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INTERNATIONAL AGRICULTURE AND TRADE REPORTS

FOOD SECURITY ASSESSMENT

Situation and Outlook Series

Two-thirds of Sub-Saharan Africa's population is projected to be undernourished in 2007.

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Contact:
Shahla Shapouri
Stacey Rosen

Principal Contributors
Munisamy Gopinath
Michael Kurtzig
Birgit Meade
Jay Mitchell
May Peters
Terry Roe
Stacey Rosen
Matthew Shane
Shahla Shapouri
Lloyd Teigen
Michael Trueblood
Keith Wiebe

Editing/Production/Design
Martha Evans
Diane Decker
Wynnice Pointer-Napper
Victor Phillips, Jr.

Cover Photo
CARE
Mali

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Preface

This report continues the series of food assessments begun in the late 1970's. *Global Food Assessments* were done from 1990 to 1992, hence the GFA series. In 1993, the title was changed to *Food Aid Needs Assessment* to more accurately reflect the contents of the report, which focuses on selected developing countries with past or continuing food deficits. This year we widened our analysis beyond the assessment of aggregate food availability to include more aspects of food security. We therefore changed the title to Food Security Assessment .

This report projects food availability for 66 countries during the next decade. The results are also used to project consumption by income group to analyze the severity of nutritional problems within the countries. The report includes an overview section that provides a global outlook of food security. That section is followed by five regional writeups (North Africa, Sub-Saharan Africa, Asia, Latin America, and New Independent States (NIS) of the former Soviet Union). The report concludes with four research papers related to food security. The topics include the institution of outward-oriented policies to achieve efficiency in resource allocation, regional policy initiatives in Southern Africa, resource use and implications on the environment, and factors to reduce income inequality. The articles review the linkages between these issues and achieving food security.

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Summary

The Food Gap Is Projected To Widen Over the Next 10 Years

The food gap to maintain consumption is projected to increase from 8.5 million tons in 1997 to 18 million tons by 2007 for the 66 countries studied here. Many low-income countries are unable to meet minimum nutritional requirements of their people, and this nutritional food gap is projected to grow from 15 million tons in 1997 to 24 million tons by 2007. But even within countries that have enough food available, low-income households often do not have the means to purchase their minimum requirements.

Since 1995, global food security has become a high profile issue as a result of concerns stemming from a spike in grain prices in 1995 and a decline in world grain stocks. The trends in policies of major agricultural producers are toward market orientation and greater awareness of environmental concerns. The expected implications of these trends together with strengthening economic growth in many developing countries are lower stockholdings, primarily in the United States, and a slowdown in the long-term decline in real commodity prices. Some are also concerned with the potential for increased price variability. Food import-dependent developing countries view the strengthened food import prices and the possibility of reduced food aid availability as a major threat to their food security. Responding to these concerns at the declaration of the World Food Summit in November 1996, participants pledged "to reduce the number of undernourished people to half their present level no later than 2015."

The question that arises from these issues is, are these low-income countries moving along the necessary path to improve their nutritional situations in the long term? The evaluation of future food availability of low-income developing countries, although extended only through 2007, indicates that per capita food consumption in many countries will decline, leading to growing gaps.

When the total amount of the projected food availability is allocated among different income groups in each country, the result shows a slight increase in the number of people who cannot meet their nutritional requirements—from 1.1 billion in the base year to 1.2 billion by 2007.

Regional comparisons of projections of food gaps place Sub-Saharan Africa as the most vulnerable region with respect to food security. By 2007, this region is projected to account for about half of the total gap (66 countries) to maintain consumption and 66 percent of the gap to meet its nutritional needs while its population comprises only 25 percent of the total. The main problem in the region is high population growth, which puts pressure on food supplies.

In addition to inadequate food availability, skewed distribution of purchasing power amplifies the nutritional problem in the region. The number of people who cannot meet their nutritional requirements is projected to increase from 303 million in the base year to 526 million by 2007. This means the region, projected to account for 25 percent of the population of the study countries, will have about 44 percent of the undernourished people.

