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ANALYSIS OF TRENDS AND PROJECTIONS OF FOOD PRODUCTION AND CONSUMPTION IN BRAZIL AND NIGERIA

BY LEONARDO A. PAULINO
AND J. S. SARMA

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FOREWORD

IFPRI's food gap studies, which are aimed at defining the general magnitude, composition, and dynamics of the Third World food problem, have primarily used agricultural data furnished by the Food and Agriculture Organization of the United Nations (FAO). The analyses of past trends in food production, consumption, and trade of developing countries, and--on the basis of these trends--the projections of their future food output and demand, have been made using FAO's country-level estimates. The results of these studies are generally presented in terms of aggregates for groups of commodities and of developing countries. Part of the continuing activity in IFPRI's food gap research has been on methodology improvement, particularly toward better food projections for Third World countries. This includes studies of methods that would enable the presentation of food trends and projections for individual countries and specific commodities.

The study discussed in this report was one of several research activities that formed IFPRI's contribution to the UNDP-assisted project on food systems and policies in developing countries that was begun in 1984 in collaboration with the United Nations Research Institute for Social Development and the United Nations University. This was an early attempt at a more detailed examination of trends in food production and consumption of individual developing countries through the use of national-source statistics below the country level. These supplementary data enable the analysis of changes among geographical areas of a country and, possibly, independent projections of its future food production and demand. The available regional-level data for the study countries provided the opportunity to compare national commodity aggregates with corresponding FAO estimates. This allowed examination of the reliability of existing food data in developing countries--an area of major concern in food policy research and to policymakers in view of the implications of study results and decisions based on these data. In this report, regional data analysis is limited largely to crop production and area because of the dearth of national-source information on food consumption among regions in the study countries--a situation probably common to most developing countries. An interesting aspect of the study is the assessment of the available production statistics from national sources; the findings appear to justify concerns regarding the weakness of data systems in Third World countries, especially in Africa.

Most of the analysis presented here for Nigeria was drawn from the report prepared by Professor S. O. Adamu of the University of Ibadan, IFPRI's research collaborator in the study. Professor Adamu obtained

regional and state data on crop production and area and on livestock and poultry from Nigeria's Federal Office of Statistics. In the case of Brazil, the assistance of the Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) in the acquisition of regional statistics on food-crop output and area is gratefully acknowledged. EMBRAPA obtained these data from the Instituto Brasileiro de Geografia e Estatística.

John W. Mellor

1. SUMMARY

This study attempts a detailed analysis of food trends in Brazil and Nigeria by using data from the national systems of these countries to supplement food statistics available from international sources. It aims to use these trends to improve the assessments of the future food situation in Brazil and Nigeria that were made in an earlier food gap study by the International Food Policy Research Institute (IFPRI) and to examine the policy implications of the observed trends and food projections. The examination of trends in the study countries and the projections to the year 2000 are limited largely to production for which there are secondary data on geographical divisions below the country level. For Brazil, in particular, the scope of the study is limited to analyzing the trends and projections of the major food crops for the five regions of the country and relating the results to those for the entire country as shown in IFPRI's food gap study. The Nigeria portion of the study examines the production trends of major food crops at both regional and state levels and projects these to 2000; output projections are then matched with three assumed scenarios of country-level demand projections

Time-series data on the production of the major food crops in Brazil are from the Instituto Brasileiro de Geografia e Estatística (IBGE) and made available to IFPRI by EMBRAPA, the Brazilian Agricultural Research Corporation. Estimates of production and area harvested for the 1961-80 period are analyzed for the five Brazilian regions of North, Northeast, Central West, Southeast, and South. For Nigeria, the organization of regional and state data on the major food crops and primary livestock products was undertaken by Professor [illegible] O. Adamu of the University of Ibadan, whose principal source of data is Nigeria's Federal Office of Statistics (FOS). Annual estimates are analyzed according to the four original regions of the country at the time of its independence in 1960, which were Western, Mid-Western, Eastern, and North. Analysis of trends and projections are also made for the 12 states that replaced these four regions in 1967.

BRAZIL

More than 40 percent of the production of major food crops in Brazil comes from the South, its smallest region in terms of land area. Population is concentrated in the economically advanced Southeast, which contains 45 percent of the people and produces nearly a fourth of the country's food. The Northeast, where most of the country's poverty problem exists, has 30 percent of the population and accounts for a fifth of production. The least inhabited areas are the North and Central West regions.

Major food crop production, which is 70 percent cereals and 30 percent noncereals, rose 50 percent between the early 1960s and the late 1970s. (As used here, the term "major food crops" includes all cereals, roots and tubers, pulses, groundnuts, and bananas and plantains. For aggregative purposes, rice is in milled form and the noncereals are in terms of cereal equivalents.) Cereals accounted for almost 90 percent of the production increase, with maize alone representing more than one-half of the total production increment between the two periods. The decline in groundnut production was more than offset by increases in production of other noncereals.

In terms of average annual growth rates during 1961-80, the production of major food crops rose 2.7 percent, with the output of cereals expanding by nearly 4.0 percent and that of noncereals by less than 1.0 percent. The 3.7 percent annual growth in maize production during the period was impressive, considering that it is the country's largest crop. Wheat had an annual growth rate exceeding 10.0 percent, but the crop is relatively minor and grown only in the southern regions. In the noncereal group, the production of roots and tubers expanded by less than 1.0 percent a year. Among regions, food production expanded most rapidly in the North, at 7.0 percent a year, followed by the Central West and the South, both of which had annual rates of more than 5.0 percent. Growth of food output was slowest in the Southeast, at less than 0.5 percent a year.

The 1961-80 trends show that expansion in cropped area was the principal source of production increases in Brazil. Harvest area under the major food crops increased at 3.0 percent a year, while output per hectare declined annually at 0.3 percent. Area expansion accounted for 90.0 percent of the growth in cereal output and totally sustained noncereal production.

Ten-year trends reveal the drastic deceleration in the growth of food output in Brazil--from almost 5 percent a year in 1961-70 to slightly over 1 percent a year in 1971-80--because of the considerable slowdown in the growth of harvest area between the two decades. These slowdowns in area expansion occurred in both cereals and noncereals. Among the regions, growth in food production accelerated only in the relatively small producing regions of the North and Central West and slowed considerably in the three other regions, especially in the South and the Southeast. Increases in regional production during the 1970s were all from expansion of cultivated area.

Assuming the continuation of the 1961-80 regional trends of food production in Brazil, projected output of major food crops for the country in 2000 would reach 82.0 million metric tons, or almost twice the 1980 level. More than one-half of the projected production would be from the South, up from the 45 percent share of the region in 1980. Relative contributions of the North and Central West would increase also, with the Northeast and Southwest absorbing the corresponding declines in percentage shares. If the regional trends of harvest area

and output per hectare are used instead of production trends, projected output would be 12 percent larger at 91.5 million metric tons. The increase arises because of the added assumption in the projection that, if trends are negative, neither of the two components would decline during 1980-2000.

With the country-level trend of production, the output projection to the year 2000 would be only 73.5 million metric tons. (This projected output level differs only slightly from the result of IFPRI's food gap study because of the close agreement between FAO data and national-source estimates.) If the country-level trends of harvest area and output per hectare (whose trend is negative and hence assumed to remain constant) are projected to continue, the production projection to 2000 would reach 77.2 million metric tons.

In the absence of consumption data at the regional level, the aggregates of these output projections are matched with IFPRI's food demand projection for the country of 91.3 million metric tons. The resulting projected food gaps in Brazil in 2000 would range from 0.2 million metric tons, if projections of production are based on regional trends of harvest area and output per hectare, to a sizable 17.8 million metric tons if output projections are on the basis of country-level production trends.

NIGERIA

Three factors have greatly influenced food production in Nigeria since the early 1960s: (1) the 1966 civil disturbance, which caused population movements and dislocation of ethnic groups that contributed to a decline in food output; (2) the creation of states and their capitals, which enhanced rapid urbanization that, in turn, led to major reductions in the farm labor force and, consequently, in cultivated area; and (3) the oil revenues that financed the enlarged food imports necessitated by low domestic production.

The large Northern region of the country accounts for more than 50 percent of the total population and about 80 percent of food production. Some 10 percent of food output is produced in the Eastern region and the remainder is about equally shared by the Western and Mid-Western regions. The Eastern and Western regions contain about 20 percent each of the total population. The civil disturbance during the 1960s affected mostly the Eastern region.

Data from national sources in Nigeria show that the production of major food crops declined between 1961-65 and 1979-83 at the rate of 1.6 percent a year. This decline resulted from rapid decreases in harvest area averaging 2.8 percent annually which suggests an annual rate of increase in output per hectare of about 1.2 percent. By comparison, the data from the Food and Agriculture Organization of the United Nations (FAO) indicate a slow growth of food production during

1961-80, with increases in harvest area offsetting the declines in output per hectare.

Analysis of production trends by crop based on regional and state data reveals that only rice, millet, and pulses showed positive growth rates of production, mainly because the larger increases in yields of these crops outweighed the decline in their area harvested. Much of the decrease in food production was in root crops, mainly yams and cassava. In general, the major source of decline in food production during the observed period was the reduction in the cultivated area, which was the result of people leaving farming.

Between 1961-65 and 1979-83, the total consumption of the major food crops declined by an average rate of 0.8 percent a year compared with the decrease of 1.6 percent a year in their output. The much slower decline in consumption compared with domestic production was made possible by the expansion of food imports. Relative to total domestic consumption, the direct use of major food crops for food increased from about 71.0 percent in the earlier period to 77.0 percent in the later period, although this use declined in absolute terms. The use of food crops as animal feed increased by more than 20.0 percent between the early 1960s and the early 1980s.

Projections of food supply and demand using regional level data on production, and alternative assumptions regarding population and per capita income growth, indicate deficits ranging from 2.9 to 6.0 million metric tons in 2000. However, with projections using state estimates of output and their relatively faster overall production growth rate, the projected deficits would be smaller and would range from near zero to 3.2 million metric tons. These projected shortfalls are comparatively small relative to those calculated from FAO data.

CONCLUSIONS

The different projections of food output for Brazil, whose country production data from the national system closely agree with those published by FAO, are useful for comparing possible approaches using trends in production, harvest area, and output per hectare for these projections. Results based on trends exhibited by country subdivisions are larger than those based on country-level trends. It is also observed that projections based on output trends would be smaller than, or at most equal to, those based on the trends of harvest area and output per hectare at the same geographical level if neither of the two components is allowed to decline.

With its large agricultural potential, land-rich Brazil could fill its projected deficit through faster growth in food production, compared with its past trend. While the country could possibly reaccelerate expansion of cultivated area, which this study has clearly shown to be the principal source of food production growth since the

early 1960s, improvement of output per hectare also appears to have a large potential. Improvements in the growth rates of both harvest area and output per hectare of the major food crops could easily achieve an average annual increase in Brazil's food production of 3.9 percent, a rate that would lead to projected food output equal to projected food demand in the country in 2000.

Brazil has depended heavily on the South region as its breadbasket; this region accounted for about one-third of the country's food output in the early 1960s. The concentration of food production in this region increased further during the 1970s; the 1976-80 averages of regional food production show that the relative share of the South had risen to more than 40 percent. If the trends in output continue, the region is projected to account for more than one-half of the country's food production in 2000. An option worth considering here would be reducing major reliance on one region as a food source and improving food production in other areas to lessen the risks of regional crop failures.

The production projections for Nigeria are much more difficult to assess if the results obtained from FAO data are used as the basis for comparison. The national-source estimates on Nigerian food production diverge widely from corresponding FAO data for the country. Major disagreement between estimates from the national system and FAO data is shown especially by figures in the 1970s, when, for major food crops as a whole, the level of estimates in the national system is only two-thirds that of FAO's. As a consequence, the calculated annual growth rates for production and harvest area that are drawn from the two sets of data vary considerably. National-source estimates indicate declining production and harvest area for both cereals and noncereals in the country. FAO data, on the other hand, show increases in production and harvest area for both crop groups, although at slow rates.

Thus for Nigeria, it is difficult to draw conclusions and make food policy suggestions based on this study because of doubts about data reliability. The wide variation between FAO and national-source estimates shown here poses the question of choice of the appropriate data set to be used. This study has strongly highlighted the need for improving quality and timely availability of agricultural statistics in Nigeria. Adequate interaction is needed between the data-collection agencies and policymakers. There appears to be more than one set of agricultural statistics from national sources in Nigeria and this suggests the need for coordination among data-collecting agencies in the country. The necessary improvements would need the support of the national government, which, in the long run, is the main beneficiary of reliable data for development planning.

2. INTRODUCTION

Research on food trends in the Third World by the International Food Policy Research Institute (IFPRI) builds on agricultural and economic data from other international organizations, especially the Food and Agriculture Organization of the United Nations (FAO), in providing a general diagnosis of the world's food problem. Specifically, studies examine the trends in food production, consumption, and trade for developing countries, and through the use of trend-oriented projections of food output and demand, develop "benchmark" scenarios of the future status of food in the Third World. Knowledge of these food trends and the consequent situations they can lead to serve as backdrops for changes in food and food-related policies, which can help improve these depicted scenarios. The study results help call attention to the need for national and international actions toward resolving the food problems of developing countries and identify areas for further IFPRI research on food policies in these countries.

Over the years, IFPRI's food gap analyses have expanded their coverage of both commodities and countries. Early assessments of the current and prospective food situations in the Third World dealt only with cereals in the developing market economies; later studies also covered the major noncereal food crops and primary livestock products in more than 100 developing countries. However, study findings and their policy implications have continued to relate to country groups, based either geographically or on selected country characteristics, and to the Third World as a whole. Although these studies help in providing information for international and, to a certain extent, national actions in the food policy area, they can be more useful if they relate to country levels.

With the various stages of economic development of Third World countries, the wide range of their natural resource endowments, and differences in their social and political characteristics, country-level food gap analysis can provide results that can lead to more specific national actions to meet the food problems of developing countries. The main constraint to this approach is the doubtful reliability of available international food statistics for many Third World countries. Because national-level data deficiencies tend to be offsetting for country groups, results of past trend studies have been presented at aggregate levels.

This study is an attempt at a more detailed analysis of food trends in developing countries, using data from national systems to supplement available food statistics from international sources. The

objectives also include providing, on the basis of these trends, improved assessments of the future food situation in Brazil and Nigeria, the two countries selected for the study, and examining the general implications of the observed trends and food projections for the food policies of these countries. While original study plans included the analysis of trends and projections of both food production and consumption in the selected countries, the detailed examination of trends and the projections to the year 2000 are limited largely to production, for which there are secondary country data for geographical divisions below the national level. The problems with data on food consumption in most developing countries are more serious than those for data on food production, and time-series estimates at levels lower than the national totals are generally nonexistent or, if available, are likely to be spotty.

