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August 2007

Is Food Insecurity More Severe in South Asia or Sub-Saharan Africa?

A Comparative Analysis Using Household Expenditure Survey Data

Lisa C. Smith, Technical Assistance to Non-Governmental Organizations (TANGO)
and
Doris Wiesmann, International Food Policy Research Institute

Food Consumption and Nutrition Division

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ABSTRACT

This paper uses data from national household expenditure surveys to explore whether food insecurity is more severe in South Asia or Sub-Saharan Africa. It employs two indicators of the diet *quantity* dimension of food insecurity, or the inability to access sufficient food: the prevalence of food energy deficiency and the prevalence of severe food energy deficiency. It also employs two indicators of the diet *quality* dimension, indicating lack of access to nutritious food: the prevalence of low diet diversity and the percent of energy from staple foods. It finds the regions' food energy deficiency prevalences to be quite close (51 percent in South Asia, 57 percent in Sub-Saharan Africa). However, the prevalence of severe food energy deficiency, which is more life threatening, is higher in Sub-Saharan Africa (51 percent versus 35 percent in South Asia). From a diet quality standpoint, the regions appear to suffer from a comparable and high reliance on staple foods in the diet to the neglect of foods rich in protein and micronutrients, but that Sub-Saharan Africa may be doing worse, as reflected in less diverse diets. The results confirm that both regions suffer from deep food insecurity problems but point to Sub-Saharan Africa as the region with the more severe problem, particularly when it comes to the diet quantity dimension of food insecurity. In deciding which region should be given greater emphasis in the international allocation of scarce development resources, the fact that the *numbers* of people affected by food insecurity are higher in South Asia should be taken into consideration.

Keywords: food security, food energy deficiency, diet quality, Sub-Saharan Africa, South Asia

1. INTRODUCTION

Estimates of food insecurity and related measures, such as poverty and malnutrition, at the broad level of the global regions have a strong influence on perceptions of where food insecurity is most severe. They in turn have a powerful influence on the international distribution of aid resources and research funds directed at this development problem. For example, they affect the allocation of resources across the region-based geographical sectors of international aid agencies, such as the United Nations institutions, donor government aid agencies, and private foundations. They also shape the priorities of research institutes and scholars that have a global focus and thus understanding of the appropriate interventions needed to address food insecurity most effectively in each region.

South Asia and Sub-Saharan Africa are widely believed to be the regions of the world with the worst food insecurity problems. For the above reasons, accurate measurement of how they compare to one another is important for an efficient allocation of scarce aid resources toward reducing food insecurity in these regions and globally. Yet, to date, alternative related indicators have given conflicting signals, as can be seen from the data presented in Table 1.

Table 1. Comparison of progress made by South Asia and Sub-Saharan Africa in some determinants of and outcomes of food security

	South Asia	Sub-Saharan Africa
Determinants		
Poverty (percent)[a]	29.9	46.4
Per capita national income (GDP in purchasing power parity $US)[b]	2,897	1,856
Democracy [c]	4.10	2.44
Per capita dietary energy supply (kilocalories/day)[d]	2,356	2,136
Net primary enrollment ratio (percent)[e]	79.0	62.0
Outcomes		
Underweight children under five (percent)[f]	47.0	31.0
Underweight women (percent)[g]	43.0	11.5
Low birth weight children (percent)[h]	30.0	14.0

[a] Estimate for 2001 (United Nations 2005). Percent of people living on less than $1 per day.

[b] Estimate for 2003 (United Nations 2005).

[c] Reported for 1995 in Smith and Haddad (2000) using data from 5 South Asian and 26 Sub-Saharan African countries. Based on an index of political rights and civil liberties.

[d] Reported for 1999-2001 in FAO (2002) using data from 5 South Asian and 40 Sub-Saharan African countries..

[e] Estimate for 2001-02 (United Nations 2005).

[f] Estimate for 2003 (United Nations 2005).

[g] Estimate from surveys undertaken in the 1990s (Smith et al. 2003) in 3 South Asian (Bangladesh, India, and Nepal) and 21 Sub-Saharan African countries. Underweight is defined as having a body mass index less than 18.5.

[h] Estimate from surveys undertaken from 1998-2002 (ACC/SCN 2004) in 5 South Asian and 40 Sub-Saharan African countries. Low birth weight is defined as having a body weight at birth less than 2,500 grams.

Estimates of key *determinants* of food security suggest that South Asia is doing better than Sub-Saharan Africa. In terms of poverty—arguably the most important determinant of people's access to food—the percent of people living on less than a dollar a day in South Asia is 30 percent while that in Sub-Saharan Africa is over 45 percent. South Asia's per-capita national income is more than 50 percent higher than Sub-Saharan Africa's. South Asia also far surpasses Sub-Saharan Africa in the area of democracy, which influences the degree to which governments focus resources on meeting basic human needs and rights, such as the right to food. South Asia's per-capita dietary energy supply, an indicator of the sufficiency of food supplies to meet needs, is roughly 200 kilocalories higher. Finally, education, a determinant of the quality of the food people eat, is higher in South Asia than Sub-Saharan Africa, as indicated by primary enrollment rates.

By contrast, estimates of a key *outcome* of food security, malnutrition, derived from actual measurements of people, indicate that South Asia is doing drastically worse than Sub-Saharan Africa. Child malnutrition is far higher in South Asia than in Sub-Saharan Africa, with the under-five underweight rate being 47 percent compared to only 31 percent in Sub-Saharan Africa. This fact, in stark contrast to how the regions' fare when it comes to the socioeconomic determinants of child nutritional status, is indeed a much pondered phenomena referred to as the "Asian Enigma" (Ramalingaswami, Jonsson, and Rohde 1996; Smith et al. 2003). Ruling out the long-held belief that the Asian body type is inherently small relative to other populations, recent research confirms that young children's potential body weights at various ages are the same across the two regions (WHO 2006). The percent of women who are underweight is extremely high in South Asia, at 43 percent but only 11.5 percent in Sub-Saharan Africa. The percent of children born with low birth weight is 30 percent in South Asia, a strong indication of widespread undernutrition among women of reproductive age; it is a far rarer condition in Sub-Saharan Africa (14 percent).

At the same time as these numbers give conflicting signals about the gravity of the food insecurity problem in the two regions, they also point to the express need for use of an indicator of food security that is based more firmly on its definition. The following commonly accepted definition was adopted at the 1996 World Food Summit:

> Food security…[is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Both the determinants and outcomes of food security listed in Table 1 are indirect indicators. For example, poverty indicates the inability to meet all basic needs, not just food (Frankenberger et al. 1997). Malnutrition among children is the outcome of the quality of caring practices for children and of health environments, not just food security (UNICEF 1998).

The measure of food insecurity currently relied on for international comparisons is the Food and Agriculture Organization of the United Nations' (FAO) measure of "undernourishment" (Naiken 2003), a direct measure of the diet quantity aspect of the definition of food security: access to sufficient food for an active, healthy life. Regional estimates are population-weighted means of national estimates of the percentage of countries' populations that do not have access to sufficient dietary energy. The measure is being used to monitor progress toward the Millennium Development Goal of halving the proportion of people who suffer from hunger by 2015. The estimation method employed is based on country-level estimates of food availability calculated using data on the production and trade of food rather than directly on data representing peoples' access to food. Measures of the distribution of available food across a country's population, as well as a per capita energy requirement, are employed to predict estimates of the prevalence of undernourishment using statistical modeling.

While the FAO method yields up-to-date annual estimates, the accuracy of these estimates has been the subject of considerable debate (Aduayom and Smith 2003; Broca 2003; David 2003; Gabbert and Weikard 2001; Haddad 2001; Naiken [in Smith 1998]; Senauer 2003; Smith 1998; Svedberg 1999, 2000 and 2003). Recent studies by Smith, Alderman and Aduayom (2006) and Smith and Subandoro (2005) confirm that the FAO country estimates differ widely from those calculated using data collected as part of household expenditure surveys on the food acquired by individual households. The source of the discrepancy is found not in the methodology itself but instead in the underlying data used to calculate national food availability and its distribution. They also find that the estimates based on household survey data are much more strongly correlated with estimates of poverty in South Asia and Sub-Saharan Africa and with child malnutrition prevalences in the latter region.

Recent FAO estimates of undernourishment—those that currently guide perceptions of the relative severity of food insecurity in the regions and how this has changed over time—are given in Table 2. By those for 2000-2002, Sub-Saharan Africa's prevalence is 50 percent higher than South Asia's, making Sub-Saharan Africa the region with the most severe food insecurity.

The purpose of this paper is to generate estimates of food insecurity for South Asia and Sub-Saharan Africa using data collected from households as part of nationally-representative household expenditure surveys undertaken in 4 South Asian and 12 Sub-Saharan African countries. During these surveys, data are collected on all foods purchased by households, consumed from their own production and, usually, foods received in-kind as well. The data are used to calculate national estimates of the quantities of foods consumed, which in turn allow regional estimates of two kinds of direct measures of food insecurity that cover key aspects of its definition. The first is the percentage of each region's population that does not have access to sufficient dietary energy, or the prevalence of "food energy deficiency." This indicator is equivalent to that of the FAO measure of undernourishment. Two energy requirements are employed: one that identifies the percent of people who are at moderate-to-high risk of not meet their energy requirement and another that identifies the percent who are high risk. The latter measure helps give an understanding of how severe food insecurity is in each region.

Table 2. FAO estimates of undernourishment for South Asia and Sub-Saharan Africa

	South Asia	Sub-Saharan Africa	Difference (percent)
1990-92	26	36	38.5
2000-02	22	33	50.0

Source: FAO (2005a).

Note: Estimates based on data from 5 South Asian and 39 Sub-Saharan African countries.

The second set of indicators employed in the paper are indicators of diet *quality*, or the inability to access *nutritious* food. They are (1) the percentage of people with low dietary diversity and (2) the percent of total energy consumption derived from staple foods.[1] These indicators are included in recognition of the fact that it is possible for a person to meet her or his energy requirement but to not achieve full physical and intellectual potential due to deficiencies of other nutrients, specifically protein and micronutrients such as iron, vitamin A, and iodine (Welch 2004). Indeed it is increasingly recognized that inadequate diet quality, rather than sufficient energy consumption, is becoming the main dietary constraint facing poor populations (Ruel et al. 2003; Graham, Welch, and Bouis 2004). Studies documenting that increased diet diversity is associated with improved child anthropometric status (Ruel 2002, 2003) further reinforce the importance of including indicators of it in analysis of food security.