Low-income Asian countries, with the second largest food gap, have made significant gains in increasing food availability over the past three decades. Most Asian countries may be able to close their food gaps by increasing imports. The region's impressive gains, however, mask food problems in large segments of the population, where purchasing power is insufficient. Although the number of people who cannot meet their nutritional requirements is projected to decline 25 percent over the next decade, the region is projected to account for about half of the undernourished people in the study countries.

In Latin America and the Caribbean, the most difficult dimension of food security is the distribution of food within each country. The number of people who cannot meet their nutritional requirements is projected to increase 55 percent between the base period and 2007. Highly skewed distribution of income limits purchasing power and access to food for low-income households which, in turn, intensifies food security problems.

North Africa is the only region with adequate resources to meet its nutritional needs. However, frequent droughts often affect each country's economic growth and welfare. The current level of food consumption is among the highest in the world and is projected to increase in all countries except Egypt. Political instability would be the only threat to food security in the region and could cause serious problems in a country such as Algeria.

Food consumption in the New Independent States (formerly referred to as the former Soviet Union) is projected to increase because of economic recovery, improved export performance, and higher food production. Only the war-torn economy of Tajikistan will likely remain vulnerable to food insecurity and is projected to have a significant food gap on a consistent basis.

The second part of *Food Security Assessment* consists of four research papers that discuss topics related to food security. The topics include the institution of outward-oriented policies to achieve efficiency in resource allocation, regional policy initiatives in Southern Africa, resource use and implications on the environment, and factors to reduce income inequality. Statistical tables for each of the countries included in the model are also provided.

Global Food Security: Overview

The food security position of many developing countries is expected to remain precarious unless special attention is focused on the low-income households in the economic growth process. For the resource-poor countries, many in Sub-Saharan Africa, but also those countries such as Haiti and Bangladesh, where poverty and agricultural resource degradation are intensifying, the situation is projected to deteriorate. [Shahla Shapouri and Stacey Rosen]

Global Food Supply

The world's resources are adequate to produce enough food for its population for at least the next few decades. Global production capacity is important for many developing countries because of their growing dependence on food imports. Even in low-income countries where foreign exchange is limited, grain import dependency increased from 8 percent of consumption in 1980 to 12 percent in 1996. In North African countries, imports contribute as much as 50 percent of food consumption and have improved the nutritional status of the region.

Since 1995, global food security has become a high profile issue because of concerns stemming from a spike in grain prices in 1995 and a decline in world grain stocks. The trends in policies of major agricultural producers are toward market orientation and greater awareness of environmental concerns. The expected implications of these trends together with strengthening economic growth in many developing countries are lower stockholding, primarily in the United States, and a slowdown in the long-term decline in real commodity prices. Some analysts are also concerned with the potential for increased price variability. Food import-dependent developing countries view the strengthened food import prices and the possibility of reduced food aid availability as a major threat to their food security. Participants at the World Food Summit in November 1996 pledged "to reduce the number of undernourished people to half their present level no later than 2015."

To evaluate the future food security situation of low-income developing countries, this report focuses on 66 countries that have been or are potential food aid recipients. Food availability is projected through the next decade (see box 1). Since aggregate measures do not include food consumption problems within a country, an attempt was made to use a consumption-income relationship (based on projected food availability) to estimate food consumption by different income groups. (It should be noted that consumption distribution results are a rough estimate of reality because of the lack of data.)

Food Insecurity Would Remain a Problem...

Although food supplies are projected to increase faster than population growth in higher income developing countries, many lower income countries remain vulnerable to food insecurity. A country will be faced with growing food insecurity when food supplies do not keep pace with population growth. Many factors adversely affect a country's food security position, including: low and variable food production, high population growth, low income and skewed income distribution, and limited foreign exchange to import food. Performance of these factors, in turn, depends on the natural resource endowment of a country, use of technology, domestic policies, employment, export earnings, import prices, political stability, and the state of the global economy.

