

# Measuring Food Security in Africa: Conceptual, Empirical, and Policy Issues

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"Food security is access by all people at all times to enough food for an active and healthy life."—World Bank

The definition of food security has broadened since the term first came to prominence at the 1975 World Food Conference. Discussions of food security in the mid- and late 1970s were strongly influenced by the shortfall in world food production and run-up in prices early in that decade. Initially, food security meant avoiding transitory shortfalls in the aggregate supply of food. By the early 1980s, however, the world food supply situation had evolved markedly. The famines striking Africa took place in a world awash in grain. Clearly, inadequate levels of global food supply were not the cause of hunger. Sen's work focused attention on the lack of access by households and individuals to food because of low incomes (entitlements) as a cause of food insecurity, and other research has shown that for most of the hungry in the world, this lack of access is chronic, not transitory. Thus, the conceptual understanding of food insecurity has gradually evolved over the past fifteen years to include not only transitory problems of inadequate supply at the national level but also chronic problems of inadequate access and unequal distribution at the household level.

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Despite a broader understanding of the complexity of food insecurity, policy makers must still look for easily measured indicators to design programs to reach the food insecure. Often, these indicators are measures of regional or national food supply or its correlates (such as rainfall), as current information on household or individual entitlements to food is usually lacking. Some policy makers may think of supply shortfalls or the lack of domestic food self-sufficiency as the "true" food insecurity problem.<sup>1</sup> More commonly, they may simply believe that the supply indicators they use are highly correlated with the true but unmeasured indicators of household or individual access to food.

A critical question then becomes to what degree are commonly used indicators of food security, as measured at one level of aggregation such as the nation or region, correlated with indicators of access to food at other levels, such as the household or the individual?<sup>2</sup> This paper addresses these issues, drawing on preliminary findings from research carried out in the OHV zone of southern Mali. The sample included approximately ninety rural households in eight villages, for which coarse grain (millet, sorghum, and maize) production and transactions data were collected over the period 1985–88 and food

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<sup>1</sup> Shortfalls in domestic supplies of grain, resulting in massive commercial or food aid imports, may represent real food insecurity to those decision makers concerned about the overall foreign exchange position of the importing country or its ability to retain its sovereignty in the face of pressure from its food suppliers (Staatz and Wohl). Because of space limitations, this type of insecurity is not addressed here, but it is important to bear in mind when considering why some policy makers give such emphasis to domestic food self-sufficiency even though it is well known that such self-sufficiency is no guarantee against hunger among the population.

<sup>2</sup> The term region, as used in this paper, refers to a subnational area, such as a province, not a regional grouping of countries, such as the Sahel.

consumption, expenditure, and anthropometric data were collected in 1988 and 1989.<sup>3</sup>

### National versus Regional Food Security

Following the trauma of the great Sahelian drought of the early 1970s, most Sahelian states, including Mali, made attaining food self-sufficiency a central pillar of their food strategies (Staatz and Wohl). Hence, the degree to which domestic consumption of basic staples was covered by national production became a key measure of food security for national policy makers. Yet, attainment of national food self-sufficiency does not guarantee adequate access to food in each region of the country. Indeed, the restrictions on private marketing of grain that most Sahelian countries imposed until the 1980s (especially the interdiction of inter-regional grain trade) helped assure that national self-sufficiency did not translate into adequate regional food supplies. However, even with the removal of restrictions on the private trade, inadequate transportation infrastructure and weak effective demand may result in gluts in one region not being translated into adequate access to food in another.

In addition, policies designed to alleviate national problems of food surpluses or shortages can exacerbate regional entitlement disparities, particularly when markets are poorly integrated and regional income inequalities are great. For example, as a result of a record coarse grain harvest in Mali in 1989, the government emphasized export promotion to boost farm-level prices and hence the incomes of those farm households (mainly in the CMDT zone of southeastern Mali) that are net sellers of grain. Some local officials in the grain-deficit zones of the West through which the exports pass, however, have attempted to block them to prevent higher prices in this very poor region. This highlights the food-price dilemma inherent in food policy, that is, the difficulty of reconciling the conflicting interests of net buyers and sellers of food (both as individuals and as regions). This dilemma is severe in many African countries, even though most of the population is rural, because many small

farmers are net purchasers of basic staples (Weber et al.).

