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FOOD SECURITY AND THE HOUSEHOLD

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Ben Senauer and Terry Roe[1]

Food security is widely defined as "access by all people at all times to enough food for an active healthy life" (World Bank, 1986). Food security is, therefore, ultimately a household and individual-level issue. Recent research has greatly enriched our understanding of household behavior concerning food and nutrition.

The key factors affecting household food security and individual nutritional status are shown in Figure 1. They are influenced by the availability of food, the ability and desire of the household to acquire it, its intrahousehold distribution, and the physiological utilization of the ingested nutrients, which both affects and is affected by the person's state of health. The person's nutritional status also has a feedback effect on their productivity, and the ability to acquire food.

INCOME AND PRICES

The general understanding has been that food insecurity and hunger are primarily the result of poverty. With economic growth and improved incomes, poor households will have the ability, and presumedly the desire, to obtain an adequate diet, at least in terms of food energy (calories). By the mid-1980s, certain conclusions concerning the income elasticity for food seemed warranted based on many different research studies. The income elasticities for staple foods are typically markedly higher for lower- than higher-income households. The income elasticity with respect to food expenditure (in value terms) considerably exceeds the elasticity for energy (calories) among poor households. Even people at low-income levels want to increase the variety and quality of their diets. The poor buy more expensive foods per calorie as their incomes rise.

However, the income elasticity for food energy (calories) was still substantial, varying across several studies from a low of 0.10 for poor urban

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households in Brazil to 0.60 for poor rural households in Sri Lanka. Most calorie-income elasticities were in the range of 0.30 to 0.40 (Alderman, 1986, pp. 37-38 and Senauer, 1990, p. 410). A 10% increase in household income would lead to a 3 to 4% increase in calorie consumption.

Several studies in the late 1980s and early 1990s challenged these conclusions and seemed to indicate that the income elasticity for calories might be very low and even close to zero (Behrman and Deolalikar, 1987; Bouis and Haddad, 1992; and Bouis, 1994). Behrman and Deolalikar (1987, p. 505) concluded that "increases in income will not result in substantial improvements in nutrient intakes." In this case, economic growth and improved income among the poor would not lead to substantial reductions in hunger and malnutrition.

The recent study by Subramanian and Deaton (1996), which used data for rural households in Maharashtra state in India and is methodologically very meticulous, obtained elasticities which support the previous conclusions. Their elasticity for food expenditures is around 0.75, and it is about equally divided between the elasticity of calories and that of the price of calories. The elasticity of calorie consumption with respect to total expenditures is in the range of 0.30 to 0.50.

The many empirical studies of the effect of prices on food demand and nutrient consumption lead to several general conclusions. The price elasticities for most foods are substantial. The absolute value may be greater than one. Typically the lower household income is the stronger the response to price changes. In other words, the absolute value of the price elasticities is greater for poorer households. With the poorest households devoting 60-80% of their income to food, they must be very responsive to substituting among foods in response to price changes (Alderman, 1986; Behrman, Deolalikar and Wolfe, 1988; and Senauer, 1990).

Price increases for preferred staple foods have been found to have positive effects on nutrient intakes in several studies (Behrman, Deolalikar, and Wolfe, 1988, p. 306). This can occur when poor households substitute foods that are a cheaper sources of nutrients for a more expensive preferred food in response to its increased price. Senauer and Garcia (1991) found, for example, that the weight in relation to height (a measure of short-run nutritional status or wasting) of preschool children in poor Philippine households improved in response to increases in the price of rice. However, the preschoolers height for age (a measure of long-run nutritional status or stunting) declined. The households presumedly substituted inferior staples, such as maize, for rice in response to its price increase. The inferior staples are a cheaper source of calories, but children's growth (height) suffers because they provide less protein and other nutrients.

