Food Security in Brazil: Can "Lula" Keep his Promise?

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Abstract

Brazil, a country with a population of more than 170 million, has embarked on a path to eradicate hunger and poverty. President Luiz Inácio Lula da Silva (commonly known as "Lula") declared as his goal to cut the number of hungry people to zero during his presidency. Poverty and hunger afflict a large proportion of the population in part because of highly skewed income distribution. The poorest income quintile (20 percent of the population) owned 2.2 percent of the national income while the richest quintile owned about two-thirds in 1998.

Using USDA/ERS food security models, we measure food availability and access, calculate the number of hungry people, and estimate income growth required to eradicate food insecurity.

According to the ERS food security assessment (FSA) model, between 20 and 40 percent of Brazil's population—roughly 50 million people—do not have sufficient incomes to purchase the amount of food necessary to fulfill nutritional requirements. However, by 2007, increases in food production and GDP are projected to raise food availability by 13 percent. This will help decrease the share of hungry people to between 15 and 20 percent of the population.

Basic nutritional adequacy is considered in another method used by ERS to estimate food security. This approach employs a food purchasing power threshold (FPPT) to account for prices of food items and balanced coverage of main food groups. This approach measures food insecurity by calculating the cost of a healthy food basket and the cost of other basic necessities. This FPPT can then be compared to income. Food security results from this approach are similar to those from the FSA model.

Both models indicate that income growth required to raise consumption in the vulnerable income groups and eradicate hunger far surpass historical growth rates. Therefore, targeted government programs seem to be a promising but costly option to meet the zero-hunger goal. Lula's program is a mix of cash transfers and investment (e.g., education). While the link between improvements in education and poverty reduction is clear, the road to success is likely to take more than the 4 years envisioned by President Lula.

Introduction

Brazil, a South American country with a population of more than 170 million, has embarked on a path to eradicate hunger and poverty. Since Luiz Inácio Lula da Silva became president in January 2003, one of the government's flagship policies has been the Zero Fome (Zero Hunger) program. President "Lula," as he is commonly known in the country announced in his inaugural speech that one of his foremost goals was to cut the number of hungry people to zero during his presidency. The Zero Fome program comprises more than 50 initiatives, a combination of cash handouts and investment in local development programs. The program has been funded at roughly $1.5 billion over a four-year period. Can "Lula" achieve his goal?

Brazil is a lower-middle income country with a per capita gross national income of $3,344 in 2000. Poverty and hunger afflict a large proportion of the population in part because this income is distributed very unevenly. Brazil's income distribution as measured by the Gini coefficient has remained at about 60 for the last 2 decades.[1] The poorest quintile owned 2.2 percent of the national income while the richest quintile owned more than 64 percent in 1998.[2]

The issue of food security is at the center of policy concerns of developing countries and the problem becomes politically more sensitive when incomes are highly skewed. Food security is defined as access to food by all people at all times to lead an active, healthy life. In this article, Brazil's food security situation is assessed at the country level and among income groups within the country in order to take into account both physical access (food availability) and economic access to food. With the help of the USDA-ERS Food Security Assessment (FSA) model, food availability and access is evaluated based on food production and imports trends. Also, an attempt is made to show the distribution and depth of food insecurity by estimating consumption levels relative to nutritional requirements by income group. The number of hungry people is calculated by identifying those income groups whose consumption falls short of nutritional requirements. A projection is made for 2007, the year President Lula hopes to have eliminated hunger. After identifying the food insecure income groups within the country (i.e., the

[1] The data seem to indicate at first glance that income distribution was unchanged but Ferreira and Paes de Barros found on closer examination that while some groups appeared to have escaped poverty during the 80s and early 90s, there was a substantial increase in extreme urban poverty. Ferreira and de Barros, 2000.
[2] These data on income distribution are taken from the World Bank Indicators 2002 based on a 1998 survey.

proportion of people that cannot consume nutritionally adequate diets), we attempted to estimate the income growth required to eradicate food insecurity.

The general notion of food availability and access focuses on quantity rather than quality of food. In order to capture a quality-aspect of nutritional adequacy—the need for a balanced diet that covers basic food groups—we use the concept of a healthy food basket. Food security can only be achieved if all households can purchase a sufficient amount of basic healthy food items. Furthermore, it is recognized that other basic necessities (shelter, education, health, etc.) besides food are required to maintain a basic standard of living. In most countries the low-income group spends most of their income on food and very little income is allocated for other essential expenditures. The food purchasing power threshold (FPPT) includes the cost of a healthy food basket plus other essential living expenses. The FPPT approach allows the estimation of the cost of eradicating hunger, and it highlights the impact of food prices on food security.

The next section will describe the FSA model with a focus on income distribution and its impact on food security. The findings for Brazil will be reviewed. In addition, the FPPT approach will be discussed and estimates of the cost of eliminating hunger and income growth necessary for the low income groups to be able to escape food insecurity will be presented.