The paper also explores the role of food security in explaining the Asian Enigma mentioned above. In particular, it looks at whether the regional estimates generated indicate that South Asia is doing substantially worse than Sub-Saharan Africa in the area of food security. If so, this would provide strong evidence that food insecurity, along with the low status of women (Smith et al. 2003), is one of the factors leading to South Asia's unjustifiably high rates of malnutrition among children and women.

The next section of the paper presents the indicators employed in detail and discusses some measurement issues. The third section lays out the data, including how the country data sets were chosen, and describes the measurement methods. Section 4 presents the estimates for the 16 study countries and discusses them in the context of their food security situations at the time of their survey. Section 5 presents the regional estimates of food insecurity for South Asia and Sub-Saharan Africa. The final section summarizes the empirical results and suggests some implications for policy.

[1] Note that low dietary diversity can reflect that people lack sufficient knowledge about healthy diets and prefer unbalanced traditional diets, although a variety of nutritious foods may be physically available and financially accessible.

2. Food Security Indicators and Measurement Reliability

The Indicators

The indicators of food security employed for this analysis are listed in Table 3. A description of how they are measured at the household level using the data collected in household expenditure surveys (HESs) is given.

The first set of indicators in Table 3 is of diet quantity, the amount of food eaten by people. Average household food energy availability per person is measured as the amount of energy in the food acquired by the household over the survey reference period (the total amount of time for which food data are collected) divided by the number of household members and days in the period. The data collected from households in HESs are either (1) expenditures on each food, and/or (2) quantities acquired of them, which are often reported in nonmetric or "local" units of measure, for example, bunches or cans. The first essential step in calculating this measure is to convert the data to metric quantities (grams or kilograms). To do so, reported expenditures on each food are divided by the food's metric price; reported quantities in local units of measure are multiplied by the metric weight of one local unit of the food. The energy content of the food acquired can then be determined using food composition tables.

The second diet quantity indicator is the percent of people in a population group who are food energy deficient, defined to be those who do not consume sufficient dietary energy to meet their requirements for basal metabolic function (a state of complete rest) and light activity (such as sitting and standing) of their age-sex group. The actual energy requirements of individuals depend on their age, sex, body size, activity level, and individual physiology, for example, metabolism. When determining the energy needs of a group of individuals, given unknown actual requirements (because of individual variation), the Expert Consultation on Energy and Protein Requirements (FAO/WHO/UNU 1985) recommends the use of average energy requirements for people of different sex and age groups, and levels of activity, that apply to all individuals globally. This "average requirement" is applied here, corresponding to the average weight person in each age-sex group. It identifies the percent of people who are at moderate-to-high risk of food energy deficiency. The light activity level is chosen for this study as a normative standard applicable to all populations.

Table 3. Indicators employed and their measures

Population-level indicator	Household-level measure
Diet quantity	
Food energy availability per capita	*Household daily food energy availability per capita.* The energy in the food acquired by a household over the survey reference period[a] divided by the number of household members and the number of days in the period.
Percent of people food energy deficient	*Whether a household is food energy deficient*. Whether a household acquires insufficient food over the reference period to meet the "average" energy requirements for basal metabolic function and light activity of all of its members.[b] The average requirement corresponds to that of the mean-weight person in various age-sex groups.
Percent of people severely food energy deficient	*Whether a household is severely food energy deficient*. Whether a household acquires insufficient food over the reference period to meet the "minimum" energy requirements for basal metabolic function and light activity of all of its members.[b] The minimum requirement corresponds to that of the lowest-weight person in various age-sex groups.
Diet quality	
Average household dietary diversity	*Household diet diversity*. The number of food groups, out of 7, from which food is acquired by a household over the reference period. The food groups are: 1) cereals, roots and tubers, 2) pulses and legumes, 3) dairy products, 4) meats, fish and seafood, and eggs, 5) oils and fats, 6) fruits, 7) vegetables.
Percent of households with low diet diversity	*Whether a household has low diet diversity.* Whether the household does not acquire at least one food from 4 of the above 7 groups over the reference period.
Percent of food energy from staples	*Percent of available food energy derived from staples*. The percent of the energy acquired by a household over the reference period that is derived from staple foods (cereals, roots and tubers).

[a] A survey's reference period for food data collection is the total time period for which households are asked to report their food acquisitions.

[b] An individual's energy deficiency situation is defined to be that of her or his household.

The third diet quantity indicator is the percent of people in a population group who are severely food energy deficient. This is defined to be those who do not consume sufficient dietary energy to meet the "minimum" requirement for basal metabolic function and light activity of their age sex-group as established by FAO (1996). The minimum requirement is that corresponding to the lower limit of the range of requirements for each age-sex group.[2] People whose energy consumption falls below this requirement cannot even meet the energy needs of the lowest-weight person of their same age and sex and are thus considered to be at high risk of food energy deficiency (FAO 1996). Note that for both of the food energy deficiency measures an individual's energy deficiency situation is defined to be that of her or his household due to lack of data at the individual level.

[2] For children below 10 years, the median of the range is used rather than the lower limit because a range was not specified for this group.

Turning to the diet quality indicators, diet diversity indicates how varied the food a household consumes is. Research to date from both developed and developing countries consistently shows that diet diversity is a good indicator of nutrient adequacy, that is, a diet that meets requirements for energy and all essential nutrients (see review in Ruel 2002). The measure of diet diversity used here is based on the classification system developed by Arimond and Ruel (2004), in which food groups rather than individual foods are used as the latter predicts nutrient adequacy better (Ruel 2002).

The diet diversity measure is calculated by simply counting the number of food groups, out of seven, from which food is acquired over the survey reference period. The first of the seven food groups—cereals, roots, and tubers—contains starchy staples that are the main source of dietary energy. The second through fourth groups—pulses and legumes, dairy products, meat, fish and seafood, and eggs—contain foods that are high in protein. The animal foods are also good sources of micronutrients, including calcium, easily absorbable iron and zinc, and the fat-soluble vitamins A and D. The fifth group—fats and oils—contains foods that may be good sources of fat-soluble vitamins, and they assist with their absorption. The sixth and seventh groups—fruits and vegetables—contain foods that are good sources of micronutrients and fiber (Latham 1997).

The percent of households with low diet diversity is measured by determining whether a household fails to acquire at least one food from four of the seven groups over the reference period. Note that there are no international recommendations for optimal food or food-group diversity and thus for determining whether a household or individual has a low quality diet based only on knowledge of which foods people eat. Proper cutoffs must be based on further research that relates measures of diet diversity to measures of nutrient adequacy in specific populations (Ruel 2002; Arimond and Ruel 2004). Therefore, the cutoff chosen here is considered tentative, and caution in interpreting the results is advisable (see below).

The last indicator is the percent of food energy from staples. At the household level it is measured as the percent of dietary energy available from staples (for example, rice, maize, cassava) in the total dietary energy available. A higher value indicates lower diet quality because energy-dense starchy staples have low bioavailable protein and micronutrients, leaving those consuming them as a large proportion of their diet vulnerable to protein and micronutrient deficiencies.

Some Reliability Issues

How reliably are the indicators measured using the data collected in HESs? One of the main advantages of using these types of surveys to measure food security is that the information comes directly from the location in which behavior regarding food consumption takes place, and from the people actually consuming the food, rather than being collected at broader geographical areas, such as countries or regions within them. Further, compared to data on other measures of households' resource holdings, such as income and assets, food expenditures data are not especially sensitive; people generally have little incentive to misreport how much food they acquire over a short period of time.[3] Systematic, scientific sampling is the norm, yielding samples that are, for the most part, nationally representative.[4] It is these traits that give confidence that gross errors in estimates of food insecurity derived from HESs are avoided. Nevertheless, the reader should be aware of several types of error that can affect estimates of food security derived from the data.[5]

First, the data collected in HESs are subject to the typical reporting biases faced by all household surveys. These include recall bias, in which respondents may have difficulty remembering their food acquisition over the recall period itself, and "telescoping," where they include events that occurred before the recall period. The data are also subject to recording and data entry errors (Deaton and Grosh 2000; Grosh and Glewwe 2000).

Another area where errors can arise is in the conversion of the data collected on food expenditures or quantities to their metric equivalents. If expenditures are collected, the prices used in conversion should obviously represent those faced by the household at the time of the purchase or, in the case of a home-produced food, if it were to buy or sell the food. But this information is not usually collected in HESs, and estimated prices must be used as proxies. They may be estimated as median unit values from households located in the immediate vicinity or even the administrative region, or they may be collected in a price survey administered at the community or broader regional level. However, in the case of price surveys, it may be difficult for a survey team to replicate the kind of transaction that a household itself would engage in. Prices faced may vary even among households that purchase from the same source due to different negotiating abilities or personal connections. Further, richer households may buy higher quality products that have higher prices (Deaton and Grosh 2000).

Data collected on the physical quantities of foods, rather than expenditures, may be more accurate if foods are weighed using scales on the spot or, for packaged foods, the weight is recorded directly from containers in which they are acquired. However, this technique is rare because it is so time consuming. Further, if the acquired food has already been consumed, it is no longer possible to physically observe and measure it. In most surveys, households report quantities acquired from memory and in nonstandard units that can have imprecise weights. The collection or estimation of corresponding metric weights of local

[3] There are exceptions, however. For example, households may falsely report a larger than true expenditure on a high prestige food (such as meat) or underreport on foods acquired in the belief that food aid may be forthcoming following the survey. These kinds of misreporting are likely to be less of a problem in HESs, in which data are collected on a large number of subjects, than in specialized household food consumption surveys.

[4] Population groups that are left out of the censuses that serve as sampling frames are migrants, homeless people, and people living in institutions. Sometimes people living in areas with violence due to conflict or that are otherwise physically inaccessible may also be left out.

[5] Further discussion of reliability issues can be found in Smith, Alderman, and Aduayom (2006).

units of measure appropriate to individual households can present as many challenges as the collection or estimation of accurate metric prices (Smith and Subandoro 2006).

A further measurement concern arises from the fact that information on food purchased and consumed away from home, for example, restaurant meals, is usually reported as one lump sum expenditure, with no information collected about the actual identity or quantity of the foods consumed. This obviously hampers conversion to energy content. The practical solution to this problem is to convert using calorie values per unit of expenditure on foods eaten at home. Yet people may eat different kinds of food having different calorie values and prices in the meals they consume outside of their homes compared to inside. It also rules out inclusion of foods eaten outside of the home in the measurement of diet diversity since the identity of the foods is unknown. The diet diversity measure will be biased downward, and the low diet diversity measure biased upward, the greater is the proportion of food acquired outside of the home in any population.