Price increases can also positively affect the demand for a food and nutrient consumption when the household produces, as well as consumes, the commodity. This point is important because a significant portion of the poor and food insecure in developing countries reside in semi-subsistence farm households. Agricultural household models encompass both the household's production and consumption decisions into a single unified theoretical framework. When a farm household produces a food commodity partly for sale and partly for consumption, a price increase affects farm profits, and household income. Empirical research with this model for a number of countries shows that the profit effect can completely offset the traditional negative price effect, so that a price increase results in an increased consumption of the product by farm households (Singh, Squire and Strauss, 1986).

INTRAHOUSEHOLD ISSUES

Intrahousehold allocation has been the subject of substantial research efforts by economists over the last dozen years. For a comprehensive review and appraisal see Haddad, Hoddinott, and Alderman (1997). The household has traditionally been treated as a unitary entity with one set of preferences that can be represented by a household utility function. The recent alternative collective models allow for different preferences among individuals in the household. The empirical research has raised questions about the unitary model's ability to adequately explain the observed behavior. However, as of yet no one collective model clearly dominates the various alternatives. Economic changes and public policies and programs can affect intrahousehold distributions under both unitary and collective models. With the latter, the intrahousehold allocation rules or decision-making process may also be affected.

Household-level data are frequently used to determine food consumption and nutritional status. However, the ultimate issue is the nutrition of individuals, particularly those who are considered "at risk" nutritionally. A practical issue is if a household-level indicator is used, how many poorly nourished individuals reside in seemingly adequately nourished households and, conversely, how many adequately nourished individuals are there in poorly nourished households? This question can be likened to the statistical concept of type I and type II errors.

Tables 1 and 2 use data collected in conjunction with a pilot food subsidy program in three provinces in the Philippines in 1983-84 (Senauer and Garcia, 1996). These data are discussed in detail in Garcia and Pinstrup-Andersen (1987). The survey covered 840 households and individual-level food consumption data were collected in 134 of those households. A 24-hour food weighing method was employed in both the household and individual food consumption surveys. For the latter, interviewers were present at meals and weighed the food served to each person and any leftovers. Snacks and food eaten between meals were also accounted for. The adjustments in calorie requirements for physical activity and body weight are based on Haddad, Kanbur, and Bouis (1992). Although from a different survey, their data were also drawn from rural Philippine households in 1984-85. Using information on individual weights and time allocation for several categories of activity, they estimated energy expended per kilogram of body weight per hour for various activities. These were used to adjust the age-gender calorie requirements. The major adjustments were for men and women, ages 16-60. Their calorie requirements each increased by approximately one-third.

In Tables 1 and 2, specific household calorie adequacy levels were chosen, and the pattern of calorie adequacy of individual members was analyzed. In the first row of Table 1 (Part A), if the household calorie adequacy ratio was less than 70%, 16.3% of family members (ages 2-60) had unadjusted individual calorie adequacy ratios over 80%; only 8.0% had adequacy ratios over 80% after adjustment for activity level. Conversely, in the last row of Part B, if household calorie adequacy was greater than 85%, 18.6% of those family members had unadjusted individual adequacy ratios below 70%, and 29.1% after adjustment for activity.

These results provide compelling evidence that because of intrahousehold allocations substantial numbers of food-insecure individuals are members of apparently food-secure households, but only limited numbers of food-secure individuals are in food-insecure households. Part A of Table 1 generally suggests that if households below a certain calorie adequacy level were targeted for a food subsidy, or other nutrition assistance, relatively few of the benefits would "leak" to individuals with substantially higher calorie adequacy levels, particularly after adjusting for activity level. In Part B if households above a certain adequacy level were excluded, a considerable number of individuals with lower adequacy ratios would be excluded.

Table 2 examines age and gender differences with respect to better-nourished individuals in poorly-nourished households (Part A) and poorly-nourished individuals in relatively better-nourished households (Part B). In Part A, there appear to be no substantial gender differences. The differences between adults and children reverse when adjusted for activity level. Before adjusting for activity, 22.7% of men 16-60 have adequacy levels over 85%; after adjusting for activity, only 2.2% do.