### Regional versus Household Food Security

In Mali, as in many other Sahelian states, policy makers rely heavily on regional indicators of food production and prices to target food aid and general development assistance. For example, all the districts (*arrondissements*) monitored for potential food shortages in Mali (the "at risk" zones) are located north of the fourteenth parallel, in the lower rainfall areas of the country (Staatz et al.). Yet, many households in the "surplus zones" south of the 14th parallel lack adequate access to food. Even in the southern CMDT zone, the most productive agricultural region of the country, where per capita coarse grain production in 1987 averaged 311 kilograms (kg) (compared with an estimated consumption requirement of 188 kg), only 43% of households that cultivated manually (27% of total households) had production above the consumption requirement. In contrast, 89% of households having at least some animal traction equipment met that norm.

Northern areas of Mali are generally perceived as being more prone to food insecurity than southern areas because of their lower and more erratic rainfall levels. Over the 1970–85 period, the annual rainfall in northern OHV ranged between 550 and 760 millimeters, compared to a 850–1,000 millimeter range in southern OHV (D'Agostino, p. 48). According to CESA-MSU survey results, average per capita grain production during the 1985–87 period was 16% to 65% higher in southern OHV than in the north (D'Agostino, Dioné, and Staatz). Yet, when sample households were ranked in terms of their food consumption security in 1988, there was no significant difference between north and south (table 1).<sup>4</sup>

The main reason that differences in regional agricultural production potential were not correlated with differences in consumption security is that households in the northern, more arid area, have more diverse income sources and rely more on the market for their food supply than their southern counterparts. In 1987–88, sample

<sup>3</sup> OHV stands for *Opération Haute Vallée*, or Upper Niger River Valley Development Authority. The OHV households were part of a larger survey of farm households in southern Mali, which also included the CMDT zone (*Compagnie Malienne du Développement des Textiles*). The CMDT zone is the main cotton-producing area of the country and also the area that produces the bulk of Mali's marketed surplus of coarse grains. For details, see Dioné.

<sup>4</sup> The consumption ranking was based on a scale that took account of the following indicators for each household: number of meals eaten per day, number of meals (which included meat or fish), number of ingredients in the sauce served with the main staple (a measure of dietary diversity), and number of times per day a nutrient-poor gruel was prepared as the main meal.

**Table 1. Household Consumption Security Rankings, Northern and Southern OHV Zone, Southern Mali, 1988 (percentage of households by category)**

Consumption Security Ranking	South	North	Total
High	8.9	7.8	16.7
Average	25.6	26.7	52.2
Low	17.8	13.3	31.1
Total	52.2	47.8	100.0

Chi-squared (df = 2) = .79

Source: D'Agostino and Sundberg, forthcoming.

Note: The consumption ranking was based on evaluation of the following indicators for each household: number of meals eaten per day, number of meals which included meat or fish, number of ingredients in the sauce served with the main staple (a measure of dietary diversity) and number of times per day a nutrient-poor gruel was prepared as the main meal.

households in northern OHV obtained 39% of their household grain supplies from the market, compared to only 8% in the south. The market becomes particularly important late in the crop year. In the period just before harvest in 1988, grain from the market served as the base for 67% of the meals in northern OHV, compared with 28% in the south.

The importance of reliance on the market in the north is reflected in how market purchases influenced household consumption security, as measured in table 1. Whereas the level of market purchases is negatively correlated with a household's consumption security in the south, it is positively correlated with it in the north (table 2). In other words, southern households at-

tempt to assure household food security through own production and tend to purchase grain only when this strategy fails. Northern households, in contrast, develop more diverse income sources that are less directly dependent on rainfall levels (table 3) and use revenues from those activities to purchase food. The northern households, living in a more risky environment, have evolved strategies that allow them to mitigate the effects on consumption security of fluctuations in household crop production to a greater extent than their southern counterparts, who have developed strategies to exploit the (normally) higher agricultural production potential of their area. These findings are similar to those observed in northern and southern areas of neighboring Burkina Faso (Reardon, Matlon, and Delgado).

**Table 3. Distribution of Major Income Sources in the OHV by Subregion (% of men and women's responses, aggregated over three seasons), 1988-89**

Income Sources	OHV-South (N = 706)	OHV-North (N = 363)
Agriculture and wild products	55.1	29.4
Commerce	15.0	10.4
Artisans' activities	7.9	20.1
Livestock	6.1	16.5
Prepared foods	4.1	16.8
Labor and migration remittances	6.0	4.1
Gifts	4.8	1.1
Other	1.0	1.6

Source: Sundberg, 1989a.

