World Food Summit brought back to centre-stage in the development debate the issue of hunger and food insecurity as both cause and effect of poverty and slow growth. In the wake of this new push, reducing hunger and food insecurity also became one of the Millennium Development Goals, bringing with it the necessity by individual countries to measure progress in achieving the proposed targets.

The relevance of food security as a top priority has varied over the past few decades, depending on the perceived severity of food insecurity around the world, the enthusiasm of governments and international aid agencies and the popularity of competing development paradigms (Maxwell, 1990:2). Nutrition was prominent in the 1970s and early 1980s, was displaced by food security during the 1980s which, in turn, was displaced by poverty in the 1990s (S. Maxwell, 1998). The conceptualization of food security has evolved over time, partly preceding and partly paralleling similar evolutions in poverty. Back in 1996, Maxwell (1996) identified three main shifts in food security paradigms since the World Food Conference of 1974: from the global and national level to the household and individual level; from a "food first" to a "livelihood" perspective and from objective indicators to subjective perceptions. In this paper, we focus on the last of these issues, which is directly related to the increasing demand for rigorous measurement methods and to the debate over qualitative versus quantitative indicators.

There is clearly a need for simple, quick, reliable and rigorous methods to measure food insecurity and hunger. Without relevant and timely information it is impossible to act in an effective manner. Yet, measuring and assessing food insecurity has proved to be a challenging and daunting task for researchers and practitioners.

Traditionally, particularly in the economics literature, a divide has persisted between objective-quantitative methods versus subjective-qualitative techniques for the measurement of poverty and food insecurity. More recently, these two types of measures and methods have been increasingly viewed as complementary. One of the main conclusions of the 2002 International Scientific Symposium on "Measurement and Assessment of Food Deprivation and Undernutrition" (FAO, 2003a) is the necessity of a suite of indicators to capture the multi-faceted nature of the food security concept. In particular, we need to combine "qualitative" and "quantitative" methods and indicators. In response, an increasing number of quantitative surveys now collect subjective-type information, which is particularly valuable for measuring vulnerability to food insecurity. Despite these methodological advances and the availability of better quality data, empirical evidence on the reliability and validity of the various subjective indicators in use remains scant. Even though much work has been done on alternative indicators, and the literature on subjective poverty lines is growing, relatively less progress has been made in terms of externally validating self-assessment indicators of food security using representative household surveys. Towards this end, the use of household surveys containing both objective and subjective information on the same household provides a valuable workbench for this type of validation.

Most examples of validation are found in the poverty literature, as can be seen in Pradhan and Ravallion (2000), Ravallion and Lokshin (1999), Lokshin *et al* (2003) and Carletto and Zezza (forthcoming). Pradhan and Ravallion (2000) and Lokshin *et al* (2003), using multivariate regression analysis, take the subjective perception of food consumption adequacy questions to construct a money matrix subjective poverty line, which is then compared to the standard objective poverty line. In terms of food security, Hamilton *et al* (1997) compare the US subjective food

security index to a variety of alternative indicators. Coates *et al* (2003) do the same for a prototype index in Bangladesh, as well as cite other studies in developing countries.

Our initial intention was to validate self-assessment indicators with respect to some standard quantitative indicators normally used as benchmarks, with the assumption that the benchmark is itself a more direct and accurate measure of the "true" food security status. Measures of consumption, poverty, anthropometry and other socio-economic variables have all been used as benchmarks. In practice, per capita calorie consumption is utilized as the main benchmark measure. However, as our work progressed, we realized that validation becomes problematic when the benchmarks are themselves problematic. More importantly, if food security is a multi-dimensional phenomenon and cannot be captured by a single indicator, how can we test alternative indicators against a single benchmark? As a result, this paper may appear to ask more questions than it answers, and the main objective is thus to contribute to these debates. Building on the analysis of four household surveys, we provide some recommendations on future research aimed at integrating objective and subjective indicators in household surveys.

The paper is structured as follows. The next section reviews the concept of food security and the search for alternative indicators. The third section briefly describes the datasets, and the fourth section presents the empirical results. The fifth section provides a discussion of the results and concludes. The annexes detail the problems encountered and the methodology and assumptions used in estimating household caloric consumption.

II. Measuring Food Security

However simple it might appear, the concept of food security and hunger has been long debated, and we do not need to pursue a new definition in this paper. The most frequently cited definition is still that proposed almost two decades ago by the World Bank, which defines food security as "access by all people at all times to sufficient food for an active and healthy life" (World Bank, 1986:1). Maxwell and Frankenberger (1992) counted over two hundred different definitions, but most revolve around the World Bank's definition. As mentioned earlier, the third shift identified by Maxwell added subjective considerations.

Despite apparent empirical strength, the operationalization of the food security concept still presents many challenges. Although definitions may be similar, measurements and assessment methodologies and methods can differ considerably, even within the boundaries of the qualitative and quantitative traditions. Food security, as with poverty, is a cross-cutting, complex and multi-faceted phenomenon. The food security literature spans a wide range of disciplines, including anthropology, nutrition, sociology, economics, geography, public health and epidemiology (Chung *et al* 1997). Conceptually, food security is generally broken down into four different components – availability, access, utilization and vulnerability – each capturing different, but overlapping, dimensions of the phenomenon. Indicators have traditionally focused on specific, easily measured aspects, such as current food supply, individual caloric intake, and so on, often without capturing the complexity of the concept (Gittelsohn *et al*, 1998). As discussed above, widespread consensus exists that no single indicator can capture all aspects of food insecurity while also providing policy makers with relevant and timely information in a cost-effective manner. For this reason, efforts have been put into finding easy to implement and reliable alternative indicators which complement each other.

As with the definitions, the literature abounds with such indicators. Maxwell and Frankenberger (1992) list 25 broad indicators and a host of other indicators related to the different aspects of food security. They distinguish between "process indicators" - capturing food supply and food access -

and "outcome indicators" - describing nutritional status. Chung *et al* (1997) note that even a single composite indicator can come with many different permutations and list some 450 variations of testable indicators. They make the distinction between "generic" indicators applicable to a variety of settings and "location-specific" indicators.

Following FAO (2003a), we identify five general types of methods/indicators. A first indicator can be labelled undernourishment, a measure commonly identified with the Food and Agriculture Organization of the United Nations (FAO). This FAO method begins with the estimate of per capita dietary food energy supply, derived from aggregate food supply data. Assumptions regarding the distribution of this supply across households are made based on income or consumption distribution, or other available data. The proportion of undernourished in the total population is then defined as that part of the distribution lying below a minimum energy requirement level (Naiken, 2003). The FAO measure is useful for comparisons of energy deficiencies across countries and over time.

A second group of indicators, which can be termed food intake, measures the amount of food actually consumed at the individual or household level. Indicators at the individual level can be obtained directly by measuring actual food intake through a number of techniques, including dietary histories, 24-hour recall, actual weighing of food eaten, food frequency questionnaires and chemical analyses. Compared to the standard household survey, this type of survey offers a more reliable measure of food energy deficiency. Food intake surveys are relatively rare, however, as they are much more costly than the standard household survey and require a level of human and financial resources not available in most developing countries.

Instead, food consumption is usually measured indirectly through household surveys. Household surveys in general, and multi-purpose household surveys in particular, are aimed at assessing living standards, not just food security. Although they are time-, resource- and skill-intensive, they are now regularly implemented in many countries. Household-level data can be used to construct a number of measures of food insecurity, including food energy deficiency and poor diet quality and diversity. The level and depth of household food energy deficiency can be measured based on household consumption. An assessment of the quality of consumption, including micronutrients, can also be drawn by estimating dietary diversity or the quantity consumed by the household of specific food items.[1]

A third approach to the assessment of dietary deficiencies is to measure food utilization through nutritional status. Anthropometric measures of children are regularly collected in random sample surveys in many countries. Anthropometric measures, as outcome measures, are well suited for monitoring and evaluating interventions, and can be collected with socio-economic information in order to analyze the determinants of malnutrition. Anthropometric attainment, however, is a non-specific indicator, because it is the result not only of food intake, but also of factors such as sanitation, health and child care practices.

Fourth, food availability is of little use if households or individuals do not have enough financial or productive resources to acquire food. The fourth group of indicators revolve around the concept of access to food and can be proxied by wealth status, measured by total consumption, expenditures or income. Access-to-food indicators, and in particular income, have served as the main food security indicators in many countries. The link between access and a given wealth proxy breaks down when local markets are not functioning, as in the case of war or disaster, for example.

[1] See Appendix I for a more detailed description of the use of multi-purpose household surveys for the analysis of food consumption.

Finally, the last approach revolves around the concept that even if households are not currently undernourished, they may be at risk or vulnerable to future deprivation. Vulnerability is an inherently dynamic concept which expresses *ex-ante* vulnerability and *ex-post* outcomes. Because it is an expression of a "future state of the world" which, by definition, we do not know *a priori*, vulnerability is, in itself, difficult to measure (Dercon, 2001). Vulnerability is often gauged through qualitative or "self-assessment" indicators of food insecurity, capturing dimensions which are difficult to isolate with traditional quantitative measures, especially in the absence of panel data. Households may regard themselves as hungry, even if there are no recognizable signs of undernutrition. Further, even if households are not currently undernourished, they may have a significant probability, or well-founded fear, of future deprivation. Other measures of vulnerability to food deprivation also drawn from household surveys include the share of income spent on food and various coping strategy indexes.

In terms of self-assessment indicators, the United States government pioneered the approach of assessing household food security on the basis of a score derived from 18 questions on food-related behaviours and conditions that are known to be associated with food deprivation (Kennedy, 2003). A number of developing countries have successfully implemented similar methodologies (see for example, Nord *et al.* 2002). This type of survey has been piloted extensively in Brazil (Segall Corrêa, *et al*., 2003), and a module has recently been included in that country's biannual national income survey. It also recently formed the centrepiece of a large food security study in Yemen and has been tested and applied in Bangladesh (Coates *et al*, 2003). Reduced forms of these subjective modules are found in many recent standard national household surveys, such as the World Bank's Living Standards Measurement Surveys (LSMS), and focus on respondents' perceived assessment of individual or household food security situation. One of the questions most commonly asked is called the Consumption Adequacy Question (CAQ), and is generally worded as follows: "Concerning your food consumption, which of the following is true?" Answers are generally coded as: 1) more than adequate; 2) just adequate; and, 3) less than adequate. This question, common to all selected surveys, is the focus of our analysis.