In Part B, there are a higher proportion of girls than boys and women than men with unadjusted adequacy ratios under 75% in relatively better-nourished households. The gender difference for adults disappears after adjusting for activity level, though. Before adjusting for activity, there are substantially fewer adults whose calorie adequacy is less than 75% of their requirements. However, after adjusting for activity, a considerably higher proportion of adults (ages 16-60) receive less than 75% of their calorie requirements than do children (ages 2-15). Approximately 48% of the adults in households with calorie adequacy ratios over 85% have adjusted individual adequacy ratios under 75%.

If confirmed with data from other locations, in which intrahousehold distribution patterns might differ, these findings have important implications for the design and targeting of food and nutrition programs and policies. Conventional household targeting criteria may lead to substantial under-coverage, of malnourished individuals. This might justify more generous or lenient household eligibility standards that would result in only relatively small leakages to relatively well-nourished household members.

NUTRITIONAL STATUS (HEALTH) PRODUCTION

Much has been learned about the determinants of individual nutritional status. Nutritional (health) status is typically measured by anthropometric indicators, for example weight and height in comparison to a reference group. Many prefer to use the more general term health status for such indicators. Behrman and Deolalikar (1988) provide an excellent review of this research area.

Gary Becker's (1965) household model serves as the theoretical foundation, with health status viewed as a household-produced good. The major inputs in an individual's health production function include: food consumption (nutrient intake); health care; other goods and service which contribute to health; the time inputs of the individual and other family members which affect health, like the childcare time of parents; demographic characteristics of the individual, like age and education; community and environmental factors which affect health, like sanitation conditions; and the person's genetic endowment.

Two issues have influenced the empirical estimation of this relationship. First, several of these explanatory factors are endogenous variables that result from individual or household choices. These variables may be simultaneously determined and themselves influenced by health status. Much of the empirical work, therefore, has estimated reduced-form health demand equations which contain only exogenous variables as explanatory factors. The second issue is that several of the explanatory factors may be unobserved because of limits on data collection or, in fact, unobservable such as genetic endowment. Longitudinal data with multiple observations for the same individuals over time allow the use of fixed-effects models which factor out the impact of time-invariant unobserved effects (Senauer and Garcia, 1986).

The results of this work have some important policy implications. Nutrient intake is only one determinant of a person's nutritional (health) status. Other factors may be of equal importance and the most crucial limiting factor may be something else. Adequately fed individuals may be malnourished because of parasitic diseases caused by unsanitary environmental conditions. More likely they will aggravate the effects of an inadequate diet. Alleviating malnutrition and improving health is not just a matter of increasing food consumption.

Much of this research has focused on the health status of preschool children, a group at high nutritional risk. The importance of the parent's, particularly the mother's, education on child health has been confirmed by many of these studies. For example, Kassouf and Senauer (1996) examined the impact of parental education on heights and weights of preschool children in Brazil. Education levels in Brazil are low; the average mother had only four years of schooling in the 1989 survey. Over 24% of the preschool children of mothers with less than four years of school suffered from stunting, at least moderate malnutrition in terms of height for age. If these mothers were all educated at least to the eleventh grade, this figure would fall to only 2.8%. The mother's education has a strong positive direct effect on nutrition, a negative indirect effect through her wage and the increased value of time, and a very large, indirect positive effect via household full income. The father's education also has a positive effect, although not as impressive as the mother's.

OTHER FACTORS AND RECENT RESEARCH

Space limitations on this paper do not allow for more than a brief mention of three other factors that bear of household food security on which there are recent research contributions. The factors are the impact of nutritional status on labor productivity, housing coping mechanisms, and food subsidy programs. As shown in Figure 1, nutritional status has a feedback loop through an effect on labor productivity, and hence the ability of the household to obtain food. Empirical studies have shown that nutritional status positively affects wages and own-farm output (Strauss, 1986; Sahn and Alderman, 1988; and Haddad and Bouis, 1991). Child malnutrition can affect lifetime earnings because of stunting, consequent poor health, and the impact on human capital development.