The projected food gaps to maintain per capita consumption at the base level (1994-96) and to meet minimum nutritional requirements showed growing needs at the aggregate level (food is measured as the sum of grains and root crops converted to grain equivalent) (see table 1 and figure 1). The additional food needed to maintain per capita consumption is estimated at 8.5 million tons for 1997, growing to 18 million tons by 2007— more than a twofold increase. Forty-three countries cannot maintain consumption by 2007. The food needed to provide minimum per capita caloric requirements is 15 million tons in 1997, increasing to 24 million tons by 2007. This is significantly larger than the food gap to maintain current consumption, but the nutritional gap increases at a slower rate. By 2007, 39 countries are projected to be unable to meet their nutritional requirement. Some of the study countries are projected to be able to meet nutritional consumption targets, but their domestic supplies (production plus commercial imports) would fall short of maintaining base consumption levels. In these cases, even if per capita consumption were to fall, their diets would most likely remain nutritionally adequate due to their historically high consumption levels. Egypt, Indonesia, Pakistan, Uganda, and Cote d'Ivoire are among them. Egypt, for example, is one of the largest per capita grain consumers in the world. With market liberalization and reductions in consumer subsidies, consumption is projected to decline in this country, but would remain higher than the minimum nutritional requirement.

When the total amount of the projected food availability is allocated among different income groups in each country, the results show a slight increase in the number of people who cannot meet their nutritional requirement—from 1.1 billion in the base year to 1.2 billion by 2007. Given the high aggregate growth of needs to meet nutritional require-

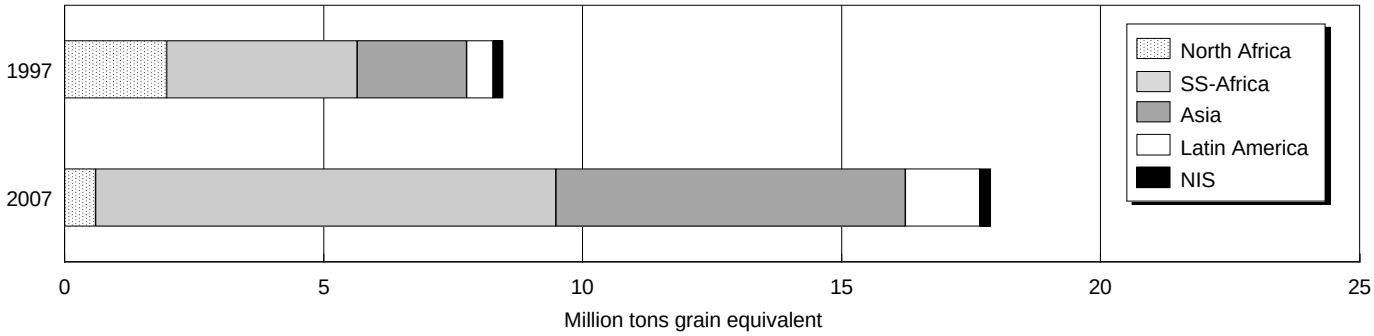
Table 1--Grain and Root Supply and Food Gaps for 66 Countries

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food	Population
			---1,000 tons ---			Million
1988	334,437	45,475	33,549	10,263	352,225	1,952
1989	351,020	47,547	33,713	9,420	369,381	1,997
1990	350,408	49,282	30,312	10,136	373,006	2,041
1991	364,460	53,417	29,352	10,638	382,303	2,086
1992	368,012	56,627	42,870	10,189	396,520	2,130
1993	375,646	58,077	43,263	8,224	405,162	2,175
1994	386,961	58,152	47,559	7,682	408,089	2,220
1995	389,683	59,560	56,281	5,388	427,881	2,267
1996	408,845	59,732	55,896	5,140	441,871	2,314
Projections				**Food gap***		
				SQ / NR	(w/o food aid)	
1997	404,886	60,838	61,594	***8,471*** / ***15,117***	434,772	2,361
2002	450,702	65,784	65,964	***12,891*** / ***19,752***	478,609	2,606
2007	496,301	71,546	74,917	***17,875*** / ***23,941***	529,566	2,856