The Food Security Assessment Model

The Food Security Assessment (FSA) model used for this analysis was developed at ERS for use in estimating food consumption and access in 70 low-income countries for a 10-year projection period[3]. The reference to food includes grains, root crops, and a category called "other," which includes all other commodities consumed, thus covering 100 percent of the diet. All of these commodities are expressed in grain equivalent.

The simulation framework used for estimating and projecting aggregate food availability is based on a partial equilibrium recursive model. The model is synthetic, meaning that the parameters that are used are either cross-country estimates or are estimated by other studies.

[3] For more information on ERS food security assessments see Shapouri, S. and Stacey Rosen, *Food Security Assessment*, various years.

The food security situation is evaluated by estimating and projecting the difference between food consumption (domestic production plus imports minus non-food use) and FAO-recommended nutritional requirements (the nutrition target), 2,200 calories per capita per day.[4] The estimated nutritional gaps only measure the gap in calorie consumption and do not consider other factors, such as poor utilization of food due to inadequate consumption of micronutrients or the lack of health and sanitary facilities. The nutrition-based target assists in comparisons of relative well-being across countries or over time.

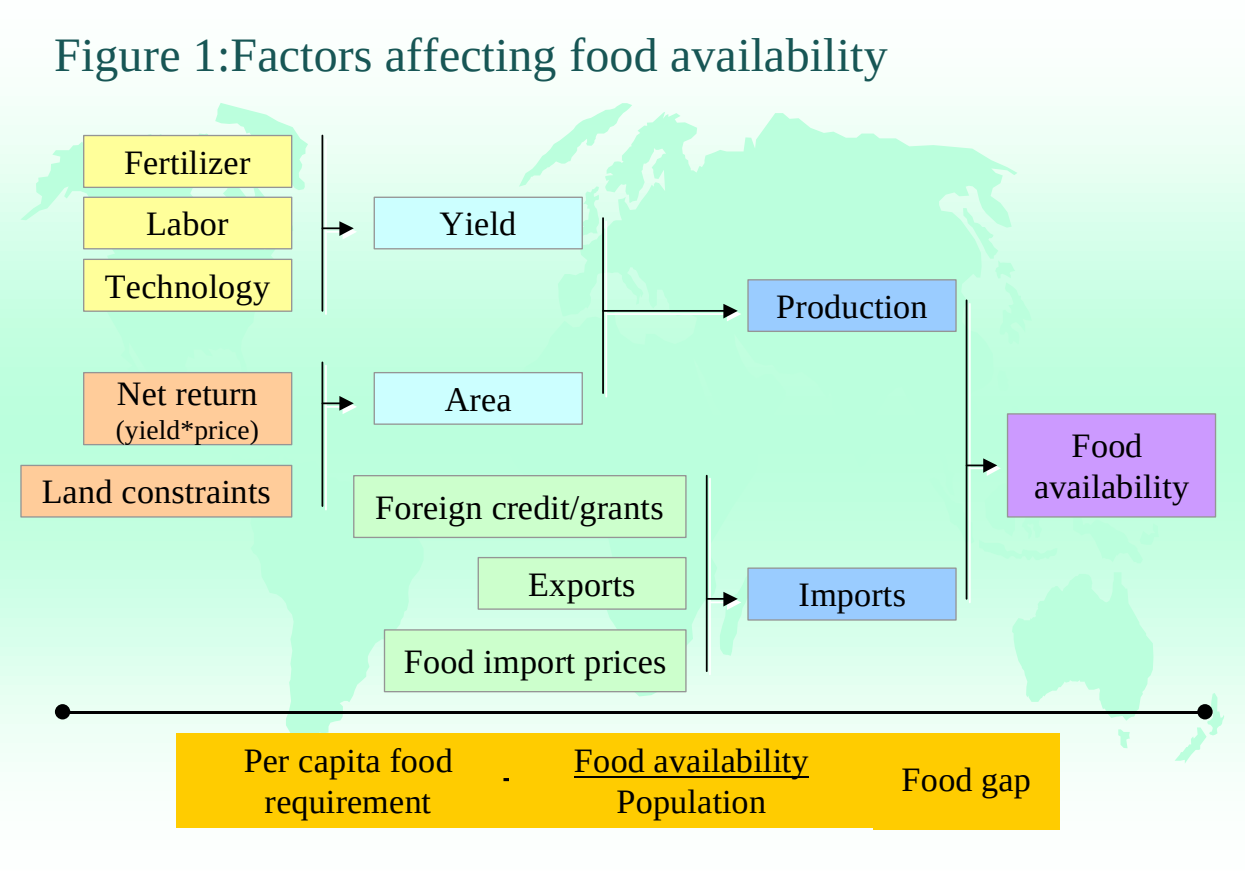
Factors Affecting Food Security

Food availability is the sum of domestically produced food and net imports. Domestic production is a function of area and yields, and imports are affected by commodity prices and export earnings (see fig.1). The sufficiency of average food availability depends on the number of consumers. Individual households' access to food depends on their purchasing power, which is a function of income and income distribution as well as of prices of food and other living expenses (see fig.2).