THE STUDY COUNTRIES

In terms of land area, Brazil is the fifth largest country in the world after the Soviet Union, China, Canada, and the United States. Of its 846 million hectares of land, however, about 86 percent is made up of forests, woodland, and pastures; croplands represent only 9 percent of Brazil's land area (Table 1). For the Third World as a whole, the ratio of croplands to total land area just slightly exceeds that of Brazil. The country's estimated 121 million population in 1980 represented about 35 percent of the total population of Latin America. Its production of major food crops in the late 1970s of about 40 million metric tons a year accounted for two-fifths of the regional total.[1] Brazil is also an important Third World producer of animal products; in 1973-77, it produced 17 percent of the meat and 11 percent each of the milk and eggs in developing countries (excluding China). In the Brazilian economy as a whole, the gross national product (GNP) per capita expanded at a rapid 6.3 percent a year during 1966-80 and was estimated at U.S. $2,100 annually at the end of that period.

Nigeria is relatively much smaller, with a land area of 91 million hectares, which is less than one-ninth of Brazil's. A third of the country's area is cropland and less than 40 percent is accounted for by forests, woodland, and pastures. Nigeria's population, estimated at 81 million in 1980, and its output of major food crops, which averaged about 18 million tons annually during 1976-80, represent about one-fourth each of the regional population and food production of Sub-Saharan Africa. Compared with Brazil, the country is relatively unimportant as a producer and consumer of livestock products. With its revenues from oil, the Nigerian economy expanded rapidly in the past. However, growth has slowed and the country's GNP per capita, which was estimated at U.S. $910 in 1980, had an annual rate of increase of 4.5 percent during 1966-80.

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[1]All tons referred to in this paper are metric tons.

Table 1--Some general information on the study countries

Description	Brazil	Nigeria	Third World
Land use, 1983			
Land area (million hectares)	846	91	7,592
Croplands[a]	75	30	797
Forests, woodland, and pastures	732	35	4,148
Other lands	39	26	2,647
Major food crops, 1976-1980 averages[b]			
Production (million metric tons)	39.4	17.9	810.4
Cereals	27.3	8.8	670.0
Noncereals	12.1	9.1	140.4
Consumption (million metric tons)	43.4	19.5	846.5
Direct food use	17.6	13.2	586.4
Animal feed	18.2	0.7	133.3
Other uses[c]	7.6	5.6	126.8
Livestock products, 1973-1977 averages			
Production (million metric tons)			
Meat	3.6	0.4	22.0[d]
Milk[e]	9.7	0.3	87.3[d]
Eggs	0.4	0.1	3.9[d]
Consumption (million metric tons)			
Meat	3.5	0.4	21.7[d]
Milk[e]	10.0	0.7	94.9[d]
Eggs	0.4	0.1	4.1[d]
Population			
Number, 1980 (millions)	121	81	3,273
Annual growth rate, 1960-1980 (percent)	2.6	3.3	2.4
GNP per capita (1979-81 = 100)			
1980 level (U.S. dollars)	2,100	910	...
Annual growth rate, 1966-1980 (percent)	6.3	4.5	...

Sources: Data from Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," FAO, Rome, 1982, and "Production Yearbook Tape, 1983," FAO, Rome, 1984; United Nations Department of International Economic and Social Affairs, "World Population Prospects as Assessed in 1982," United Nations, New York, 1983 (computer printout); and World Bank, "Gross National Product by Country Data Tape, 1961-1980," World Bank, Washington, D.C., 1981. Data on China are from data sets organized by Bruce Stone of the International Food Policy Research Institute.

[a] Arable land and land under permanent crops.
[b] Includes cereals, roots and tubers, pulses, groundnuts, and bananas and plantains.
[c] Seeds, other nonfood uses, and allowances for waste.
[d] Excluding China.
[e] In terms of whole milk.

DATA USED

Time-series data on the production of major food crops for Brazil are from the Instituto Brasileiro de Geografia e Estatística (IBGE), the national statistical organization. These were made available through the Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), the Brazilian Agricultural Research Corporation, a public entity attached to the Ministry of Agriculture and responsible for the coordination and advancement of agricultural research in Brazil. The IBGE data set, which includes estimates on area and production of the food crops covered in IFPRI's food gap studies, is available even by states; however, some of the states are of recent creation and, with the changes in their size and number since the early 1960s, the longer time-series data related to regions are used for analysis. Crop estimates for the years 1961 to 1980 are processed and analyzed for the five regions of Brazil--North, Northeast, Central West, Southeast, and South. There are currently 27 states, including the Federal District, which contains the nation's capital. The study failed to obtain a similar set of data for Brazilian livestock products.

In the case of Nigeria, the organization of regional and state data for both major food crops and livestock products was undertaken by Professor S. O. Adamu of the Department of Statistics of the country's University of Ibadan, whose principal source of information was the country's Federal Office of Statistics (FOS). Professor Adamu also assisted in the analysis of the collected data and has discussed some of the problems of Nigerian agricultural statistics in a preliminary report.[2] The country's four administrative regions at the time of independence in 1960 were subdivided in 1967 into 12 states; in 1976, five of these states were formed into 12 new states, resulting in a total of 19 states. For the Nigerian food trends and projections in this study, data processing and analysis cover the original four regions of the country and the 12 states that existed from 1967 to 1976. The regions and their covered states are Western (Lagos and Western), Mid-Western (Mid-Western), Eastern (Rivers, Southeastern, and East-Central), and Northern (Kwara, Benue-Plateau, Northeastern, Kano, North-Central and Northwestern). Time-series data span the years 1965-83 for regions and 1969-83 for states.

DATA FROM NATIONAL SOURCES AND FROM FAO

International data on agriculture published by FAO are generally those furnished officially to the organization by its member countries. However, for some countries, especially in the Third World, FAO appears

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[2]S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

to make some data adjustments, possibly assisted by estimates from unofficial sources. Table 2 shows a comparison of the aggregates of the regional or state data, or both, and the published FAO estimates on the production of major food crops in the two study countries. Five-year averages of country-level data from these two sources were obtained for the 1961-65 and 1976-80 periods and then were compared by using the FAO estimate as denominator.

There is almost perfect agreement between estimates from the two data sources on the total production of the major food crops in Brazil during 1961-65 despite the slight differences that exist between the estimates for maize, pulses, and bananas and plantains. Close data agreement is observed also for the 1976-80 period, with a divergence of less than 1.0 percent shown for the output of major food crops as a whole. This difference can be traced to the data on millet and sorghum, other minor grains, roots and tubers, and bananas and plantains. The widest divergence is shown by the combined estimates for other minor grains, but like millet and sorghum, the total production of these items in Brazil is relatively small. Estimates from the two sources for cereals as a group differ by only 1.0 percent. Figures for the noncereals diverge by less than 0.5 percent, much of which is contributed by roots and tubers, particularly cassava. Although certain data differences exist for some crops, one can easily conclude that the FAO essentially publishes the Brazilian official statistics on food production.

In the case of Nigeria, however, there is less agreement between output data from the national system and those from FAO, especially during the 1976-80 period. For major food crops as a whole, the 1961-65 estimates diverge by less than 1 percent as a result of offsetting differences between the estimates for cereals and noncereals. Cereal figures from the national source all exceed those of the FAO data, although only slightly for millet and sorghum, but by as much as 11 percent for maize. National source estimates for roots and tubers give a total that is 17 percent above the FAO total, but those for pulses and groundnuts are below the FAO estimates by 7 percent and 40 percent, respectively. For Nigeria, there were no estimates from the national system for wheat, other minor grains, or bananas and plantains, which, based on FAO figures for the late 1970s, together account for some 2 percent of the total output of major food crops.

Major disagreement between estimates from the national system and FAO data for Nigeria is clearly shown by the 1976-80 production averages. Except for groundnuts, for which the local source figure exceeds the FAO estimate by nearly 30 percent, the FAO output data for other major food crops are much larger than those from the national system. The largest relative difference is observed between the estimates for roots and tubers, the ranking food crops of the country, whose production figures from the two sources diverge by almost 60 percent. Local estimates for maize for the 1976-80 period average about one-half of the FAO figures. Divergences in other major food

Table 2--A comparison of estimates from national sources and FAO data on the production of major food crops in Brazil and Nigeria

Commodity	Ratio of National Aggregate to FAO Estimate			
	Brazil		Nigeria[a]	
	1961-1965	1976-1980	1961-1965	1976-1980
Major food crops[b]	1.000	0.992	0.993	0.632
Cereals	1.000	0.990	1.009	0.778
Wheat	1.000	1.000	(c)	(c)
Rice	1.000	1.000	1.020	0.664
Maize	1.000	1.000	1.113	0.484
Millet and sorghum	(c)	(c)	1.002	0.857
Other grains	1.000	0.988	(c)	(c)
Noncereals	1.000	0.997	0.977	0.491
Roots and tubers	1.000	0.996	1.173	0.429
Pulses	1.000	1.000	0.933	0.715
Groundnuts	1.000	1.000	0.600	1.273
Bananas and plantains	1.000	1.002	(c)	(c)

Sources: Data from Food and Agriculture Organization of the United Nations, "Production Yearbook Tapes, 1975 and 1983," FAO, Rome, 1976, 1984; Instituto Brasileiro de Geografia e Estatistíca, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária); and S. O. Adamu, "Analysis of Food Trends and Projections of Food Production and Consumption in Nigeria" (a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986, mimeographed).

[a] National estimates, especially those starting from 1977, include adjustments by S. O. Adamu.

[b] For purposes of aggregation, rice is in husked form and the noncereals are converted to cereal equivalents based on calorie content relative to wheat.

[c] No estimates furnished by national sources. Based on 1976-1980 FAO data, the relative shares of these commodities in the total for major food crops are 0.6 percent for millet and sorghum in Brazil, 0.1 percent for wheat and 0.3 percent for other grains in Nigeria.

crops are about 30 percent each for rice and pulses, and 15 percent for millet and sorghum. With the wide difference in the estimates for roots and tubers, the aggregate noncereal production from national source data is only one-half of the corresponding FAO total. For cereals as a group, the divergence of output totals is about 20 percent, and for major food crops as a whole, the sum of individual crop output estimates from the national data system is less than two-thirds of the total shown by FAO figures.

The close agreement between official country data and the FAO estimates of Brazilian food crop production seems to be matched by the very wide divergence of estimates on crop output between these two sources in the case of Nigeria. The above data comparisons point to a serious problem of Nigerian agricultural statistics. For purposes of this study, the wide differences between FAO and national-system data for Nigeria should be kept in mind when comparing the trends and projections based on these two sets of estimates.

METHODOLOGY

The analysis of production trends and the food projections in this study essentially follow the approaches of IFPRI's Third World food gap studies. However, instead of the country-level FAO estimates, time-series data from national sources for the regions or states, or both, of the study countries are used. As indicated earlier, annual data for 1961-1980 are available for the five regions of Brazil. In the case of Nigeria, two sets of time-series estimates are employed: data for 1965-83 for the four original regions of the country, and for the 1969-83 period for the 12 states that existed during 1967-76.

In examining historical trends of output and area harvested, measures of average annual growth rates are drawn from the estimated semi-logarithmic equation fitted by the method of least squares to the data for each commodity and commodity group, for each region or state, and for the study country as a whole. In the case of Nigeria, 5-year averages are used also in measuring annual growth rates. Aggregated annual data are employed in measuring the growth rates of commodity groups and for country levels. For food crops, the annual growth rates of output per hectare are derived directly from those obtained for production and area harvested. The relative contributions of area harvested and output per hectare to production increase are calculated on the basis of their annual changes (in logarithms) shown by the fitted equations. For Brazil, in particular, 10-year trends for the 1961-70 and 1971-80 periods are examined also.

Projections of production assume a continuation of the trends shown by the available estimates for each region or state; regional or state output projections, or both, are added for the study country as a whole. For regions or states with negative production trends, it is also assumed that no further decline in output would occur beyond the

end year of the data period. Attempts are made to generate production scenarios using separate projections of area harvested and output per hectare. In such cases, the latter assumption is also applied to either of these two components. The projected levels of area harvested and output per hectare are multiplied to obtain the production projection of each region or state.

As mentioned earlier, country-level FAO data are used for food demand projections. For Brazil, the projections of IFPRI's food gap studies are matched with the output projections obtained in this study. In the case of Nigeria, national scenarios of future demand are developed based on assumed rates of growth in population and income.

Appendix A contains supplementary tables and Appendix B presents a more detailed discussion of methodology.

3. FOOD PRODUCTION AND CONSUMPTION TRENDS FROM FAO DATA

Using country-level FAO data, the IFPRI food gap studies on major food crops and primary livestock products in the Third World examined the trends of production and consumption by subregions, regions, other country typologies, and the Third World as a whole from the early 1960s to the late 1970s.[3] Based on food trends by country, food output projections for the Third World to the end of the century were also developed. The food production and consumption trends in Brazil and Nigeria, as shown by the results of these studies, are briefly presented below.

BRAZIL

The country's production of major food crops, which averaged 39 million tons annually in 1976-80, is about 70 percent cereals and 30 percent noncereals (Table 1). Brazil has performed relatively well as a food producer, with an average per capita production of major food crops in that period of 325 kilograms, compared with 250 kilograms for the Third World as a whole. Consumption of these basic food staples in the late 1970s, however, exceeded output and had to be filled by food imports. Estimates for the years 1976-80 show that a little over 80 percent of domestic food consumption was accounted for by food and feed uses that had about equal relative shares; the rest went to seeds, other nonfood uses, and allowances for waste.

Between 1961 and 1980, Brazilian food production increased at an average annual rate of 2.8 percent, compared with 2.6 percent a year for the country's population (Table 3). Ten-year production trends show that growth of food output decelerated from nearly 5.0 percent annually during 1961-70 to less than 1.5 percent during 1971-80; this was a result of a major slowdown in the growth of area harvested, together with an absolute decline in overall crop yields.

Total domestic use of major food crops in Brazil during 1976-80 averaged more than 43 million tons a year, expanding at an average

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[3] J. S. Sarma and Patrick Yeung, Livestock Products in the Third World: Past Trends and Projections to 1990 and 2000, Research Report 49 (Washington, D.C.: International Food Policy Research Institute, 1985); and Leonardo A. Paulino, Food in the Third World: Past Trends and Projections to 2000, Research Report 52 (Washington, D.C.: International Food Policy Research Institute, 1986).