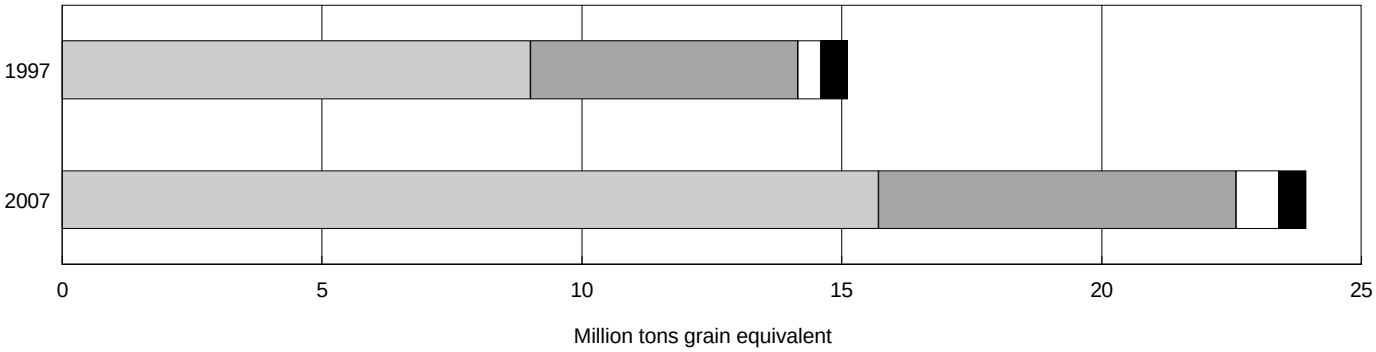
*SQ stands for status quo and describes the amount of grain and root crops needed to support 1994-96 levels per capita consumption and NR stands for nutritional requirements and describes the amount needed to support minimum nutritional standards (see box 1).

Figure 1--Food Gaps:

Gap to Maintain Consumption Levels in 1997 and 2007



Nutritional Gap in 1997 and 2007



Box 1

How Food Security Is Assessed

The goal of this report is to project food availability and access in 66 lower income developing countries—37 in Sub-Saharan Africa, 4 in North Africa, 11 in Latin America and the Caribbean, 9 in Asia, and 5 in the NIS (see appendix table 1 for a list of countries and appendix 2 for a detailed description of the methodology). The period covered is 1997 (current), 2002 (5 years out), and 2007 (10 years out). Projections of food gaps for the countries through 2007 are based on differences between consumption targets and estimates of food availability, which is domestic supplies (production plus commercial imports) minus nonfood use. The estimated gaps are used to evaluate food security of the countries.

The **food gaps are calculated using two consumption targets:** 1) maintaining base per capita consumption or status quo (SQ), which is the amount of grain and root crops needed to support 1994-96 levels per capita consumption, and 2) meeting nutritional requirements (NR), which is the gap between available food and food needed to support minimum per capita nutritional standards (for definitions of terms used see the Methodology in appendix 2). Comparison of the two measures either for countries, regions, or the aggregate, indicates the two different aspects of food security: consumption stability and meeting the nutritional standard.

The aggregate food availability projections fail to take into account food insecurity problems due to food distribution difficulties within a country. Although lack of data is a major problem, an attempt was made in this report to project **food consumption by different income groups** based on income distribution data for each country. The concept of the income-consumption relationship was used to allocate the projected level of food availability among different income groups.

Finally, based on the projected population, **the number of people who cannot meet their nutritional requirements** is projected. The reference to food includes grains and root crops (converted to grain equivalent) which, in most countries, account for as much as 80 percent of all calories consumed.

The common terms used in the reports are: *domestic food supply* which is the sum of domestic production and commercial imports, *food availability* which is food supply minus non-food use such as feed and waste, *import dependency* which is the ratio of food imports to food supply, and *food consumption* which is equal to food availability.

ments, this implies that nutritional problems will intensify (see table 2). In other words, according to these estimates, the nutritional problems will not spread in terms of the number of people, but the problem will become more severe.