III. The data

We analyze four household surveys to estimate household calorie consumption and total expenditure/consumption, dietary diversity and anthropometry, which are compared with the answers to the subjective food CAQ. The surveys are: the Nepal 1995/96 Living Standard Measurement Survey (NLSMS); the 2000 Indonesia Family Life Survey (IFLS3); the Albania 2002 LSMS (ALSMS) and the 2001 Madagascar Household Survey (MHS). Details on each survey can be found in Appendix II, as well as details on the process by which calorie consumption was constructed for each country. Only for Albania were we able to construct all five variables. For Nepal we were limited to dietary diversity and the subjective indicators. For Madagascar, household calorie consumption, total expenditure and dietary diversity were constructed, as well as the subjective indicator. For Indonesia, only the subjective and anthropometric indicators were available. An interesting feature of the Indonesia survey is that it asked the CAQ for the whole household as well as just for the children of the household.

IV. The results

4.1 Perception of food adequacy

Subjective indicators were included in all four household surveys, and the distribution of responses across countries can be seen in Table 1. In all cases, with the exception of Indonesia, approximately 50 percent of those surveyed considered their food consumption (and in the case of Madagascar,

food expenses) less than adequate. The incidence of subjective food insecurity is many times smaller in Indonesia, around 10 percent, which allows us to make our first point. Subjective indicators, as defined here, are not comparable across countries. It is extremely unlikely that the real (though unknown) incidence of food insecurity in Madagascar is the same as Albania, a country with much higher per capita GDP, much lower incidence of poverty, and lower incidence of food insecurity according to the caloric threshold and FAO indicators.

A small percentage of households stated that they had more than sufficient food consumption/expenses—two percent in Nepal, three percent in Madagascar and Albania, and 17 percent in Indonesia. It is not clear how respondents interpret this question. Also, in all four countries, the percentage of households stating that they had sufficient food consumption is higher in rural than in urban areas, although the difference is slight in Albania[2].

[Table 1. Text here]

4.2 Caloric Availability

How do the results for subjective measures of food insecurity compare to the other indicators? We first compare the subjective indicators with calorie consumption for those countries where the latter indicator is available—Albania and Madagascar.[3] Median per capita daily calorie consumption and the percentage of households below the caloric norm, for Albania as a whole and at the urban/rural and regional level, are found in Table 2. Although the national median value of 2912 is plausible when compared to the FAO figure of 2940 (FAO, 2003b), the results are somewhat counter intuitive and contrary to the incidence of poverty in Albania. Approximately 17 percent of the Albanian population is found to be below the caloric threshold level. Calorie consumption is greater and a higher percentage of households are above the threshold in rural areas. Tirana has the lowest median calorie consumption, and the lowest share of households above the threshold (less than 75 percent) of all regions, while the other regions are all roughly similar. In terms of the headcount index of poverty, Tirana has the lowest incidence of poverty, while the Mountain region has an incidence 2 to 3 times higher. For the Coastal region, the incidence of poverty and the percentage of households below the caloric threshold are roughly similar. Similar results are evident with Madagascar, as we shall see shortly.

[Table 2. Text here]

The finding of higher calorie consumption in rural areas does not sit well with the common finding of higher poverty in rural areas, such as we find for Albania. There could be various reasons behind these results. First, because of heavier physical activities, rural people may consume, on average, more calories which are cheaper relative to the calories consumed by the urban population. In addition, or alternatively, there may be a systematic misreporting in rural or urban areas, or both, such as underestimating calories in urban areas as it is difficult to estimate calories from meals/foods eaten outside and/or in kind food, or overestimating consumption of home production

[2] In the case of Madagascar, the subjective question refers to food expenses, and not to food consumption, and we are unclear on how respondents interpreted the question. If the question is interpreted as referring only to purchased foods, then we might expect a downward bias in the percentage of households reporting less than adequate consumption, increasing in size as we move from urban to rural areas, as food purchases and calories from food purchases are higher in urban areas.

[3] Results are presented only for those households whose estimated per capita per day calorie consumption lies in the range of 1000 to 6000 kcal. The sample size has thus been reduced from 5,075 to 4,558 for Madagascar (90% of the full sample) and from 3,599 to 3,456 for Albania (96%). Although point estimates are different with reduced samples, the overall results of the analysis – in particular the correlation with the subjective measure - do not change significantly.

in rural areas. Finally, there may be some kind of systematic non-sampling errors (e.g. not accounting for food stores, wastage and bulk purchases out of the recall period, food fed to animals and to guests etc.), or simply errors in calculation.

There is also a parallel here with the debate on poverty lines, namely the difference between the Food Energy Intake (FEI) method and the Cost of Basic Needs (CBN) method. It is not uncommon for poverty analyses based on the FEI method, where separate poverty lines are calculated, to indicate higher poverty rates in urban than in rural areas. At a given level of income, urban households tend to consume fewer - but more expensive – calories (Tarp *et al*, 2002). Therefore, higher calorie consumption in rural areas is not an uncommon result, and has been found in other similar empirical studies (Hoddinott and Yohannes, 2002; Skoufias, 2001).

Despite all these difficulties, as illustrated in Figure 1, while we do not estimate the income elasticity of calories, there is clearly a positive relationship between per capita calorie consumption and per capita real total consumption in Albania (correlation coefficient of 0.53).

[Figure 1. Text here]

Harkening back to Table 1, contrary to the calorie consumption results, in which rural areas have a significantly higher median, a marginally higher share of rural households (53 to 51 percent) perceived food consumption as inadequate. Despite these contradictory results, on average, the correlation between the two indicators is evident. The higher the per capita total consumption and the per capita calorie consumption, the more likely is that a household reported adequate food consumption, as can be seen in Table 3 and Figure 2.

[Table 3. Text here]

[Figure 2. Text here]

However, this relationship holds only on average. Correlation is measured using correlation coefficients and two-by-two contingency tables, looking in particular at sensitivity and specificity. Sensitivity is defined as the proportion of food secure (as identified by the benchmark) that is identified also by the alternative indicator (i.e. the probability of a true positive). Specificity refers to the proportion of food insecure that is correctly identified by the alternative indicator (i.e. the probability of a true negative). A higher specificity means that the subjective indicator is more likely to find a household having reported a less than adequate food consumption among those below the caloric threshold (or with undernourished children in the case of anthropometric measures) than a household having reported a more than/just adequate consumption among those above the caloric threshold (or without undernourished children, that is, sensitivity). In other words, higher specificity means that the subjective indicator produces more false positives than false negatives, and is thus better at identifying food insecure households.

Although the contingency table below (Table 4) is significant at conventional confidence levels, it shows that calorie consumption and subjective perceptions do not classify the same households as food insecure. Sensitivity and specificity are low. More than half of the 83 percent of households above the caloric threshold felt that their food consumption was less than adequate. About 58 percent below the threshold felt the same way.

[Table 4. Text here]

Similar results emerge from Madagascar. Using the figures based on the 30-day recall, overall median per capita calorie consumption is 2274 kcal, which is roughly approximate to the 2080 kcal estimated by the FAO method (FAO, 2004)[4]. As for Albania, median calorie consumption is higher in rural areas than in semi-urban areas, and in semi-urban areas greater than in urban areas (Table 5).

[Table 5. Text here]

Per capita calorie consumption and real per capita food and total expenditure (consumption aggregates) are positively correlated, with a correlation coefficient of 0.58 for food expenditure and 0.38 for total expenditure. Per capita calories increase as per capita expenditure increases, particularly for the bottom quintiles, as seen in Figure 3.

[Figure 3. Text here]

Also in the case of Madagascar there is an evident correlation between the subjective measure, on one side, and the calorie and total consumption measures, on the other side. The higher the per capita total consumption and the per capita calorie consumption, the more likely is that a household reported adequate food consumption, as it can be seen in Table 6 and Figure 4.[5]

[Table 6. Text here]

[Figure 4. Text here]

However, once again, this is true only on average. The correlation coefficient between subjective food adequacy and calories is only 0.1, while the correlation with total consumption is 0.23. While statistically significant, the two-by-two matrix in Table 7 shows that just over half of the 68 percent of households above the caloric threshold felt that they had less than adequate food expenditures. Similarly, approximately 45 percent of those households below the caloric threshold considered that they had adequate food expenditures. Again, these two measures do not classify the same households as food insecure.

[Table 7. Text here]

4.3 Dietary Diversity

In her review of the literature, Ruel (2002) finds that while there is no consensus in terms of conceptualizing or measuring dietary diversity, various measures of dietary diversity have been positively associated with nutrition adequacy, child growth, per capita consumption and energy availability. In its simplest form, dietary diversity can be defined as the number of different foods or food groups consumed over a given reference period (Hoddinott, 1999a and 1999b; Hoddinott and Yohannes, 2002). For Albania, Madagascar and Nepal, we tested the subjective variable against four different diversity scores:

1) Simple count of foods (as listed in the questionnaire)
2) Simple count of food groups (as listed in the questionnaire)

[4] Using the 7-day recall we obtain a slightly lower median, closer to the FAO estimate.

[5] This is not true for the "more than adequate" category which, at the national level at least, has calorie and total consumption values lying in between the "just adequate" and the "less than adequate" categories' values. This is mainly due to the low number of observations in the "more than adequate" category. This is also a reason why we merge the "more than adequate" and "just adequate" categories, as the former provides little added information.

3) Simpson Index, given by $1 - \sum \Pi_i^2$
4) Shannon Index, given by $- \sum \Pi_i \log(\Pi_i)$

where Π_i is the calorie share of food i (i=1,2...). If only one food item was consumed, the last two indexes would be zero, so variety increases with the index value, thus establishing a continuum between a "diverse" and a "non-diverse" diet. We present results only for the simple count of foods, as none of the indexes tested outperformed the others and dietary diversity – however measured – is found to be poorly correlated with subjective food adequacy in all countries analyzed.