Food availability

Grains account for one-third of Brazil's diet. Brazil's grain production growth in the 1990s was entirely generated by higher yields as area stagnated or even declined. This increase in yields was in part due to continued adaptation of domestic corn varieties to tropical conditions and more widespread corn-soybean rotation, which improved weed and disease control and nitrogen fixation[5]. In addition, after a decade of slow growth, fertilizer use grew 8 percent per year during the 1990s. Yields of corn are equal to the Latin American and Caribbean average, which is about 30 percent below the world average (close to 3 tons per hectare compared to more than 4 tons for the world average). The model results project a grain production growth rate of 2.1 percent per

[4] The recommendation is based on the average per capita energy requirement for Latin America and the Caribbean as presented in The Sixth World Food Survey, FAO, 1996, p.53.
[5] Agriculture in Brazil and Argentina, Development and Prospects for Major Field Crops, USDA-ERS, WRS-01-3, 2001.



year during the next 5 years, on average. This is slightly higher than growth achieved during the 1990s. Root and tuber production is relatively small compared to grain production, in grain equivalent about 12 percent of the total grain and root supplies.

Imports are financed by export earnings. Brazil's main export products are soybeans and products, coffee, meats and products, frozen concentrated orange juice, sugar and products, and tobacco. Exports totaled $10.5 billion in 1999[6]. Exports have grown 6 percent per year over the last 2 decades. Despite a recent slow-down in growth, exports are projected to resume the historical growth path by 2005. Brazil's agricultural imports comprise a much smaller share of trade than agricultural exports. Among the main food imports are wheat, for which domestic growing conditions are rather poor, and corn which is mainly used for feed in the rapidly expanding poultry sector. Grain import dependency averaged 16 percent in the 1990s.

[6] Brazil briefing room, http://www.ers.usda.gov/Briefing/Brazil/.

Brazil's participation in MERCOSUR, a customs union comprised of Argentina, Brazil, Uruguay and Paraguay, with Chile and Bolivia being associate members, has helped considerably to promote trade within the region. GDP growth can partly be attributed to the growth effects resulting from this trade agreement.

On a national level, food availability in Brazil is more than sufficient for its entire population. Domestic production of food, plus imports, minus exports result in per capita food availability of more than 340 kg per capita per year, about one-third more than per capita nutritional requirements in grain equivalent. Based on the FSA model and assumptions about price trends, yield growth, area expansion, and export earnings, we project average per capita food availability to increase 13 percent by 2007.