Table 3--Trends in food production and consumption in Brazil and Nigeria based on FAO data for indicated periods

Component	Average Annual Growth Rate	
	Brazil	Nigeria
	(percent)	
Production		
Major food crops, 1961-80	2.8	0.7
Cereals	3.8	0.8
Noncereals	0.9	0.7
Livestock products, 1961-65 to 1973-77		
Meat	4.3	1.9
Milk	5.2	1.4
Eggs	5.1	3.0
Consumption		
Major food crops, 1966-80	2.5	2.2
Food use	1.9	3.0
Feed use	3.6	3.7
Livestock products, 1961-65 to 1973-77		
Meat	4.2	1.5
Milk	4.2	6.6
Eggs	5.1	3.0

Sources: Data from Food and Agriculture Organization of the United Nations, "Agricultural Supply Utilization Accounts Tape, 1981," "Global Agricultural Programming System Supply Utilization Accounts Tape, 1978," and "Production Yearbook Data Tapes" (various years), FAO, Rome.

annual rate of 2.5 percent between 1966 and 1980, or about as fast as population growth. It may be pointed out that although per capita income growth was about 5.0 percent a year in this period, the income elasticities of Brazilian demand for cereals are low and those for root crops are already negative. The uses of major food crops for direct human consumption and for animal feed, which accounted for slightly more than 40.0 percent each in the late 1970s, expanded by less than 2.0 percent and at 3.5 percent a year, respectively. Between 1966-70 and 1976-80, the relative share of feed use in total domestic use went up almost 4.0 percentage points, while that of direct food use dropped by 2.5 percentage points. During the same period, Brazilian food deficits increased nearly fourfold to about 3.7 million tons a year in 1976-80, which could be attributed largely to the slowed growth of food output in the 1970s.

Brazil is an important Third World producer of animal products. Data for 1973-77 indicate that Brazil consumed most of its output of livestock and poultry products in that period. The country consumed 96 percent of its meat production and imported about 3 percent of its consumption of milk and milk products in those years; as may be expected for eggs, the production and consumption of the commodity were in balance. Between 1961-65 and 1973-77, the average rate of growth in meat production was more than 4 percent a year, while growth in milk and eggs exceeded 5 percent a year.

NIGERIA

In 1976-80, major food crop production in Nigeria averaged 18 million tons a year, which was roughly 2 million tons short of the average annual consumption of these commodities for the period. Between 1961 and 1980, growth of food output in the country was very slow, increasing at an average rate of only 0.7 percent a year while population was growing at 3.3 percent. This poor performance of Nigerian food production during those two decades resulted in a rapid growth in its food imports to fill domestic requirements.

In terms of cereal equivalents, food output in Nigeria is about equally shared by cereals and noncereals, whose annual rates of growth in production during 1961-80 were also about the same. Increases in food output were totally sustained by area expansion, which averaged 1.1 percent a year. Behind Nigeria's poor performance in production, however, 10-year trends show that growth of food output significantly accelerated from the 1960s to the 1970s, with improvement in overall crop yields more than offsetting the major slowdown in area expansion that occurred between decades.

More than 65 percent of the total consumption of major food crops in Nigeria in 1976-80 was for direct use as food, while about 4 percent was accounted for by animal feed and the rest by seeds, other nonfood uses, and waste. Growth of food consumption in the country between

1966-70 and 1976-80 was about 2.2 percent annually, with average yearly increases in food and feed uses of 3.0 percent and 3.7 percent, respectively. Fast-expanding consumption from a rapidly increasing population and growing incomes in the face of a very slow growth in food production shifted Nigeria's food situation from one of surplus in the earlier period to a deficit during the later period.

Based on 1973-77 estimates, Nigeria's production of milk, meat, and eggs represented less than 0.5 percent, 2.0 percent, and 3.0 percent, respectively, of the total outputs of the commodities in developing countries (excluding China). Between the early 1960s and the mid-1970s, the average yearly rates of increase in the production of these primary livestock products were 1.4 percent for milk, 1.9 percent for meat, and 3.0 percent for eggs. The fastest growth in the consumption of animal products in Nigeria was in milk, at 6.6 percent a year during the same period; deficits in milk and milk products in 1973-77 represented nearly 60.0 percent of their domestic consumption. Meat consumption expanded at the slow rate of 1.5 percent annually while, as may be expected, growth of the country's consumption of eggs kept abreast of the increases in egg production.

4. FOOD TRENDS IN BRAZIL

POPULATION AND FOOD PRODUCTION

The relative contributions of Brazil's five regions to its food production readily show that the South, which is the smallest region in terms of land area, is the country's main breadbasket. More than two-fifths of the output of major food crops in Brazil comes from the South, where land area is only 7 percent of the total area of the country (Figure 1, Table 4, and Appendix 1, Table 19). A completely opposite situation is indicated by the North region, which contains more than two-fifths of the land, including the Amazonian areas, but accounts for less than 5 percent of the production of basic food staples. The South is well endowed with arable lands, showing a ratio of crop harvest area to land area of almost 30 percent compared with less than 0.5 percent in the North.

However, much of the Brazilian population is concentrated in the Southeast region, which, as shown by 1980 estimates, contains about 45 percent of the people in the country and includes the heavily populated states of São Paulo and Rio de Janeiro. The Southeast ranks second in Brazil's production, accounting for close to one-fourth of total food output. Another well-populated region is the Northeast, which holds nearly 30 percent of the people in the country and accounts for about one-fifth each of Brazil's land area and production of major food crops. The least inhabited regions of the country are the North and Central West, which jointly represent almost two-thirds of Brazil's land area but contain only 11 percent of the population.

In terms of the food output relative to population among regions, the per capita production of major food crops is highest at almost 900 kilograms in the agriculturally productive South, followed by the earlier-noted, less-inhabited Central West with 600 kilograms. The relative shares of food production in these two regions are more than proportionate to their population shares. As would be expected, food production per capita is lowest in the more industrial and densely populated Southeast at less than 200 kilograms. Low measures of per capita food production of about 200 kilograms are indicated also for the North and Northeast. Data given earlier indicate that while the Northeast accounts for a significant share of the production of major food crops in Brazil, it also contains a sizable portion of the population.

Figure 1--The five regions of Brazil

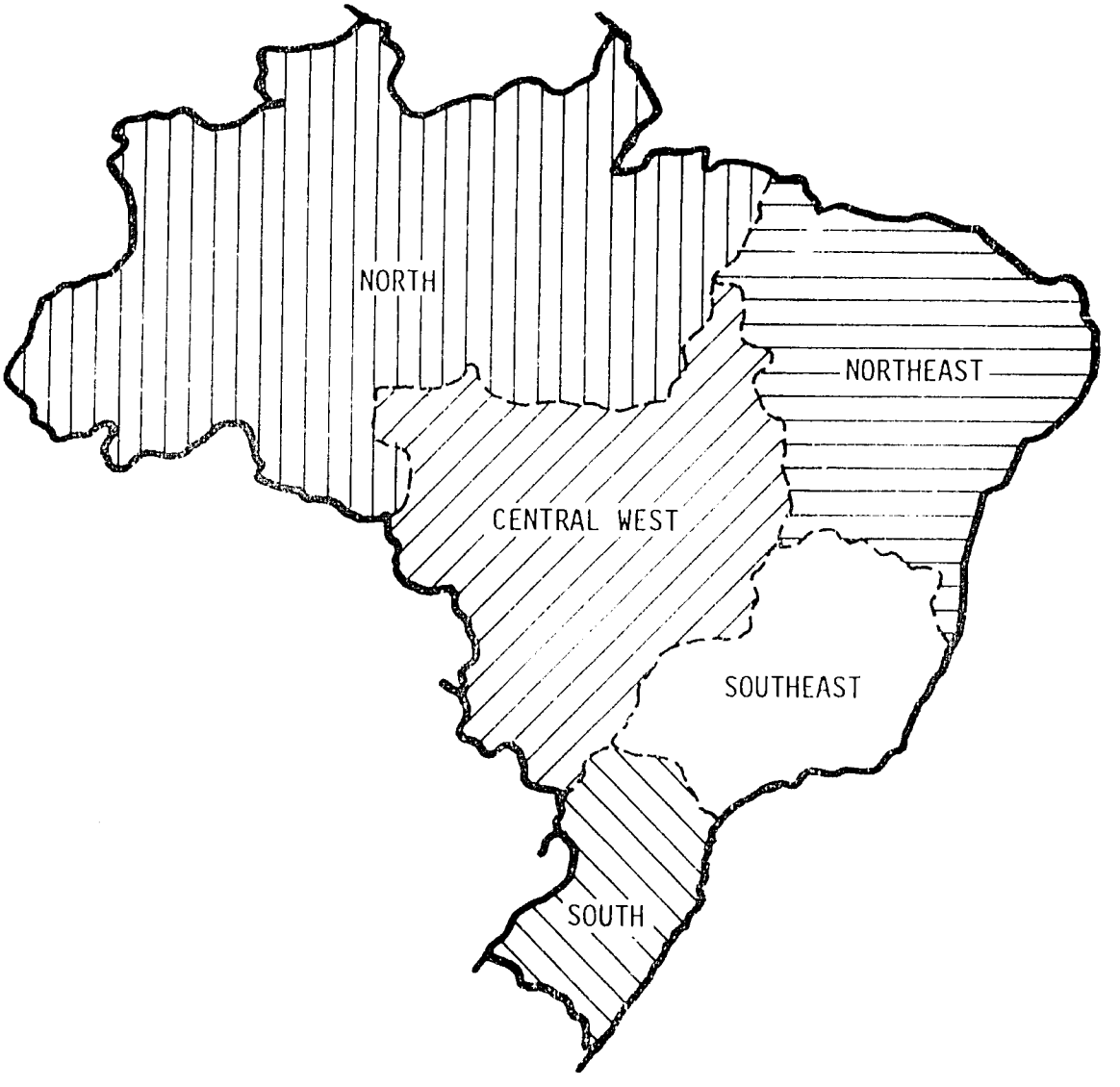

Table 4--Land area, population, and major food crop area and production among regions in Brazil

Region	Relative Distribution Among Regions			Ratio of Major Food Crop Area to Land Area	Food Production per Capita
	Land Area	1980 Population	Area/Production of Major Food Crops, 1976-80[a]		
	(percent)			(percent)	(kilograms)
North	42	5	3	0.3	200
Northeast	18	29	20	4.9	220
Central West	22	6	11	2.3	595
Southeast	11	44	23	9.6	170
South	7	16	43	29.0	870
Total	100	100	100	4.5	325

Sources: Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária); and James Wilkie and Peter Reich, eds., Statistical Abstract of Latin America, various issues (Los Angeles: UCLA Latin American Center Publications, various years).

[a] The relative distributions of area harvested and production of major food crops among the five regions are essentially the same.

The Schuh-Alves[4] study described the Brazilian population as highly concentrated geographically, mostly in the two or three regions of the Atlantic littoral. These refer largely to the economically advanced Southeast and the relatively poor Northeast.

DISTRIBUTION OF FOOD CROP PRODUCTION

The production of major food crops in Brazil is about 70 percent cereals and 30 percent noncereals. Food crop data for the 1976-80 period show that maize, the principal crop, represents more than two-fifths of food output, followed far behind by the crop group of roots and tubers with a little over 20 percent (Table 5). Rice is nearly as important as the root crops group, accounting for 18 percent of production. The other food crops are comparatively minor; of these, wheat and pulses are about equally important, each representing slightly more than 5 percent of food output.

Cereals form about 85 percent of the production of major food crops in both the South and Central West, while the noncereals predominate in both the North and Northeast, where these items represent more than two-thirds of the total in each of those regions. The distribution between these main crop groups in the Southeast represents about the average for the country as a whole.

More than one-half of the total food production in the South is maize, while rice and wheat equally share nearly 30 percent. Rice is the most important food crop of the Central West, where it accounts for nearly half of food output; maize follows close behind with almost 40 percent. In the Southeast, maize represents close to three-fourths of food production, followed far behind by the root crops group and rice. Roots and tubers are the major components of food production in the North and Northeast, with almost 60 percent and over 50 percent, respectively.

Across regions, more than one-half of the cereal output of the country is produced in the South, which accounts for over half the

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[4]G. Edward Schuh and Eliseu Roberto Alves, The Agricultural Development of Brazil (New York: Praeger Publishers, 1969). This comprehensive analysis of the development of the Brazilian agricultural economy from the immediate post-World War II period to the mid-1960s was undertaken by Schuh and Alves in one of the Ford Foundation-supported "benchmark" studies of Third World countries in 1966 and 1967. The study included a detailed examination of trends in the production, consumption, and trade of both food and export crops in Brazil. While comparatively limited in scope, this present examination of the country's food trends provides some information on the changes in Brazil's output of major food crops during the one and a half decades after that study.

Table 5--Distribution of production of major food crops in Brazil, by region, 1976-80 averages

Crop	North	Northeast	Central West	Southeast	South	Total
			(million metric tons)			
Major food crops	1.22	7.77	4.60	8.94	16.82	39.35
Cereals	0.40	2.44	3.93	6.43	14.07	27.27
Wheat	...	...	0.05	0.17	2.50	2.72
Rice	0.25	1.12	2.15	1.06	2.37	6.95
Maize	0.15	1.32	1.73	5.20	9.05	17.45
Other grains	...	...	...	...	0.16	0.16
Noncereals	0.82	5.33	0.67	2.51	2.75	12.08
Roots and tubers	0.71	4.11	0.37	1.26	1.78	8.23
Pulses	0.03	0.65	0.14	0.55	0.78	2.15
Groundnuts	0.00	0.01	0.05	0.31	0.08	0.44
Bananas and plantains	0.08	0.56	0.10	0.39	0.11	1.25

Source: Data from Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária).

Note: Parts may not add to totals due to rounding.

production of maize, a third of the rice, most of the wheat, and almost all of the other coarse grains. Thirty percent each of the production of rice and corn in the country comes from the Central West and the Southeast, respectively. The biggest producer of noncereal food crops is the Northeast, which contributes half of Brazil's production of roots and tubers. The agriculturally rich South is also a large contributor of roots and tubers and of pulses in the country's food output. The production of groundnuts is mostly from the Southeast, while that of bananas and plantains comes mainly from the Northeast and Southeast.

PRODUCTION INCREASE, 1961-65 TO 1976-80

Brazil's yearly production of major food crops expanded by 13 million tons between the early 1960s and the late 1970s, an increase that was one-half the average annual output of these commodities in 1961-65 (Table 6). Nearly 90 percent of this increment was cereals, with maize alone accounting for about 55 percent of the total increase in output. Rice and wheat contributed 15 percent each to food production. Part of the increase in the output of noncereal food crops, which came from root crops, bananas and plantains, and, slightly, from pulses, filled up the absolute decline in groundnut production.

As would be expected, much of the growth of Brazilian food output was contributed by the South, which accounted for almost three-fifths of the production increase. This increment would have been larger if the noncereal output level of the region had not declined. About a third of the expansion in the country's food production was about equally shared by the Northeast and Central West regions, while the North and Southeast jointly contributed 10 percent of the increase.

In terms of relative performances in food production, however, the most rapid growth of output occurred in the North, where production more than doubled as a result of a fourfold increase in cereal production and more than a doubling of noncereal output between 1961-65 and 1976-80. However, although performance was impressive, food production in the North has a relatively small base and, as seen earlier, represents less than 5 percent of the total production of major food crops in Brazil. The next largest relative increase in regional food output was 90 percent in the Central West, where cereal production rose to more than twice the 1961-65 levels although noncereal output stayed relatively unchanged. In the South, where food production expanded by 80 percent, cereal output also more than doubled, but there was a decrease in the production of noncereals, particularly roots and tubers. Total food output in the Northeast increased by only 40 percent, which it achieved from both cereals and noncereals.