Figure 5 shows that, for Albania, on average, as we move from the first to the fifth dietary diversity quintile, the percentage of households reporting less than adequate food consumption declines. These trends are similar nationally as well as separately between urban and rural households. The decrease is however not monotonic and the correlation coefficient is in fact quite low (0.15).

[Figure 5. Text here]

A similar picture is depicted in Figure 6 for Madagascar. Although the relation is now monotonic, the correlation is virtually identical than for Albania (0.16).

[Figure 6. Text here]

In the case of Nepal, dietary diversity is more correlated with subjective food adequacy than in the case of Albania and Madagascar. This relationship holds both nationally as well as for rural and urban households. The higher correlation coefficient of 0.3 is evident in Figure 7, where the decrease in the percentage is much more marked than in the other two countries. However, once again, this is true only on average, as the correlation coefficient is still not very high.

[Figure 7. Text here]

4.4 Anthropometry

Anthropometric indicators were calculated for Albania and Indonesia. Two anthropometric indices (z-scores) were calculated – wasting and underweight – and compared to the subjective food adequacy answers.

[Table 8. Text here]

In Albania (Table 8), approximately 13 percent of children were underweight, and 8 percent wasted, with higher percentages in rural areas in both cases. In comparing with the subjective indicator, we find no correlation for both indices, as it can be seen in the matrices in Tables 9 and 10. Both contingency tables are statistically insignificant.[6]

[Table 9. Text here]

[Table 10. Text here]

[6] As one would expect, similar results have been found for stunting. Results for stunting are not shown because stunting reflects long-term processes, which are less likely to be related to current food consumption. Note that these figures are not the same as those reported in World Bank and INSTAT (2003) because neither the age group nor flagging criteria are the same.

Indonesia has a higher incidence of underweight children than Albania, but a similar prevalence of wasted children, as seen in Table 11. For all these indicators, the percentages are similar across urban and rural areas. The Indonesia survey also collected data on child subjective food adequacy, which in theory is more likely to be correlated with the anthropometric measures[7]. However, all matrices are statistically insignificant, with little evident correlation. We present only the results corresponding to child subjective food adequacy (Tables 12 and 13 below).

[Table 11. Text here]

[Table 12. Text here]

[Table 13. Text here]

4.5 Multivariate regression

If subjective food adequacy (as defined here) is only weakly correlated with calorie consumption and with dietary diversity, and not at all with anthropometry, what is behind the subjective indicator? Does it reflect real perceptions of households regarding food insecurity, or is it too vague or blunt an indicator? Is it too subjective to lead to valid comparisons among households? One way to explore further the relationship across indicators is to use multivariate regressions to determine which socio-economic characteristics are associated with perceptions of subjective food adequacy. We model the relation as a Probit, where a positive coefficient of a given explanatory variable can be interpreted as being associated with a higher probability of food adequacy[8].

Two models are estimated. The second model is identical to the first except for the use of per-capita food expenditures in lieu of per-capita calorie consumption to see whether subjective answers are more responsive to food expenditure than to calories, but also because the food CAQ for Madagascar asked about food expenses, not consumption.

We start by simply regressing the CAQ response on per-capita calorie consumption (and food expenditure) to quantify how much of the variability of respondent's perception is explained by our objective indicators. In the case of Albania, even though the binary model is statistically significant and the marginal effect fairly high, including only per capita calorie consumption explains very little (1 percent) of the variation of the subjective indicator. The same applies to per capita food expenditure (6 percent). This confirms our earlier discussion: per capita calorie consumption has little overlap with subjective perceptions and that much remains to be explained of the variability of our dependent variable.

More formally, the full model can be expressed as:

$$CAQ = \alpha + \beta_1 C + \beta_2 D + \beta_3 A + \beta_4 NF + \beta_5 Z + \beta_6 M + \beta_7 O + \beta_8 R + \beta_9 E + \beta_{10} G + \beta_{11} RD + \beta_{12} S + \varepsilon$$

where

[7] The age range here is between 3 and 59 months

[8] We also estimated ordered probit models (i.e. including all three categories of the subjective question), but results (not shown here) are similar to those of the standard probit.

- CAQ is the Consumption Adequacy Question in dichotomous form.
- C refers to the log of per capita calories per day or to the log of per capita food expenditure (two separate, identical models)[9].
- D refers to a dietary diversity index (Simpson index for Albania and the simple food count for Madagascar).
- Following Morris *et al* (2000), A refers to a household asset index, calculated as:

$$\text{Asset score} = \sum f_{gi} * w_g$$

where *g* is the list of assets, *w* is a weight equal to the reciprocal of the proportion of the study households who owned one or more of that item (w_g) and *f* is the number of units of asset *g* owned by the household (f_{gi}). The product is then summed over all possible assets. The score includes both agricultural and non agricultural assets[10].

- NF refers to the share of non food items in total consumption.
- Z refers to a vector of household characteristics including household size, dependency ratio, gender, age of the household head, pension status, gender of the respondent and age composition of the household
- M refers to migration variables (for Albania, the number of permanent migrants in Greece and Italy; for Madagascar, the number of temporary migrants)
- O refers to occupation of the household head (skilled vs. unskilled) and to whether the household head is employed (as defined by the International Labour Organization: at least one hour worked per week)
- R refers to the religion of the head of the household
- E refers to education (adult average in Albania; household head in Madagascar)
- G refers to a series of geographical location variables.
- RD refers to relative deprivation, that is, a household's wealth position relative to other households in a given geographical area. Following Stark and Taylor (1989), relative deprivation is measured by the product of the mean excess wealth of households *j* wealthier than household *i* and the proportion of households in the community that are richer than household *i*. It can be expressed as follows:

$$RD_i = \left(\frac{\sum_{y^j > y^i} \left[y^j - y^i \right]}{\sum_{y^j > y^i} 1} \right) \cdot \left(\frac{\sum_{y^j > y^i} 1}{N} \right) = \left(\frac{\sum_{j=1}^{N} \left[\max\left(0, \left(y^{\ j} - y^{\ i} \right)\right)\right]}{N} \right)$$

where i,j = 1…N;
N = number of households in the community;
$y^{i,j}$ = household *i*'s/*j*'s wealth. For Albania, the reference community is the village, which is feasible given access to census data. For Madagascar, the reference community is the province.[11] The Albania method is preferred, since we consider it

[9] Anthropometry has not been included due to the reduced number of observations.
[10] Using a score with only agricultural or non-agricultural assets yields the same results (not shown here).
[11] More precisely, the following procedure was followed to construct the relative deprivation variable for Albania: (a) a set of variables representing demographic composition, physical and human capital assets was prepared both for the LSMS families and for the Census of all Albanian households; (b) in the Census, all the families living in the same villages containing at least one LSMS enumeration area were kept; (c) the two datasets were appropriately linked (some community variables surveyed in the LSMS were reported to the Census families, even if they had not been surveyed in the Census) and appended; (d) factor analysis was applied to all the families in order to create a score representing an index of wealth; (e) in each village, the index of relative deprivation was calculated, based on the wealth

more likely for households to be worried about their relative position in regards to their immediate neighbours, rather then to a larger provincial population.

- S refers to other subjective variables (for Albania, poverty and health condition; for Madagascar, poverty condition).

The results for the two full models can be found in Table 14 for Albania and Table 15 for Madagascar.

[Table 14. Text here]

Once we add the full specification, the log of per capita calories becomes statistically insignificant. However, adding the remaining variables explains a larger part (36 percent) of the variation in food adequacy perception. When per capita calorie consumption is replaced by per capita food expenditure, the model produces similar results. However, unlike per capita calories, per capita food expenditure remains statistically significant.

Just as interesting is the role of the different types of variables in explaining perceptions of food adequacy in Albania. First, dietary diversity is highly correlated to subjective food adequacy, with a very high marginal effect (0.55). However, the dietary diversity index becomes insignificant when per capita calories are substituted with per capita food expenditure. This suggests that the dietary diversity index may convey similar information as food expenditure, and in fact the two are collinear, with a high coefficient of correlation (0.6). Second, a number of wealth indicators are associated with perceptions of greater food adequacy. These include the share of non-food items in total consumption, ownership of assets and higher wage/skilled occupations. Greater levels of human capital, in the form of average years of education among adults in the household, are also associated with a higher probability of food adequacy. Third, differences in household size and gender and age composition do not appear to influence perceptions of food adequacy. However, in the case of Albania, at equal levels of calorie/food consumption, being a female respondent, a widow, or a pensioner is associated with a greater probability of food inadequacy. In terms of other household characteristics, Catholic households have a higher probability of food adequacy, while having a migrant living in Greece is associated with a lower probability. Fourth, in terms of the regional variables, compared to the excluded Coastal region and after controlling for other factors, households living in the Central and Tirana regions have a worse perception of food consumption.

Fifth, food adequacy is highly correlated with other subjective perceptions.[12] Households that are satisfied with their general current situation, who are little concerned about providing the family with food and other basic needs for the future, who do not perceive themselves as poor and who think that life has improved during the previous three years have a higher probability of considering their food consumption adequate. This suggests that perceptions of food consumption are influenced not only by the current situation (however the question was formulated), but also by changing status over time ("relative" food security) and the perspectives for the future (vulnerability). If this is the case, then we should not be surprised that little correlation is found with *current* caloric adequacy. However, the statistical significance of other subjective answers may be simply capturing "attitudinal characteristics" (Carletto and Zezza, forthcoming, and Lokshin *et*

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score; (f) only the LSMS families were kept for the rest of the analysis. The factor analysis which produces the index of wealth for each family is based on family size, demographic structure, characteristics of the head of the household, education, engagement in agricultural activities, work activities, household unemployment rate, dwelling characteristics, assets, community characteristics, regional location, migration networks. For Madagascar, census data were not available. Wealth is proxied by total per capita real consumption, and relative deprivation is calculated at the urban/rural provincial level.

[12] We should not infer a causal effect of the other subjective variables on subjective food adequacy, when in fact it is just as possible that perceptions of food adequacy influence these other subjective variables.

al, 2003), rather than relative food insecurity and vulnerability. In other words, if a person is pessimistic about the present situation, it is likely that she is pessimistic also about the past and the future.