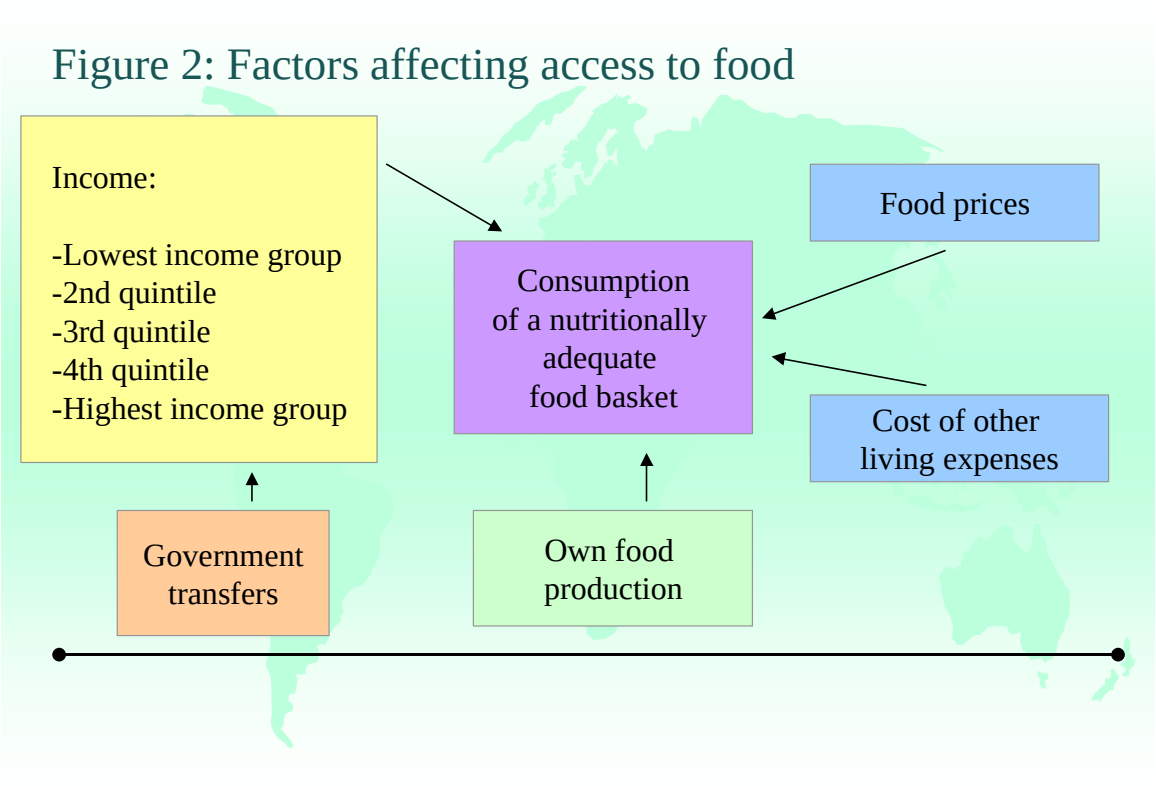
Access to food

National-level estimates represent average food availability and mask the impact of unequal incomes on food security. In order to capture differences in access to food, we estimate food consumption at the disaggregate level, by income group. Food consumption for each income group is compared to the nutritional target which allows for estimating the number of people who live in hunger, i.e. who are unable to purchase sufficient food to fulfill nutritional requirements and are, therefore, nutritionally vulnerable. The shortfall between estimated consumption and the nutritional target highlights the intensity of food insecurity.

Initially, Brazil's population was divided into five equal income groups or quintiles. The lowest income group was further disaggregated so that the lowest 5, 10, and 15 percent of the population could be examined. Given the large population of Brazil, even 10 percent of the population constitutes a large absolute number of people—more than 17 million in 2002.

Insufficient purchasing power—a function of income and prices—is the most important cause of *chronic* undernutrition among developing countries. We use an indirect method of projecting calorie consumption by different income groups based on income distribution data[7]. The

[7] The method is similar to that used by Shlomo Reutlinger and Marcelo Selowsky in "Malnutrition and Poverty," World Bank, 1978.

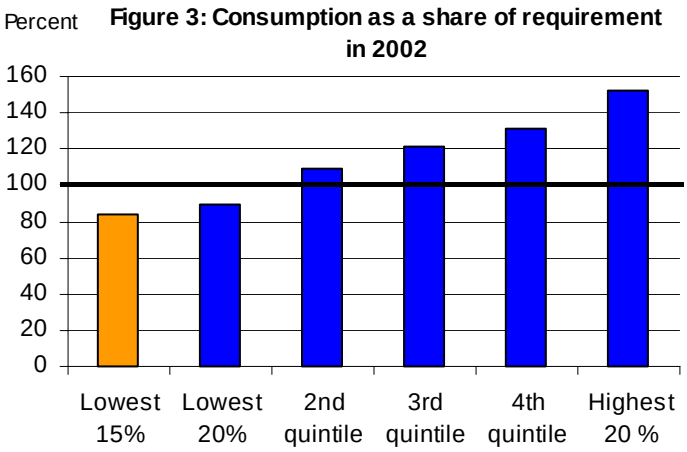


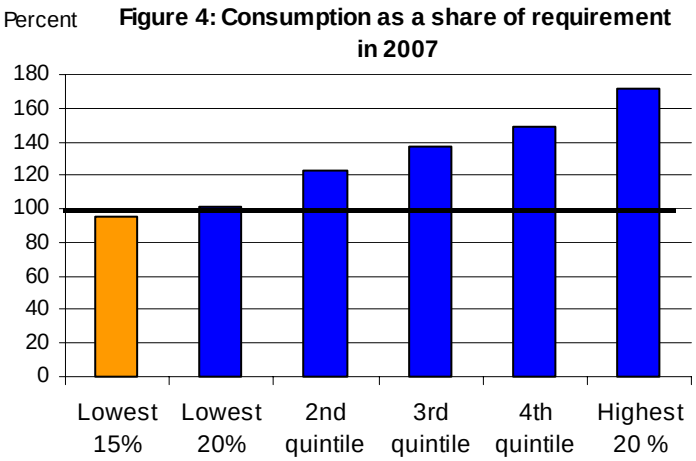
procedure uses the concept of the income/consumption relationship and allocates the total projected amount of available food among different income groups (see Appendix 1 for a more detailed discussion of the methodology.)

As mentioned earlier, Brazil has a highly skewed income distribution, even for Latin American standards where income is more unequally distributed than in most other parts of the world. The lowest 10 percent of the population hold less than 1 percent of the country's income. Conversely, the highest 20 percent hold nearly two-thirds of the country's income. This skewed distribution of income translates into a skewed distribution of food. According to the model results, the ratio of consumption to nutritional requirements for the poorest 10 percent of the Brazilian population was estimated at 79 percent (i.e., the population in the poorest 10 percent group were estimated to be consuming only 79 percent of the nutritional requirement) in 2002. The consumption/requirement ratio was estimated at 89 percent for the poorest 20 percent quintile. The second poorest quintile was estimated to have access to 110 percent of requirements—meaning that consumption was 10 percent higher than requirements in this quintile, on average. These results imply that between 20 and 40 of the population (i.e., about 50 million people) in Brazil do not have sufficient incomes to purchase the amount of food that fulfills their nutritional requirements. However, by 2007, food production increases and GDP growth are projected to increase national food availability by 13 percent. This will help decrease

the share of hungry people to between 15 and 20 percent of the population. (2007 fig on consumption by income quintile here).