Poor households have a number of coping mechanisms to cushion the impact from shocks due to agricultural shortfalls and market shortages or other uncertainties (Von Braun, et. al., 1992). The household, extended family, and community can provide a safety net. The stages of household coping involve first, risk management and loss prevention and then, loss containment and disposal of assets. Under extreme conditions such as famine, the household may collapse (Von Braun, 1992; and Webb, Von Braun and Yohannes, 1992). Finally, food subsidies are a topic which although important can not be covered here, but Pinstrup-Andersen (1988) provides an excellent review.

THE WORLD'S POOR

Most of the food insecure are the world's poor. The World Bank has calculated that 1.2 billion persons live on $1.00/day or less. The calculations are based on country level average per capita income figures and use the Bank's Atlas method to convert national currencies to U.S. dollars. There are two basic problems. Purchasing power parity (PPP) for currency exchange is preferable to the Atlas method. More crucially, the estimates do not account for the possible skewed distribution of income in countries. Work at Minnesota and the Economic Research Service of the U.S. Department of Agriculture seeks to remedy these problems (Gopinath, Roe and Shane, 1997).

In this research an income distribution profile is derived for each country in the world for which data are available by fitting a gamma distribution to the country's distribution data. For countries in which such data are unavailable, these results are used to estimate the parameters of the distribution based on each country's characteristics. This is done so that the estimated distribution exactly yields the country's observed average per capita income. A gamma distribution has two parameters and, therefore, can better approximate the underlying income distribution. The estimates are shown in Table 3 for major regions and the world.

Given the World Bank's work on poverty and that of others, a reasonable definition of the world's poor might be those living on $2.00/day or less. Some one billion people are in this category, representing 19% of the world's population. This figure agrees quite well with the widely used number of approximately 800 million hungry people in the world (Bread for the World, 1994). The estimated poor using the improved income distributions and two purchasing power dollars/day or less is also quite close to the World Bank figure of 1.2 billion which used one Atlas dollar/day or less. Of the world's one billion poor, 10% live in Latin America and the Caribbean, 24% in Sub-Saharan Africa, 41% in South Asia, 2% in the Middle East and North Africa, 17% in China and Korea, less than 1% in Eastern Europe, 4% in the Former Soviet Union, and 1% in the OECD countries. As you read down each column, the figures are cumulative.

Additional calculations were made of the amount of income realized by persons living at each level of income per day by region and for the world. The key point is that the one billion poor receive only 1.3% of the world's total income, $397 million of the world's $30.47 trillion total per year. The implication is that a very small transfer in relation to world income could have a very large impact on the incomes and welfare of the world's poor and food insecure.

SPECIAL FOOD DRAWING RIGHTS

Large food price increases can have a devastating impact on the world's one billion poor, putting them at greater nutritional risk. They typically spend 70% or more of their income on food, hence there is a large real income effect on people already at the subsistence level. Their existing inadequate diets can deteriorate even further with subsequent increases in morbidity and mortality and declines in human capital.

Real food prices have declined over the last several decades. Evidence seems to be growing, however, that the rate of increase in agricultural production may be slowing. Future increases in demand, assuming a 1.7% per year growth in world population and a 1.2% annual growth in world GNP per capita, are likely to cause real prices to rise slightly, but not of a magnitude to cause a food crisis. The upward pressure on prices would be greater if world population grows more rapidly than assumed or populous countries, such as China and India experience faster economic growth (Roe and Gopinath, 1996; and Gopinath, Roe and Shane, 1997).

However, it is the variance of world supplies and stocks that lead to price spikes which can have a devastating impact on the world's one billion poor. Even during the previous era of declining real food prices, the variability of prices, as measured by the coefficient of variation, increased (Gopinath, Roe and Shane, 1997). There are reasons to believe that with greater variations in yields and smaller stocks due to less government intervention, price variability may be greater in the future. The world needs to devise a way to protect the one billion poor from the kind of transitory shock to world markets and prices that occurred in the early 1970s, and somewhat in 1995-96. As shown in the previous section, the size of the necessary transfer in relation to world income is relatively small.