The probit models for Madagascar tell a similar story, albeit with some notable exceptions. Dietary diversity, occupation (except having a member of the household owning a non-agricultural enterprise), household asset score, religion and migration are statistically insignificant in both models. Household composition and characteristics still have little influence. However, the share of non food in total consumption and greater levels of human capital are also associated with a higher food adequacy. In terms of regional variables, people living in poorer regions have a lower perception of food adequacy. Furthermore, relative deprivation is statistically significant, suggesting that perceptions of food adequacy are influenced by relative wealth status. The poorer a given household compared to a reference group, the higher the probability of perceived food inadequacy.

Also in the case of Madagascar, other subjective perceptions count. Those households whose budget has improved compared to the year before the interview and those who think that they are currently among the wealthy(ier) households, have a higher perception of food adequacy. This makes eminent sense given the importance of relative wealth as measured by total per capita consumption.

[Table 15. Text here]

V. Discussion and conclusions

The simple descriptive analysis presented suggests that, overall, calorie consumption, dietary diversity and anthropometry are at best weakly correlated to subjective perceptions of food consumption. "Subjective" and "objective" indicators do not classify the same households as food (in)secure. The weak correlations are similar to those found in other studies. Hamilton *et al* (1997) find only a weak correlation between income and the US food security measure, with correlation coefficients ranging from -0.12 to -0.33, depending on the definition of income utilized. Coates *et al* (2003) found in a small sample in Bangladesh somewhat higher correlation coefficients (0.42-0.44), though they find particularly low correlation with calorie consumption. Both of these food security indicators were far more sophisticated than the CAQ utilized in our study, and were the result of extensive field testing.

The lack of correlation between anthropometry and perceptions is not surprising, at least for underweight. Anthropometric indicators reflect not only food consumption, but also care practices, health and other environmental factors. More surprising is the lack of correlation between wasting and perceptions, especially the (weakly) negative correlation found between wasting and subjective children's food consumption adequacy in Indonesia. Coates *et al* (2003) found a similar lack of association between anthropometric measures and the subjective indicator in Bangladesh.

Dietary diversity appears to be more correlated with subjective perceptions than calories or anthropometry, at least for Albania. This corresponds to conventional wisdom on the relationship between food consumption, calories and wealth. As households become wealthier, instead of maximizing calories, improve the quality of consumption (substituting better types of the same foods or expanding the diversity of foods eaten) and the type of consumption, such as eating out more often. This implies small marginal changes in caloric intake as incomes increases, but a large change in the composition of the diet and in the cost of each calorie. Hoddinott and Yohannes (2002), in their cross country study, find that as households diversify their diets, they increase the

consumption of relatively prestigious non staple foods rather than increasing the variety of consumption within the group of staples. Note, however, that dietary diversity is not interchangeable with dietary quality, but instead is only one component (Ruel, 2002).

The lack of correlation between subjective perceptions and calories may also be due to the biases inherent in estimating calorie consumption using household surveys. However, the fact that there is little correlation in Albania, which has the best quality data on food consumption among the surveys analyzed, suggests that the two may really be weakly correlated. Furthermore, there is no *a priori* reason by which the two should always match. This could be explained also by the fact that the percentage of households reporting less than adequate consumption is much higher than the percentage of households below the caloric norm. Devereux (2003) argues that, for conceptual reasons, self-reported subjective methodologies tend to be systematically biased towards overestimating food insecurity in comparison with quantitative methods. In any case, as we have stressed, a weak relationship between standard quantitative indicators – such as income and consumption - and subjective indicators is a common finding in the literature.

The multivariate results for Albania show that the responses to the food adequacy question depend on a variety of household level and wealth characteristics. This confirms the earlier work of Pradhan and Ravallion (2000) for Nepal and Lokshin *et al* (2003) for Madagascar, who perform similar regressions albeit with a different objective. Also, both of these studies find that relative income or, more generally, the relative position in society, influence reported perceptions. In Madagascar, Lokshin *et al* (2003) found that households living in population clusters with a high mean income are more likely to perceive their food consumption expenditure as less adequate compared to an average household, and that higher intra-cluster inequality negatively affects perceptions of food consumption adequacy. We find similar results for both Madagascar and Albania.

We take their analysis a step further, however, and we find for Madagascar that households that are poorer compared to their neighbours (relative deprivation)—holding household and community level wealth constant—have a lower perception of food adequacy. Finally, if the household's economic situation has worsened in the past—holding wealth constant—the household is much more likely to have a lower perception as well. These two results together suggest that the food adequacy questions may be capturing relative food adequacy, in comparison with neighbours, and respondent's perception of changing status over time. As such, they would reveal perceptions of vulnerability and would denote something quite different from standard quantitative measures. Our multivariate regressions show that perceptions of food adequacy are highly correlated with perception of relative and absolute wealth, both in the past and in the present. It is therefore not surprising the finding of weak (or, lack of) correlation with *current* food security and wealth as measured by quantitative indicators, which cannot capture vulnerability. On the other hand, we have argued that the correlation among subjective indicators may be due also to "attitudinal characteristics" and not to relative food insecurity and/or to vulnerability. Panel data would be needed to control for fixed individual effects and thus to determine whether perceptions are determined by vulnerability.

Finally, the measure of perception of food adequacy that we have been analyzing in this paper is alarmingly simple, when compared to the US food security index or to standard calorie consumption measures. On the other hand, available evidence from a comparison of the US food security index with a simple food adequacy question similar to the CAQ shows that the simple measure performs fairly well (Hamilton *et al*, 1997). Only 16 percent of those who reported often not having enough to eat, and 22 percent of those with sometimes not enough to eat, were classified

as food secure by the latter index. Similarly, over 95 percent of those reporting having enough food were considered food secure with the index.

While the relative imprecision of the CAQ compared to the more sophisticated US-type subjective food index may be sufficient for academic studies, when it comes to targeting food security interventions this imprecision translates into missing food insecure households. The recent trend in a number of countries such as Brazil, Yemen and Bangladesh to redesign a food security index based on local conditions and notions of food consumption is an important step forward, and should be encouraged in other countries carrying out LSMS-type household surveys.

We therefore conclude that the subjective modules, as they are currently implemented in LSMS-type surveys, are not very useful for measuring food insecurity. While subjective food adequacy indicators may provide insight on the vulnerability dimension of food insecurity, the CAQ is a too blunt and ambiguous indicator for directly mapping food insecurity. An effort towards developing subjective food security modules should go hand in hand with research into how to improve household survey data for food security measurement along other dimensions of the phenomenon, particularly calorie consumption. This is surely not an easy task. The US food security module is the product of several years of methodological advances and of field testing. It measures the sufficiency of household food through food-related behaviours as directly experienced by people. One of its main drawbacks is that, while its *internal* validity and consistency have been extensively tested (at the population level, not at the level of an individual household), its *external* validity has not (Bickel *et al*, 2000). The inclusion of a contextually sensitive module similar to the US's into household surveys in developing countries, reflecting also future vulnerability, provides an excellent opportunity to validate externally "subjective" indicators, both at the population level and at the level of the individual household.

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Tables and Figures

Table 1. Percentage of food insecure households, using a variety of indicators

	Perception of food adequacy (% of "less than adequate" answers)			Poverty headcount	Below caloric threshold	FAO measure
	National	Urban	Rural	National	National	National
Nepal	51	36	52	42	na	26
Madagascar	52	45	55	70	35	37
Albania	52	51	53	25	17	6
Indonesia-household	10	7	13	16	na	6
Indonesia-children	9	6	10	na	na	na

Source: own calculations; FAO (2003b and 2004); Prennushi (1999); World Bank and INSTAT (2003); Strauss, et *al* (2004b)

Table 2. Percentages of households above/below the caloric norm and median caloric consumption per capita per day. Albania

	National	Urban	Rural	Coastal	Central	Mountain	Tirana
	(n= 3,456)	(n= 1,899)	(n= 1,557)	(n= 955)	(n= 954)	(n= 971)	(n= 575)
Caloric threshold							
Below (%)	17.3	21.8	13.4	17.7	15.0	15.0	26.3
Median kcal per capita	2,912	2,673	3,131	2,863	3,007	2,992	2,567
Poverty*							
Moderate (%)	25.4	19.5	29.6	20.6	25.6	44.5	17.8
Extreme (%)	4.7	4.1	5.2	3.6	4.6	10.8	2.3
Subjective							
Not adequate (%)	52.3	50.8	53.4	44.7	56.2	55.9	54.2

*Extreme poverty headcount index is based on a food poverty line, or the cost of obtaining a minimum amount of calories. Moderate poverty headcount is based on the food poverty line plus essential non food items.
Source: ALSMS, own calculations; World Bank and INSTAT (2003); Azzarri, *et al* (forthcoming).

Table 3. Real per capita total consumption and daily per capita caloric consumption by subjective food adequacy answer. Albania

	More than/just adequate (n=1,706)	**Less than adequate** (n= 1,872)
Real per capita total consumption (New Leks)		
Median	7,963	5,877
Mean	9,261	6,566
	(n=1,622)	(n= 1,813)
Daily per capita caloric consumption (Kcals)		
Median	3,042	2,833
Mean	3,157	2,944

Source: ALSMS, own calculations

Table 4. Contingency table between per capita caloric availability and subjective food adequacy. Albania

	Above caloric threshold	Below caloric threshold	*Totals*	χ^2: 7.546	Sensitivity: 0.48
Food exp. more than/just adequate	1,370 (40) (48)	248 (7) (42)	*1,618* *(47)*	Design-based F: 4.337 P: 0.0379	Specificity: 0.58
Food exp. less than adequate	1,473 (43) (52)	343 (10) (58)	*1,816* *(52)*	Un-corrected Cramer's V: 0.0682	
Totals	*2,843* *(83)* *(100)*	*591* *(17)* *(100)*	*3,434* *(100)*		

Source: ALSMS, own calculations

Table 5. Percentage of households below the caloric norm and median caloric consumption per capita, per day, by location. Madagascar

30 day recall	**National** (n= 4,558)	**Urban + Semi-urban** (n= 2,753)	**Rural** (n= 1,773)
Below (%)	32.4	37.2	30.8
Median kcal per capita	2,274	2,158	2,317
Poverty			
Moderate (%)	69.6	44.1	77.1
Subjective			
Not adequate (%)	52.5	45.6	54.8

Source: MHS, own calculations; Rakutomehefa, Razakamanansoa and Romani (2002)

Table 6. Median and mean calorie consumption by subjective food adequacy and location. 30-day recall. Madagascar

	Kcal per capita per day	**More than/just adequate**	**Less than adequate**
		(n=2,336)	(n= 2,190)
National	Median	2,425	2,140
	Mean	2,640	2,463
		(n=928)	(n= 731)
	Median	2,250	1,982
Urban	Mean	2,438	2,247
		(n=594)	(n= 500)
	Median	2,248	2,210
Semi-Urban	Mean	2,535	2,410
		(n=814)	(n= 959)
	Median	2,501	2,165
Rural	Mean	2,696	2,498
	Real monthly per capita total consumption	Malagasy Franc	Malagasy Franc
		(n=2,561)	(n= 2477)
National	Median	850,759	547,233
	Mean	1,347,280	757,999

Source: MHS, own calculations.