Some additional reliability issues pertain specifically to the measurement of the percent of people who are food energy deficient. The first has to do with the fact that data for all food sources except home production are collected on food *acquired* rather than *consumed*. Since most foods are perishable and consumed with high frequency, and people try to smooth their consumption of food over time, acquisitions tend to match fairly well with consumption, even over a short time period. However, some foods, such as some grains, can be stored. Thus over any given time period there will be households who are drawing down stocks acquired before the period in order to meet current consumption; there will also be households who are accumulating stocks that will be consumed after the period. This leads to greater variability in household calorie availability than in household calorie consumption. Because households in a large population group are equally likely to be drawing down as accumulating stocks, any availability-consumption gap at the household level represents random error, and estimates of population mean calorie consumption are unbiased. When it comes to estimates of food energy *deficiency*, however, the increased variability can theoretically lead to biased estimates (Deaton and Grosh 2000). While empirical evidence to date, taken from small samples of relatively homogeneous populations, shows that this is not a major concern (Smith, Alderman, and Aduayom 2006), further investigation using national samples is needed.

The second concern in the estimation of food energy deficiency arises from the use of reference periods for food data collection that are shorter than one year, the period for which estimates are usually desired. This is not a problem if the objective is to obtain an unbiased estimate of mean household energy consumption over a year’s time, in which case short reference periods along with short recall periods are desired to overcome recall bias (Deaton and Grosh 2000). On the other hand, if the objective is to obtain an unbiased estimate of the prevalence of food energy deficiency, as long a reference period as possible (implemented through multiple visits) should be used in order to eliminate some of the day-to-day randomness in households' food consumption that inflate variation in the data. There is some evidence that the short reference period problem is not as much of a concern when it comes to foods (as opposed to nonfoods) (Deaton and Grosh 2000). Other evidence suggests, however, that measures of dispersion across households in calorie consumption based on single-visit, short reference periods can be significantly higher than those based on multiple visits throughout a year (FAO 1996).

A final issue is that what is actually being measured is whether the energy availability of a *household* falls below its energy requirement, not whether that available to each member falls below her or his own *individual* requirement. If food is not distributed according to need within households, then there may be some people living in households classified as food energy surplus who are in fact not meeting their requirement. Similarly, there may be some people living in households classified as food energy deficient who are nevertheless meeting their requirements. If these two "error" groups are not of the same size, then there will be inaccuracies in the estimation of the percent of people who are food energy deficient in a population group.

There are also some reliability issues relating specifically to the measure of low diet diversity. As already mentioned, the cutoff chosen (with a household classified as having low diet quality if food is not acquired from at least four of seven food groups) is not based on research, and no international standards currently exist. Consequently, the measure may not be exact in identifying households with low quality diets. Whereas it is very likely that a household consuming three or less food groups cannot meet the micronutrient needs of its members, there is no guarantee that people in households consuming four or more food groups have nutritionally adequate diets. For a given number of food groups consumed, nutrient adequacy may vary across countries according to cultural patterns of food consumption, which influence the combination of food groups in the diet as well as the quantities consumed from each group.

Furthermore, larger households may have higher dietary diversity simply because of a greater variety in preferences but, ceteris paribus, their members may not have higher nutrient adequacy (or higher per capita dietary energy availability) than members of smaller households (Hoddinott and Yohannes 2002). Consequently, because poorer households tend to be larger on average, the percent of households with low diet diversity may systematically underestimate the proportion of households suffering from low diet quality.

In addition, inequitable intrahousehold allocation might affect the (micro)nutrient adequacy of individual household members more than the adequacy of dietary energy intake. In some countries where the status of women is low, men eat first, most, and best (Smith et al. 2003). While men have higher dietary energy requirements than women, pregnant and lactating women have the highest micronutrient requirements, and all women of reproductive age have higher iron requirements than men. Eating the left-overs after foods rich in micronutrients (animal-source foods, for example) have been picked from the family meal may therefore hurt women's micronutrient adequacy disproportionally. This cannot be reflected by a household-level measure of dietary diversity.

Lastly, measurement of diet diversity using household expenditure surveys is based only on the foods acquired for consumption inside the home. This is because, as mentioned above, data are generally only collected on the total expenditure on foods eaten out of the home, not on each individual food. The identity of the foods is thus unknown. The diet diversity measure will be biased downward, and the low diet diversity measure biased upward, the greater is the proportion of food acquired outside of the home.

3. DATA AND MEASUREMENT METHODS

Selection of Data Sets

The South Asian data sets, listed in Table 4, were selected from among 10 nationally representative surveys conducted in five countries since 1990 (see Smith and Subandoro 2005). Only Nepal is not included.[6] The data sets from Sub-Saharan Africa were selected from among 76 surveys (Smith, Alderman, and Aduayom 2006). All of the data sets were subjected to a thorough review to ensure that they are of good quality and contain appropriate data for calculation of the measures of food security. The minimum requirements for the selection of data sets are as follows:

1. Nationally representative survey of households;
2. Data collected for a comprehensive list of at least 30 food items;
3. Recall period of one month or less;
4. Data collected on both home-produced food acquired and monetary purchases; and
5. Complementary data available for converting reported food acquisition data to metric quantities (metric weights or prices).

The importance of national representativeness (criterion 1) is obvious. With respect to criterion (2), the minimum number of food items of 30 was chosen as it was found that the items in surveys with fewer were generally too broad for accurate recall of their acquisition and determination of dietary energy content (for example, “vegetables” or “meats”). A recall period less than one month (criterion 3) was chosen because it was felt that any greater period would lead to unacceptable reporting error. With respect to criterion (4), as is now well known, home-produced food makes up a large portion of the diets of developing country households, particularly rural households, and must be included for an accurate assessment of food insecurity. As for criterion (5), complementary data for converting reported food acquisition data to metric quantities are necessary for calculating the diet quantity measures of food security, as discussed above.

[6] This country was excluded as it did not meet the recall period criterion for data set selection.

Table 4. Basic information on the surveys

Country	Year of data collection	Name of survey	Data collection agency	Survey duration (months)	Number of households
South Asia					
Bangladesh	2000	Household Income and Expenditure Survey 2000	Bangladesh Bureau of Statistics	12	7,440
India	1999	National Sample Survey 55th Round Socio-Economic Survey	National Sample Survey Organization	12	120,309
Pakistan	1998	Pakistan Integrated Household Survey 1998/1999	Pakistan Federal Bureau of Statistics	16	16,305
Sri Lanka	1999	Sri Lanka Integrated Survey 1999/2000	Department of Census and Statistics	12	7,500
Sub-Saharan Africa					
Burundi	1998	Enquête Prioritaire 1998 - Etude nationale sur les conditions de vie des populations	Institut de Statistiques et d'Etudes Economiques du Burundi	6	6,668
Ethiopia	1999	Household Income, Consumption and Expenditure Survey 1999/2000	Central Statistical Authority of Ethiopia	12[b]	17,332
Ghana	1998	Ghana Living Standards Survey 4	Ghana Statistical Service	12	6,000
Guinea	1994	Enquête intégrale sur les conditions de vie des ménages guinéens avec module budget et consommation	Direction Nationale de la Statistique	12	4,416
Kenya	1997	Welfare Monitoring Survey III	Central Bureau of Statistics	3	10,874
Malawi	1997	Integrated Household Survey 1997/98	National Statistical Office	12	10,698[c]
Mozambique	1996	Mozambique *inqérito nacional aos agregados familiares sobre as condições de vida*	Instituto Nacional de Estatistica	15	8,273
Rwanda	2000	Enquête intégrale sur les conditions de vie des ménages au Rwanda	Direction de la Statistique du Ministère des Finances et de la Planification Economique	urban: 15 rural: 12	6,420
Senegal	2001	Enquête Sénégalaise aupres des ménages II	Direction de la Prévision et de la Statistique	4	6,052
Tanzania	2000	Tanzanian Household Budget Survey	National Bureau of Statistics of Tanzania	12	22,178
Uganda	1999	Uganda National Household Survey 1999/2000	Uganda Bureau of Statistics	12	10,696
Zambia	1996	Zambia Living Conditions Monitoring Survey – I (1996)	Central Statistical Office	3	11,763

[a] The number of households surveyed was 10,784, but 1,586 were dropped from the data set before its release.

[b] This survey was undertaken in two rounds of 2-3 months each representing key seasons of the annual cycle.

[c] The number of households surveyed was 12,960, but 2,262 were dropped from the data set before its release (See Smith, Alderman, and Aduayom 2006, Appendix B).

Data Collection

Table 4 gives some basic information on the surveys. Most were conducted in the latter half of the 1990s, with Guinea (1994), Senegal (2001), and Bangladesh (2000) being the only exceptions. For the majority, data collection was distributed evenly throughout a full year in order to capture seasonal variability. The Kenya, Senegal, and Zambia surveys took place over three months only, however, and the Burundi survey over six. Sample sizes range from 4,416 households for Guinea to 120,309 for India, the country with the largest population. Detailed information on the data collection is given for each country in Smith, Alderman, and Aduayom (2006) and Smith and Subandoro (2005).

The surveys were conducted using two- or three-stage stratified sampling designs, thus ensuring full geographic coverage and representativeness at the national level. Although there is great variation, the most common design was stratification into urban and rural areas within major administrative regions (provinces, states, etc.), followed by random sampling of communities (the primary sampling units, or PSUs) within the strata, and then random sampling of households within communities. When such complex sampling designs, rather than simple random sampling, are used, it is important to correct for the design so that any calculated statistics apply to the population group of interest (Deaton 1997). In this study, sampling weights provided with the surveys and variables delineating the strata and PSU for each household were used to correct for the sampling design in the calculation of all food security measures using the "svy" commands in STATA Special Edition Version 8 (Statacorp 2003).

Table 5 gives more details about the data collection for each country.

The number of food items ranges from a low of 33 (Burundi) to a high of 274 (Malawi). Despite the varying degree of specificity in the delineation of food items, they cover all of the food groups making up the human diet.[7] In most surveys the commonly consumed foods within a food group are listed individually followed by a residual category to capture all other foods in the group. For example, a questionnaire may list "mangoes," "bananas," and "oranges" individually, followed by the item "other fruits."

While data were collected on both food purchases and consumption of food from home production for all of the countries, they differ with respect to the data collected on in-kind foods received. In some of the countries data were collected on in-kind food received from a variety of sources (e.g., gifts, wages, government aid, etc.) while in others data were only collected on gifts. In four countries no data on in-kind food received were collected.