A question arises as to how much income growth would be needed for the poorest income groups to fulfill requirements within five years. According to our estimates, incomes of the poorest 10 percent would have to grow 4 percent per year, more than double the historical income growth of 1.8 percent. Incomes of the poorest 15 percent would have to grow nearly 3 percent per year. On the other end of the spectrum, the highest income quintile is estimated to consume 52 percent more than nutritional requirements.





The current number of hungry people—50 million—equals that of official Brazilian estimates. It should be noted that the rough estimates of hungry people do not account for the fact that poor people may be able to feed themselves or supplement their diets with the help of subsistence farming or garden plots not considered in "income". There is no doubt that such food production, especially in rural areas, helps the poorest to survive. Furthermore, there are economists who believe that the link between consumption and income is weak. Health reports on infant weight suggest that only 12 million or 7 percent of the Brazilian population are malnourished.[8]

[8] The Economist, A survey of Brazil, February 22, 2003.

Allowing for Nutritional Adequacy

While the FSA model allows for estimates of food availability by income group and the income growth required to eliminate food insecurity, it does not include two key factors: 1) prices of food items and 2) the quality-aspect of nutritional adequacy. We estimated the Food Purchasing Power Threshold (FPPT) in order to account for both of these factors, as well as the fact that household expenditures must be allocated between spending on food and on other essential living expenses, such as housing, fuel, and education.

The cost of a food basket can furthermore reflect seasonal and local differences provided that appropriate price data are available[9]. In this article we simplify the approach by using national average income data and an average of Sao Paulo and Rio de Janeiro food retail prices[10]. Provided data were available, the ideal would be to replicate the analysis for several poverty-prone regions based on local income and price data. The FPPT approach to monitoring food insecurity has the flexibility to target vulnerable regions and populations on a timely basis.

The Food Purchasing Power Threshold Approach

The FPPT approach measures food insecurity by calculating the cost of a food basket and the cost of other basic necessities. This FPPT can then be compared to available income. Inadequate purchasing power is generally viewed as the main cause of food insecurity. The cost of a basket of food relative to income is a practical indicator of food security. Any decline in food costs and/or increase in income are expected to improve food security of a household. This approach also allows an estimation of the number of people who lack the purchasing power to satisfy their basic needs. With the evaluation of the size of the gap between per capita income and the FPPT, it is possible to more clearly determine the depth of poverty and hunger. Monitoring the changes in food costs relative to the purchasing power of consumers can also provide information on the effectiveness of government food security policies, the efficiency of marketing systems, and the investment required to adequately address the problems of food insecurity.

[9] A food basket approach formed the basis of official Brazilian household surveys. Different poverty lines derived from the cost of a food basket reflecting local eating habits and prices were constructed by Rocha (1993). A description of the areas covered is found in Ferreira and Litchfield, 2001.

To estimate the purchase price of the food basket, we distributed 2,200 calories among specific food and nutrient groups according to several criteria. These criteria included typical country food consumption patterns, FAO/World Health Organization nutritional guidelines for developing countries, and standards from various U.S. government agencies[11]. The goal was to have roughly 65 percent of daily calories coming from carbohydrates, 20 percent from fat, and 15 percent from protein.

Brazil's average per capita calorie consumption has grown steadily over the last three decades at an annual rate of 0.7 percent; it reached 2,985 in 2000[12]. Grains account for the largest share of the diet, about one-third, and wheat and rice are the most popular cereals.[13] Meat consumption accounts for 11 percent of the diet and sugar consumption 19 percent. The grains included in the healthy food basket are rice, wheat, and corn; fat is represented by cooking oil and protein consumption is ensured by including meat—mostly beef and poultry—and milk.[14]

It is unreasonable to assume that even the poorest people will spend their entire income on food. High-income countries spend a relatively small percentage of their income on food. In the United States, for example, the percentage of household expenditures spent on food is roughly 8 percent. High-income countries typically spend a large share of their incomes on items that are not considered necessities, such as recreation, etc. The poorer a country, the higher the share of income spent on food. However, we must still allow for expenditures on other necessities, such as housing and clothing. The share of food spending can vary considerably, depending on income level and whether the household is in a rural or urban area. EUROSTAT reports that Brazil's share of total consumer expenditure spent on food was 17.6 percent in 2000. This is a national average and it is safe to assume that the low-income groups spend a considerably higher

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[10] The prices are taken from Statistics on Occupational Wages and Hours of Work and on Food Prices, ILO, Geneva, 2001.

[11] The standard for the percentage of calories from carbohydrates was recommended by the National Research Council's *Diet and Health Report*, 1989; the recommendation for the percentage of calories coming from fat (less than 30 percent) comes from *Nutrition and Your Health: Dietary Guidelines for Americans*, U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2000.

[12] FAOSTAT, April 2003.

[13] Cassava consumption is about 5 percent of the total. It was not included in the "healthy food basket" for lack of comparable price data.