…Especially in Many African Countries

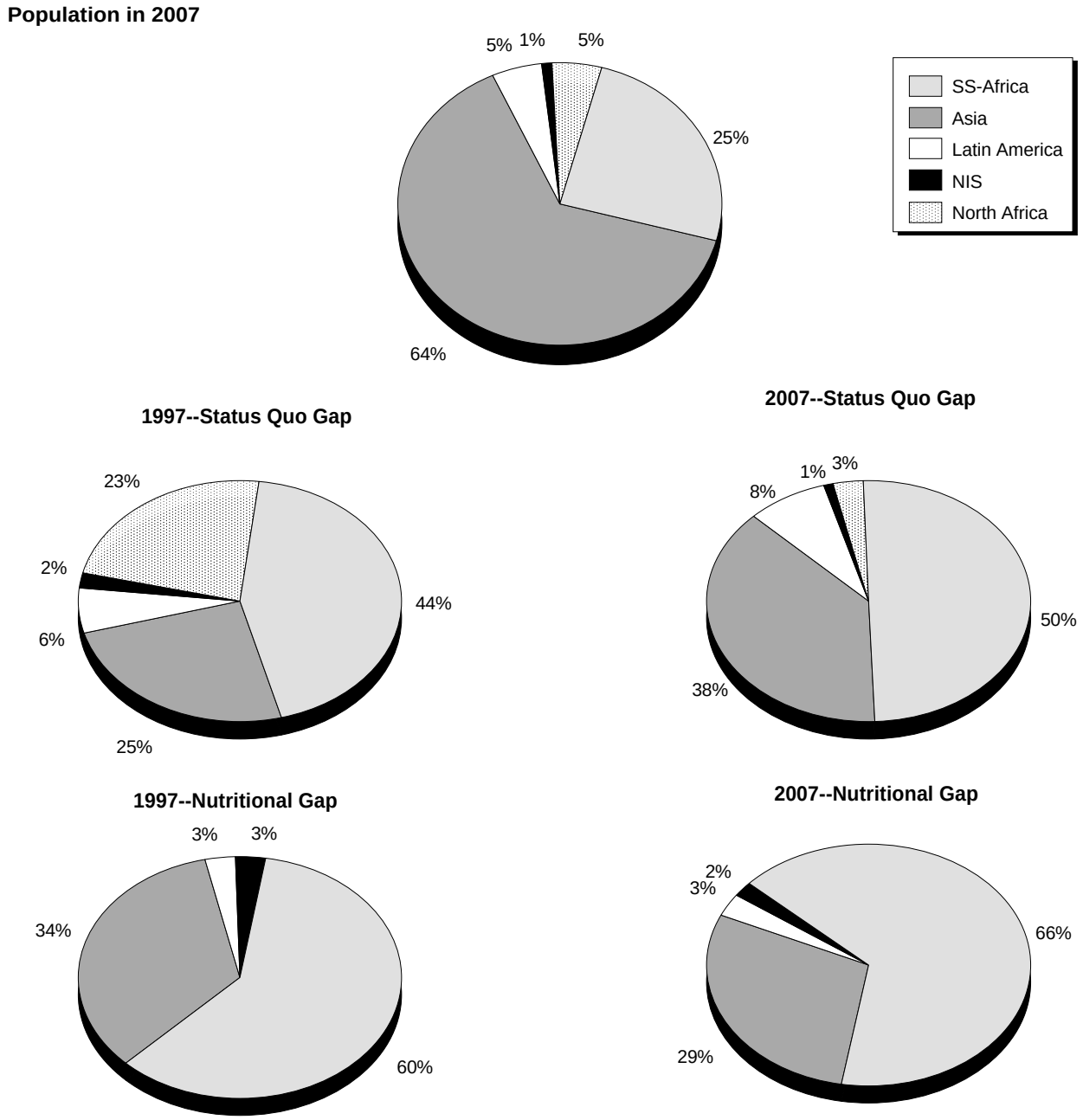
Regional comparisons of projections of food gaps by 2007 place Sub-Saharan Africa (37 countries) as the most vulnerable region with respect to food security. By 2007, this region is projected to have about 50 percent of the total gap (for 66 study countries) or—8.9 million tons—to maintain consumption. The region is also expected to have 66 percent of the total gap—or 15.7 million tons—to meet its nutritional needs. Meanwhile, Sub-Saharan Africa's population is only 25 percent of the total of the study countries (see figures 2 and 3). The projected food needs to maintain consumption for the region as a whole are significantly larger than current total food aid availability for all countries. The main contributing factor to the food gap in Sub-Saharan Africa is high population growth, which puts pressure on food supplies. In fact, production growth is projected to be greater in Sub-Saharan Africa than in other regions (2.4 percent per year compared with less than 2 percent in other regions), but because of high population growth, there is a declining per capita production trend.