Table 7. Contingency table between per capita caloric availability and subjective food adequacy. 30-day recall. Madagascar[13]

	Above caloric threshold	Below caloric threshold	*Totals*	χ^2: 6.5883	Sensitivity: 0.49
Food exp. more than/just adequate	1,500 (33) (49)	656 (15) (45)	*2,156.1* *(48)*	Design-based F: 2.2116 P: 0.1379	Specificity: 0.55
Food exp. less than adequate	1,570 (35) (51)	810 (18) (55)	*2,379.8* *(52)*	Un-corrected Cramer's V: 0.073	
Totals	*3,070* *(68)* *(100)*	*1,466* *(32)* *(100)*	*4,536* *(100)*		

Source: MHS, own calculations

Table 8. Prevalence of undernutrition. Albania[14]

	National	**Rural**	**Urban**
	(n=1,099)	(n=600)	(n=499)
Underweight (%)	13.4	15.8	8.8
Wasted (%)	(n=999) 8.6	(n=572) 9.0	(n=427) 7.8

Source:ALSMS, own calculations.

Table 9. Weight-for-Age and Subjective food adequacy. Albania

	Normal	Underweight	Totals	χ^2: 2.608	Sensitivity: 0.43
More than/Just Adequate	406 (89) (43)	53 (12) (36)	*45* *(100)* *(42)*	Design-based F: 1.2541 P: 0.2635	Specificity: 0.64
Less than Adequate	542 (85) (57)	94 (15) (64)	*636* *(100)* *(58)*	Un-corrected Cramer's V: 0.0699	
Totals	*948* *(87)* *(100)*	*147* *(13)* *(100)*	*1,095* *(100)*		

Source: ALSMS, own calculations.

[13] Note that we find a lack of correlation also between calories from food expenditure alone and subjective adequacy of food expenses (results not shown here)

[14] The cut-off is -2 standard deviations for both wasting and underweight. The age range is 0-60 months. Observations have been flagged, using the default flagging criteria of the software EpiInfo-NutStat 2002 (± 6 standard deviations for underweight and -4 standard deviations and +6 standard deviations for wasting) (CDC, 2002). Observations outside these ranges were dropped. Individual sampling weights have been used in the computations.

Table 10. Weight-for-Height and subjective food adequacy. Albania

	Normal	Wasted	Totals	χ^2: 0.3153	Sensitivity: 0.40
More than/Just Adequate	364 (92) (40)	32 (8) (37)	*396* *(1)* *(40)*	Design-based F: 0.1796 P: 0.672	Specificity: 0.63
Less than Adequate	545 (91) (60)	54 (9) (63)	*599* *(100)* *(60)*	Un-corrected Cramer's V: 0.0131	
Totals	*909* *(91)* *(100)*	*86* *(9)* *(100)*	*995* *(100)*		

Source: ALSMS, own calculations.

Table 11. Prevalence of undernutrition, Indonesia

	National (n=1,671)	**Rural** (n=869)	**Urban** (n=802)
Underweight (%)	25.5	25.4	25.5
Wasted (%)	9.0	8.1	10.0

Source: IFLS3, own calculations.

Table 12. Weight-for-Age and children's subjective food adequacy. Indonesia

	Adequate	Less than Adequate	Totals	χ^2: 0.6517	Sensitivity: 0.92
Normal	912 (75)	76 (78)	*988* *(75)*	Design-based F: 0.4889 P: 0.4848	Specificity: 0.06
Underweight	313 (25)	21 (22)	*334* *(25)*	Un-corrected Cramer's V: 0.0047	
Totals	*1,225* *(100)*	*97* *(100)*	*1,322* *(100)*		

Source: IFLS3, own calculations.

Table 13. Weight-for-Height and children's subjective food adequacy. Indonesia

	Adequate	Less than Adequate	Totals	χ^2: 0.3658	Sensitivity: 0.927
Normal	1,119 (91)	87 (90)	*1,206* *(91)*	Design-based F: 0.2692 P: 0.6042	Specificity: 0.09
Wasted	106 (9)	10 (10)	*116* *(9)*	Un-corrected Cramer's V: - 0.0017	
Totals	*1,225* *(100)*	*97* *(100)*	*1,322* *(100)*		

Source: IFLS3, own calculations.

Table 14. Probit of Perception of Food Adequacy, Albania.

Dependent Variable (0 = less than adequate; 1 = more than/just adequate)				
	Calorie consumption		Food Expenditures	
Independent variables	**Coefficient**	**Robust z statistics**	**Coefficient**	**Robust z statistics**
Per capita kcal / food expenditure				
Log of per-capita calories per day	0.179	(1.53)		
Log of per-capita food expenditure			0.34	(3.05)***
Dietary Diversity				
Simpson Index of dietary diversity	1.386	(3.20)***	0.707	(1.62)
Wealth				
Household asset index	0.088	(2.73)***	0.074	(2.26)**
Share of non-food items in total consumption	0.008	(2.96)***	0.011	(3.68)***
Household Composition				
Household size	0.053	(1.18)	0.072	(1.60)
Age of HH head	0.002	(0.69)	0.002	(0.58)
Female headed HH – dummy	0.125	(1.04)	0.135	(1.13)
Dependency ratio	0.06	(0.34)	0.055	(0.32)
Respondent is female	-0.106	(1.69)*	-0.099	(1.58)
HH head is divorced	-0.03	(0.08)	-0.046	(0.12)
HH head is widow(er)	-0.215	(1.66)*	-0.226	(1.75)*
HH head is single	-0.137	(0.82)	-0.159	(0.95)
Whether HH member(s) received a pension or other assistance during the past 12m	-0.148	(1.96)*	-0.153	(2.03)**
Number of HH members 0-14 years of age	-0.062	(1.25)	-0.063	(1.25)
Number of HH members 15-34 years of age	-0.049	(1.11)	-0.053	(1.20)
Number of HH members 35-59 years of age	-0.044	(0.80)	-0.047	(0.86)
Migration/Remittances				
HH has permanent migrants in Italy	-0.024	(0.24)	-0.023	(0.22)
HH has permanent migrants in Greece	-0.351	(2.58)***	-0.353	(2.58)***
Occupation				
Occupational group of HH head – 0=unskilled, 1=skilled	-0.26	(2.01)**	-0.257	(1.99)**
Unemployed HH head, dummy	-0.063	(0.49)	-0.051	(0.40)
Health				
HH head suffers from chronic illness – dummy	-0.023	(0.34)	-0.026	(0.38)
Religion				
HH head is Catholic	0.638	(2.60)***	0.633	(2.62)***
HH head is Orthodox	-0.318	(1.37)	-0.347	(1.52)
HH head is Muslim	-0.033	(0.16)	-0.052	(0.26)
Education				
Average HH years of education	0.025	(2.02)**	0.021	(1.65)*
Location				
Urban	-0.242	(2.29)**	-0.229	(2.21)**
Central Region (excluded is Coastal)	-0.444	(4.02)***	-0.423	(3.79)***
Mountain Region	0.104	(0.84)	0.111	(0.90)
Tirana Region	-0.456	(3.55)***	-0.467	(3.61)***
Relative Wealth				
Relative Deprivation Index	-0.117	(0.95)	-0.11	(0.91)
Subjective				
Satisfaction with current situation	0.483	(8.64)***	0.479	(8.57)***
Concern in providing family with basic needs in next 12m	0.111	(2.61)***	0.111	(2.59)***
Ten-step wealth ladder	0.294	(9.04)***	0.282	(8.58)***
General situation past 3 years	0.369	(8.43)***	0.367	(8.35)***
Rating health condition with respect to one year ago, HH-head; 0=Worse/same, 1=Better	-0.116	(1.79)*	-0.117	(1.81)*
Constant	-6.175	(5.19)***	-7.054	(6.84)***
Observations	3351		3351	
Log Likelihood	-1484.99		-1479.61	
chi2	908.10		908.15	
Pseudo-R2	0.36		0.36	

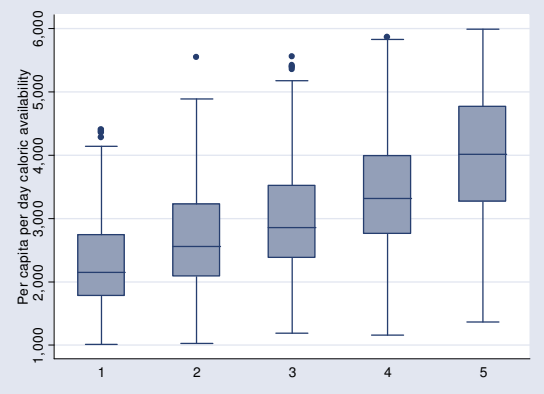
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 15. Probit of Perception of Food Adequacy, Madagascar.