[14] Retail prices were available for Sao Paulo and Rio de Janeiro. After calculating the food basket cost for both cities, the average was used for the simplified estimation employed in this paper.

share of their total consumption expenditure on food. In this study, we assume two different scenarios: 1) the food cost share is equal to expenditures on other essential items, i.e. 50 percent each (this assumption is supported by data from the UN's 1996 International Comparison Project)[15] and 2) food spending is 30 percent and other spending is 70 percent of consumption expenditures. These two scenarios are intended to offer a range of results.

Once we have determined the FPPT, we can compare it with available per capita income. The FPPT was compared to income levels in each of Brazil's income groups. Group income levels were calculated based on World Bank data on average 2000 per capita GNI and most recently available income distribution data.

The ratio of available income to the FPPT is a meaningful indicator of the intensity of food insecurity. A ratio greater than 1 indicates that income levels exceed the FPPT and, therefore, people in that particular quintile, on average, are not vulnerable to food insecurity. Any number less than 1 indicates some degree of vulnerability to food insecurity for populations in that income group. The lower the number, the more severe the problem.

The annual cost of the healthy food basket in 2000 was $235, which brings the FPPT to $470 under the assumption that food spending is 50 percent of total consumption expenditures. The FPPT is $780, when assuming that "other" spending is 70 percent of consumption expenditures (see fig. 5). Comparing these amounts to per capita income by income group shows that in both scenarios, between 20 and 40 percent of the population are estimated to be unable to purchase a nutritionally adequate food basket—a result closely matching that of the FSA model. However, the ratios of income to FPPT are much lower than the consumption/requirement ratios obtained with the FSA model. Under the 50-50 scenario, the ratio of income to FPPT is estimated at 50 percent for the poorest 10 percent income group; this ratio is estimated at 62 percent for the poorest 15 percent, and at 79 percent for the lowest 20 percent of the population. Under the 30-70 scenario, the ratios of income to FPPT are even lower—ranging from 30 percent to 47 percent for the same income groups (see fig. 6).

[15] ERS calculations based on UN data for the share of personal consumption expenditures spent on food also support this finding. See as an example table 101 in Putnam, J. and J.E. Allshouse, 1999.

Figure 6: Ratio of income to Food Purchasing Power Threshold (FPPT)

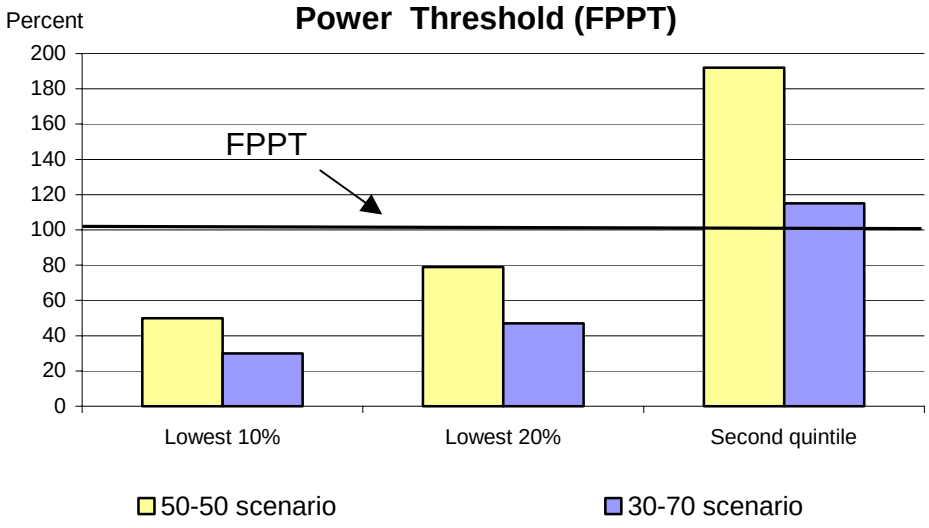
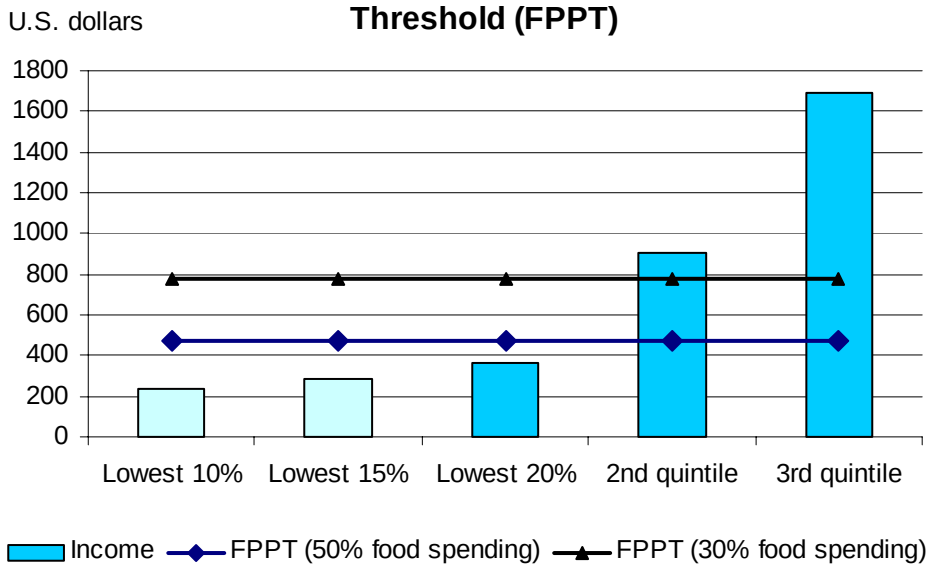