[7] Note that for the countries included in this study there is no statistically significant correlation between the number of foods included in the survey and the number of foods groups calculated for the diet diversity measure. This suggests that the possibility that foods groups are more easily missed when fewer individual foods are covered during the interview is not a major concern.

Table 5. Food data collection

Country	Number of food items[a]	Means of data collection	Food sources for which data collected	Number of visits	Recall period (days)	Reference period[b] (days)
South Asia						
Bangladesh	120	Interview	Purchase, home production, in-kind	non-spice foods: 7 spices: 2	non-spice foods: 2 spices: 7	14
India	143	Interview	Purchase, home production, in-kind[c]	1	7	7
Pakistan	82	Interview	Purchase, home production, in-kind	1	14 (for 60 food items) and 30 (rest)	14 (for 60 food items) and 30 (rest)
Sri Lanka	53	Interview	Purchase, home production, gifts	1	7	7
Sub-Saharan Africa						
Burundi	33	Interview	Purchases, home production	1	15	15
Ethiopia	213	Interview	Purchases, home production, in-kind	8[d]	3-4	28
Ghana	109	diary and interview	Purchases, home production, gifts	literate: 6 illit.: 30	1	30
Guinea	112	Interview	Purchases, home production	urban: 10 rural: 7	urban: 3 rural: 2	urban: 30 rural: 14
Kenya	70	interview	Purchases, home production	1	7	7
Malawi	274	diary and interview	Purchases, home production, in-kind	purchases: literate: 1 illitt: 9 other: 1	purchases: literate: 1 illit: 3 other: 3	purchases: 14-28 other: 3
Mozambique	217	interview	Purchases, home production, in-kind	3	first visit: 1 others: 3	7
Rwanda	94	interview	Purchases, home production	urban: 10 rural: 7	urban: 3 rural: 2	urban: 30 rural: 14
Senegal	258	diary and interview	Purchases, home production, in-kind	purchases: literate: 1[e] illit: urban: 10 rural: 7 other: urban: 10 rural: 7	purchases: literate: 1 illit.: 3 other: 3	urban: 30 rural : 21
Tanzania	129	diary and interview	Purchases, home production, in-kind	literate : 2-3 illit: 30	1	30
Uganda	47	interview	Purchases, home production, gifts	1	7	7
Zambia	40	interview	Purchases, home production, in-kind	1	purchases maize: 30 rest: 14 other: 14	purchases maize: 30 rest: 14 other: 14

[a] This is the number of food items used for the final analysis, not the original number listed in the questionnaire. In some cases fewer food items are used for the analysis as some had to be combined for conversion to metric quantities.

[b] A survey's reference period for food data collection is the total time period for which food acquisition is recorded. In the cases where there was only one visit to each household, the reference period equals the recall period. However, when there were several visits, the reference period generally equals the number of visits multiplied by the recall period. In the few cases where the diary method was used, the recall period is one day (households are to fill in the diary on a daily basis), and the reference period is the length of time the diary is maintained.

[c] Households were asked to report on all food consumed and to tell the enumerator whether its source was purchase, home grown, free collection, or "other."

[d] This survey was undertaken in two rounds. The information here is for each individual round.

[e] Multiple visits made by the enumerator to households with a literate member were only for recording the diary entries over the last 3 days.

The recall periods range from one day to two weeks. The only exceptions are for Pakistan and Zambia, where it is 30 days for a small number of food items. A recall period of one day is assumed whenever the diary method is used. In the cases where there was only one visit to each household, the survey reference period equals the recall period. However, when there were several visits (e.g., Bangladesh, Ghana), the reference period equals the number of visits multiplied by the recall period. In the cases where the diary method was used, the reference period is the length of time the diary is maintained. The most common reference periods for the surveys in this study are one week, two weeks, and one month. The only exception is Malawi, for which data on home-produced and in-kind food acquired were collected using a three-day reference period.

As seen here, the methods of data collection differ across the countries in a number of respects. Smith and Subandoro (2005) show that, despite these differences, the estimates of the food security measures are largely comparable across the countries.

Calculation of Metric Quantities of Food

To convert the raw data collected to metric quantities, one of two methods were used, depending on the type of data collected. Smith, Alderman, and Aduayom (2006) and Smith and Subandoro (2005) report the type of food data collected in each of the surveys. For all of the surveys from South Asia, the type of data collected from households is the same for food purchases and consumption of food from own production. For many of the Sub-Saharan African surveys, they differ.

*Method A: Local Quantity * (Metric Weight)*

This method was used where households were asked to report food quantities, and either the quantities were reported directly in metric units (in which case the metric weight is implicit) or they were reported in nonstandard or "local" units of measure and complementary metric weights were available. Examples of local units of measure used in the surveys are bowls, bottles, cans, glasses, cups, packets, jar, and bags. Another common unit of measure is "unity" (also referred to as "piece" or "single"), which is most often used when reporting acquisition of fruits, vegetables, and eggs. For these types of measures, the weights were obtained either by collecting them in the country, as estimates from knowledgeable in-country sources, or from preexisting databases, such as the United States Department of Agriculture Nutrient Database for Standard Reference, Release 15 (USDA 2003) (for foods reported in unities) or other surveys. When foods were reported in volumetric measures (liters, milliliters), specific gravities from the Australia-New Zealand Food Composition Table (ANZFCT 2003) were used to convert to metric weights.

Method B: Expenditure/(Metric Price)

This method was used to "recover" quantities acquired when households reported their food expenditures (but not quantities), and complementary metric prices were available. Sources of metric prices were (1) derived from household-reported metric prices or unit values (the latter calculated as expenditure divided by metric quantity),[8] (2) collected in local markets as part of a community price survey, or (3) collected as part of a separate survey, the most common being a Consumer Price Index Survey carried out in all regions of a country.

The Energy Content of Foods

Once conversion to metric quantities has taken place, determination of the energy content of foods acquired for consumption in the home is straightforward. Where a country has its own food composition table, this is used as the primary source of calorie conversion factors; where not, the table of a nearby country was used. In some cases the American food composition table (USDA 2003) was used for foods known to vary little in calorie composition across countries. The actual energy value of a food acquired was computed as metric quantity multiplied by the food's calorie value, which was then multiplied by the food's edible portion. Edible portions are generally near 100 percent for grains (including flours derived from grains) and beverages but are lower for fruits, vegetables, roots and tubers, and animal products (Smith and Subandoro 2006). As discussed in the last section, the price per calorie of foods acquired for consumption inside the home was applied to expenditures on food consumed outside of the home, because only total expenditures on these foods as a group are reported.

Data Cleaning

The raw data were subjected to thorough cleaning so as to avoid any influence of major errors on the estimates. Data cleaning took place in three stages.

First, for each food, weights of foods in local units of measure, reported prices and derived unit values were cleaned manually by examination for outliers at both ends of the distribution, often separately for each major region of a country. Outlying prices and weights were set to missing and not used in further calculations. When outlying unit values were detected, both the expenditure and quantity used to calculate them were set to missing.

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[8] In any given survey, depending on the food, at least some households report directly in metric quantities. If expenditures are also available, a metric unit value could be derived as an estimated price. Household-level unit values used to estimate metric prices for other households were only used if at least five households reported a price for the food at a given geographic level. For instance, if a metric unit value was available for a food for at least five households in a community, then a community price was calculated and used for other households in the community if needed.

In a second stage the computed metric quantities of individual foods were cleaned. Any quantity per household adult equivalent[9] that was more than three standard deviations from the sample median value was replaced with an estimated value using Ordinary Least Squares regression. This technique was also used to replace values set to missing in the first stage of data cleaning. The independent variables in the food-specific regression equations were number of household adult equivalents, variables representing the age-sex composition of the household, whether it is female-headed, age of the household head, whether at least one adult member has a primary/secondary education, the number of assets owned by the household (calculated from survey-specific lists of assets), whether the household is located in an urban area, region of residence, and month of survey, where appropriate. Note that because this technique takes into account household-specific characteristics, it preserves variation in the data better than the more common one of replacement with means or medians of other households.

The third stage of data cleaning took place for household-level energy availability. A household's total calories per adult equivalent was replaced with an estimated value using the same regression prediction method applied in the second stage when (1) a metric quantity that was identified as an outlier or set to missing in the cleaning process could not be estimated[10] or (2) not enough information was available to estimate calories from food consumed outside of the home[11] or (3) a household had no reported food acquisition data.

Some households were dropped from the analysis altogether. This was the case if (1) more than 50 percent of the quantities of foods reported were set to missing or identified as outliers, or (2) calculated daily energy per adult equivalent was greater than 12,000 kilocalories. Note that no lower bound was used as it is possible, if unlikely, that a household acquires no food at all over a survey's reference period.

Calculation of Estimates of Food Energy Deficiency

Calculation of estimates of the prevalence of food energy deficiency using the *average* energy requirement for light activity are straightforward. These requirements are published by age-sex group and can be applied at the household level.[12] The total energy in the food a household acquires is compared to the sum of the daily energy requirements of each of its members. Following, those households not

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[9] An "adult equivalent" is defined using a male 30-60 years old as the reference category and comparative average energy requirements for moderate activity for the various other age and sex groups.

[10] In some cases, not enough non-missing observations were available for running a regression.

[11] Households with more than 75 percent of total food expenditures on food acquired outside of the home were not considered eligible for the "price per calorie of food acquired for consumption in the home" method. These households' acquisition of in-home food was deemed to be too small, relatively speaking, to use for estimating acquisition of out-of-home food.

[12] An additional 500 calories is added for each child less than one year old to account for the greater needs of breastfeeding mothers. Unfortunately the extra energy needs of pregnancy cannot be taken into account as the pregnancy status of household members was not recorded.

meeting the requirement are classified as energy deficient and the others as not. A variable is created that assigns the classification of households to each of its members, from which the percent of people in each country is calculated.