The poorest production performance was in the Southeast, where cereal production increased by 15 percent, which was the smallest among the regions, and noncereal output fell below the 1961-65 level by 16

Table 6--Distribution of increases in food production in Brazil, by crop and region, 1961-65 to 1976-80

Crop	North	Northeast	Central West	Southeast	South	Total
			(million metric tons)			
Major food crops	0.76	2.22	2.17	0.47	7.59	13.21
Cereals	0.31	0.52	2.15	0.89	7.75	11.63
Wheat	...	...	0.05	0.16	1.93	2.15
Rice	0.20	0.42	1.04	-0.58	0.96	2.05
Maize	0.11	0.10	1.06	1.30	4.77	7.34
Other grains	...	...	...	...	0.09	0.09
Noncereals	0.45	1.70	0.02	-0.43	-0.17	1.58
Roots and tubers	0.36	1.33	-0.10	-0.28	-0.33	0.98
Pulses	0.02	0.03	-0.00	0.07	0.06	0.17
Groundnuts	...	0.00	0.04	-0.30	0.05	-0.20
Bananas and plantains	0.07	0.35	0.08	0.09	0.05	0.64

Source: Data from Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária).

Note: Parts may not add to totals due to rounding.

percent. Overall food production in this region increased by just 6 percent between the observed periods. The very slow growth of food production in the Southeast may be attributed to the decline in the production of rice, roots and tubers, and groundnuts, which represented about 30 percent of the total production of major food crops in that region during the late 1970s.

PRODUCTION TRENDS AMONG CROPS AND REGIONS, 1961-80

A detailed examination of the annual data on the production of major food crops in the five regions of Brazil gives the estimates of the average annual growth rates shown in Table 7. These rates are for individual commodities and commodity groups and for regions and the country as a whole during 1961-80. The trends indicated by these estimates confirm the changes in regional food production discussed in the previous section.

Production of major food crops in Brazil increased at an average annual rate of 2.7 percent, with cereal output expanding at nearly 4.0 percent a year and noncereal production increasing at slightly less than 1.0 percent annually. The outputs of wheat and coarse grains other than maize had rapid annual increases of over 10.0 percent and 5.0 percent, respectively. With the low level of production of these commodities in the country, these fast rates are not surprising. Wheat is reported only in the three southern regions, and mostly in the temperate South, which also reports the only estimates on coarse grains other than maize in Brazil. The 3.7 percent average annual growth rate for maize production in Brazil is impressive, considering that it is the country's ranking crop, accounting for about 45 percent of the total production of major food crops during 1976-80. Rice production also expanded at a fairly rapid rate. Of the noncereals, only bananas and plantains displayed a fast growth in output, but these commodities could influence only slightly the rate of increase of the crop group's output because of their relatively small production share. Production of roots and tubers, which accounts for more than two-thirds of noncereal production in Brazil, increased by less than 1 percent a year.

These 1961-80 rates of increase in food production reflect the relative production performances of the five regions. Food production expanded most rapidly in the North, at nearly 7.0 percent a year, followed by the Central West and South, with annual rates each exceeding 5.0 percent. Although growth in cereal output was slow in the Northeast, the rate of increase in food production did not fare too badly because of a respectable 2.5 percent annual growth rate in noncereal output. For this region, noncereals represent about 70.0 percent of the total production of major food crops. The populated Southeast, which, as mentioned earlier, accounts for a significant portion of Brazilian food output, performed poorly because growth in the output of major food crops had a very slow rate of less than 0.5 percent a year. The region's cereal production, which in 1976-80 was almost one-fourth

Table 7--Average annual growth rates of production of major food crops in Brazil, by region, 1961-1980

Crop	North	Northeast	Central West	Southeast	South	Total
			(percent)			
Major food crops	6.8	2.2	4.5	0.3	4.1	2.7
Cereals	(a)	1.6	5.6	0.9	5.5	3.8
Wheat	...	...	(a)	(a)	(a)	(a)
Rice	(a)	3.2	4.7	-3.0	3.5	2.4
Maize	9.1	0.5	6.7	1.8	5.1	3.7
Other grains	...	...	...	...	5.3	5.3
Noncereals	5.5	2.5	-0.0	-1.1	-0.3	0.9
Roots and tubers	4.9	2.5	-1.8	-1.4	-1.1	0.8
Pulses	8.4	0.2	-0.6	0.9	0.7	0.6
Groundnuts	6.6	1.7	(a)	-5.0	8.1	-2.8
Bananas and plantains	(a)	6.6	9.7	1.7	4.7	4.9

Source: Data from Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária).

[a] More than 10 percent.

of the total in the country, rose at about 1.0 percent a year, while noncereal production declined at about the same rate.

The Northeast had the fastest growth in cereal output at more than 10.0 percent a year. It may be observed that much of the production increases in noncereals made in the northern regions were negated by the stagnation of production in the Central West and the output declines that occurred in the southern regions. The poor production performance of noncereals in these areas could be attributed mainly to decreases in the production of roots and tubers, most of which was cassava.

TRENDS OF PRODUCTION AND AREA HARVESTED

Twenty-year Trends

An examination of the 1961-80 trends in the production of major food crops in Brazil reveals that area expansion was the main source of growth in food output in the country in those two decades. Harvested area for major food crops expanded even faster than production during that period, hence increases in food output may be attributed wholly to the expansion in crop area. The total production of major food crops and area harvested increased at average annual rates of 2.7 percent and 3.0 percent, respectively, indicating a rate of decline in output per hectare of about 0.2 percent a year (Table 8) for these crops.

As seen in the preceding section, the production of major food crops in the country expanded in all of its five regions, with annual rates of increase ranging from almost 7.0 percent in the North to a very slow 0.3 percent in the Southeast. The South region, Brazil's breadbasket, showed an impressive 4.1 percent yearly growth in food output. Decreases in harvest area for the major food crops occurred only in the Southeast. The four other regions of the country had rapid expansion in food crop area, with growth rates ranging from more than 7.0 percent a year, also in the North, down to 3.2 percent a year in the Northeast. However, these rates of increase in harvest area were all higher than production growth, showing that output per hectare of major food crops declined in these regions. Thus, except in the Southeast, where the observed slow growth of food production during the period could be credited totally to a 0.5 percent annual increase in output per hectare, the regional increases in production of major food crops taken as a group are all a result of an increase in area harvested.

Table 9 presents the trends for production and harvest area of cereals and noncereals and the contribution of area to their growth in output. It can be observed that expansion of harvest area was the main contributor to both the 3.9 percent annual growth in cereal production and the slow 0.9 percent annual increase in the production of noncereals. Average yearly increases in harvest area during the two

Table 8--Average annual growth rates of production and area harvested of major food crops in Brazil, by region, 1961-80, 1961-70, and 1971-80

Region/Period	Average Annual Growth Rate		Relative Contribution to Production Increase	
	Production	Area Harvested	Area Harvested	Output per Hectare
	(percent)			
North				
1961-80	6.8	7.2	100	(a)
1961-70	5.6	5.0	91	9
1971-80	(b)	(b)	100	(a)
Northeast				
1961-80	2.2	3.2	100	(a)
1961-70	4.6	4.6	100	(a)
1971-80	0.0	2.1	100	(a)
Central West				
1961-80	4.5	6.3	100	(a)
1961-70	4.7	6.2	100	(a)
1971-80	5.5	7.4	100	(a)
Southeast				
1961-80	0.3	-0.3	(a)	100
1961-70	2.9	2.1	72	28
1971-80	-0.6	-1.7	...	...
South				
1961-80	4.1	4.2	100	(a)
1961-70	6.8	5.6	83	17
1971-80	1.2	1.9	100	(a)
Total				
1961-80	2.7	3.0	100	(a)
1961-70	4.9	4.3	87	13
1971-80	1.2	1.9	100	(a)

Source: Data from Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária).

[a] Negative; contribution to production increase attributed totally to cofactor.
[b] More than 10 percent.

Table 9--Average annual growth rates of production and area harvested of cereal and noncereal food crops in Brazil, by region, 1961-80, 1961-70, and 1971-80

Region/ Period	Average Annual Growth Rates				Relative Contribution to Production Increase			
	Cereals		Noncereals		Cereals		Noncereals	
	Production	Area Harvested	Production	Area Harvested	Output/ Area	Hectare	Output/ Area	Hectare
	(percent)							
North								
1961-80	(a)	7.3	5.5	7.1	70	30	100	(b)
1961-70	7.4	5.5	5.1	4.5	75	25	89	11
1971-80	(a)	(a)	8.9	(a)	74	26	100	(b)
Northeast								
1961-80	1.6	3.2	2.5	3.2	100	(b)	100	(b)
1961-70	2.1	4.2	5.7	5.0	100	(b)	88	12
1971-80	-0.3	2.2	0.2	1.9	...	...	100	(b)
Central West								
1961-80	5.6	6.7	0.0	3.5	100	(b)	...	...
1961-70	4.7	6.5	4.7	5.1	100	(b)	100	(b)
1971-80	8.0	8.4	-4.7	1.0	100	(b)	...	...
Southeast								
1961-80	0.9	-0.2	-1.5	-0.5	(b)	100	...	...
1961-70	3.2	2.4	2.3	1.2	76	24	53	47
1971-80	0.5	-1.8	-3.0	-1.5	(b)	100	...	...
South								
1961-80	5.5	4.9	-0.4	1.5	90	10	...	...
1961-70	6.5	5.5	7.6	5.9	86	14	79	21
1971-80	3.6	2.9	-7.2	-2.3	81	19	...	...
Total								
1961-80	3.8	3.4	0.9	1.9	91	9	100	(b)
1961-70	4.7	4.4	5.3	4.1	93	7	79	21
1971-80	3.1	2.5	-2.3	0.2	82	18	...	...

Source: Data from Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária).

[a] More than 10 percent.
[b] Negative; contribution to production increase attributed totally to cofactor.

decades were 3.4 percent for cereals and 1.9 percent for noncereals. These rates of growth in production and area show a very slow growth in cereal yields of 0.3 percent a year, and an average yearly decline of 1.0 percent in output per hectare for noncereals. Furthermore, based on these estimates, growth in harvest area represented more than 90 percent of the increase in cereal output and all of the increase in noncereal output for Brazil during the 20 years ending in 1980.

At the regional level, crop yields contributed to an increase in food production only for cereals in the three regions of the North, Southeast, and South. In the Southeast, growth of output per hectare was the sole source for growth of cereal production because of the decline in harvest area during the period. Increases in output per hectare accounted for 10-30 percent of the increase in cereal production in the two other regions. In the case of noncereals, production declined in the southern regions and stagnated in the Central West. Although noncereal output expanded in the two northern regions, increases were wholly from area expansion, since output per hectare in these areas decreased.

Ten-year Trends

The average annual growth rates for the production of major food crops during 1961-70 and 1971-80 given in Table 8 show the drastic deceleration in the growth of food output in Brazil--from nearly 5 percent a year in the earlier period to just over 1 percent a year in the later period. Area expansion, which provided nearly 90 percent of food production increases in the 1960s, considerably slowed in the 1970s to less than half its average annual rate of the previous decade. However, this much-slowed growth in harvest area was still the source of output increases in the 1970s because of the decline of output per hectare in that period.

Among regions, growth in food production accelerated between the two decades in the North and Central West but underwent major slowdowns in the other regions. In the food-producing South, the annual rate of increase in output dropped from almost 7.0 percent in the 1960s to only 1.2 percent in the 1970s. Growth in food production in the Northeast decelerated from more than 4.0 percent a year to stagnation in the later period. In the Southeast, increases in output during the 1960s turned to production declines in the 1970s.

As a result of decreases in crop yield, increments in regional food production during the 1970s were all from area expansion. Crop yields made only minor contributions to output growth among the regions during the 1960s, particularly in the North (9 percent), South (17 percent), and Southeast (28 percent).

Ten-year trends for the principal food crop groups at the national level show the slowdown of area expansion and, consequently, of production growth in both cereals and, more drastically, noncereals. In

cereals, growth in harvest area contributed more than 90 percent of output increases during the 1960s. Deceleration of area expansion, coupled with some improvement in crop yield, reduced the relative share of harvest area to the slowed cereal production growth in the later decade.

Noncereal production during the 1960s outshone that of cereals. Increases of noncereal output exceeded 5 percent annually, and noncereal yields contributed more than a fifth of their production growth. However, the performance of noncereals during the following decade was poor because the harvest area was almost stagnant and output per hectare decreased. As a result, there was a rapid decline of 2 percent a year in the production of this crop group during the 1970s.

Among the regions and between decades, a deceleration in growth in harvest area, and consequently in production of both cereals and noncereals, occurred in the Northeast and the two southern regions. By contrast, the growth in harvest area and production of both crop groups accelerated in the North. With annual rates of growth in harvest area exceeding 5 percent in the 1960s, cereal production in the North, Central West, and South expanded rapidly in that decade. In the 1970s, growth in cereal production accelerated in the North and Central West. Although growth in cereal output slowed in the productive South from the 1960s to the 1970s, it remained fairly rapid during the later decade. Cereal production expanded at a very slow rate in the Southeast.

In 1961-70, except in the Southeast, growth rates for regional noncereal output of about 5 percent or more annually were achieved through rapid increases in the harvest area of this crop group. Improvements in output per hectare also helped to raise the noncereal production of several regions in that period. Poor performance in regional production of noncereals occurred in the 1970s with either rapid output declines or stagnant production, except in the North. The rapid growth of noncereal output in the North during 1971-80 could only partly offset the decreases in other regions because it accounts for just less than 10 percent of noncereal production in the country. Output per hectare of noncereals declined during the 1970s in all regions, including the North, where the rapid increase in the region's noncereal output came solely from growth in harvest area.

FOOD SITUATION IN 2000

Production

Based on data from Brazil's national statistical system, the production of major food crops in the country in 1980 was 42.6 million tons (Table 10). (See Appendix 1, Table 20, for additional regional data.) The FAO production figure for Brazil in that year was slightly higher at 42.8 million tons. Although the production statistics for

Table 10--Production and deficits of major food crops in Brazil: 1980 estimates and projections to the year 2000

Data Source/Level/Type or Approach	Production		Food Gap
1980 estimates (million metric tons)			
National source data	42.61		6.22
FAO data	42.84		5.99
Projections to 2000[a] (million metric tons)			
National source data			
Regional trends			
Production	82.03	(3.3)	9.28
Area and output/hectare	91.48	(3.8)	0.17
Country trends			
Production	73.54	(2.7)	17.77
Area and output/hectare	77.21	(3.0)	14.10
FAO data	74.82	(2.8)	16.49

Sources: Production figures based on data from Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária); and Food and Agriculture Organization of the United Nations, "Production Yearbook Tapes, 1975, 1979, 1981, and 1983," FAO, Rome, 1976, 1980, 1982, and 1984. Food gap figures are based on the consumption estimates and projections for Brazil drawn from the FAO data-based study by Leonardo A. Paulino, Food in the Third World: Past Trends and Projections to 2000, Research Report 52 (Washington, D.C.: International Food Policy Research Institute, 1986), showing an actual estimate in 1980 of 48.83 million metric tons and a projected demand in 2000 of 91.31 million metric tons.