Dependent Variable (0 = less than adequate; 1 = more than/just adequate)				
	Calorie consumption		Food Expenditures	
Independent variables	**Coefficient**	**Robust z statistics**	**Coefficient**	**Robust z statistics**
Per capita kcal/ food expenditure				
Log of per capita kcal per day, 30-day recall	0.049	(0.69)		
Log of per capita food expenditure			0.196	(3.01)***
Dietary Diversity				
Simple count of foods consumed, monthly recall	0.001	(0.25)	-0.004	(1.11)
Wealth				
Household asset index	-0.001	(0.06)	-0.000	(0.01)
Share of non-food items in total consumption	0.005	(2.44)**	0.008	(3.73)***
Household Composition				
Household size	-0.04	(0.48)	-0.069	(0.87)
Age of HH head	-0.002	(0.50)	-0.000	(0.10)
Female headed HH - dummy	-0.102	(1.29)	-0.122	(1.67)*
Dependency Ratio	-0.185	(0.98)	-0.153	(0.88)
HH head is divorced	0.017	(0.09)	0.054	(0.31)
HH head is widow(er)	0.187	(1.69)*	0.234	(2.28)**
HH head is single	0.045	(0.37)	0.012	(0.10)
HH head entitled to pension	-0.019	(0.24)	-0.041	(0.55)
Number of HH members 0-14 years of age	0.025	(0.31)	0.061	(0.78)
Number of HH members 15-34 years of age	0.05	(0.57)	0.096	(1.16)
Number of HH members 35-59 years of age	-0.022	(0.28)	-0.007	(0.10)
Migration				
Number of temporary migrants: more than 1 month away	-0.008	(0.22)	0.005	(0.16)
Housing				
Log of house surface (area)	0.089	(2.50)**	0.079	(2.39)**
Occupation				
Occupational group of HH head – 0=unskilled, 1=skilled	0.022	(0.27)	0.057	(0.72)
Unemployed, ILO definition: 1h worked per week - HH head	0.051	(0.50)	0.109	(1.13)
Member of HH with non-agric enterprise; 0=no, 1=yes	0.119	(2.08)**	0.096	(1.77)*
Health				
HH head suffered from disease/wound, dummy	0.066	(0.77)	0.105	(1.28)
HH head went for a medical visit – dummy	0.104	(0.92)	0.005	(0.04)
Religion (excluded is traditional)				
HH head is Catholic	-0.06	(0.76)	-0.094	(1.27)
HH head is Protestant	0.013	(0.16)	-0.016	(0.21)
HH head is Muslim	-0.177	(0.96)	-0.199	(1.12)
HH head is of another religion	-0.03	(0.27)	-0.041	(0.39)
Education				
Highest diploma obtained by HH head	0.04	(2.93)***	0.038	(2.89)***
HH head has ever done studies – dummy	0.031	(0.44)	0.003	(0.04)
Location				
Urban	0.039	(0.40)	-0.143	(1.27)
Semi urban	0.067	(0.95)	-0.015	(0.22)
Fianarantsoa Province (excluded is Antananarivo)	-0.399	(4.18)***	-0.28	(2.82)***
Toamasina Province	-0.423	(4.42)***	-0.325	(3.31)***
Mahajanga Province	0.057	(0.60)	0.099	(1.06)
Toliara Province	-0.196	(2.04)**	-0.184	(2.06)**
Antsiranana Province	0.045	(0.44)	0.081	(0.85)
Relative Wealth				
Relative Deprivation Index	-0.000	(3.89)***	-0.000	(1.39)
Subjective				
Household's budget compared to last year	0.285	(8.30)***	0.272	(8.38)***
Current standard of living	0.748	(21.59)***	0.74	(22.73)***
Constant	-2.949	(4.48)***	-5.221	(5.39)***
Observations	3543		3952	
Log Likelihood	-1832.58		-2046.43	
chi2	1246.48		1384.32	
Pseudo-R2	0.25		0.25	

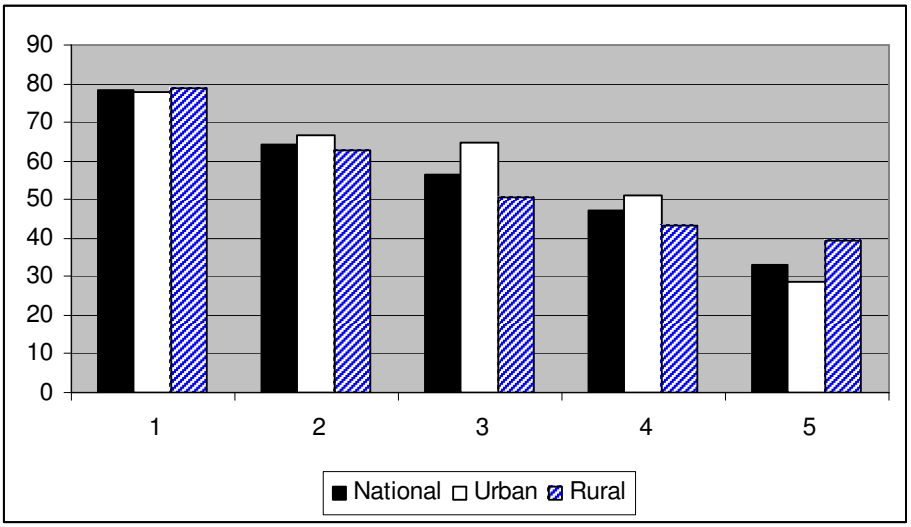
* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1. Per capita per day calorie consumption by per capita total expenditure quintiles. Albania[15]



Source: ALSMS, own calculations

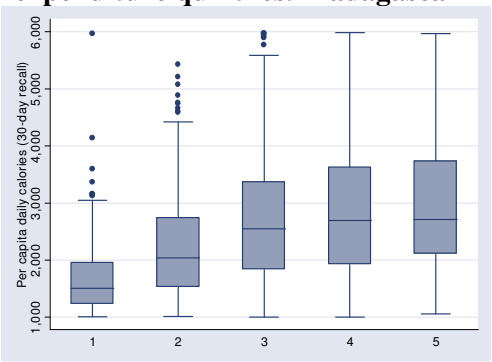
Figure 2. Subjective food adequacy indicator (percentage of "less than adequate") by real per capita total expenditure quintiles and location. Albania



Source: ALSMS, own calculations

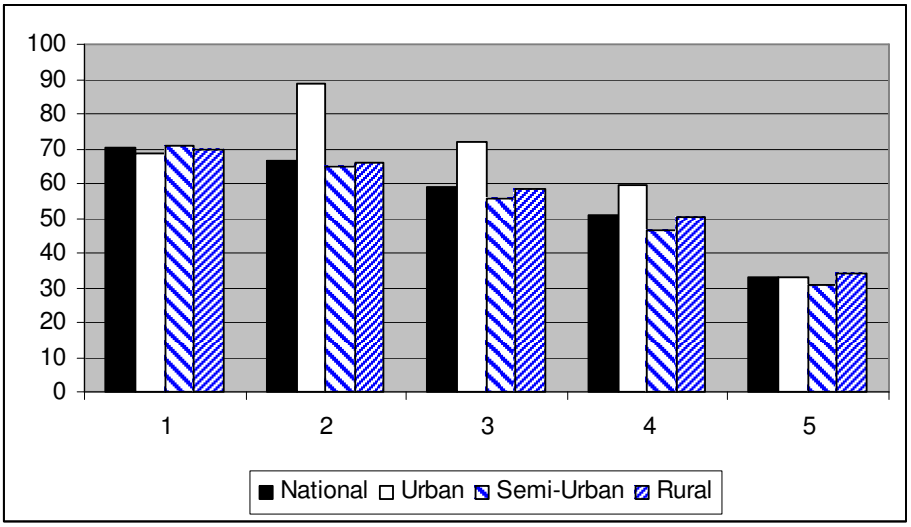
[15] Quintiles have been calculated with un-weighed observations. However, using sampling weights gives similar results (not shown here).

Figure 3. Per capita per day calorie consumption (30-day recall) by total per capita expenditure quintiles. Madagascar[16]



Source: MHS, own calculations

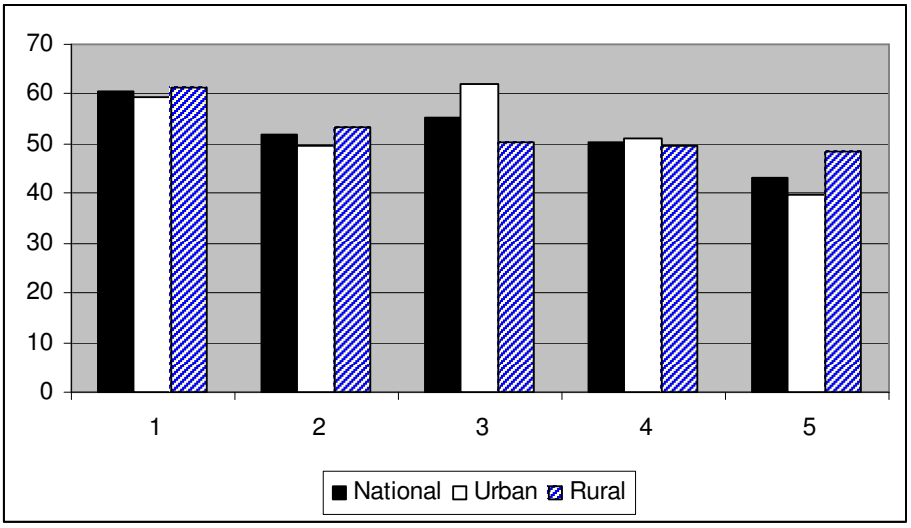
Figure 4. Food adequacy answers (percentage of "less than adequate") by real per capita total expenditure quintiles and location. Madagascar



Source: MHS, own calculations

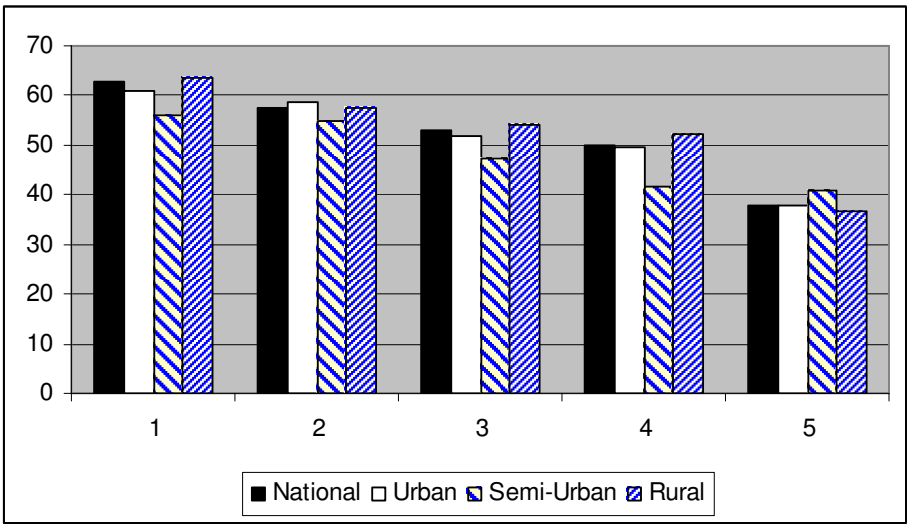
[16] The positive relationship between calories and food expenditure (not shown here) is even clearer than in Figure 3.