Another contributor to the food gap is the financial constraints that limit Sub-Saharan Africa's food imports. Commercial food imports grew 2.3 percent per year during 1980-96, or less than half the rate of other regions. The lack of adequate foreign exchange to support food imports is the reason for the region's growing reliance on food aid. The region's share of global food aid receipts has increased during the last two decades. Food aid's share of total food imports ranged from 20 to 50 percent during 1980-96, but there clearly has been an upward trend.

In addition to inadequate food availability, skewed distribution of purchasing power amplifies the nutritional problem in the region as scarce food supplies end up being distributed very unevenly among populations. The number of people who cannot meet their nutritional requirement is projected to increase from 303 million in the base year to 526 million by 2007. This means that Sub-Saharan Africa, projected to account for 25 percent of the population of the study countries, will have about 44 percent of the undernourished people.

Low-income Asian countries, with the second largest food gap, have made significant gains in increasing food availability over the past three decades. Most Asian countries may be able to close their food gaps by increasing imports. Import dependency has averaged less than 5 percent since 1990. Countries such as India and Pakistan have restricted imports of food as part of their policy of food self-sufficiency, but have the capacity to increase their imports. The region's impressive gains, however, mask food problems in large segments of the population, where purchasing power is insufficient. Although the number of people who cannot meet their

Figure 2--Distribution of Population and Food Gaps



nutritional requirement is projected to decline by 25 percent over the next decade, the region is projected to account for half of the undernourished people in the study countries.

Latin America's food import dependency is growing—increasing from 30 percent in the early 1980's to about 40 percent in 1995-96. This trend is expected to continue, and while not alarming, the region's food import dependency may not be sustainable over the long term. Foreign exchange earnings of the countries have improved significantly, but debt service payments continue to be burdensome, particularly in lower income countries such as Haiti, Honduras, and Nicaragua, where the value of debt exceeded the value of GNP in 1995. The more difficult dimension of food security in the region is the distribution of food within each country. The number of people who cannot meet their nutritional requirement is projected to increase. Highly skewed distribution of income limits purchasing power and access to food for low-income households which, in turn, intensifies food security problems.

North Africa is the only region with adequate resources to meet its nutritional needs. However, frequent droughts often affect this region's economic performance. The current level of food consumption is among the highest in the world and is projected to increase in all countries except Egypt. Political instability would be the only foreseeable threat to the food security of the region and could cause serious problems in a country such as Algeria.

In the New Independent States (NIS) of the former Soviet Union, food consumption is projected to increase because of

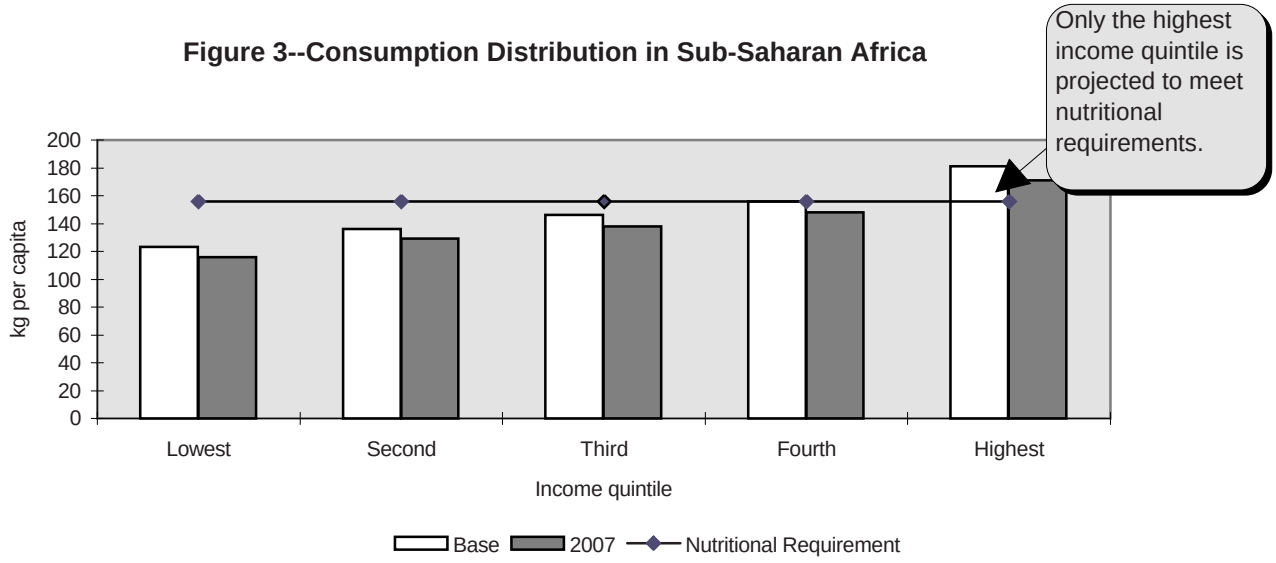
Table 2--Ratio of Food Consumption to Nutritional Requirements