[a] Based on 1961-80 trends. Figures in parentheses show the average annual growth rates (percent) of production corresponding to the projections.

Brazil that are available from the national system generally agree closely with those published by the FAO, as shown early in this report, estimates for individual years can differ significantly.

Assuming that the 1961-80 regional trends of food production in Brazil will continue into the future, the country's projected output of major food crops by the year 2000 would reach 82 million tons, or almost twice its production of these commodities in 1980. This would be equivalent to a projected yearly increase of 3.3 percent in the national food output, compared with the 2.7 percent annual rate reported during 1961-80. More than one-half of the projected production would come from the South, whose projected 4.1 percent annual production growth rate would raise its relative share by seven percentage points above its 45.0 percent contribution to Brazil's food production in 1980. Relative shares are projected to increase also for the Central West and North regions.

With slower growth rates for food output, the Northeast and, especially, the Southeast would absorb the corresponding declines in relative contributions to the country's projected production. The near-stagnant growth projected for food production in the Southeast would reduce the region's 1980 share of food output of 22 percent to only 12 percent in the year 2000. It would then become the second smallest contributor to the country's food production, after the Northeast, which is projected to account for 6 percent at the end of the century.

If, instead of production trends, the regional trends of harvest area and output per hectare during the 1961-80 period are used for these projections, Brazil's output of major food crops would reach 91.5 million tons, or about 12 percent larger. This is with the added assumption that neither of the two factors would decline after 1980 if their trends are negative. Declines in either area harvested or output per hectare arising from negative trend rates are part of the projections when using production trends. The 1961-80 data show declining trends in harvest area in the Southeast and in output per hectare in the other regions.

Use of national-level time-series data, that is, aggregates of the annual estimates of the five Brazilian regions, provides another pair of projections for the country. Assuming that the trend in national production during 1961-80 continues to the year 2000, Brazil's output of major food crops would be projected at 73.5 million tons. If the national-level trends in harvest area and output per hectare of the major food crops instead are projected to continue, subject to the assumption of negative growth rates given earlier, the country's projected food output by 2000 would reach 77.2 million tons. Brazil's average annual growth in output per hectare of major food crops during 1961-80 was -0.2 percent.

With FAO data for the same period, IFPRI's food gap study for Third World countries indicated a projected production of major food crops for Brazil of 74.8 million tons.[5] This was based on the country-level trend of food production. (Use of the alternative approach with FAO data is not made because area estimates for bananas and plantains are not available from the system.)

Food gaps. FAO data for Brazil show that the total domestic use of major food crops in the country during 1980 amounted to 42.8 million tons.[6] This meant a food gap in that year of 6.2 million tons, if matched with national-source production estimates. A slightly smaller deficit of 6.0 million tons is indicated if based on FAO production figures. (FAO trade data for Brazil show net imports of these commodities in 1980 amounting to 6.1 million tons.)

The IFPRI study cited earlier projected Brazilian demand for the major food crops to the year 2000 at 91.3 million tons.[7] With the different production projections tried here using national-source estimates for the 1961-80 period, the food deficit projections for the country by the end of the century range from a small 0.2 million tons, if projection of future production is based on the regional trends of harvest area and output per hectare, to a sizable 17.8 million tons on the basis of country-level output trends.

Given the range of Brazil's food gap projections, the deficit of 9.3 million tons based on the regional output trends for the projected production appears to be an average measure. The projection of food production that results in this food gap gives increased weight to regional output performance; furthermore, the use of production trends restrains the additional upward bias of projecting output with the use of area and output per hectare trends. Table 10 shows that using FAO data for both consumption and production projections would result in a larger projected food deficit for Brazil--16.5 million tons by the year 2000.

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[5]Paulino, Food in the Third World.

[6]As mentioned in the discussion on methodology, the FAO consumption data are used to complement the national source production estimates to show scenarios of Brazil's 1980 and prospective food situation.

[7]Paulino, Food in the Third World, p. 60. Demand projections in the study assume the continuation of the 1966-80 trends in GNP per capita and use the United Nations medium variant population projections.

5. FOOD TRENDS IN NIGERIA

Nigeria is located on the West Coast of Africa and is bordered on the west by Benin, on the north by Niger, on the east by Cameroon, and on the south by the Atlantic Ocean (Figure 2). The climate is tropical, characterized by high humidity, generally high temperature, and substantial rainfall in coastal lands, decreasing northwards where rain may occur for about five months of the year. There are two broad seasons--the wet from about April to October and the dry from about November through March of the following calendar year.

POPULATION AND FOOD PRODUCTION

Three factors have influenced population distribution and food production in Nigeria since its independence in 1960; namely, the civil disturbances of 1966, the creation of new states in 1967 and 1976, and the emergence of oil revenues. Far-reaching population movements took place because of the civil disturbances in the mid-1960s as people returned to their places of ethnic origin across the country. The creation of new states with new state capitals accelerated the movement of people away from the rural or semiurban areas and rapidly increased urbanization, which rose from 13 percent of the total population in 1960 to 21 percent in 1980. This resulted in the reduction of rural farming households, which, in turn, adversely affected the total area under cultivation. Total labor force in agriculture declined from 71 percent in 1960 to 54 percent in 1980. Increased urbanization and falling domestic food production expanded the demand for food imports, which were facilitated by increased foreign exchange earnings from oil exports.

In 1983, the estimated population of Nigeria was close to 92 million and the total major food crop production in that year was 13.5 million tons, or a per capita food output of nearly 150 kilograms. Relative to these national totals, the large Northern region accounted for more than half of the population and four-fifths of the output of food crops in that year. The Eastern region shared about 22 percent of the population but only about 10 percent of the food output. For the Western region, the shares of population and food output were 20 percent and 6 percent, respectively; those of the Mid-Western region were about 4.4 percent each (see Table 11).

Considering the 12-state structure, the contribution of the Northwestern state to food output was the highest. It accounted for 38 percent of the food production of Nigeria and 10 percent of its popula-

Figure 2--The four regions and twelve states of Nigeria

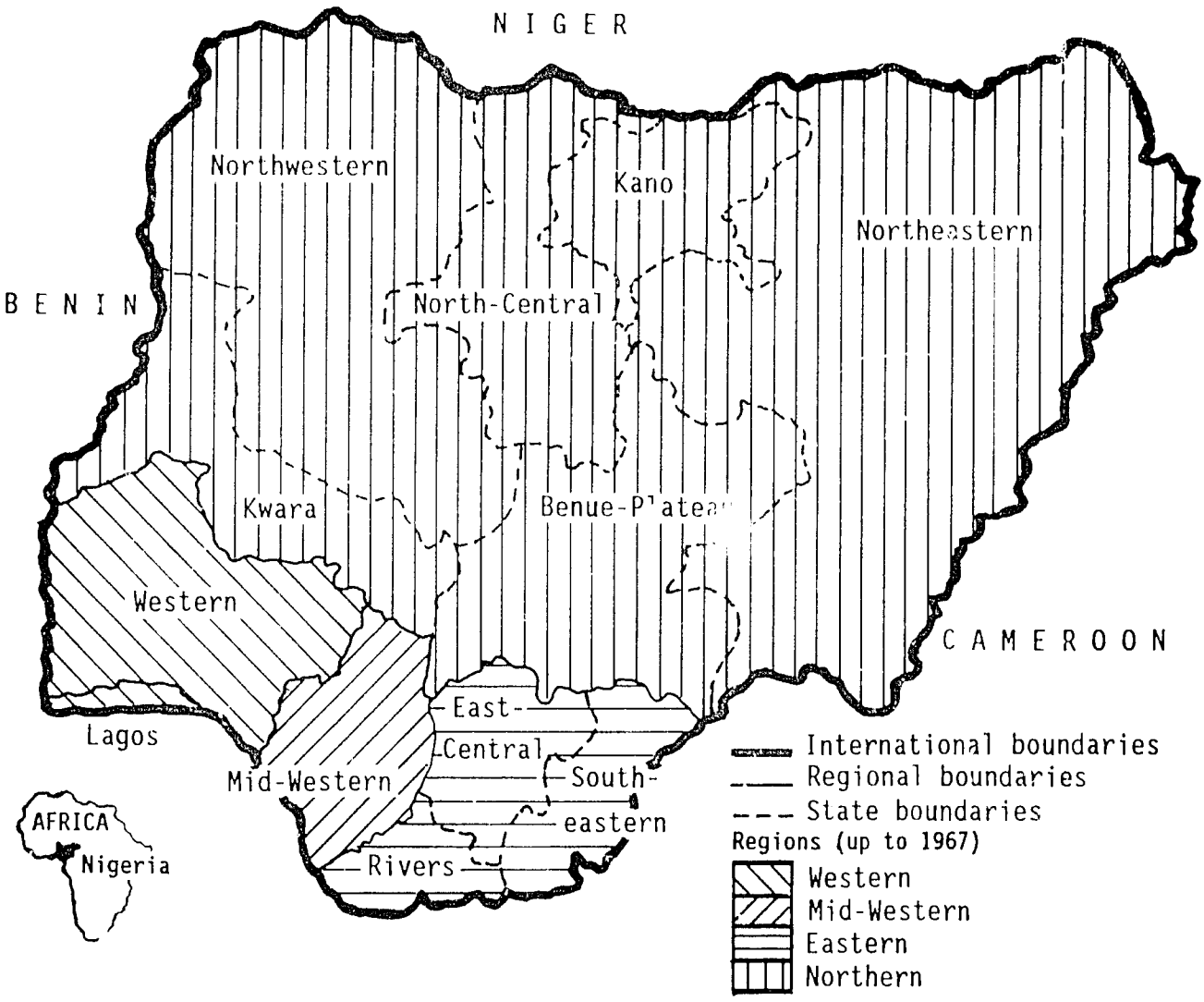

Table 11--Estimates of population and food production in Nigeria, 1983

Country/State/ Region	Population		Food Crop Production		
			Amount	Share	Per Capita
	(millions)	(percent)	(1,000 metric tons)	(percent)	(kilograms)
Nigeria	91.62	100.0	13,548	100.0	148
12-state structure					
Lagos	3.17	3.5	2	(a)	1
Western	15.44	16.8	822	6.1	53
Mid-Western	4.02	4.4	593	4.4	147
Rivers	2.81	3.1	265	2.0	94
Southeastern	5.69	6.2	167	1.2	29
East-Central	11.84	12.9	992	7.3	84
Benue-Plateau	7.28	7.9	1,184	8.7	163
Northeastern	13.08	14.3	1,681	12.4	128
Kano	9.44	10.3	876	6.5	93
North-Central	6.70	7.3	1,547	11.4	231
Northwestern	9.34	10.2	5,157	38.1	552
Kwara	2.80	3.1	261	1.9	93
4-region structure					
Western	18.61	20.3	824	6.1	44
Mid-Western	4.02	4.4	593	4.4	147
Eastern	20.34	22.2	1,424	10.5	70
Northern	48.65	53.1	10,707	79.0	220

Source: S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

Note: Parts may not add to totals due to rounding.

[a] Less than 0.5 percent.

tion in 1983. Next in importance is the Northeastern state, with one-eighth of the food production and 14 percent of the population. The Western state, with about 17 percent of population, contributed only 6 percent to food crop production.

The average annual production of food crops in Nigeria during 1979-83 was 12.1 million tons, of which 63 percent was cereals and 37 percent was noncereals; noncereals included yams and cassava (each contributing about 35 percent), and groundnuts, pulses, and cocoyam.[8] Nearly half of the output of cereals was accounted for by sorghum, followed by millet with 37 percent. Maize production was a little above 9 percent of the cereals (Table 12).

About 10.5 million hectares were under food crops during 1979-83, of which cereals accounted for about 70 percent. Among the noncereals, pulses occupied 1.4 million hectares or roughly one-eighth of the area under food crops, although their output formed less than 6 percent of the food crops. One-third of the total area in food crops was under sorghum, followed closely by millet with a 30 percent share.

Three-fourths of the food output in the Northern region was cereals, while in the other three regions cereals shared only 10-16 percent. Further, of the 7.7 million tons of cereal output in Nigeria, the Northern region accounted for more than 96 percent. In the case of noncereals, this region contributed only about 55 percent. Of the total food crop area harvested in Nigeria, nearly 70 percent was devoted to cereals and 30 percent to major noncereal food crops. Again, the bulk of the area under cereals was in the Northern region--more than 7 million hectares out of the total food crop area of almost 10 million hectares in this region (Table 13).

The average yield per hectare of major food crops in Nigeria was 1.15 tons during 1979-83. Noncereal crops yielded more on a per hectare basis, around 1.44 tons in cereal equivalents, while the yield of cereals was just slightly over 1 ton per hectare. At the regional level, the overall yield per hectare of major food crops in the Northern region was low, with the average yield per hectare of both cereals and noncereals just over 1 ton. The output per hectare of food crops in the three other regions varied between 2.3 tons and 2.9 tons. Yields of noncereals were relatively high in these three regions--3.7 tons in the Western, 3.1 tons in the Mid-Western, and 2.5 tons in the Eastern.

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[8]The period 1979-83 refers to the five crop years from 1979/80 to 1983/84.

Table 12--Distribution of area and production of major food crops in Nigeria, 1979-83 averages

Commodity	Area		Production	
	(million hectares)	(percent)	(million metric tons)	(percent)
Major food crops	10.54	100.0	12.06	100.0
Cereals	7.47	70.9	7.66	63.5
Rice	0.16	1.5	0.23	1.9
Maize	0.60	5.7	0.70	5.8
Millet	3.22	30.5	2.87	23.8
Sorghum	3.49	33.2	3.85	31.9
Noncereals[a]	3.07	29.1	4.41	36.5
Cassava	0.52	4.9	1.56	12.9
Cocoyam	0.05	0.5	0.05	0.5
Yam	0.60	5.7	1.59	13.2
Pulses	1.35	12.8	0.66	5.5
Groundnuts	0.55	5.2	0.54	4.5

Source: S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

Note: Parts may not add to totals due to rounding.

[a] The output of noncereals is in cereal equivalents.

Table 13--Production, area harvested, and yield per hectare of major food crops in Nigeria, by region, 1979-83 averages

Crop Group	Region				
	Western	Mid-Western	Eastern	Northern	Total
Major food crops					
Production (1,000 metric tons)	632	591	1,045	9,798	12,066
Area harvested (1,000 hectares)	221	227	454	9,634	10,536
Yield/hectare (kilograms)	2,855	2,598	2,304	1,017	1,145
Cereals					
Production (1,000 metric tons)	101	61	127	7,368	7,656
Area harvested (1,000 hectares)	77	56	84	7,251	7,468
Yield/hectare (kilograms)	1,309	1,090	1,516	1,016	1,025
Noncereals[a]					
Production (1,000 metric tons)	532	529	919	2,430	4,409
Area harvested (1,000 hectares)	145	171	370	2,383	3,069
Yield/hectare (kilograms)	3,675	3,093	2,482	1,020	1,437

Source: S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

Note: Parts may not add to totals due to rounding.