One possibility is to establish a special food drawing right fund akin to the exchange rate drawing rights managed by the International Monetary Fund, which countries can use to protect their currencies. When there was a spike in world food prices, low-income countries could use the food drawing rights to make purchases on world commodity markets as needed to protect their poor and sustain their food consumption through the transitory shock. The drawing rights fund would be managed by an international agency and the conditions of withdrawal and repayment after the shock would be established.

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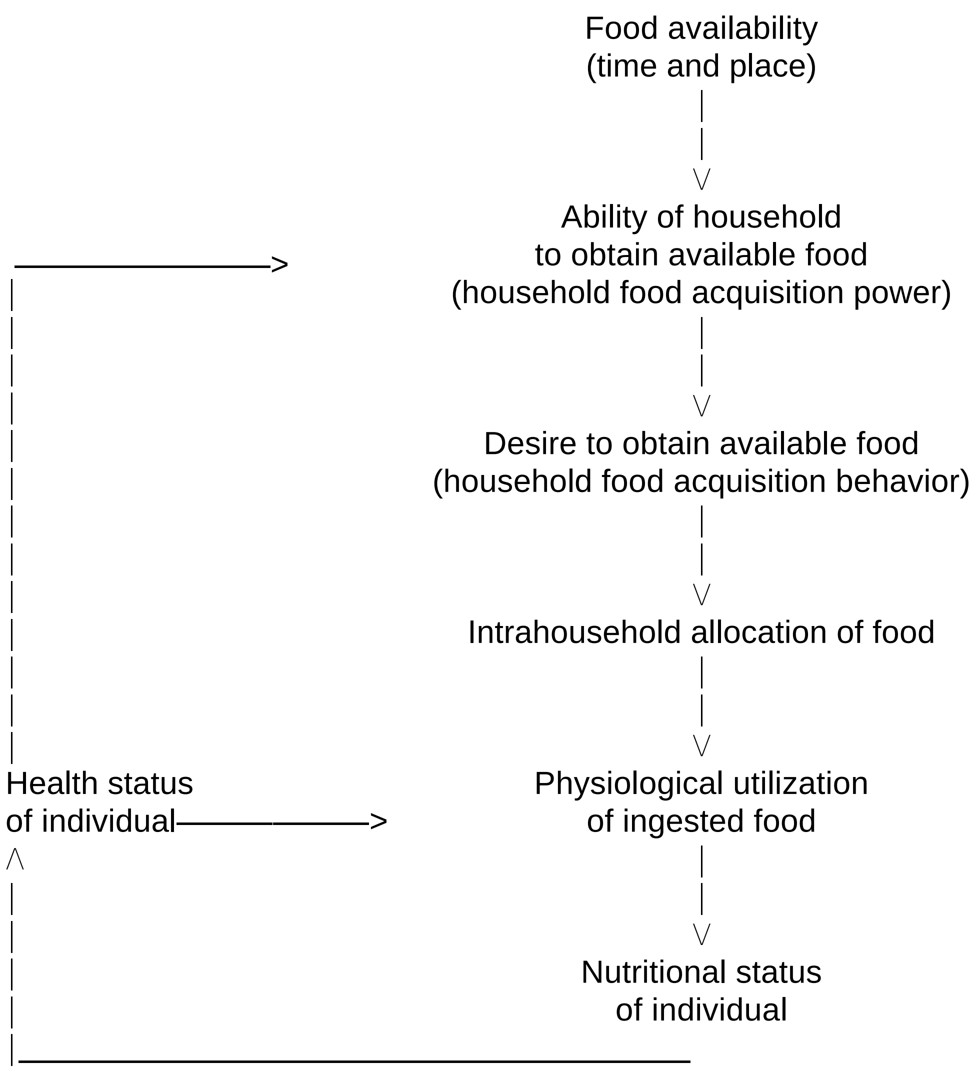
Figure 1. Factors Affecting Household Food Security and Individual Nutritional Status



Source: Per Pinstrup-Andersen, 1981.