**Table 2. Correlates of Household Food Security in the OHV by Subregion, 1987-88**

Indicator	OHV-South		OHV-North	
	t-ratio	signif.	t-ratio	signif.
Coarse grain production per household	2.32	.03	2.62	.02
Coarse grain production per capita	.23	.82	2.49	.02
Coarse grain availability per household	1.96	.06	2.57	.02
Coarse grain availability per capita	-.31	.76	2.03	.06
Coarse grain purchases per household	-2.24	.04	2.17	.05
Coarse grain sales per household	1.49	.15	-1.30	.21
Number of farm household workers	2.21	.04	1.48	.16
Number of revenue sources per household	2.31	.03	0.36	.72
Household size	1.66	.11	1.45	.17
Ownership of animal traction equipment	chi square = 9.23		chi square = 7.00	
		.06		.14

Source: D'Agostino and Sundberg, forthcoming.

Note: Unless otherwise stated, the statistics presented in this table are *t*-values from tests of the equivalence of the population means for consumption-secure and consumption-insecure households. A significant positive *t*-ratio indicates that consumption-secure households measured significantly higher on this variable than consumption-insecure households. For animal traction equipment ownership, three levels of ownership were measured (nonequipped, semi-equipped, and fully equipped). The chi-square test measures whether the distribution of ownership was different between consumption-secure and consumption-insecure households.

The findings suggest that the functioning of rural product and factor markets in grain deficit zones plays an extremely important role in determining household food security. In particular, the ability of rural distribution markets to deliver grain reliably to grain-deficit rural households at low cost is central to the ability of these households to assure adequate levels of consumption. Yet, many of these rural distribution markets are thin, and prices are consequently volatile.<sup>5</sup> Price volatility hits hardest those poor households that sell grain early in the season to meet pressing cash needs (especially tax payments) and repurchase grain late in the season to meet consumption needs (D'Agostino and Staatz).

The ability of rural households to obtain income to purchase the grain depends critically on the functioning of the markets for the goods and services these households sell (table 3). In addition, the capacity of these households to weather short-term fluctuations of real income depends on the functioning of rural capital markets. In the long run, the goal of policy should be to decouple a household's food consumption status from short-term fluctuations in agricultural production by improving both rural capital markets and the markets for the goods and services the households sell (von Braun).

If differences in per capita grain production levels across geographic zones are not good predictors of household food consumption security, what are? Table 2 summarizes the factors that were significantly different between consumption-secure and consumption-insecure households within northern and southern OHV. A few indicators, such as coarse grain production and availability per household, are positively correlated with consumption security within both subzones, indicating that even though the northern households are more market oriented, own production continues to play an important role in their food strategies. In both subzones, larger households (which have more diverse income sources) tend to be more consumption secure than small households. But what is striking in table 2 is that many indicators are valid for one subregion but not the other. For example, size of the farm labor force and ownership of animal traction equipment are more significantly correlated with household consumption security in the south

than in the north because in the south agriculture contributes more to family income. Most striking, the level of grain purchases is negatively correlated with household consumption security in the south but positively correlated with it in the north, for reasons explained above.

This diversity in the subregional correlates of household food security suggests that any attempt to develop indicators to monitor household consumption security needs to be area specific. Few easy-to-monitor indicators are robust across all subzones. One possible method to obtain indicators is to use local village informants. The two enumerators employed by the consumption survey (women with 9th grade educations) were asked to give their subjective rankings of the household consumption security of all the sample households. The correlation between these rankings and those based on the scale described in footnote 4 was .87, suggesting that local informants may be a cost-effective way of monitoring household food security. A major challenge, however, would be to assure the objectivity of their rankings if such rankings served as the basis for the distribution of benefits, such as food aid, to food-insecure households.

### Regional versus Individual Food Security

If aggregate measures of regional food production are not good indicators of household food security, it is even less likely they will be reliable guides to individual nutritional status as measured, for example, by anthropometrics. In order to evaluate children's nutritional status, children aged 0-7 years from the sample households were weighed and measured in three different seasons to evaluate their degree of protein-energy malnutrition (PEM): early November 1988 (just before the main grain harvest), early February 1989 (immediate post-harvest period), and late August 1989 (peak of the hungry season).<sup>6</sup> Aggregating across the three rounds, the overall rate of short-term PEM, or wasting, as measured by weight-for-height, was 4.2%. The prevalence of chronic PEM, or stunting, as measured by height-for-age, was 37.0%.