Calculation of estimates of the prevalence of severe food energy deficiency must take place using country-level data because the *minimum* requirements for light activity are only available at the country level and thus cannot be applied to household-level data. The approach taken here is to employ the model developed by FAO (Naiken 2003) for predicting country-level food energy deficiency prevalences using estimates of (1) national energy availability per capita; (2) the coefficient of variation of dietary energy availability per capita, a measure of the variability in energy consumption across a country's population; and (3) a national energy requirement per capita. The two-parameter log-Normal distribution model is applied to these data to predict the prevalences, as follows:

Let μ_i^* be country *i*'s energy availability per capita and CV_i^* be the country's coefficient of variation of dietary energy consumption. Then the standard deviation (σ_i) and mean (μ_i) of countries' log-Normal distributions are calculated as

$$\sigma = \sqrt{\ln(CV_i^{*2} + 1)}\,,$$

$$\mu_i = \ln(\mu_i^*) - \frac{\sigma_i^2}{2}\,.$$

These values are used to compute a Z-score:

$$z - score_i = \frac{\ln(z_i) - \mu_i}{\sigma_i} \quad i = 1, \ldots, N,$$

which can be looked up in a table of standard normal probabilities to find the estimated proportion of energy deficient people. Note that Smith, Alderman, and Aduayom (2006) show that there is very little difference in national prevalences of food energy deficiency estimated using requirements applied at the household and country levels.[13]

Calculation of Regional Estimates of Food Insecurity

While the majority of South Asian countries are included in this study, with only Nepal excluded, the majority of Sub-Saharan African countries are not. Further, the data used were collected over a wide time range, from 1994 to 2001. To obtain representative region-level estimates of the indicators of food

[13] The average energy requirements are used for this analysis as only they can be used to calculate national energy requirements as well as be applied at the household level.

insecurity for a common time period, the country-level estimates are combined with those from three East Asian countries—Lao People's Democratic Republic, Malaysia, and Papua New Guinea[14]—to predict year 2000 values for all South Asian and Sub-Saharan African countries using Ordinary Least Squares (OLS) regression. The number of countries for which values are predicted is 5 for South Asia (Nepal is added to the study countries) and 42 for Sub-Saharan Africa. Following, regional means are calculated using the actual estimates calculated from the data for the few countries for which they are available for the year 2000 and predicted values for the rest. The means are weighted using the population proportion of the countries in each region.

[14] Appendix B contains information about these surveys.

4. NATIONAL ESTIMATES OF FOOD SECURITY MEASURES FOR STUDY COUNTRIES

This section presents the estimates of the diet quantity and diet quality indicators of food security for the 4 South Asian and 12 Sub-Saharan African countries. The estimates are discussed in the context of the food security situations in the countries at the times of their surveys. They are given in Table 6.

South Asian Countries

Clearly, food insecurity is a significant problem in all four South Asian countries. Although energy availability per capita is above the national per-capita average requirement for light activity (roughly 2,050 kilocalories) in the countries, signaling that enough food is available for meeting the needs of all people, the percent of people food energy deficient is nearing or above 50 percent. Further, near or above 30 percent of people are severely food energy deficient, meaning that they are at a high risk of food energy deficiency. Thus diet quantity is a serious development problem in the region. In terms of diet quality, the average household consumes foods from near six out of seven of the food groups that are key to human nutritional well-being, indicating a diverse diet. Nevertheless, the percent of food energy from staples is quite high in all four countries.[15]

Table 6. National estimates of food security measures

		Food energy availability			Diet quality		
Country	Year	Energy availability per capita	Food energy deficiency (percent of people)	Severe food energy deficiency (percent of people)	Diet diversity	Low diet diversity (percent of households)	Percent of food energy from staples
South Asia							
Bangladesh	2000	2,100	53.7	29.4	6.1	3.7	82.4
India	1999	2,172	52.4	34.2	5.7	10.9	66.5
Pakistan	1998	2,422	44.1	31.2	6.5	1.9	56.2
Sri Lanka	1999	2,108	56.7	42.1	5.8	11.5	59.9
Sub-Saharan Africa							
Burundi	1998	1,592	74.8	69.5	4.5	44.0	62.3
Ethiopia	1999	1,648	76.4	61.9	4.8	36.4	83.2
Ghana	1998	2,328	51.4	45.3	5.8	8.0	66.9
Guinea	1994	2,510	45.1	37.5	6.0	7.7	66.3
Kenya	1997	2,579	43.9	37.2	5.4	25.0	61.8
Malawi	1997	1,614	73.3	69.3	4.4	49.8	69.3
Mozambique	1996	2,059	60.3	57.1	4.2	62.6	77.3
Rwanda	2000	1,860	65.3	57.9	4.5	49.2	62.6
Senegal	2001	1,967	60.2	55.7	5.9	8.1	55.5
Tanzania	2000	2,454	43.9	37.9	5.9	9.7	70.6
Uganda	1999	2,636	36.8	28.5	4.4	50.9	69.4
Zambia	1996	1,764	71.1	64.6	4.6	43.7	77.8

[15] Smith and Subandoro (2006) provide the following guideline for interpreting this indicator: very high: 75 percent+, high: 65-75, medium: 50-65, low: < 50.

The finding that over half of the populations of Bangladesh and India are food energy deficient is not surprising. These countries have the highest poverty rates in the region: 36 and 25 percent of their populations, respectively, are classified as extremely poor (living on less than $1 per day) (World Bank 2005), indicating deep problems of chronic poverty and thus access to food. They also have among the highest malnutrition rates in the world. Over 45 percent of children under five years old are underweight (WHO 2005).

Bangladesh is one of the most densely populated countries in the world. Its agricultural sector absorbs 63 percent of the labor force. Thus food security is integrally linked with agricultural production. The doubling of foodgrain production since independence in 1971 with the aid of improved varieties and technology has served to support the large population base rather than enhance living standards (FAO 2005b). A major threat to food security is recurrent natural disasters, especially flooding. Two years before its survey, flood waters covered two-thirds of the land area of Bangladesh, leading to major crop losses. Despite the massive social and economic impact, the government was successful in avoiding a major food crisis through a mix of public interventions, private market trade flows, and an extensive system of private borrowing (del Ninno et al. 2001). Due mainly to an overdependence on rice in the diet (Rashid 2004), food insecurity in the country is marked by an extremely high percent of energy derived from staples of 82 percent. This indicates a diet that is seriously nutritionally imbalanced.

Turning to India, from a macroeconomic standpoint, this large country has been a great success since the 1980s, with annual economic growth averaging 5.7 percent, the highest rate among large countries outside of East Asia (World Bank 2002a). Its economic liberalization in the early 1990s was followed by historically high rates of growth and, while there is considerable debate due to measurement issues, reductions in poverty as well (Deaton 2003). Given such success, we would expect it to have a lower food energy deficiency rate than Bangladesh. However, like Bangladesh, the country is highly agricultural, and agricultural growth declined sharply, from 8 to 1 percent over 1998 to 1999 (the year of the survey), due to below-normal monsoon rains and serious damage from a cyclone that hit the Orissa coast. Further, two major tropical cyclones left approximately 10 million people homeless, with millions losing their crops. At the same time, there was deficit rainfall in 8 of the country's 29 states (Bandyophadhyay 1999). These conditions undoubtedly worsened food security in the country at the time its survey was taking place.

Despite a 20-year-long ethnic conflict, Sri Lanka has maintained healthy economic growth throughout the 1990s. The percent of its population estimated to be living below $1 per day was only 6.6 percent in 1995 (World Bank 2005). We would thus not expect it to have a food energy deficiency prevalence of 57 percent, on par with India and Bangladesh, and a much higher severe food energy deficiency prevalence than the other three countries. However, the proportion of people living on less than $2 per day is quite high, at 45 percent (World Bank 2005), indicating that while poverty is not severe on a widespread basis, it remains an issue in the country. Further, the majority of poor households, mostly small-scale farmers and landless laborers, experiences seasonal food shortages despite the country's achievement of near self-sufficiency in rice. Their food security is highly dependent on rainfall patterns and, due to irregular rainfall, recurrent drought, and neglect of irrigation infrastructure, agricultural productivity in small-scale farming has been declining since the mid-1990s (FAO 2005c). Finally, throughout 1999 (the year of the survey), Sri Lanka suffered from considerable political uncertainty and a volatile security situation due to elections, with its president surviving an assassination attempt and intensified civil conflict (FAO/WFP 1999). These factors may help explain the country's relatively high rate of food energy deficiency at the time of its survey.

Pakistan's lower rate of food energy deficiency than Bangladesh and India is to be expected, given a poverty rate of only 13.4 percent (World Bank 2005) and lower child malnutrition rate as well, of 35 percent (WHO 2005). Nevertheless, we estimate that 44 percent of people are not consuming sufficient dietary energy for maintaining light activity levels. This may be partially attributable to a considerable slowdown in economic growth in the latter part of the 1990s, when the survey took place, due to poor performance of the manufacturing, service, and agricultural sectors. The decade of the 1990s is characterized by a "deteriorating socioeconomic situation," increases in poverty and inequality, stagnating food production, and the "re-emergence of food poverty and insecurity as an issue" (World Bank 2002b; United Nations System in Pakistan 2000).

In sum, food insecurity in the South Asia region is manifested as a problem of both diet quantity and diet quality, and is largely driven by chronic poverty. While economic and, in particular, agricultural growth has fueled an increasing potential to meet the food needs of populations, there have been some setbacks, especially with respect to agricultural productivity growth. Natural disasters and, in the case of Sri Lanka, conflict, have also hampered food security. Note that South Asia was not directly hit by the Asian Financial Crisis that began in 1997. Although the region's economic growth rate dropped slightly, there was apparently a quick recovery (ADB 1998).

Sub-Saharan African Countries

Energy availability per capita among the Sub-Saharan African study countries ranges from 1,592 kilocalories per person in Burundi (1998) to 2,636 in Uganda (1999) (see Table 6). It falls quite near or below the average energy requirement for light activity for seven of the countries—Burundi, Ethiopia, Malawi, Mozambique, Rwanda, Senegal, and Zambia—signaling deep food insecurity problems. In these countries there is not enough food for all people to meet their requirements even if the food were to be distributed according to need.

The percent of people who are food energy deficient ranges from 37 percent in Uganda to 76 percent in Ethiopia. Such great variability across countries can also be found in the percent of households with low diet quality, which ranges from 8 percent in Guinea to 63 percent in Mozambique. Food insecurity is obviously a major problem in all 12 countries. Almost one-third, and in most countries a much higher percentage, of the population is not consuming enough food to meet both the average and minimum requirements for basal metabolic function and light activity. Additionally, in 8 out of 12 of the countries, a quarter or more of households suffer from low diet diversity and in almost all of the countries there is a high reliance on staples in the diet.

Uganda, Kenya, Tanzania, Guinea, and Ghana form a cluster of countries with relatively low rates of food energy deficiency, in the 35-50 percent range. With the exception of Uganda, the prevalences of low diet quality are also low. At the time of their surveys, these countries were in a situation of economic and political stability for the most part, with no recent adverse climatic shocks. Nevertheless, they were experiencing ongoing problems of chronic poverty endemic in most Sub-Saharan African countries due to, among other factors, poor agricultural productivity and infrastructure, poor health outcomes, including HIV/AIDS, low levels of education, poor governance, low prices for primary products, and, in some areas, high population densities.