Region	Year 1/	Income quintiles				
		Lowest	Second	Third	Fourth	Highest
North Africa	Base	1.22	1.28	1.33	1.38	1.50
	2007	1.24	1.31	1.36	1.41	1.53
Sub-S. Africa	Base	0.74	0.82	0.88	0.94	1.08
	2007	0.70	0.77	0.83	0.88	1.02
Asia	Base	0.92	0.98	1.02	1.06	1.18
	2007	0.94	1.00	1.04	1.09	1.20
Latin America	Base	0.96	1.06	1.13	1.21	1.41
	2007	0.93	1.03	1.10	1.17	1.36
NIS 2/	Base	0.91	0.99	1.04	1.09	1.20
	2007	0.99	1.07	1.12	1.18	1.29

1/ 1994-1996 average.

2/ Based on average regional income distribution.

Figure 3--Consumption Distribution in Sub-Saharan Africa



economic recovery, improved export performance, and higher food production. Only the war-torn economy of Tajikistan will likely remain vulnerable to food insecurity and is projected to have a significant food gap on a consistent basis.

Food Aid Remains Vital to Many Countries

Food aid, which was introduced because of high production surpluses in donor countries, has become a crucial resource for the poor countries and countries in need of emergency support. The decline in grain stocks of major donors, such as the United States, means that food aid is no longer a relatively "free good" since commodity aid must be purchased from the open market. The United States and the European Union (EU) have historically supplied about 75-85 percent of the world's grain food aid. However, with growing market liberalization in these countries, falling global stocks, and shrinking food aid budgets of the major donor countries, food aid availabilities have declined considerably. Food aid shipments for 1996/97 are estimated at roughly 7.5-million tons, the same as the previous year. Food aid donations have not been this small since the mid-1970's. The 7.5 million tons, if not increased, will cover 42 percent of the needs to maintain consumption and only 31 percent of the nutritional gap by the year 2007.

This trend in donations is mirrored in the trend of receipts by the low-income food-deficit countries. In 1992/93, food aid donations to this group of countries were more than 10 million tons, or about 15 percent of their total grain imports. In 1996/97, these donations are estimated to drop to 6.5 million tons, or 10.4 percent of their grain imports. This decline implies that these countries, already facing severe financial constraints, must allocate more of their foreign exchange to food imports, thereby squeezing out imports of other essential goods.

As food aid donations have been declining, the type of food aid being supplied has also changed. Early on, most food aid was program food aid, which is non-targeted food assistance. This type of aid is provided on a bilateral basis to support recipient governments' budgets or reduce balance of payments deficits. More recently, donors have moved toward relief and project aid, which is targeted to specific groups of nutritionally vulnerable people. This trend toward a more humanitarian approach to food aid is clearly evident in the appropriations for the U.S. Public Law (PL) 480 program. PL 480's Title I program provides government-to-government sales of agricultural commodities to developing countries under long term credit arrangements. This program was cut roughly 25 percent between fiscal years (FY)1995 and 1998. Conversely, funding for Title II, the program under which the United States delivers emergency food and World Food Program shipments, has remained relatively stable. FY 1998 funding for Title II, $837 million, is roughly three and a half times larger than Title I.