Figure 5. Food adequacy answers (percentage of "less than adequate") by simple food count quintiles and location. Albania



Source: ALSMS, own calculations.

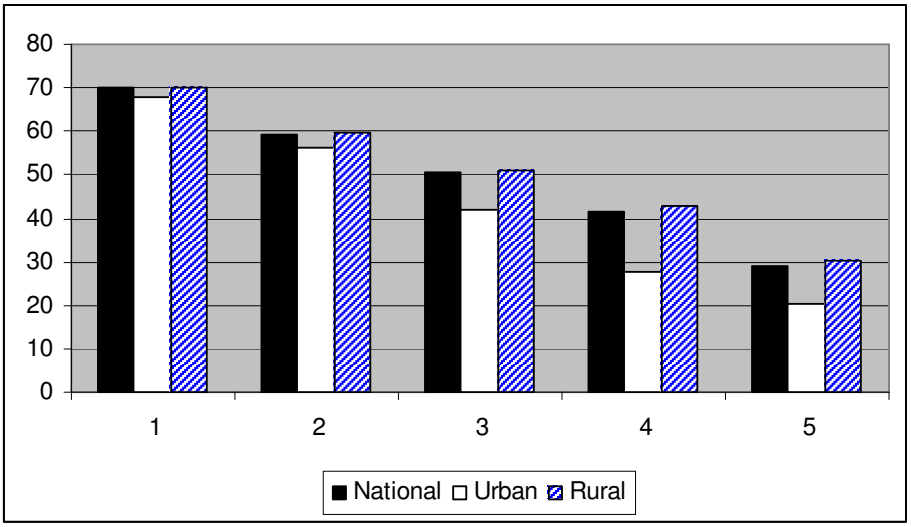
Figure 6. Food adequacy answers (percentage of "less than adequate") by simple food count quintiles and location. Madagascar[17]



Source: MHS, own calculations.

[17] Note that a diversity index for Madagascar computed using only food purchases (to better compare with the subjective question) was also tested, but the results were similar.

Figure 7. Food adequacy answers (percentage of "less than adequate") by simple food count quintiles and location. Nepal



Source: NLSMS, own calculations.

Appendix I. Multi purpose surveys

Multi-purpose surveys collect information on a great variety of domains. They are mostly used to assess living standards, measure and map poverty and assess the impact of policies. While in the past surveys did not have the explicit goal of calculating household calorie consumption, some recent surveys are implemented with this purpose in mind, whether the intention is to use the information to calculate food-based indicators or to calculate poverty lines (Smith, 2003). Yet, even when the food consumption modules are designed with this purpose, problems emerge in calculating calorie consumption at the household level – the most basic estimate that can be calculated and the main "benchmark" against which validating alternative indicators.

Using household surveys to assess food security has both strengths and weaknesses. In terms of strengths, multiple policy-relevant food insecurity measures can be constructed from household surveys. As mentioned earlier, these include calorie insufficiency (with respect to a caloric cut-off and depth), poor diet quality and dietary diversity. By jointly collecting data on food expenditure/consumption along with pertinent socio-economic data, household surveys permit causal analysis for identifying actions to reduce food insecurity. Collecting this data over time permits identification of key factors for targeting food security initiatives as well as monitoring the incidence of food insecurity at different levels of aggregation. On the negative side, data are not collected for all countries regularly; these surveys involve moderately high collection and processing costs; intra-household food distribution can seldom be determined, and measurement (sampling and non-sampling) errors are oftentimes serious.

The existence of non-sampling errors in estimates of food consumption is well known. The most important identified in the literature are[18]:

- under-reporting of meals fed to guests, non-household members and workers
- meals/foods eaten outside not reported (or only expenditure is reported)
- recall biases and different recall periods which need to be standardized
- food wastage (including losses in storage and processing) and food fed to pets and animals not accounted for
- reporting and measurement errors (data collection and data entry) and "interviewer's effects" ("prestige errors", shirking etc)

These non-sampling errors may induce biases in the estimates, especially for richer households. For example, because consumption by non-household members is usually greater for richer households, the resulting bias is systematically correlated with income (Bouis, Haddad and Kennedy 1992; Bouis 1994). But downward biases are not excluded, mainly because of misreporting or non-reporting. Surprisingly, little empirical research has been conducted on the actual size of these biases. Smith (2003) shows that the overall means of calorie availability and of intake from three of the few surveys conducted in which both were collected from the same households (Kenya in 1985, the Philippines in 1984, and Bangladesh in 1995) are very close. Lence (2003) argues that for these surveys the distributions of the two estimates are very different, where the correlation coefficient is only 0.35 and a simple regression of food intake on food acquisition yielded a R^2 of only 0.12.

"Sampling" errors derive mainly from the fact that household surveys are designed to yield unbiased estimates of the mean of key variables, but not of the variance. Therefore, the distribution of a variable may be seriously biased. This is a concern in that food security is often highly influenced by seasonal factors. This may explain the differences in the distributions reported by

[18] See in particular Bouis and Haddad (1992), Bouis, Haddad and Kennedy (1992) and Smith (2003)

Lence (2003). Similarly, we find plausible medians/means for household calorie consumption, but the distributions do not seem to be unbiased.

Appendix II. Description of the data sets

The Nepal 1995/96 LSMS has a food consumption module which includes food purchases and home consumption, plus a question on the annual value of foods in kind received. The recall period for purchases and home consumption is one month, the "typical month consumption" over the previous year. A total of 65 items were listed, including general categories (other cereals etc.), of which only 46 could be converted into calories, plus meals taken outside home and miscellaneous food expenditure (for which only expenditure was reported). The subjective module contains two questions on food consumption. The first is worded as described in section II and with a month recall, and the second was asked to those who answered that their food consumption was less than adequate for the family's needs, and was formulated as follows: "Do you consider that you, or any member of your family, eats too little food to live a healthy and active life? (yes/no)". Calorie consumption and dietary diversity were computed, although numerous problems were encountered in the construction of the calorie consumption variable, and thus we considered it unreliable. Anthropometry was not computed because the age variable was not deemed reliable.

In the 2001 Madagascar (MHS) questionnaire, information on food consumption was split among various modules: a) the food expenditure section contained only food purchases and a question on the annual value of foods in kind received. There are two recall periods for food purchases, 7-day recall and monthly recall, the latter intended to account for seasonality factors. The food list contains 66 items, including general categories, of which 62 were convertible into calories; b) meals eaten outside (7-day recall; only expenditures reported); c) food wage (annual recall; only values reported); d) self-consumption from non-agricultural enterprises (annual recall; same food items as the food expenditure section; only values reported); e) livestock self-consumption (number of animals slaughtered for self-consumption during the year, with a generic list of 10 animals, including general categories); f) self-consumed harvest (69 convertible food items, annual quantities). The subjective question was formulated as following: Your expenses related to food: 1) are below your household's needs; 2) are on average compared to your household's needs; 3) exceed your household's real needs. Calorie consumption and dietary diversity were computed. Anthropometric data were not collected.

The Albania 2002 LSMS included a food diary that was left in the household by the interviewer during the first visit for the household to compile, and then collected during the second visit. Upon collection, interviewers checked the entries (also with the help of a checklist provided at the end of the booklet) and corrected them as appropriate with the help of the most knowledgeable person in the household. The diary consisted of a three-part section, one for each of 14 days, for the recording of (1) food products purchased daily; (2) non-purchased food products consumed by the household (e.g. from own production or payments in kind); (3) food eaten outside the home (e.g. at work, in restaurants); and a checklist for use by the interviewer with a list of the 14 main food products consumed in Albania. A specific column was provided to the interviewers to record the 'reference period' for bulk purchases of food. Whenever unusually large quantities of a specific item were recorded, the interviewer asked the household –upon collecting the diary- to specify the expected period over which the said quantity would be consumed to allow for ex-post adjustments of the purchased quantities. In addition, interviewers were instructed to check, for the 14 main food staples in the checklist, whether any consumption of the item had been recorded in the diary. Whenever an item had not been recorded, the interviewer would ask the respondent to report whether the item (a) had not been used in the 14-day period, or (b) had been consumed but the household had forgotten to record its consumption, or else (c) had been consumed by the household drawing on stocks purchased or produced outside the 14-day period. If the inclusion of an item had simply been forgotten, the interviewer would then fill the appropriate section of the diary by asking the household to recall the details of that consumption. If the household reported consuming an item

purchased before the beginning of the 14 day period, then information on the frequency of purchase, quantity, unit of measure and value of the purchase were recorded in the columns provided to this end in the checklist. The diary listed over 180 items, including general categories and composite dishes. The subjective food adequacy question referred to the "current level of food consumption of the family". Household calorie consumption, dietary diversity and anthropometric indicators were all computed.

In Indonesia, the 2000 IFLS3 is the third wave of a panel survey (See Strauss, et *al*, 2004a). Only anthropometric indicators were calculated for this study because the items in the food expenditure section were too aggregated to allow calculation of calories. The interesting feature of the IFLS3 is the inclusion of two subjective food adequacy questions. The first is the same as in the other surveys, and has a one month recall. The second is the same as the first but refers specifically to children in the household, also with one month recall.

Appendix III. Methodology and assumptions in estimating caloric availability and adequacy

Each survey is different and requires different methodologies and assumptions. However, in estimating calorie consumption, we followed a standard procedure, which can be divided in the following steps.