Uganda, the country with the lowest food energy deficiency prevalence (37 percent), has been referred to as one of Africa's six "bright stars" (Sachs 2004). In addition to having particularly fertile soils, and thus great agricultural potential, at the time of its survey it had a stable, democratically elected government and a relatively fast-growing economy due to the economic reform efforts of the Museveni government (FEWS NET 1997; Resnick 2004). Given these circumstances, its high prevalence of low diet quality, at 51 percent of households, suggests a need for more policy focus on this aspect of food security.

At the time of their surveys, Kenya, Tanzania, and Guinea had relatively strong economies after years of economic reforms. Kenya's survey, in 1997, followed on a year of poor weather conditions in several districts and low prices of maize, its staple crop. Maize imports were able to make up for the deficit (UNDHA 1996).[16] Tanzania also experienced poor weather conditions in the years leading up to its survey, including a drought in 1996/97 and El Nino flooding in 1997/98 (Wobst 2001). Guinea was experiencing the destabilizing effects of the in-flux of refugees fleeing from civil wars in Liberia and Sierra Leone (U.S. Department of State 2004). Despite 15 years of economic reform and democratization in Ghana, the collapse of cocoa prices in the 1960s and 1970s and the subsequent economic collapse in the early 1980s have left it with a weak economy and slow growth in its agricultural sector. While falling real food prices over the 1980s and 1990s may have improved the food security situation (Nyanteng and

[16] Note that the survey took place April through June of the year, during the country's long rains. The harvesting of crops from the short rains takes place in February and March, which may have offset the dip in food availability typically found during the rainy seasons of countries with uni-modal rainfall patterns. Analysis of the seasonal patterns of energy availability in neighboring Uganda, which lies at the same latitude, shows that this time of year confirms with annual averages.

Asuming-Brempong 2003), the present analysis nonetheless finds over half of its population to be food energy deficient.

With the exception of Senegal, all of the countries with aggregate food deficits had experienced adverse climatic shocks or severe conflict-induced instability in the years leading up to their surveys, with long-term consequences for both food supplies and the ability of households to gain access to them.

Ethiopia had been experiencing recurrent droughts for decades, including that of 1984, which was followed by a devastating famine in which over one million people perished. It had also been experiencing chronic political instability, including border wars, leading to internal and external refugee crises. The survey year itself was marked by the war with Eritrea, which exacerbated the country's weak economy. At the time of its survey, its poverty rate was among the highest in the world, at 82 percent (World Bank 2003). Ethiopia shares with Bangladesh in South Asia the problem of an extremely high reliance on staples in the diet: 83 percent of the average household's food energy is derived from staples.

At the time of their surveys, Rwanda and Burundi were recovering from ethnically-motivated civil wars accompanied by violence and displacements that severely disrupted food production and completely devastated people's livelihoods (UNDHA 1996). Economic embargoes against Burundi by neighboring countries exacerbated the situation there (World Bank 2004).

Malawi, Zambia, and Mozambique were all recovering from the effects of severe drought. The food security situation in these countries is also compounded by high prevalences of HIV/AIDS (Zhang et al. 2004). Malawi and Zambia, with food energy deficiency prevalences of 73 and 71 percent, respectively, share a similar story of endemic poverty exacerbated by economic crisis associated with agricultural liberalization in the 1980s that hurt small farmers and a major drought in 1992-93. The drought led to food shortages, credit defaulting, and household asset depletion that further deepened poverty (Frankenberger et al. 2003).[17] In addition to experiencing the effects of the drought, Mozambique was recovering from the aftereffects of continuous civil war over 1979-92 that severely disrupted transport, communications, and markets and led to internal and external population displacements (Arndt, Jensen, and Tarp 2000).

Senegal's ranking among countries like Mozambique and Rwanda is unexpected.[18] However, while it experienced no major political or climatic shocks in the years leading up to its survey, its semi-arid climate leaves it with endemic drought. Water is a basic constraint to agricultural production. Additionally, the 1990s witnessed a severe economic recession linked to long-term trends in population

[17] Note that the Zambia survey took place only over three months during the countries' dry season, which is usually associated with higher-than-average food availability. The food energy deficiency rate may thus be understated, which is confirmed by analysis of the seasonal energy availability pattern in neighboring Malawi.

[18] This is especially so, given that its survey took place from February through May of the year, during the countries' dry season, when household food availability should be at its highest.

growth, land degradation, and declining prices of major exports and worsened by the 1994 CFA devaluation. The growth of its agricultural sector on which most people rely for their livelihoods was slow and variable throughout the 1990s (IFPRI 1998), and poverty increased over the decade (Ndiaye 2003).

To summarize, Sub-Saharan Africa shares with South Asia endemic poverty as a major factor underlying food insecurity. It differs from South Asia in two main respects. First, in many countries insufficient food availabilities to feed populations, fueled by adverse climatic shocks or conflict-induced instability, are still a major problem. This leads to extremely high rates of food energy deficiency for these countries and more variability across countries in how widespread food insecurity is. Second, the problem of diet quality is marked not only by a strong reliance on staples in the diet but also by less diverse diets, particularly in East and Southern Africa.

5. FOOD INSECURITY IN SOUTH ASIA AND SUB-SAHARAN AFRICA: COMPARISON AT THE REGIONAL LEVEL

This section presents and compares regional estimates of four of the food security indicators discussed in this paper: food energy deficiency, severe food energy deficiency, low diet diversity, and the percent of energy from staples. Table 7 presents the estimates of these indicators for each study country along with means across the study countries in each region. They are illustrated in Figures 1, 2, and 3.

Table 7. HES estimates of key indicators of food insecurity, South Asian and Sub-Saharan African countries

Country	Year	Food energy deficiency	Severe food energy deficiency	Low diet diversity	Percent of energy from staples
		(percent)	(percent)	(percent)	
South Asia					
Bangladesh	2000	53.7	29.4	3.7	82.4
India	1999	52.4	34.2	10.9	66.5
Pakistan	1998	44.1	31.2	1.9	56.2
Sri Lanka	1999	56.7	42.1	11.5	59.9
South Asia mean		**51.7**	**34.2**	**7.0**	**66.3**
Sub-Saharan Africa					
Burundi	1998	74.8	69.5	44.0	62.3
Ethiopia	1999	76.4	61.9	36.4	83.2
Ghana	1998	51.4	45.3	8.0	66.9
Guinea	1994	45.1	37.5	7.7	66.3
Kenya	1997	43.9	37.2	25.0	61.8
Malawi	1997	73.3	69.3	49.8	69.3
Mozambique	1996	60.3	57.1	62.6	77.3
Rwanda	2000	65.3	57.9	49.2	62.6
Senegal	2001	60.2	55.7	8.1	55.5
Tanzania	2000	43.9	37.9	9.7	70.6
Uganda	1999	36.8	28.5	50.9	69.4
Zambia	1996	71.1	64.6	43.7	77.8
Sub-Saharan Africa mean		**58.5**	**51.9**	**32.9**	**68.6**

Figure 1: National estimates of food energy deficiency prevalences for South Asian and Sub-Saharan African countries

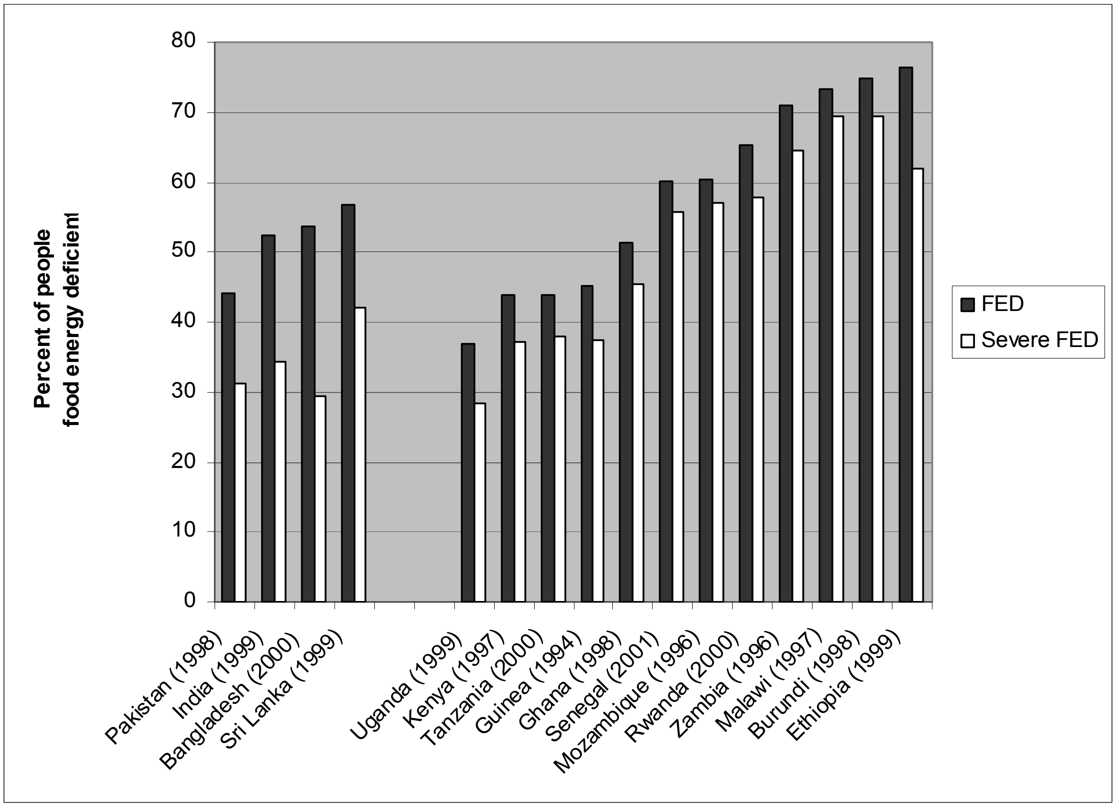


Figure 2: National estimates of low diet quality prevalences for South Asian and Sub-Saharan African countries