The fact that northern households were at least

<sup>5</sup> Between October 1987 and August 1988, the prices paid by sample households in northern OHV for millet and sorghum more than quadrupled, from under 29 CFA.F/kg to slightly over 130 CFA.F/kg. (D'Agostino and Staatz).

<sup>6</sup> Sample sizes for the 3 rounds were 268, 277, and 256, respectively. A child was considered wasted if her weight-for-height fell at least two standard deviations below the median NCHS/WHO growth reference curves. Similarly, a child was considered stunted if her height-for-age fell at least two standard deviations below the NCHS/WHO median curves. For details, see Sundberg 1989b.

as consumption-secure as their southern counterparts is borne out in the anthropometric measures. Children in the northern areas had significantly lower levels of chronic PEM than children in the south, 23% versus 43% ( $t = 4.73$ ,  $p < .01$ ). There was no significant difference in the prevalence of wasting between north and south, although mean weight-for-height is significantly lower in the south ( $t = 2.96$ ,  $p = .003$ ). One possible explanation for the substantially lower incidence of growth stunting in the north is that health and sanitation problems (particularly the incidence of malaria) are likely to be greater in the more humid south. Given the strong synergies between disease and malnutrition, the disease problems may have been manifested in more growth stunting in the south.<sup>7</sup> Cultural differences between the two subzones, such as child feeding practices, may also have been a factor, although the vast majority of the sample in both areas were of the same ethnic group. (The issue of child-feeding practices will be explored in future analysis).

### Household versus Individual Food Security

Poor health and sanitation and inappropriate child feeding practices may prevent adequate levels of household consumption security from translating into satisfactory nutritional status for the most nutritionally vulnerable members of the households, such as preschool children or pregnant and lactating women. Indeed, for the OHV zone as a whole as well as for each subzone, the data indicate no correlation between the household consumption security ranking reported in table 1 and either of the anthropometric measures (the prevalence of wasting and stunting within the household). This is a striking finding: it implies that even if one could accurately assess household food security as measured by the frequency of meals and indicators of dietary diversity used in the consumption-security scale, this alone would not be a reliable guide to the nutritional status of the children in the household. The household consumption ranking derived by the enumerator, however, was positively correlated with long-term nutritional status ( $r = .43$ ,  $p < .01$ ) in northern OHV, thus suggesting that the

use of local informants may be an effective tool for monitoring both household food security and individual nutritional status.

For both the northern and southern subzones, there are very few significant correlations between the anthropometric measures and the household-level economic and demographic indicators shown in table 2. In the south, there are no significant correlations between long-term nutritional status and household-level indicators. Short-term status, however, is negatively correlated with two variables: coarse grain purchases per household ( $r = -.40$ ,  $p < .01$ ) and the degree to which the products from women's individual fields were sold ( $r = .49$ ,  $p < .001$ ). On average, the more grain purchases a household made, the worse off its children were nutritionally. This finding parallels the negative correlation between purchases and household food security in the south (see table 2). This underscores the conclusion that, in the south, higher purchases reflect a failure of the agricultural production strategy, which renders the household more vulnerable to consumption and nutritional deficiencies. Second, in households where women sold a greater part of the products from their individual fields, children were more likely to be wasted. A possible explanation is that women who retained their own production for home consumption increased the diversity of their children's diet, thus contributing to a better nutritional outcome. This hypothesis will be explored in further analysis of the food consumption data.<sup>8</sup>

In the north, short-term nutritional status is negatively correlated with household size ( $r = -.48$ ,  $p < .01$ ), number of farm workers ( $r = -.43$ ,  $p < .01$ ), household grain sales ( $r = -.53$ ,  $p < .001$ ), and gifts of grain received by the household ( $r = -.39$ ,  $p < .01$ ). The direction of correlation between household size and farm workers, on the one hand, and nutritional status, on the other, is the opposite of that between these same demographic variables and household food security (although the latter correlates are not statistically significant—see table 2). Nutritional status may decline as household size increases because, although staple grain quantities may increase commensurately with the number of consumers, typically sauce ingredients are not

<sup>7</sup> The village with by far the worst anthropometric rankings was the only village in the sample surrounded by low-lying wet areas, suggesting that the incidence of mosquito-borne diseases may have been higher there. This village was also one of the most isolated of the sample villages from surrounding markets, thereby hindering the ability of households to diversify their incomes.