[a] The production and yield per hectare of noncereals are expressed in terms of cereal equivalents.

TRENDS IN AREA HARVESTED AND PRODUCTION OF FOOD CROPS

Despite improvements in the yield per hectare (Table 14), the output of food crops declined between 1961-65 and 1979-83 at the rate of 1.6 percent a year, largely as a result of a 2.8 percent average annual decline in harvest area. Among the cereals, rice and millet showed increases, but the output of the ranking crops, maize and sorghum, declined over this period. The area under all cereals declined, the rate of decline in maize being particularly rapid at 4.2 percent a year. Yields per hectare of all the cereals rose over the same period. The rates of growth in the yields per hectare of rice and millet were large enough to more than compensate for the decline in the harvested area.

The area harvested and production of noncereals declined at the rates of 4.0 and 3.2 percent, respectively. Absolute declines in the area under cocoyam, groundnuts, and yams were particularly large. In the case of cocoyam, overall production declined at more than 10.0 percent a year, with the area declining at nearly 9.0 percent a year; these rates indicate that yield per hectare declined as well. Although yields per hectare of the other noncereals showed positive growth rates, these were more than offset by the rates of decline in harvested area, with the result that production declined by 4.4 percent a year in the case of yams, 4.2 percent for groundnuts, and 2.0 percent for cassava.

Regional data show that for the period between 1965-69 and 1979-83, the output of food crops in Nigeria decreased by 2.7 million tons, of which the decline in the Western region of 2.0 million tons was the largest. While cereal production showed a small increase of 125,000 tons during this period, that of noncereals exhibited a major decline of 2.8 million tons. Yams accounted for 1.1 million tons of this decrease in output, while groundnuts and cassava represented about equal shares of their joint production decrease of 1.5 million tons. Of the decline in food crop production in the Western region, nearly 70 percent was in the output of noncereals. Cassava and yams together accounted for 92 percent of this decline. Although the output of cereals in the Northern region increased by 750,000 tons, this area's overall food crop production showed a decrease because of the decline by about 1 million tons of noncereals.

Based on food production data available for 12 states, food crop production in Nigeria between 1969-73 and 1979-83 declined by 2.9 million tons, comprising about 0.2 million tons of cereals and 2.7 million tons of noncereals. More than one-half of the decline in food crop production was in the Western state (1.5 million tons). Again, two-thirds of the decline in this state was in noncereals, largely in cassava and yams. The Northwestern state, however, exhibited an increase of 1.4 million tons of cereals, comprising sorghum and millet. In this state, the output of groundnuts and pulses also increased, contributing to a net increase of nearly 0.2 million tons in the output

Table 14--Average annual growth rates of production, area harvested, and yield per hectare of major food crops in Nigeria, 1961-65 to 1979-83

Crop Group/Crop	Production	Area Harvested	Output per Hectare
		(percent)	
Major food crops	-1.6	-2.8	1.3
Cereals	-0.3	-2.2	1.9
Rice	1.8	-0.7	2.5
Maize	-2.5	-4.2	1.8
Millet	0.5	-1.7	2.3
Sorghum	-0.5	-2.2	1.8
Noncereals	-3.2	-4.0	0.9
Cassava	-2.0	-2.2	0.3
Cocoyam	-10.1	-8.7	1.5
Yam	-4.4	-5.0	0.6
Pulses	0.9	-2.3	3.2
Groundnuts	-4.2	-6.5	2.5

Source: S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

of noncereals. Smaller increases in the output of food crops were reported also in Benue-Plateau and Rivers states. Both the Kano and North-Central states showed large declines in the output of food crops; production in these two states decreased a total of 1.5 million tons.

Except in the case of cocoyam in all the regions, cassava in the Mid-Western and yams in the Western region, the yield per hectare of major food crops generally showed a positive growth between 1965-69 and 1979-83. The growth in the yield per hectare of major food crops in the country in this period was a rapid 3.9 percent a year. However, area harvested declined in all the regions and for all major food crops. The rates of decline in total area under food crops were particularly high, decreasing by as much as 12.0 percent a year in the Western region, where major reductions in area harvested occurred for both cereals and noncereals. Decreases in the area under food crops in the Northern and Mid-Western regions were relatively small. The large declines in area harvested and small increases in yield per hectare resulted in an overall decline in the production of food crops in all four regions. The rate of decline of output in the Western region of nearly 10.0 percent a year was the highest, while the lowest was in the Northern region at 0.2 percent a year.

An examination of the rates of change in production between the years 1969-73 and 1979-83 for food crops, cereals, and noncereals in each of the 12 states also shows similar trends. In general, the yield per hectare of crops increased over this period and area harvested declined. The rates of decline in the harvest area under food crops exceeded 10 percent a year in the Western, Southeastern, and Kwara states.

Analysis of food production trends by crop based on regional and state data reveals that only rice, millet, and pulses showed positive growth rates for production, mainly because the larger increases in productivity of these crops outweighed the decline in the area harvested. In general, the major source of decline in food production during the observed period was the reduction in the cultivated area, which was the result of people leaving farming. Much of the decrease in food production was in root crops, mainly yams and cassava. There was the possibility of food production decline having regional and state biases, since movement away from farming was quite uneven among regions. Much of the impact of the decline in food production had been on the southwestern part of the country, where urbanization was more significant; this area is also close to the federal capital city of Lagos. Yams and cassava, the output of which declined more steeply, also form a major source of food in this part of Nigeria.

FACTORS INFLUENCING PRODUCTION TRENDS

As referred to earlier, the number of farming households, which averaged 8.8 million during 1973-75, declined to 5.6 million during

1981-83. This reduction adversely affected area under cultivation. In particular, the area under food crops declined considerably, which resulted in a decrease in overall food production during this period.

Virtually all crops in Nigeria are produced under rainfed conditions. Until 1970, only a limited crop area was under controlled irrigation and drainage. Subsequent national development plans attached importance to irrigation and several river-basin development projects were undertaken. In the 1981-85 development plan, 35 percent of the total allocation for agriculture was earmarked for the development of water resources. As of September 1984, of the expected 250,000 hectares of land to be irrigated, only 33 percent had actually been irrigated. Most of this area is located in the Northern region of the country.

A major input for agricultural production is fertilizer. The supply of fertilizers in Nigeria rose almost thirtyfold from the early 1960s to an average of 0.6 million tons a year during the 1979-83 period. Domestic production during this later period was less than 50,000 tons and the rest was imported from outside. Five states, Benue-Plateau, Northeastern, Kano, North-Central, and Northwestern, got 85 percent of the supplies and accounted for more than 90 percent of the area fertilized. Data on the amounts of fertilizer actually used by the farmers are not available over a long period. However, although much fertilizer was reported to have been wasted between 1969-73 and 1974-78, part of the increase in yields per hectare observed in different states for different crops can be attributed to increased fertilizer application.

Use of animal power in Nigerian agriculture is limited. The country's Ministry of Agriculture and Natural Resources maintains in each state a fleet of tractors and implements for hire to the farmers for plowing and seedbed preparation, with the heavy equipment generally used for land clearing and stumping. As of 1979, all tractors were imported and, moreover, they were of different makes with no standardization. Tractor imports rose from fewer than 500 in 1968 to almost 5,000 in 1976, but these decreased to 3,300 in the early 1980s. Most of the tractors bought since 1979 are shared between individual large private farms and associations of small farmers.

FOOD CONSUMPTION TRENDS

The years 1961-65 appear to be the main period when Nigeria had reasonable food availability and imports of food were at the lowest levels. Food imports averaged 36,000 tons a year during this period but rose to nearly 0.60 million tons by 1976 when Operation Feed the Nation, a program designed to increase food production, was launched. Imports went up further to 0.86 million tons in 1980 when the "green revolution" program replaced the earlier program. By 1983, imports of major food crops had risen to 1.4 million tons. Over this period,

exports of food crops, mainly groundnuts, of over 0.80 million tons (in cereal equivalents) a year during 1961-65, completely disappeared by the beginning of the 1979-83 period.

Consequently, between 1961-65 and 1979-83, the total consumption of the major food crops declined by an average rate of 0.8 percent a year compared with the decrease of 1.6 percent a year in their output. The much slower decline in consumption compared with domestic production was made possible by the expansion of food imports.

Among major food crops, the average consumption of cereals increased from 8.1 million tons during 1961-65 to 8.9 million tons during 1979-83, or about 0.5 percent a year. On the other hand, over the same period, noncereal consumption declined from 7.1 million tons to 4.4 million tons. The average yearly net imports of cereals in Nigeria increased to 1.2 million tons during 1979-83, comprising 0.65 million tons of wheat, 0.44 million tons of rice, and 0.13 million tons of maize.

Relative to total domestic use, the direct consumption of these crops for food increased from about 71 percent in the earlier period to 77 percent in the later period, although in absolute terms their use directly for food declined from 10.9 million tons to 10.3 million tons over the same period. The per capita consumption of major food crops as a group decreased considerably, from 195 kilograms in 1961-65 to 118 kilograms in 1979-83, or roughly 40 percent in the intervening period. The use of food crops as animal feed increased from 0.26 million tons in the early 1960s to 0.32 million tons in the early 1980s.

TRENDS IN PRODUCTION AND CONSUMPTION OF LIVESTOCK PRODUCTS

Available estimates show that the average annual livestock population in Nigeria during 1979-83 comprised 5.8 million cattle, 10.8 million sheep, 26.2 million goats, 0.7 million pigs, and 64.6 million poultry. Most of the livestock and poultry population was in the Northern region, which accounts for almost all of the cattle, about 90 percent each of sheep and goats, and 70 percent each of pigs and poultry in Nigeria. Compared with the averages during 1963-65, sheep showed the fastest increase--2.7 percent a year, followed by cattle with 2.2 percent. Pig numbers, however, declined at an annual rate of 2.2 percent. The annual rates of increase in poultry and goat populations were 1.2 and 1.8 percent, respectively.

Data on the yearly slaughter of livestock show much smaller numbers, averaging 1.6 million cattle, 0.8 million sheep, 1.9 million goats, and fewer than 0.1 million pigs during 1979-83. The relative share of each region in the number of slaughtered animals is closely proportionate to the share of the total population that consumes the type of meat.

Between 1963-65 and 1979-83 the average annual production of meat in Nigeria increased by only 62,000 tons, to 0.27 million tons by 1979-83, or an average annual growth rate of 1.5 percent. Cattle and goats accounted for 57.0 percent of the output in 1963-65, a share that increased to around 62.0 percent in 1979-83. However, the production of pork rapidly declined at an average of 1.9 percent a year.

Milk production increased from around 0.15 million tons in 1963-65 to 0.22 million tons in 1979-83, representing an average increase of 2.2 percent a year. The output of eggs rose at the faster rate of 2.7 percent a year, with average annual production increasing from 67,000 tons to 105,000 tons over the same period.

Average consumption of meat rose from 0.24 million tons a year during 1963-65 to 0.37 million tons a year in 1979-83, showing an average annual increase of 2.6 percent. This was much faster than the rate of increase in the output of meat. The more rapid increase in consumption of meat was made possible by the increase of meat imports into Nigeria--from 28,000 to 95,000 tons over this period. More than a tenfold increase in milk imports--from 17,000 tons (in terms of whole milk) in 1963-65 to 181,000 tons in 1979-83--enabled rapid growth in its consumption. The consumption of milk, which rose at 5.2 percent a year, increased from 0.17 million tons to 0.40 million tons over the same period. In the absence of recorded trade in eggs, their entire output is treated as consumed within the country.

FOOD PROJECTIONS TO 2000

Major Food Crops

The section on methodology mentioned two types of data series that were used in projecting the output of major food crops in 2000: (1) regional-level estimates of area and yield per hectare for the years 1965 to 1983 and (2) state-level estimates of area and yield per hectare for the years 1965 to 1983.[9] Using trends shown by both sets of estimates, the projected output is calculated by multiplying the projections of area and yield per hectare for each crop and then aggregating the results for all food crops. The projections thus obtained are given in Table 15.

The total area under food crops is projected on a regional basis at around 10.0-10.5 million hectares in 2000, or about the same level prevailing in 1979-83. Output projections based on the 12-state series of data are about 15 percent higher than those based on the 4-region structure. Cereals represent about two-thirds of the projected total

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[9]See S. O. Adamu, "Analysis of Trends and Projections," for another set of projections based on national aggregates, but not presented here.

Table 15--Alternative production projections for Nigeria in the year 2000

Crop	Projected Production in 2000	
	Based on 4-Region Structure, 1965-83	Based on 12-State Structure, 1969-83
	(million metric tons)	
Major food crops	19.38	22.26
Cereals	13.03	14.66
Rice	0.57	0.47
Maize	1.10	1.48
Millet	5.41	5.32
Sorghum	5.95	7.38
Noncereals[a]	6.35	7.60
Cassava	1.80	2.83
Cocoyam	0.06	0.07
Yams	1.93	2.16
Pulses	1.85	1.59
Groundnuts	0.67	0.95

Source: S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

Note: Parts may not add to totals due to rounding.

[a] Noncereals are in wheat equivalents.

in both cases. The major cereals are sorghum and millet, which together form 86 percent of the total cereal production projected for 2000. For the noncereals, cassava and yams share about 60-65 percent of total projected output.

Compared with the average levels of production in 1979-83, the projected levels in 2000 imply annual growth rates of 2.5 percent under the 4-region structure and 3.3 percent for the 12-state structure.

Two annual rates of population growth, namely 2.5 percent and 3.3 percent, and two annual rates of per capita income, namely 3.0 percent and 5.0 percent, were assumed in calculating the demand projections. The projected population in 2000 worked out to about 140 million under the lower growth assumption and to 160 million under the higher. The three projections of demand for food crops in Nigeria, including the requirements for human consumption, feed, seed, and industrial use and allowance for waste, range between 22.3 and 25.4 million tons, as shown in Table 16.[10]

The resulting supply-demand balances are projected to be deficits ranging from 2.9 to 6.0 million tons if the output projections are based on the 4-region structure. If, however, projections are based on the 12-state structure, the projected levels of production in 2000 will be larger and the resulting smaller deficits would range from a near-balance under Assumption A to a net deficit of 3.2 million tons under Assumption C.

If per capita income growth accelerates to 5.0 percent and if the population growth rate continues to be high, the output of food crops would need to grow at 4.0 percent a year over the average production level during 1979-83, compared with the projected growth of 2.5 percent under the 4-region structure and 3.3 percent under the 12-state structure.

Livestock and Poultry Products

Projections of output of livestock products to 2000 are extrapolations of past trends in the production of meat, milk, and eggs in each region. The regional estimates are aggregated to give the national output projections for 2000. In the case of consumption, the method adopted to project demand follows that used for food crops. The detailed assumptions are given in Appendix 2, Methodology.