1) All reported quantities are converted into grams.
2) Quantities expressed in units/pieces and in wrong units of measurement (e.g. litres of maize etc.) are converted into quantities (see step 3). For some food items, units are directly converted into grams, using some "standard" weight per unit. For example, eggs and various fruits (bananas, oranges etc.) are directly converted, assuming some standard weight. Information on unit weights comes from secondary sources or, more frequently, from the USDA nutrition database (see below).
3) Unit values for each food item are computed as reported expenditure divided by grams, so as to obtain costs per gram. Unit values are computed for both market purchases and home consumption. However, the former are normally used. Medians of unit values for each food item and each administrative unit are then computed. Indicator variables are created to see how many unit values per food item there are for each administrative unit. This allows us to see on how many observations the medians have been computed for each food item and each administrative level. Quantities expressed in wrong units of measurement or in difficult-to-convert units are imputed by dividing reported expenditure by a median unit value. The choice of which median to use is done on the basis of the number of observations and on the distribution/range of medians, following the general rule of using the median at the lowest possible administrative level. As a rule of thumb, if the median at some administrative level was computed on less than five observations, the next administrative level was used. However, the choice was ultimately dependent on the distribution of the medians. Imputation was done for all food sources (purchases, home consumption and in kind). Price data were available only for Albania. When available and when plausible, prices were used to impute quantities.
4) Food items not convertible into calories (because calorie-less or because there were no observations on quantities, and thus on unit values) and irrelevant items for household's diet (e.g. alcoholic beverages, for which there were no observations on quantities and unit values anyway) were dropped. The items dropped were not important in households' consumption, so we are confident that excluding them does not affect estimates significantly.
5) Once all quantities and expenditures are converted into grams, grams per capita per day are computed for each food item. Quantities per capita are used for the trimming of outliers (re-imputing implausibly high values). The trimming is done for each food item, by source of food (purchases, home consumption, in kind etc.) and by location (urban/rural). The trimming is done in two steps. First, outliers are re-imputed by dividing expenditure by median unit values, following the same procedure as in step 3. If the imputation does not work (i.e. there are still outliers or imputed quantities are implausibly low/high), extreme values are "squeezed" to the 90^{th}-99^{th} percentile of the (weighed) per capita distribution, depending on the magnitude of the values in the upper tail of the distribution. The choice of which percentile to use was done on a case-by-case basis, also using common knowledge on human nutrition. For example, if the per capita distribution for rice shows that in rural areas the 90^{th} percentile is 600 grams per capita per day and the 95^{th} is 1000 grams, the 90^{th} is chosen (i.e. if the imputation does not work, those observations above the 600 grams are assigned the value of 600 grams per capita per day). As a rule of thumb, the lowest percentile used is the 90^{th}, even if it is an outlier/too high value itself. This was a problem especially for staples in rural Nepal and Madagascar, where one could find that half of the observations or those above the upper inter-quartile range were simply too high (for

instance, a 75th percentile of 800g-1kg of cereals per capita per day). This partly explains the higher calorie consumption found in rural areas, but only partly, because it may well be the case that if a household reported exaggerated quantities for many food items, this household would still be an outlier even after trimming of all items.

6) Reported values on meals/foods eaten outside, miscellaneous food expenditure and other not-well-specified expenditures/values are converted into calories assuming that the cost per calorie is higher, equal or lower than the cost per calorie of food purchased, depending on the type of expenditure or value. Calories were therefore imputed using the general formula: kcal = Ekcal*exp*s/totexp, where *Ekcal* is total calories from food purchases, *exp* is expenditure for the calories to be imputed, *totexp* is total household expenditure on food purchases and *s* is the adjusting factor. For meals eaten outside we assumed that the cost per calorie is 20% higher - a conservative assumption. Outliers in resulting calories were trimmed, using the derived distribution of calories per capita per day (e.g. if observations above the 90th-99th percentiles were higher than, say, 3000 kcal per capita per day, outliers were squeezed to the 90th-99th percentile). In the case of Madagascar we used the median cost per calorie at the rural/urban province level, because there were too few observations at lower administrative levels.
7) Grams are converted into calories (using food composition tables) and total household calorie consumption is compared to the household-specific caloric norm.

We used age- and sex-specific caloric requirements taken from the 2001 FAO/WHO/UNU Expert Consultation Interim Report on Human Energy Requirements (FAO/UNU/WHO, 2001). The high side of light physical activity is assumed for all (1.6*BMR), and the requirement used is that corresponding to the mean of the weight/requirement range for appropriate age and sex groups The table below shows the daily caloric requirements used.

Daily caloric requirements by age and sex[19]

Age	Male	Female
0	649	600
1	948	851
2	1129	1035
3	1252	1145
4	1360	1231
5	1467	1320
6	1350	1225
7	1450	1325
8	1550	1450
9	1675	1575
10	1825	1700
11	2000	1825
12	2175	1925
13	2350	2025
14	2550	2075
15	2700	2125
16	2825	2125
17	2900	2125

[19] We also calculated household caloric adequacy by using the universal cut off of 2,100 kcal per capita per day. Even though estimates are clearly different depending on which cut-off is used, final results (i.e. correlation with the subjective indicator) do not change significantly (results not shown here).

18-29	2794	2322
30-59	2678	2200
≥ 60	2255	2000

The Food Composition tables used were:

1) For Nepal, the "Nutrient Contents in Nepalese Foods" FCT, Ministry of Agriculture of Nepal, Nutrition Programme Section, Kathmandu, 1994.
2) For Madagascar, the "Food Composition Table for Use in Africa" (Source: FAO, personal communication)
3) For Albania, the Slovak Food Composition Table (ALIMENTA database. Source: FAO and Food Research Institute of Slovakia, 2000)

The FCTs listed above were complemented by the USDA Nutrition Database ("Composition of Foods Raw, Processed and Prepared", US Department of Agriculture National Nutrient Database for Standard Reference, Release 16, January 2004).

Additional assumptions and methodology for calorie conversion for Madagascar

The 2001 MHS questionnaire was particularly problematic for calculating calories. Information on food consumption was split among various modules (see Appendix II).

The questionnaire includes also a section on transfers in and out of the household, to members and non-members of the household, including food. The question on food transfers asked to estimate the value of food received and given out during the year prior to the interview. Since the food expenditure section contains also a column on food in kind received, broken down by food item, we disregarded the sections on transfers. This is not a problem also because there were relatively few households that reported values for transfers (less than 200).

For imputing calories from food wage and from self-consumption from non-agricultural enterprises (most of which were trading enterprises and hotels/restaurants), we assumed that the cost per calorie is 20% less than the cost per calorie from market purchases.

For the livestock self-consumption section, we used FAO data on dressed (eviscerated) carcass weight - grams per animal - excluding offal and slaughter fats (complemented with USDA data on some offal) and dressed carcass weight as percentage of live weight (for animals for which there are data). An average calorie value was then used for meat and offal/fats. However, data were not available for all animals and calories are therefore a rough approximation (especially for offal and fats, where calories values for liver have been used - when available - when not, 100 kcal/100g have been used because values for kidney and liver - the only offal found in the FCTs - of various animals range around 100). This probably means under-estimating calories, because we do not account for fat. On the other hand, this is probably counter-balanced by the likely over-estimation of the offal/fats weight and that derived from not accounting for wastage. The source and magnitude of biases are not known. However, given the relatively low number of households that reported self-consumption of livestock, it is unlikely that estimates for calories from livestock have seriously biased overall estimates.

General problems in the calculation of household caloric availability

The calculation of household caloric availability presented formidable challenges. The main problems encountered included:

- *Units of measurement*. Some food items are expressed in the wrong unit of measurement because of data entry mistakes (e.g. litres of rice) and some are expressed in undefined units. In such cases, quantities have to be imputed using unit values. Besides the usual problem of unit values not being the same thing as prices because contaminated by quality differences, unit values have at times a too wide range and/or there are too few observations. As a result, imputation is often unsatisfactory. This is true also for some frequently consumed items for which there are many observations. Having prices is not necessarily better than using unit values, if collected prices are biased. For example, in the case of Albania, for some items, the price range is dubious, with items costing up to 20 times more in different areas. Furthermore, for some items, prices are expressed in units, without specifying the weight (e.g. bread), in which case the weight has to be estimated combining unit values and prices.
- *Vague food items*. Many food items are too vaguely specified (e.g. pastry cook, baking, frozen sweets etc). Together with dubious imputing of quantities and misreported quantity values, giving a calorie content is sometimes more a guess than an accurate estimation.
- *Imputing quantities from values.* When only expenditure is available, quantities (or directly calories) have to be imputed. This is especially a problem when respondents are asked to report the annual value of a particular item received in kind or the food wage, as in the case of Nepal and Madagascar.
- *Unavailable and/or inadequate Food Composition Tables* (FCTs). Nepal was the only country for which a FCT was available to us. For the rest, we had to resort to other FCTs and nutrition databases (see above for details). Even when a FCT is available, some food items are not reported or, being the foods listed in the questionnaire quite vague (e.g. bread, without specifying which type) and foods listed in the FCT more specific (i.e. different varieties), some average caloric content is to be used, unless prior information on local diets is available (which was not to us).
- *Different recall periods for different sections.* This was a problem especially for Madagascar and for calculating calories for in kind food for Madagascar and Nepal.
- *Misreported quantities and/or values.* This is especially the case for Nepal and, more generally, for staples, with some implausibly high quantities per capita.

We are conscious of the fact that the assumptions made to impute calories when only expenditure or values are available (and especially when they are annual values) can create serious biases. For these reasons we calculated calorie consumption including and excluding these components. For Nepal, we calculated calorie consumption including and excluding in kind food received and meals eaten outside/miscellaneous food expenditure in turn, thus producing four different estimates. Given the relatively small importance of these components, estimates were close to each other. For Madagascar, we differentiated between calories derived from food purchases and total calories (computed using all components), and between recall periods (7-day and 30-day recall). For Albania, we computed calories including and excluding meals/foods eaten outside. In all cases, the basic results presented in the paper (especially the correlation with the subjective question) are not significantly affected by the inclusion/exclusion of these components, besides a rank reversal between urban and rural areas in Madagascar using calories from food purchases only.

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