Table 1. Relation between household indicators and individual calorie adequacy (percentages)

	A. Percent of Household Members (Ages 2-60) with Individual Calorie Adequacy Greater than[a]:				
	70	75	80	85	90
If household calorie adequacy was less than:[b]					
70	29.9	22.4	16.3	11.5	8.3
	(18.2)	(12.2)	(8.0)	(5.1)	(3.6)
75	...	26.3	19.8	14.7	10.9
	...	(14.5)	(9.9)	(6.7)	(4.7)
80	...	...	22.8	17.2	12.9
	...	...	(11.3)	(7.9)	(5.5)
85	...	...	...	19.0	14.7
	...	...	...	(9.2)	(6.5)

	B. Percent of Household Members (Ages 2-60) with Individual Calorie Adequacy Less Than:				
	65	70	75	80	85
If household calorie adequacy was greater than:					
70	26.2	32.9	...	...	...
	(37.5)	(48.9)	...	...	...
75	19.3	26.2	32.1	...	...
	(29.1)	(40.3)	(49.9)	...	...
80	14.8	21.6	27.7	35.5	...
	(22.6)	(32.8)	(41.6)	(52.4)	...
85	11.4	18.6	24.8	31.9	38.7
	(18.0)	(29.1)	(38.4)	(49.5)	(61.3)

[a]The first row relates to unadjusted calorie adequacy and the second row (with the figures in parentheses) to calorie adequacy adjusted for activity level as discussed earlier.

[b]Household calorie adequacy is not adjusted for activity level.

Source: Senauer and Garcia, 1996.

Table 2. The relation between household indicators and individual calorie adequacy by age and gender

Age (years)	Female	Male
A. If household calorie adequacy was less than 75 percent, percent of household members (by age and gender) with individual calorie adequacy greater than 85 percent[a]:		
2-6	8.3 (12.4)	9.9 (11.1)
7-15	6.9 (6.1)	7.3 (7.7)
16-60	22.5 (3.9)	22.7 (2.2)
B. If household calorie adequacy was greater than 85 percent, percent of household members (by age and gender) with individual calorie adequacy less than 75 percent[a]:		
2-6	37.8 (21.6)	35.6 (33.9)
7-15	40.0 (40.0)	21.1 (21.1)
16-60	18.1 (48.2)	11.3 (47.9)

[a]The first row relates to unadjusted calorie adequacy and the second row (with figures in parentheses) to calorie adequacy adjusted for activity level.

Source: Senauer and Garcia, 1996.

Table 3. Population Living on X Dollars per Day or Less (in millions of people)

$/Day in PPP	Latin Am. & Carrib.	Sub-Sah. Africa	South Asia	Mid East & N. Africa	China, Korea, Hong Kong	East Europe	Former Sov. U	OECD	World
0.5	46.482	68.101	44.954	5.999	21.606	0.371	10.856	3.545	201.914
1	69.000	139.363	145.359	11.884	63.931	0.826	20.525	6.677	457.564
2	103.356	244.169	414.431	24.794	176.811	2.027	40.524	12.682	1,018.794
4	154.460	345.457	911.592	52.835	427.853	6.560	84.793	24.676	2,008.225
8	225.052	418.914	1,381.424	105.445	820.125	26.136	166.385	51.035	3,194.516
16	308.993	453.439	1,584.190	171.941	1,137.437	72.287	244.538	117.800	4,090.624
32	386.899	465.397	1,642.307	213.162	1,223.536	102.684	280.298	289.713	4,603.996
64	435.846	470.177	1,657.488	225.659	1,237.061	107.472	291.877	596.391	5,021.971
128	451.526	471.414	1,661.675	229.165	1,242.842	107.6001	293.088	829.732	5,287.042
256	453.078	471.500	1,662.174	229.892	1,243.866	07.600	293.100	877.254	5,338.464
512	453.100	471.500	1,662.200	229.997	1,243.900	107.600	293.100	878.699	5,340.095
1024	453.100	471.500	1,662.200	230.000	1,243.900	107.600	293.100	878.700	5,340.100

Source: Gopinath, Roe and Shane, 1997.