Based on the above-mentioned assumptions, the output of livestock products in Nigeria in 2000 is projected to reach about 0.36 million

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[10]See S. O. Adamu, "Analysis of Trends and Projections," for another set of demand projections that assumes a population growth of 3.3 percent and per capita income growth of 5.0 percent. These are not presented here.

Table 16--Projected demand and deficits of food crops in Nigeria in the year 2000

Assumption	Projected Demand	Projected Deficits: Based on 4-Region Structure	Projected Deficits: Based on 12-State Structure
	(million metric tons)		
A. Population growth, 2.5 percent; Per capita income growth, 3.0 percent	22.3	2.9	0.1
B. Population growth, 2.5 percent; Per capita income growth, 5.0 percent	24.4	5.0	2.2
C. Population growth, 3.3 percent; Per capita income growth, 3.0 percent	25.4	6.0	3.2

Source: S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

tons of meat, 0.25 million tons of milk, and 0.15 million tons of eggs. These projected levels represent increases over the base level (1979-83 average) of 33 percent for meat, 13 percent for milk, and 44 percent for eggs. Projected demand for the livestock and poultry products varies according to the assumptions regarding population and per capita income growth. Table 17 shows the estimates of demand and projected deficits based on these assumptions.

The table also indicates the growth rates in output required to meet the projected domestic requirements from indigenous production. Very rapid growth rates ranging from 7 to 14 percent a year are required to achieve self-sufficiency in these products. Such rapid growth would also make large demands on feed grains. If domestic production is not accelerated, Nigeria would have to resort to large imports to meet its domestic needs.

Table 17--Projected demand and deficits of livestock products in Nigeria by the year 2000

Commodity	Assumptions Regarding Growth of Population and Per Capita Income[a]		
	A	B	C
	(thousand metric tons)		
Meat			
Demand	1,032	1,493	1,197
Deficit	670	1,131	835
Output growth rate required for self-sufficiency	(8.2)	(10.6)	(9.1)
Milk			
Demand	1,257	1,943	1,458
Deficit	1,009	1,694	1,209
Output growth rate required for self-sufficiency	(10.8)	(13.6)	(11.7)
Eggs			
Demand	330	510	383
Deficit	179	359	232
Output growth rate required for self-sufficiency	(6.9	(9.7)	(7.9)

Source: S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

Note: Figures in parentheses are in percent per year.

[a] A = 2.5 percent population growth and 3.0 percent per capita income growth; B = 2.5 percent population growth and 5.0 percent per capita income growth; and C = 3.3 percent population growth and 3.0 percent per capita income growth.

6. COMPARISON OF RESULTS WITH THOSE OBTAINED USING FAO DATA

As shown in the preceding two chapters, this study has used estimates from national sources to examine past trends in food production and to develop output projections to 2000 for Brazil and Nigeria. In assessing the food projections of these two countries, it would be useful to compare the study results with those obtained with the use of FAO data in order to identify the areas of major divergence for possible reconciliation or data improvement, or both. It may be pointed out that the national-level approach that is necessarily followed when using FAO data is not expected to give the same results as those based on regional or state levels, even if the aggregated estimates for the country in the latter cases are identical with the FAO estimates.

A detailed examination of the production trends drawn from data furnished by national sources is made below for Brazil and Nigeria by comparing these trends and their resulting projections to 2000 with those arrived at using FAO data. The overall trends in food production and consumption in the two countries, as reflected by FAO estimates, were presented earlier in this report.

BRAZIL

The close agreement between the FAO estimates and those of the national data system for Brazil on the production of major food crops was discussed in Chapter 2. Such data agreement is further shown in Table 18, which presents the trends in production and harvest area of individual crops drawn from time-series estimates for the 1961-80 period from the two data sources. It is readily noted that the corresponding average annual growth rates for both production and area harvested (and, consequently, of output per hectare also) are almost identical for the major food crops. The divergences between the percentage growth rates from the two sources for each crop are only in the first and second decimal places, except for the coarse grains other than maize. As shown before, these other coarse grains form only a small fraction of the production of major food crops in Brazil and are produced only in the South region of the country. It can be observed also that, in the case of harvest area, no estimates on bananas and plantains are available from the FAO data system; excluding these crops, however, the average annual growth rates of the harvest area for noncereals are identical for both data sources.

Despite almost equal production trends shown by the two data sets, the country-level projections of food production to 2000 given in Table

Table 18--Estimates of annual growth rates of production and area harvested of major food crops in Brazil and Nigeria obtained from FAO and national source data, 1961-80

Crop	Brazil				Nigeria			
	Production		Area Harvested		Production		Area Harvested	
	FAO	National Source	FAO	National Source	FAO[a]	National Source[b]	FAO[a]	National Source[b]
	(percent)							
Major food crops	2.8	2.7	...	3.0	0.9	...	...	...
(Excluding bananas and plantains)	(2.7)	(2.7)	(3.0)	(3.0)	(0.9)	(-1.6)	(1.1)	(-2.8)
Cereals	3.8	3.8	3.5	3.4	0.9	-0.3	1.2	-2.2
Wheat	(c)	(c)	(c)	(c)	1.9	...	0.0	...
Rice	2.3	2.4	3.0	3.0	9.5	1.8	6.2	-0.7
Maize	3.7	3.7	2.5	2.5	2.7	-2.5	2.3	-4.2
Millet and sorghum	(c)	(d)	(c)	(d)	0.1	-0.1	1.9	-2.0
Other grains	6.8	5.3	4.5	3.0	2.8	...	1.2	...
Noncereals	0.9	0.9	...	1.9	0.8	...	...	...
(Excluding bananas and plantains)	(0.6)	(0.5)	(1.9)	(1.9)	(0.9)	(-3.2)	(0.8)	(-4.0)
Roots and tubers	0.8	0.8	1.5	1.4	2.3	-3.6	0.9	-4.2
Pulses	0.6	0.6	2.7	2.7	2.3	0.9	3.8	-2.3
Groundnuts	-2.8	-2.8	-3.3	-3.3	-6.9	-4.2	-6.4	-6.5
Bananas and plantains	4.9	4.9	(d)	2.4	-0.2	(d)	(d)	(d)

Source: S. O. Adamu, "Analysis of Trends and Projections of Food Production and Consumption in Nigeria," a preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed); Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária); and Food and Agriculture Organization of the United Nations, "Production Yearbook Tapes, 1975, 1979, 1981, and 1983," FAO, Rome, 1976, 1980, 1982, and 1984.

[a] From 1961-65 to 1978-82.
[b] From 1961-65 to 1979-83.
[c] More than 10 percent.
[d] No available estimates.

10 show 73.5 million tons, using national source data, and 74.8 million tons, using FAO estimates. The FAO data-based output projection exceeds that from national-source estimates by 2 percent. Considering the close agreement of the two data sets, this would indicate the sensitivity of these projections to even slight differences in annual growth rates, particularly for long projection periods. On the basis of country-level trends of harvest area and output per hectare, the projected production from national-source estimates rises above that using output trends by 3.7 million tons or 5 percent, and about 3 percent over the FAO data-based projection.

Using the trends for food output, the aggregate of the projections for food production for the five regions of Brazil amounts to 82.0 million tons, or 12 percent higher than its counterpart projection using country-level trends. And finally, if regional projections are based on trends in harvest area and output per hectare, the aggregate projection for the country would increase steeply to 91.5 million tons, a level that is again 12 percent larger than the regional aggregate based on output trends. These two regional aggregates are respectively 10 percent and 22 percent over the FAO data-based output projection for Brazil.

These different projections of food output for Brazil, for which country production data from the national system closely agree with those published by the FAO, provide useful comparisons among possible approaches in using the trends in production, harvest area, and output per hectare for these projections. Food production projections based on trends exhibited by country subdivisions are larger than those based on country-level trends. It is also observed that projections based on output trends would be smaller than, or at most equal to, those based on the trends of harvest area and output per hectare at the same geographical level, if neither of the two components is allowed to decline. With the use of production trends, projected output would increase even if one of the two components is declining, as long as the increases from one component more than offset decreases from the other. If zero growth is assumed for negative trends of harvest area or output per hectare during the projection period, the production projections based on their trends would be larger than those based on output trends alone.

Thus, in increasing order, Brazilian output projections based on the kind of trends and level of approach used would be (1) production trends at the country level, (2) trends of harvest area and output per hectare at the country level, (3) production trends at the regional level, and (4) trends of crop area and output per hectare at the regional level. The output projection based on the production trends drawn from FAO data falls between (1) and (2). What seems clear here is that the more disaggregated the data on which the trends for the projections are based, the larger the projection of production.

NIGERIA

Compared with the output projections for Brazil, those for Nigeria are much more difficult to assess if the results obtained from FAO data are used as the basis for comparison. As shown early in this report, the national-source estimates on food production for Nigeria are widely divergent from corresponding FAO data for the country. As a consequence, the calculated annual growth rates for production and harvest area that are drawn from the two sets of data vary considerably (Table 18).

Average annual growth rates shown by national-source data of both production and harvest area of cereals and noncereals have opposite signs compared with those obtained from FAO data. For major food crops as a whole, and excluding bananas and plantains, national-source data show an average rate of decline of 1.6 percent a year, whereas FAO estimates give an average rate of increase of 0.9 percent a year for about the same period--from the early 1960s to the early 1980s; annual growth rates for harvest area from the two sources are -2.8 percent and 1.1 percent, respectively. National-source estimates indicate declining production and harvest area for both cereals and noncereals in the country. FAO data, on the other hand, show increases in production and area for both crop groups, although at slow rates. As suggested by the growth rates of production and harvest area from national-source estimates, output per hectare of all the food crops increased.

Among the individual food crops, there was little agreement in the signs of the estimated growth rates for both production and area harvested. In cases where signs of growth rates agree, the absolute levels differed widely, except in the harvest area of groundnuts. Both FAO and national-source data show increasing production of rice, a relatively minor crop in Nigeria, but the FAO data-based growth rate is five times higher than the rate obtained from national-source estimates. Data from both sources indicate rapidly declining production and harvest area for groundnuts, a major foreign exchange earner of Nigeria in the 1960s; however, the rate of decline in production shown by FAO estimates is much faster than the rate shown by national-source data. The only agreement is in the harvest area of groundnuts, for which both data sources show almost identical rates of decline.

The calculations made earlier for Brazil show the divergence that can result in the trend output projections even from nearly identical estimates of production growth rates. With the wide differences of the trends shown between those obtained from FAO and national-source data in production and harvest area for Nigeria, very large variations can be expected in the projections of food production for the country. However, the aggregates of regional and state food output projections to 2000 for Nigeria based on national-source data of 19.4 million tons and 22.3 million tons, respectively, are close to the 20.4 million tons obtained using FAO data.

With the observed declining production trends in most food crops, and a much lower base level (production in the early 1980s) for projections compared with those using FAO estimates, the resulting projected level of output in 2000 for Nigeria is reached as a result of upward tendencies in the method of projection that is used. As noted in the production projections for Brazil, highly disaggregated projections are biased upward. For Nigeria, these result from using (1) trends in harvest area and output per hectare, instead of the production trend, (2) regional and state trends, instead of country-level trends, and (3) individual crop trends, instead of the overall trends for major food crops as a group.

As shown earlier, projections of food consumption for Nigeria are developed in this study based on assumptions regarding population and income growth rates. As in IFPRI's food gap analysis, these demand projections are at the country level. However, the projected levels of food demand obtained here for Nigeria are comparatively much lower than the projections based on FAO data. The scenario showing the largest demand projection assumes a population growth rate of 3.3 percent a year, as in the IFPRI study, and a GNP per capita annual growth rate of 3.0 percent.

The relatively low level of Nigeria's projected food demand to 2000 shown here may be traced to two factors. First, in the absence of consumption data that are consistent with the production estimates from national sources, this study assumes that consumption in Nigeria equals production plus net imports. Assuming that the population estimates used in both studies are the same, the base level of per capita consumption in this study would be lower than the FAO base level because of the low national-source estimates of production during the 1970s. These base levels serve as starting points for the per capita consumption projections. Second, the IFPRI food gap study used the 1966-80 annual growth rate in per capita GNP of 4.5 percent, which is much faster than the cited scenario with the highest demand projection for Nigeria in 2000.

7. CONCLUSIONS AND FOOD POLICY IMPLICATIONS

In attempting to examine the food trends and develop food projections for Third World countries with the use of data from national systems to complement the estimates available from FAO, this study found two selected countries whose national-source estimates at the country level on food production relate differently to those from FAO. Data from Brazil's national system for 1961-1980 are essentially those published by FAO, as reflected by the very close agreement of the two data sets. In the case of Nigeria, however, although food production estimates from national sources were close to FAO data for the early 1960s, estimates for the 1970s are widely divergent from those published by the international agency. The agreement between FAO data and estimates from national sources for Brazil provided the opportunity to compare the food projections from different approaches in using the regional-level components of the latter set with the country-level projections developed from FAO estimates. For Nigeria, food projections are developed using regional and state-level data and observations made based on the behavior of results shown for Brazil.

This chapter highlights some of the study results, the conclusions that may be drawn from them, and some of their implications for food policies in the two countries.

Trends in the production of major food crops in Brazil show that the growth rate for food production in Brazil during 1961-1980 was just slightly faster than the 2.6 percent annual rate of population increase. The country relied almost entirely on area expansion for the increases it achieved in food output during the 1960s and 1970s. The output per hectare of major food crops as a whole declined and the relatively small contributions of increases in crop yields to production growth occurred only in the coarse grains. Production performance could have been much better if not for the considerable deceleration in area expansion, from over 4 percent a year in the 1960s to less than 2 percent a year in the 1970s. Food production during 1961-70 ex[illegible] by almost 5 percent annually.

Regionally, food output had the fastest growth in the North region where production more than doubled between 1961-65 and 1976-80. But this region, which has the largest area but is the least populated in Brazil, represents less than 5 percent of Brazil's food production. Both the Central West and the South almost doubled their output, but production in the Northeast, where the country's poverty problem is largely found, expanded by less than 50 percent. A major change in Brazilian agricultural production since the early 1960s has been the

greatly reduced importance of the densely populated and more developed Southeast region as a food producer. The share of the Southeast in the production of the country's major food crops dropped from about one-third during the early 1960s to 22 percent in the late 1970s.

The various approaches used in projecting Brazilian food production from national-source data result in different levels of projections to the year 2000. Use of country-level trends gives lower projections than those based on regional trends; also, at each of these geographical levels, the use of production trends results in a lower projection than that based on a combination of the trends of harvest area and output per hectare. As seen in Chapter 6, the output projection to 2000 based on the country-level trend of production differs only slightly from that using FAO data. With Brazil's declining output per hectare, and hence an assumed zero growth for the projection period, the projected output level in 2000 on the basis of the trends in both harvest area and output per hectare becomes higher than the projection based on production trends. The regional-level projections, which use the combined trends, give the highest output projection for the country.