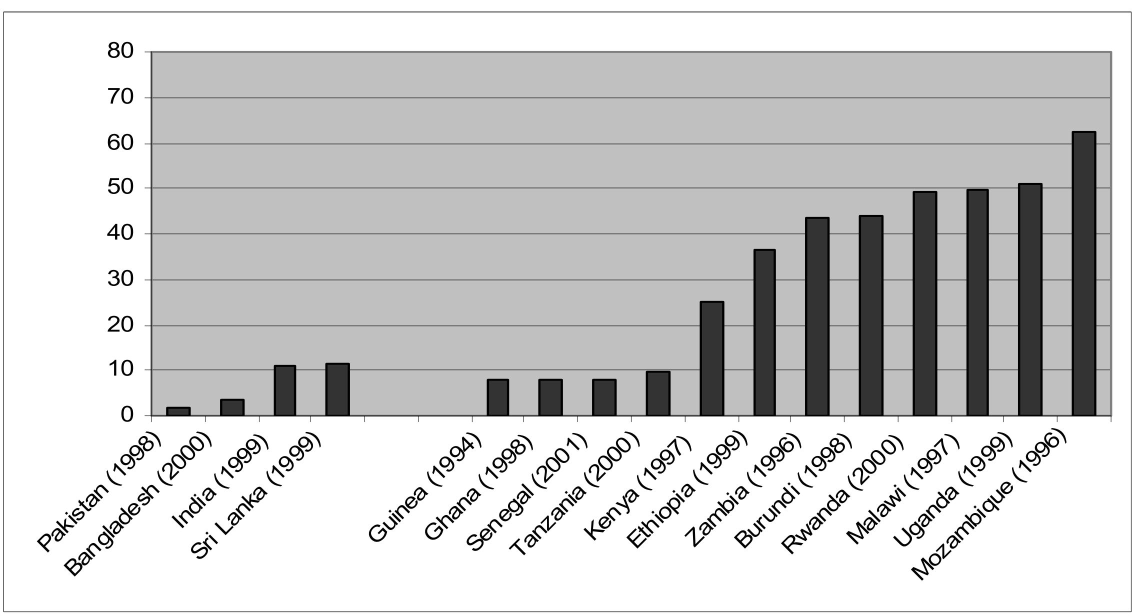
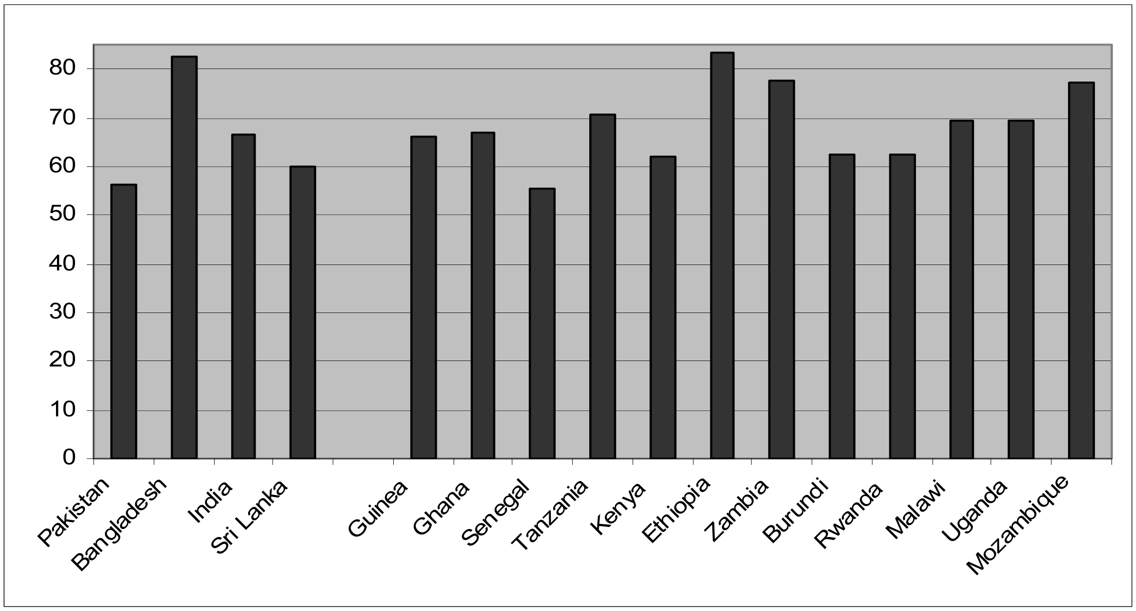


Figure 3: National estimates of the percent of energy from staples for South Asian and Sub-Saharan African countries



The mean food energy deficiency prevalence for the South Asian countries is 52 percent; that for the Sub-Saharan African countries is somewhat higher, at 59 percent. In the case of severe food energy deficiency, the difference between the two regions is more pronounced. The mean prevalence of low diet diversity is far higher for the Sub-Saharan African countries than the South Asian countries, but the percent of energy from staples is roughly equal.

As discussed in Section 3, regional estimates of the indicators that are representative of all countries in the regions, and for a common time period—the year 2000—are generated for this paper's analysis using Ordinary Least Squares regression. The independent variables in the regressions are chosen based on several considerations, including relevance to the determination of food security, data availability, statistical significance and predictive power, and whether their coefficients have the expected sign. For food energy deficiency and severe food energy deficiency, the following were chosen:

1. Gross Domestic Product per capita (GDP) (in purchasing power parity constant 2000 international dollars);
2. dummy variable indicating whether the country was in a crisis in or around the year of the estimate (political, environmental, or economic);
3. age dependency ratio (dependents to working-age population);
4. primary school enrollment (percent gross);
5. Sub-Saharan Africa dummy variable.

For low diet diversity, gross secondary school enrollments is added and the Sub-Saharan Africa dummy variable is replaced with a South Asia dummy variable. For the percent of energy from staples the independent variables are the first two in the above list, gross secondary school enrollments, a South Asia dummy variable, and cereal yields in kilograms per hectare. It is important to keep in mind that the independent variables chosen are not meant to be a comprehensive list of the determinants of food insecurity but instead relevant variables chosen to yield an OLS regression equation with the highest possible R-squared.

The data are from *World Development Indicators 2005* (World Bank 2005) with the exception of the crisis variable, a dummy variable created using information from the Center for International Disaster Information (CIDI 2006) and the United States Department of State (U.S. Department of State 2006). Other variables considered were degree of democracy (using an index of political rights and civil liberties from Smith and Haddad 2000), population densities, life expectancies, and foreign aid receipts.

The regression output can be found in Appendix A. The relevance of the income and crisis variables is obvious, and their signs are in the expected directions. The sign of the dependency ratio (first three indicators) is negative, signaling that even though households in populations with a greater proportion of dependents may find it more difficult to meet food needs, they need less food. The coefficients of the education variables are statistically insignificant in the energy deficiency regressions. While they are significant as a set in the low dietary diversity regression, they are very small. The coefficient of cereal yields in the percent of food energy from staples regression is positive, as would be expected. The Sub-Saharan Africa dummy variables in the food energy deficiency equations have a positive sign. The South Asia dummy variable in the low diet diversity equation is large and has a negative sign, as would be expected from the data in Table 7. In the food energy from staples regression it is also negative, but statistically insignificant and small.

Table 8 shows the mean values of the indicators by region for the year 2000. South Asia's food energy deficiency prevalence is estimated to be 51 percent; Sub-Saharan Africa's is 57 percent. Sub-Saharan Africa's is higher, but the difference is small (only 11 percent higher). When it comes to severe food energy deficiency, however, we find that Sub-Saharan Africa's rate is far higher than South Asia's, near 50 percent higher.

While roughly one-third of the population of South Asia is estimated to be at high risk of food insecurity, over half is estimated to be at high risk in Sub-Saharan Africa.[19] Note that the proportions of severely food energy deficient are much higher than those reported by FAO (see Table 2), despite use of the same energy requirement.

Table 8. Predicted year 2000 indicators of food insecurity for South Asia and Sub-Saharan Africa

	South Asia	Sub-Saharan Africa	Difference
			(percent)
Diet quantity			
Food energy deficiency (percent)	51.2	56.9	11.1
Severe food energy deficiency (percent)	34.5	50.8	47.2
Diet quality			
Low diet diversity (percent)	10.6	28.3	167.0
Percent of energy from staples (percent)	63.2	64.9	2.7

Turning to diet quality, Sub-Saharan Africa is doing far worse than South Asia when it comes to diet diversity. The rate of low diet diversity for South Asia is 11 percent, while it is 28 percent for Sub-Saharan Africa, almost triple. Taking a look at the source of the differences, Table 9 reports on the incidence of consumption of the food groups making up the diet diversity index. It is roughly the same for the starchy staples (cereals, roots and tubers), animal products, and vegetable food groups. However, for the rest of the groups the incidence is much higher in South Asia. The largest difference is for dairy products (68 percent for South Asia versus 48 percent for Sub-Saharan Africa), a source of foods that are rich in protein and micronutrients, particularly calcium.

[19] The coefficients of variation (CVs) of per capita dietary energy availability, representing the distribution of total food available across a country's population, are substantially higher for the Sub-Saharan African countries than the South Asian countries (Smith, Alderman, and Aduayom 2006; Smith and Subandoro 2005). Some of this higher variability is artificial, being due to the fact that the "expenditure divided by price" method of converting the food data collected to metric food quantities (see Section 3) is employed for many of the Sub-Saharan African surveys but not at all for the South Asian surveys. Because higher CVs induce greater estimates of food energy deficiency, one may wonder whether the higher rates for Sub-Saharan Africa are simply due to this difference in data collection methods. Such a possibility was investigated by recalculating the regional food energy deficiency estimates after applying a correction factor to each country's food energy deficiency prevalence for the method of data collection. Specifically, the correction factor is calculated as the coefficient from a regression of the CV of dietary energy availability on the percent of cases in each country for which the expenditure divided by price method is used. This resulted in little change in the regional estimates of food energy deficiency. For example, that for severe-to-moderate deficiency only declines from 56.9 to 50.8 percent. We thus conclude that the difference in the food energy deficiency estimates between the regions is not due to differences in methodology employed for conversion to metric food quantities.

Table 9. Predicted year 2000 percent of households consuming foods from food groups making up diet diversity index, South Asia and Sub-Saharan Africa

	South Asia	Sub-Saharan Africa	Difference
			(percent)
Cereals, roots and tubers	99.8	99.1	0.7
Pulses and legumes	95.7	77.7	23.2
Dairy products	67.5	47.6	41.8
Meats, fish and seafood, and eggs	79.9	85.3	-6.3
Oils and fats	86.8	72.1	20.4
Fruits	69.9	56.6	23.5
Vegetables	99.3	93.2	6.5

Note: Regional values are predicted using the same regression model used for the low diet diversity indicator.