<sup>8</sup> Sales from women's individual fields are not correlated with the overall level of grain sales of a household or with the number of nonagricultural enterprises. Thus, it does not appear that women who sold a high proportion of the output from their fields did so because their households had fewer alternative income-earning opportunities than their neighbors.

augmented by a similar ratio and are therefore stretched thinner in larger families, thus lowering the per capita intake of protein, vitamins, and minerals. Households in the north with higher total grain sales are likely to have more wasted children, perhaps because these transactions represent distress sales of grain, which is not truly surplus but is sold only to meet pressing cash needs. Finally, it is intuitive that households with more malnourished children received a larger quantity of gifts of grain.

Long-term nutritional status in the north is positively correlated with only a single variable, grain production per capita ( $r = .44, p < .01$ ). Thus, in spite of the importance of nonfarm activities in the northern households' income strategy, agricultural production remains vital to both the overall food security of the household (table 2) and the nutritional status of its vulnerable members.

These findings suggest that a number of factors intervene in the OHV to prevent adequate levels of household food availability from translating into satisfactory child nutritional status. Poor health and lack of adequate nutrition education are likely to be among the most important of these variables. Policy therefore needs to focus on developing mechanisms to address these variables. Work in Guatemala has highlighted the importance of community-level health and nutrition investments in improving the link between higher rural incomes and the nutritional status of children (Von Braun, Hotchkiss, and Immink). In the OHV, short-term and long-term malnutrition rates varied widely by village. While by far the highest rates were found in one of the most isolated villages with poor health facilities (see footnote 6), among the other seven villages, the incidence of malnutrition did not seem to vary systematically with the level of village infrastructure, as measured by the presence of dispensaries, maternal health clinics, and schools. Just because a village had such infrastructure, however, does not mean it was effective, as lack of supplies and poorly trained and poorly motivated staff often impede the facilities' effectiveness. Such facilities probably also need to focus their activities more closely on nutritional issues to have a strong impact.

One should be cautious in interpreting and generalizing from these preliminary results. The OHV zone has poorly developed markets, a low degree of cash-cropping, and weak village infrastructure. One important area for further research is to replicate this type of study in areas such as the cotton-producing CMDT zone, where

cash-cropping, off-farm income earning opportunities, and the degree of village-level health infrastructure are higher to see if the lack of correlation between indicators of household food security and child nutritional status holds up.

## Conclusions

The analysis has shown that for Mali, commonly used indicators of food security at the regional and national level are often poor predictors of household and especially individual food security. Hence, they may be poor guides to interventions to help the hungry. This poses three challenges for policy makers. One is to develop more accurate, area-specific indicators and cost-effective means to monitor individual and household food security.

The second is to decouple household and individual food security from the vagaries of local agricultural production. Reforms and infrastructure improvements aimed at improving the ability of private traders to move food at low cost among regions and improving the functioning of product, service, and factor markets to allow the food insecure to earn reliable income streams are crucial. Such improvements must be tied to improvements in productivity in cereals cultivation in order to help drive down the real cost of food to rural consumers. Over the long run, strengthening rural capital markets to allow households to bridge temporary shortfalls in income also is important. In designing reforms, it is important to have information on the degree, timing, and conditions of participation of the food insecure in these various markets in order to maximize the impacts of such reforms on the hungry (for examples, see Staatz). The third challenge for both researchers and policy makers is to develop a better understanding of how disease, intrahousehold food distribution, and nutrition education mediate the relationship between household food availability and individual food security. The goal should be to develop mechanisms to strengthen the currently weak relationship in Mali between higher rural incomes and improved nutrition of vulnerable groups.

Finally, it is important not to misinterpret these findings. Although rural households in northern OHV rely heavily on the cereals market and on nonagricultural enterprises to assure their food security, one should not conclude that increasing agricultural productivity is unimportant to them. Even within the north, household consumption security and long-term child nutri-

tional status are correlated with labor productivity in grain production, demonstrating that own production continues to play an important role in these households' food strategies. Even more important, the success of a strategy of relying on the market depends critically on the ability of the food system to produce and deliver grain to these rural households at low price. Given Mali's landlocked position, a large part of this grain will continue to be produced domestically, at least in the medium term. Thus, improvements in productivity in cereal farming as well as marketing are needed.

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