Figure 5: Income versus Food Purchasing Power Threshold (FPPT)



Given that President Lula's goal is to eliminate hunger within 4 years, we wanted to measure the income growth required to achieve this goal. Under the 50-50 scenario, incomes for the poorest 10 percent of the population would have to grow at an annual rate of close to 20 percent. For the poorest 20 percent, annual growth would have to be around 6 percent—more than 3 times the historical growth. Under the 30-70 scenario, incomes would have to increase by 35 percent for the poorest 10 percent of the population, and 20 percent for the poorest 20 percent of the population. This level of persistent income growth is highly unlikely. Targeted government programs seem to be a more promising option in meeting the zero-hunger goal.

Therefore, the question arises as to the cost of supplementing income in order for the entire population to reach the food purchasing power threshold. The poorest 20 percent of the population had an average per capita income of $368, or $102 short of the lower FPPT. Multiplying this $102 by the number of people affected yields a cost of $3.5 billion for just one year. This is more than twice the entire budget of President Lula's Zero Hunger program. This means that the same expenditure would be required in subsequent years because these cash transfers lack the long-term benefits that come with investment programs. Lula's program is a mix of these transfers—which come with their own set of difficulties in targeting and misuse—and investment, for example in education. The link between improvements in education and poverty reduction is well known[16], but the road to success is likely to take more than the 4 years envisioned by President Lula.

As mentioned earlier, the FPPT approach is based on household income and food retail prices. While real international food prices have declined for years, food security cannot improve if domestic prices do not decline accordingly. Ferreira and Litchfield (2001) highlight five channels through which higher inflation can lead to increases in income inequality as described by Neri (1995)[17]. Macroeconomic stability, which is ultimately reflected in low inflation and stable prices, is crucial for eradicating hunger.

Concluding comments

Brazil, a country with a population of more than 170 million, has embarked on a path to eradicate hunger and poverty. The recent policy goal is to cut the number of hungry people to zero in the next 4 years. Poverty and hunger afflict a large proportion of the population in part because of highly skewed income distribution. The poorest income quintile (20 percent of the population) owned 2.2 percent of the national income while the richest quintile owned about two-thirds in 1998.

[16] In the foreword of the World Development Report 2000/2001, Attacking Poverty, James Wolfensohn, president of the World Bank, sums up the report's recommendation of action in three areas, the first of which is "Promoting opportunities: Expanding economic opportunity for poor people by stimulating overall growth and by building up their assets (such as land and education)(…..)".

[17] These five channels can be summed up as: 1) economies of scale, 2) barriers to entry, 3) higher skill labor markets are usually tighter and better at preserving salaries, 4) less portfolio reallocation opportunities from cash to consumption goods for poor households with high share of food spending, 5) less storage opportunities for poor households.

According to our results (based on the FSA model), between 20 and 40 percent of Brazil's population—roughly 50 million people—do not have sufficient incomes to purchase the amount of food necessary to fulfill nutritional requirements. However, by 2007, increases in food production and GDP projected to raise food availability by 13 percent. This will help decrease the share of hungry people to between 15 and 20 percent of the population or 4 to 5 percent annually. The FPPT approach, which covers basic nutritional adequacy shows results that are similar to those from the FSA model indicating that the number of vulnerable people will remain above 35 million people.

In sum, without policies that target the food insecure portion of the population, we project poverty to decrease, but remain significant through 2007. Cash transfers are valuable in alleviating immediate hardship, but it is investment in education and other long-term strategies that have proven successful in reducing or eliminating poverty and food insecurity.

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Appendix 1--Methodology

Projections of Food Availability:

The model includes three commodity groups, grains, root crops, and "other." The production side of the grain and root crops are divided into yield and area response. Crop area is a function of 1-year lag return (real price times yield), while yield responds to input use. Commercial imports are assumed to be a function of domestic price, world commodity price, and foreign exchange availability. Foreign exchange availability is a key determinant of commercial food imports and is the sum of the value of export earnings and net flow of credit. Foreign exchange availability is assumed to be equal to foreign exchange use, meaning that foreign exchange reserve is assumed constant during the projection period. Brazil is assumed to be a price taker in the international market, meaning that world prices are exogenous in the model. However, producer prices are linked to the international market. The projections of consumption for the "other" commodities are simply based on a trend that follows the projected growth in supply of the food crops (grains plus root crops). (see Appendix 1 for a more detailed Methodology).