The second indicator of diet quality, the percent of energy from staples, tells a different story than the diet diversity indicator. The percents are roughly equal for the regions, at 63 percent for South Asia and 65 percent for Sub-Saharan Africa, indicating a high and comparable degree of reliance on staples for meeting energy needs in both regions.[20]

[20] The correlation between the two diet quality indicators for the study countries is 0.317 (p = 0.232) with Bangladesh included and 0.523 (p = 0.046) when Bangladesh is excluded.

6. CONCLUSIONS AND DISCUSSION

In its exploration of whether food insecurity is more severe in South Asia or Sub-Saharan Africa, this paper finds the prevalence of food energy deficiency, a measure of the sufficiency of access to food, to be 51 percent in South Asia. It is 57 percent in Sub-Saharan Africa. The difference is insignificant from the standpoint of food security policy. However, the prevalence of severe food energy deficiency, which is more life threatening, is estimated to be 51 percent in Sub-Saharan Africa—i.e., almost all of the energy deficient are severely energy deficient—but a lower 35 percent in South Asia. These results indicate that from a diet quantity point of view, Sub-Saharan Africa is the region with the most severe food insecurity problem.

Turning to diet quality, the percent of food energy derived from staples is roughly equal in South Asia and Sub-Saharan Africa (63 percent and 65 percent, respectively), indicating that they suffer from a comparable and high reliance on staple foods in the diet to the neglect of foods that are rich in protein and micronutrients. The prevalence of low diet diversity in Sub-Saharan Africa is nevertheless almost triple that of South Asia, 28 percent versus 11 percent, indicating that Sub-Saharan Africa is doing worse than South Asia. Even though South Asian households tend to have a more diverse diet (particularly, a substantially greater incidence of consumption of pulses and legumes, diary products, oils and fats, and fruits), the *quantities* of the non-staple foods eaten may be quite low. With the evidence presented in this paper we can only conclude that Sub-Saharan Africa's diet quality problem is comparable to that of South Asia or possibly worse.

From a policy standpoint, these results confirm that South Asia and Sub-Saharan Africa as global regions both have deep food insecurity problems but point to Sub-Saharan Africa as the region with the most severe problem. When considering which region should be given more emphasis in the international allocation of scarce development resources, however, the severity of the problem should not be the only factor considered but also its magnitude in terms of numbers of people. Because South Asia's population is far larger than Sub-Saharan Africa's, the numbers of people experiencing food insecurity are undoubtedly larger there. The number of severely food energy deficient people is in fact greater in South Asia than in Sub-Saharan Africa (approximately 459 million versus 325 million in 2000).

The paper's analysis helps to deepen our understanding of the Asian Enigma. Does food insecurity play a role in making child malnutrition so much higher in South Asia than Sub-Saharan Africa, even though the former is doing much better in terms of other major socioeconomic determinants of malnutrition? If so, this provides support for enhanced emphasis on food security as a focus of development efforts in South Asia. The analysis does not find that food insecurity is higher in South Asia than in Sub-Saharan Africa. We can thus conclude that it is not the most limiting factor driving South Asia's extraordinarily high child malnutrition rates. However, the region does in fact have a major food energy deficiency problem that, when *combined* with other factors found to explain the enigma, such as women's low status and associated poor child-caring practices, may exacerbate malnutrition (i.e., an "interaction effect" may be at play). For instance, women with low status may have a harder time providing enough food for themselves and their children in an environment of food scarcity. In this case, the large gap in child malnutrition rates between South Asia and Sub-Saharan Africa could be widened as a consequence of food insecurity, even if it is equally or more severe in Sub-Saharan Africa.

It is important to note some limitations of this study. First, while data constraints are partially overcome by predicting the values of the food security indicators for all of the Sub-Saharan African countries, the analysis of this paper is based on direct data from only 12 of them. Second, as noted in section 2, there are still some outstanding reliability issues in the use of household expenditure survey data for the measurement of food energy deficiency. Third, as the analysis has brought to light, more research needs to be conducted on the use and interpretation of indicators of diet quality for international comparisons.

On a final note, this paper has looked at food security from the broad perspective of the global regions. It provides needed information about the relative severity of food insecurity across the two regions having undoubtedly the most severe problems. It thus aids in a more efficient allocation of resources by institutions and individuals with an international outlook on the effort to overcome food insecurity. However, as we have seen, variation in food insecurity across countries within the regions is high, particularly within Sub-Saharan Africa. Further, previous studies have shown that geographic variation within the study countries of both regions can be strong (Smith and Subandoro 2005; Smith, Alderman, and Aduayom 2006). For the practical purposes of policy and program implementation it is, of course, important to target the population groups within the regions for whom food insecurity is most severe.

APPENDIX A. ORDINARY LEAST SQUARES REGRESSION MODELS FOR PREDICTING REGIONAL ESTIMATES OF FOOD INSECURITY FOR SOUTH ASIA AND SUB-SAHARAN AFRICA

Table A.1. Food energy deficiency regression model, STATA output

```
      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  5,    12) =    8.22
       Model |  2166.22311     5  433.244622           Prob > F      =  0.0014
    Residual |  632.553233    12  52.7127694           R-squared     =  0.7740
-------------+------------------------------           Adj R-squared =  0.6798
       Total |  2798.77634    17  164.633903           Root MSE      =  7.2604

------------------------------------------------------------------------------
         fed |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gdp_pc |  -.0036239    .0014815    -2.45   0.031    -.0068517   -.0003961
      crisis |   21.14777    4.084482     5.18   0.000     12.24845    30.04709
     age_dep |  -53.87479    22.67327    -2.38   0.035    -103.2756   -4.473977
    prim_enr |  -.0649056    .0719246    -0.90   0.385    -.2216158    .0918047
         ssa |   7.944767    6.658321     1.19   0.256    -6.562468      22.452
       _cons |   100.6504    18.94594     5.31   0.000     59.37071      141.93
------------------------------------------------------------------------------
```

Table A.2. Severe food energy deficiency regression model, STATA output

```
      Source |       SS       df       MS              Number of obs =      18
-------------+------------------------------           F(  5,    12) =   10.38
       Model |  3061.06202     5  612.212405           Prob > F      =  0.0005
    Residual |  707.867496    12   58.988958           R-squared     =  0.8122
-------------+------------------------------           Adj R-squared =  0.7339
       Total |  3768.92952    17  221.701736           Root MSE      =  7.6804

------------------------------------------------------------------------------
     fed_sev |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gdp_pc |  -.0023188    .0015672    -1.48   0.165    -.0057333    .0010958
      crisis |   20.76139    4.320802     4.80   0.000     11.34717    30.17561
     age_dep |  -42.21848     23.9851    -1.76   0.104    -94.47754    10.04057
    prim_enr |  -.0676804     .076086    -0.89   0.391    -.2334576    .0980968
         ssa |   15.76269    7.043559     2.24   0.045     .4160942    31.10929
       _cons |   74.40205    20.04212     3.71   0.003     30.73403    118.0701
------------------------------------------------------------------------------
```

Table A.3. Low dietary diversity regression model, STATA output

Source	SS	df	MS
Model	5748.65644	6	958.109407
Residual	1831.30799	11	166.482544
Total	7579.96443	17	445.88026

Number of obs	= 18
F(6, 11)	= 5.76
Prob > F	= 0.0063
R-squared	= 0.7584
Adj R-squared	= 0.6266
Root MSE	= 12.903

ldd	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdp_pc	-.0063754	.0030921	-2.06	0.064	-.0131811	.0004303
crisis	16.20704	6.979668	2.32	0.040	.8448929	31.56918
age_dep	-96.98337	65.30559	-1.49	0.166	-240.72	46.75327
prim_enr	.4701667	.1589915	2.96	0.013	.1202289	.8201046
sec_enr	-.4234027	.3622539	-1.17	0.267	-1.220718	.3739128
sasia	-29.07246	12.73118	-2.28	0.043	-57.0936	-1.051321
_cons	92.04418	61.60527	1.49	0.163	-43.54811	227.6365

Table A.4. Percent of food energy from staples regression model, STATA output

Source	SS	df	MS
Model	1041.61928	5	208.323857
Residual	772.651966	12	64.3876639
Total	1814.27125	17	106.721838

Number of obs	= 18
F(5, 12)	= 3.24
Prob > F	= 0.0444
R-squared	= 0.5741
Adj R-squared	= 0.3967
Root MSE	= 8.0242

pstaple	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gdp_pc	-.0065001	.0017741	-3.66	0.003	-.0103656	-.0026347
cereal_yield	.0084178	.0033194	2.54	0.026	.0011853	.0156502
crisis	6.553941	4.586974	1.43	0.179	-3.440216	16.5481
sec_enr	.1547798	.1511266	1.02	0.326	-.1744968	.4840565
sasia	-8.64794	6.251808	-1.38	0.192	-22.26946	4.97358
_cons	58.37784	5.877089	9.93	0.000	45.57277	71.18292

Definitions of variables:

Fed	prevalence of food energy deficiency
Ldd	prevalence of low diet diversity
gdp_pc	Gross Domestic Product per capita (in purchasing power parity constant 2000 international dollars);
crisis	dummy variable indicating whether country was in a crisis in or around the year of the estimate (political, environmental, or economic);
age_dep	age dependency ratio (dependents to working-age population);
prim_enr	primary school enrollment (percent gross);
sec_enr	secondary school enrollment (percent gross);
cereal_yield	cereal yields (kilograms per hectare);
ssa	Sub-Saharan Africa dummy variable;
sasia	South Asia dummy variable.

APPENDIX B. ADDITIONAL INFORMATION ON SURVEYS FROM THREE EAST ASIAN COUNTRIES

Table B.1. Basic information on the surveys

Country	Year of data collection	Name of survey	Data collection agency	Survey duration (months)	Number of households
Lao PDR	2002	Lao PDR Expenditure and Consumption Survey III 2002/2003	National Statistical Center	12	8,092
Malaysia	1998	Malaysia Household Expenditure Survey 1998/1999	Department of Statistics	12	9,198
Papua New Guinea	1996	Papua New Guinea Household Survey 1996	World Bank	12	1,207

Table B.2. Food data collection

Country	Number of food items[a]	Means of data collection	Food sources for which data collected	Number of visits	Recall period (days)	Reference period[b] (days)
Lao PDR	130	diary and interview	Purchase, home production	[a]	1	30
Malaysia	346	diary and interview	Purchase, home production, inkind	[a]	1	30
Papua New Guinea	34	Interview	Purchase, home production, gifts	1	14	14

[a] Multiple visits were made by enumerators to households but only for the purposes of checking on the completeness of diary record keeping.

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