The aggregate of regional projections based on the production trends appears to be about the average level of these food production projections to the year 2000 for Brazil. It provides an adequate reflection of the changes in food production among regions, as drawn from national-source data, and excludes the further upward bias resulting from the use of regional trends in harvest area and output per hectare. Based on the demand projection to 2000 for Brazil in IFPRI's food gap study of Third World countries, this projection of the production of major food crops in the country indicates a potential food deficit of 9.3 million tons, or about 10 percent of the projected demand. (The projection of production based on FAO data results in a projected food deficit of 16.5 million tons.)

With its large agricultural potential, land-rich Brazil would likely fill its projected deficit through a faster growth of food production compared with the past trend. While the country could possibly reaccelerate area expansion, which this study has clearly shown was mostly the source of growth in food production in that period, the improvement of output per hectare appears to have a big potential. Data indicate that overall crop yield declined during 1961-1980 both regionally and for the country as a whole. Increases in output per hectare provided limited contributions to food production growth in the 1960s, and crop yields even declined in the 1970s. Improvements in the growth rates for both harvest area and output per hectare for the major food crops could easily achieve an average annual increase in Brazil's food production of 3.9 percent, which would lead to projected food output matching projected food demand in the country in 2000.

In the past, Brazil has depended heavily on the South as its breadbasket. Although this region is smallest in terms of land area,

it accounted for about one-third of the country's food output in the early 1960s. The concentration of food production in the South increased further during the two study decades with the decline in importance of the Southeast region as a food producer. The 1976-80 averages of food production in Brazil show that the relative share of the South had risen to more than 40 percent. If the regional trends in output continue, the South is projected to account for more than one-half of the country's food production in 2000. An option worth considering here would be reducing major reliance on one area as a food source and improving food production in other areas to lessen the risks of regional crop failures. The Schuh-Alves study mentioned earlier suggested the large agricultural potentials that exist in the North and Central West regions of Brazil.

An examination of crop production trends in Brazil would be incomplete without a mention of soybeans, a crop that has been considered "the major success story of Brazilian agriculture in the 1970s."[11] Appendix 1, Table 21, shows the phenomenal growth of soybean production in Brazil in 1971-80. During this period, the production of soybeans expanded sixfold, to an average of 12 million tons a year in 1978-80, or at a very rapid growth rate of about 20 percent a year. The area harvested for this crop in the late 1970s was equivalent to about one-fifth that of major food crops. In the South region, which accounts for four-fifths of Brazil's soybean output, estimates of area harvested in that period equal 40 percent of the area of major food crops in the region. The World Bank study cited also pointed to the rapid growth in the domestic use of soybeans in the 1970s, both for food and for feed, although the crop was developed mainly for export.

In the case of Nigeria, many of the conclusions based on the trends drawn from the food data available for the study are rather tentative because of the wide divergence between the aggregates of the national-source regional estimates for the country and the corresponding FAO country-level statistics. The real food trends in Nigeria would be hard to gauge because the large differences between annual estimates from the two sources have resulted in opposing trends in production, area harvested, and output per hectare of major food crops in the country. Nonetheless, results drawn from national-source data are presented here, bearing in mind these differences.

Major factors that have influenced the trends of food production in Nigeria since the early 1960s are (1) the civil disturbance in the mid-1960s, which caused population movements and dislocations of ethnic groups, (2) the creation of states that enhanced rapid urbanization, which in turn led to major reductions of the agricultural labor force

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[11]World Bank, A Review of Agricultural Policies in Brazil, a World Bank Country Study (Washington, D.C.: World Bank, 1982). (Note: The term "major food crops" in IFPRI food gap studies does not include soybeans.)

and cultivated area, and (3) the oil reserves that funded large food imports to fill domestic food needs, which had expanded rapidly due to urbanization and low food production. The first two of these factors would explain Nigeria's slowly increasing (if based on FAO data) or declining (if based on national-source data) food output during the past decades. The civil disturbance in 1966, however, affected mostly the southeastern portion of the country.

Food production trends in Nigeria are determined mainly by the Northern region (covering six of the dozen states created in 1967), which accounts for half the country's population, four-fifths of food production, and more than 90 percent of the area harvested for food crops. This region produces most of Nigeria's output of cereals, which represents two-thirds of the total food output of the country.

The decline in food production, as shown by national-source data, resulted from decreases in harvest area that more than offset increases in output per hectare. (FAO country data indicate a rate of increase in harvest area that was slightly faster than the rate of decline in crop yields.) Most of the decreases in Nigerian food production occurred in the Western region and mostly in roots and tubers and groundnuts. Regional trends indicate declines of harvest area in all regions and for all major food crops.

Projections of food supply and demand for Nigeria using the regional level data on production and alternative assumptions regarding population and per capita income growth indicate deficits ranging from 2.9 to 6.0 million tons in 2000. However, using projections of state output and their faster overall production growth rate, the projected deficits will be smaller and would range from near zero to 3.2 million tons. (These projected shortfalls are comparatively small relative to those calculated from FAO data).

If Nigeria is to become increasingly less dependent on food imports, the present declining trends in food crop production would need to be reversed. A major possible source of production growth will be an increase in the area under food crops. Over the years, the farm labor force has been declining rapidly and policies need to be evolved that would reverse this trend. Not only do people have to be encouraged to stay in farming, but those who have already left the land may be persuaded to return to farming. Peasant farmers and new modern farmers should be allowed to develop side by side, grow together, and interact. Agricultural research and extension services should be strengthened and the supplies of agricultural inputs expanded.

For Nigeria, in particular, conclusions and food policy suggestions are rendered difficult because of the scarcity of reliable national-source data. The wide variation between FAO and national-source estimates shown here poses the question of choice in the data set that meets the reliability criterion. This study has strongly highlighted the need for improvement of quality and availability of

agricultural statistics in Nigeria. Adequate interaction is needed between the data collection agencies and the data users, especially the agricultural planning agencies and policymakers. There appears to be more than one set of agricultural statistics from national sources in Nigeria and this suggests the need for coordination among data-collecting agencies in the country. A well-coordinated approach can bring all the agricultural series together for comprehensive assessment and evaluation on a continuing basis. Where inconsistencies are observed, the reconciliation of past estimates would be desirable, but more important, methodological improvements in data collection can be developed and implemented. These improvements would need the support of the national government, which in the long run is the main beneficiary of reliable data for development planning.

APPENDIX 1: SUPPLEMENTARY TABLES

Table 19--Estimates of land area, population, and major food crop area harvested and production in Brazil, by region

Region[a]	Land Area	1980 Population	Major Food Crops, 1976-80 Averages	
			Area Harvested	Production
	(million hectares)	(millions)	(million hectares)	(million metric tons)
North	355	6.0	1.18	1.22
Northeast	154	35.4	7.60	7.77
Central West	188	7.7	4.28	4.60
Southeast	92	52.6	8.78	8.94
South	57	19.4	16.47	16.82
Total	846	121.1	38.31	39.35

Sources: Data from James Wilkie and Peter Reich, eds., Statistical Abstract of Latin America, various issues (Los Angeles: UCLA Latin American Center Publications, various years); and Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária).

[a] States by region: North (Acre, Amapa, Amazonas, Para, Rondonia, and Roraima), Northeast (Alagoas, Bahia, Ceara, Maranhao, Noronha, Paraiba, Pernambuco, Piaui, Rio Grande Norte, and Sergipe), Central West (Federal District, Goias, Matto Grosso, and Matto Grosso Sul), Southeast (Espirito Santo, Minas Gerais, Rio de Janeiro, and Sao Paulo), and South (Parana, Rio Grande Sul, and Santa Catarina).

Table 20--Production of major food crops in Brazil, 1980 estimates and projections to 2000 based on 1961-80 trends

Region	Actual 1980 Estimates	Trend Projections to the Year 2000[a] Based on Total Production		Based on Area and Output/Hectare	
	(thousand metric tons)				
North	1,486	4,771	(6.8)	5,147	(7.3)
Northeast	7,428	13,064	(2.2)	15,915	(3.2)
Central West	5,075	11,524	(4.5)	16,230	(6.3)
Southeast	9,496	9,743	(0.3)	10,305	(0.5)
South	19,121	42,932	(4.1)	43,888	(4.2)
Total	42,606	82,034	(3.3)	91,485	(3.8)

Sources: Data from Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária).

[a] Trend projections of production and output per hectare are for major food crops as a whole. Figures in parentheses show the 1980-2000 average annual growth rates (in percent) of production corresponding to these regional projections.

Table 21--Soybeans: Trends of production and area harvested in Brazil, 1971-80

Region	Annual Growth Rate, 1971-80		1978-80 Averages	
	Production	Area Harvested	Production	Area Harvested
	(percent)		(thousand metric tons)	(thousand hectares)
North	...	...	...	...
Northeast	(a)	(a)	4	3
Central West	(a)	(a)	1,203	824
Southeast	(a)	(a)	1,075	645
South	18.5	17.4	9,328	6,759
Total	20.6	19.2	11,610	8,231

Sources: Data from Instituto Brasileiro de Geografia e Estatística, "Levantamento Sistematico de Produção Agrícola, 1980," IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária).

a More than 25 percent.

APPENDIX 2: METHODOLOGY

Basic calculations in the analysis of food trends in this study are done on the estimates for regions or states and their aggregates to obtain the average annual growth rates relating to country subdivisions and the study country as a whole. For projections to the year 2000, calculations are done for each state or region and then aggregated for the study country. Since lower-level errors tend to be offsetting for aggregates, it can be expected that the projections for the whole country are more reliable than those for individual states or regions.

PRODUCTION TRENDS

The analysis of trends in production, area harvested, and output per hectare makes use of the time-series data on each commodity or commodity group for each state or region, or both, and for the study country. Following the approach of IFPRI's food gap studies, a semi-logarithmic trend equation is fitted to the annual estimates for an observed period in order to obtain the respective average growth rates of the production variables. (This same procedure is applied in examining the trends in food consumption and its components.)

The general equation fitted to each set of data is

$$Y_t = e^{a + bt},$$

where

Y_t = estimate of the variable in year t,

a = constant term (the logarithm of the variable's estimate for t = 0, the base year),

b = slope of fitted equation (also equal to the logarithm of the value one plus the annual rate of growth of the variable), and

t = period in years, starting from the base year.

The resulting estimated values of the slope (b) of the fitted equation are used also to estimate the relative contributions of area harvested and output per hectare to production growth.

In some cases (mostly for Nigeria), the five-year averages of data at both ends of the observation period are used to obtain estimates of the average annual growth rates. The time span of total changes in the variable whose trend is being measured is the number of years between the midpoints of the end periods. The equation used here is

$$Y_t = Y_0 (1 + r)^t,$$

where

Y_0 = estimate of the variable in earlier period,

$_t$ = estimate of the variable in later period,

r = annual growth rate, and

t = time span of change in years.

PRODUCTION PROJECTIONS

Assuming that past trends in production will continue into the future, output projections are essentially extrapolations of the trend obtained with the use of the above equation fitted to the data for the country and its regions or states. For Brazil, in particular, the production of major food crops is projected as a group to 2000 for the country as a whole and for its five regions based on data of the 1961-80 period. Regional projections are aggregated to represent one scenario of the country's production of major food crops in 2000. It is further assumed that if the output trends are negative, production would not decline beyond 1980. Thus the 1980 trend estimate of production serves as the projected output in 2000.

A second approach that is used extrapolates the trends of area harvested and output per hectare of major food crops, also as a group. The product of the projected levels of those variables in 2000 gives the projected production for that year. If the growth rates of area harvested and output per hectare are both positive, the result would be identical with the production projection based on output trends. It is assumed also, as in the use of output trends, that neither harvest area nor output per hectare would decline after 1980 if the trend of either one of the two factors is negative. The application of this assumption results in a higher projection of production than that based on output trends, which approach permits a decline in one of the factors as long as output growth is positive.

In the case of Nigeria, production projections are calculated by crop and then aggregated for projecting the output of major food crops as a whole for each region or state. In view of the observed negative country trends in area harvested for almost all of the major food crops in Nigeria, the occurrence of which is not likely to continue for the

next two decades, the second approach mentioned above for Brazil is used, that is, the production projections by region or state are extrapolations of the trends in harvest area and output per hectare, subject also to the assumption governing negative trends. Data availability has limited the observation period for measuring these trends to the years 1965-83 for regional projections and 1969-83 for state-level projections.

DEMAND PROJECTIONS

Problems of data availability for estimates of consumption parameters for regions or states limit the approach on demand projections to the country level. For Brazil, the demand projection for major food crops obtained in IFPRI's food gap analysis is matched with the production projections calculated here for the different food gap scenarios. That earlier study used FAO consumption data for the 1966-80 period, the United Nations medium-variant population projections, and the 1966-80 trends in the growth of per capita income.

For Nigeria, the calculation of per capita consumption estimates by crop for the 1979-83 base period assumes that total consumption is equal to total production plus net imports during that period and thus ignores stock changes. Projections of demand are made using different combinations of assumed annual growth rates of population and per capita income between the base period and 2000. The respective annual growth rates of population and per capita income for these combinations are (1) 2.5 percent and 3.0 percent, (2) 2.5 percent and 5.0 percent, and (3) 3.3 percent and 3.0 percent.

BIBLIOGRAPHY

Adamu, S. O. "Analysis of Trends and Projections of Food Production and Consumption in Nigeria." A preliminary report submitted to the International Food Policy Research Institute, Washington, D.C., 1986 (mimeographed).

Food and Agriculture Organization of the United Nations. "Production Yearbook Tapes, 1975, 1979, 1981, and 1983." Rome: FAO, 1976, 1980, 1982, and 1984.

_____. "Agricultural Supply Utilization Accounts Tape, 1981." Rome: FAO, 1982.

_____. "Global Agricultural Programming System Supply Utilization Accounts Tape, 1978." Rome: FAO, 1979.

Instituto Brasileiro de Geografia e Estatística. "Levantamento Sistematico de Produção Agrícola, 1980." IBGE, Brasilia, 1984 (data tape obtained by IFPRI through the Empresa Brasileira de Pesquisa Agropecuária.

Paulino, Leonardo A. Food in the Third World: Past Trends and Projections to 2000. Research Report 52. Washington, D.C.: International Food Policy Research Institute, 1986.

Sarma, J. S., and Yeung, Patrick. Livestock Products in the Third World: Past Trends and Projections to 1990 and 2000. Research Report 49. Washington, D.C.: International Food Policy Research Institute, 1985.

Schuh, G. Edward, and Alves, Eliseu Roberto. The Agricultural Development of Brazil. New York: Praeger Publishers, 1969.

United Nations Department of International Economic and Social Affairs. "World Population Prospects as Assessed in 1982." United Nations, New York, 1983 (computer printout).

Wilkie, James, and Reich, Peter, eds. Statistical Abstract of Latin America, various issues. Los Angeles: UCLA Latin American Center Publications, various years.

World Bank. "Gross National Product by Country Data Tape, 1961-1980." World Bank, Washington, D.C., 1981.

_____. A Review of Agricultural Policies in Brazil. A World Bank Country Study. Washington, D.C.: World Bank, 1982.