For the grains and root crops (*c*) commodity group, food consumption (*FC*) is defined as domestic supply (*DS*) minus nonfood use (*NF*). *n* is country index and *t* is time index.

$$FC_{cnt} = DS_{cnt} - NF_{cnt} \qquad (1)$$

Nonfood use is the sum of seed use (*SD)*, feed use (*FD*), exports *(EX)*, and other uses (OU).

$$NF_{cnt} = SD_{cnt} + FD_{cnt} + EX_{cnt} + OU_{cnt} \qquad (2)$$

Domestic supply of a commodity group is the sum of domestic production (*PR*) plus commercial imports (*CI*) and changes in stocks (*CSTK*).

$$DS_{cnt} = PR_{cnt} + CI_{cnt} + CSTK_{cnt} \qquad (3)$$

Production is generally determined by the area and yield response functions:

$$PR_{cnt} = AR_{cnt} * YL_{cnt} \qquad (4)$$
$$YL_{cnt} = f(LB_{cnt}, FR_{cn,,} K_{cnt}, T_{cnt}) \qquad (5)$$
$$RPY_{cnt} = YL_{cnt} * DP_{cnt} \qquad (6)$$
$$RNPY_{cnt} = NYL_{cnt} * NDP_{cnt} \qquad (7)$$
$$AR_{cnt} = f(AR_{cnt-1}, RPY_{cnt-1}, RNPY_{cnt-1,} Z_{cnt}) \qquad (8)$$

where *AR* is area, *YL* is yield, *LB* is rural labor, *FR* is fertilizer use, *K* is the indicator of capital use, *T* is the indicator of technology change, *DP* is real domestic price, *RPY* is yield times real price, *NDP* is real domestic substitute price, *NYL* is yield of substitute commodity, *RNPY* is yield of substitute commodity times substitute price, and *Z* is exogenous policies.

The commercial import demand function is defined as:

$$CI_{cnt} = f(WPR_{ct}, NWPR_{ct}, FEX_{nt}, PR_{cnt}, M_{nt}) \qquad (9)$$

where *WPR* is real world food price, *NWPR* is real world substitute price, *FEX* is real foreign exchange availability, and *M* is import restriction policies.

The real domestic price is defined as:

$$DP_{cnt} = f\,(DP_{cnt-1}, DS_{cnt}, NDS_{cnt}, GD_{nt}, EXR_{nt}) \qquad (10)$$

where *NDS* is supply of substitute commodity, *GD* is real income, and *EXR* is real exchange rate.

Projections of food consumption by income group--

Assuming a declining consumption and income relationship (semi log functional form):

$$C = a + b \ln Y \qquad (11)$$
$$C = C_o/P \qquad (12)$$
$$P = P_1 + \ldots\ldots + P_i \qquad (13)$$
$$Y = Y_o/P \qquad (14)$$
$$i = 1 \text{ to } 5$$

where *C* and *Y* are known average per capita food consumption (all commodities in grain equivalent) and per capita income (all quintiles), C_o is total food consumption, *P* is the total population, *i* is income quintile, *a* is the intercept, *b* is the consumption income propensity, and *b/C* is consumption income elasticity (point estimate elasticity is calculated for individual countries). To estimate per capita consumption by income group, the parameter *b* was estimated based on cross-country (67 low-income countries) data for per capita calorie consumption and income. The parameter *a* is estimated for each country based on the known data for average per capita calorie consumption and per capita income.

Historical Data

Historical supply and use data for 1980-2001 for most variables are from the USDA database. Data for grain production in 2002 are based on a USDA database as of September 2002. Food aid data are from FAO, and financial data are from the International Monetary Fund and World Bank. Historical nonfood-use data, including seed, waste, processing use, and other use, are estimated from the FAO *Food Balance* series. The base year data used for projections are the average for 1999-2001, except export earnings that are 1998-2000.

Appendix 2--Methodology on food basket cost calculation

The food items in each food group were chosen according to their importance in the Brazilian diet as indicated by the 2000 FAO food balance sheet and the availability of retail food prices for the food item. Food prices were mostly taken from the U.N. International Labour Office (ILO)[18]. The number of calories consumed per day was used to determine the share of each food item within its group. The cost of each food item was determined using domestic retail food prices as stated by ILO, which were converted into U.S. dollars using International Monetary Fund (IMF) exchange rates. Next, the cost of each food group was calculated as the weighted average of the cost of individual food items (the weight being each food item's share as determined by calories consumed per day). This calculation resulted in a price per kg of carbohydrates, proteins, or fat.

This cost was multiplied with the number of grams eaten from each food group in order to satisfy nutritional guidelines. The daily target was 2,200 calories per capita, comprised of sixty-five percent (1,430 calories) carbohydrates, 15 percent (330 calories) protein, and 20 percent (440 calories) fat. In order to convert these calories into gram of food, the food items' respective conversion rates[19] were weighted according to the food items' share in the food group. The daily cost of the three food groups were aggregated and then multiplied by 365 to obtain the annual cost of the food basket.

[18] Statistics on Occupational Wages and Hours of Work and on Food Prices, October Inquiry results, 1999 and 2000, International Labour Office, Geneva, 2001.
[19] Conversion rates were used based on B.A.Schmitt,1979, Appendix B: Calorie Content for Selected Commodities.