Food Security of Lower Income Countries: Opportunities and Obstacles

Global market liberalization of agriculture should increase market access for exports from food importing countries and generally enhance market efficiency. Clearly, the trade gains will vary by country. Larger countries with diversified exports are in a better position to benefit than the small countries who are dependent on a few export commodities.

Domestic policies of the countries should play a crucial role in increasing participation in the international market. The paper entitled "World Food Insecurity: A Policy Dilemma" in the Special Articles section argues that outward-oriented policies that allow an economy to be open to world goods and capital markets will achieve efficiency in allocation of resources and could improve global food security. Market liberalization, however, can confront countries with new challenges. Given that many countries are reducing the role of government in the agricultural sector, the management of risk resulting from production shortfalls and import price hikes will become essential to ensuring food security. Regional policy initiative proposals (as opposed to national level proposals) can reduce the impact of supply variability on food security of the countries. The next paper, entitled "Can Regional Policy Initiatives Help Achieve Food Security in Southern Africa?" examines the options that could be considered in this area such as establishing a regional strategic grain reserve, implementing an international food import insurance program, and establishing a free trade zone. The costs and benefits of different options will vary, but these regional policy initiatives will result in a food security gain for small countries with limited resources to cope with high food supply variability.

Even for the countries with adequate food supplies to meet their consumption requirement, the future food security challenge depends on the way resources are used and their linkages to environment and sustainability. As the paper "Resources, Sustainability, and Food Security" indicates, the quality and quantity of natural and other resources should be taken into account for improved analysis of sustainable resource use and food security.

The resource-poor countries, however, are expected to remain vulnerable to food insecurity. In these countries, the problems arising from inadequate food supplies are exacerbated by inadequate purchasing power resulting from skewed income distribution. In countries such as Tanzania or Ethiopia, large segments of the population are undernourished. In these countries, reducing income inequality in addition to adopting policies to increase income growth, can reduce food insecurity. With increases in income, lower income groups tend to increase their food consumption more than high income groups. Even in countries with adequate aggregate food supplies, skewed income distribution limits access of low income groups to sufficient amounts of food. For example, if available food were distributed equally in the countries of India, Pakistan, the Dominican Republic, El Salvador, Sudan, Cote d'Ivoire, and Nigeria, all residents would have been able to meet their nutritional requirement. The last paper on "Income Distribution and Food Security" examines the impact of factors that can reduce income inequality and improve food security of the countries. Level of income, increased agricultural investment, investment in education to reduce fertility rates, and political freedom are found to be important contributing factors to reductions in income inequality.

To summarize, food insecurity among many countries is expected to continue unless special attention is focused on low-income households in the economic growth process. A decline in per capita food consumption is projected for most Sub-Saharan African countries, as well as some in Latin America and Asia. If this trend continues, the pledge of the participants in the World Food Summit cannot be met. For Sub-Saharan Africa in particular, accepting a decline in per capita consumption from already low levels could have severe nutritional consequences. For the resource-poor countries, many in Sub-Saharan Africa, but also countries such as Haiti and Bangladesh, where poverty and agricultural resource degradation are growing, the situation is expected to deteriorate. To reverse this trend, both internal and external political and policy commitments are required. Historically, increased investment and policy adjustment have increased purchasing power and food security of many developing countries. There is no reason to believe that the historical achievements cannot be repeated in the future.

North Africa

Frequent droughts affect this region's economic performance but food security is usually not endangered. Food consumption is projected to increase in all countries except Egypt unless commercial imports grow enough to avoid a decline. [Michael Kurtzig]

The region's grain production dropped 33 percent in 1997 due to a severe drought in Algeria, Morocco, and Tunisia. Despite this shortfall, all countries in the region—with the exception of Morocco—will be able to maintain base per capita consumption levels with domestic supplies (production plus commercial imports). Morocco's food gap for 1997 is estimated at nearly 2 million tons. For the longer term, only Egypt shows a food gap near 600,000 tons in 2007. The region relies on imports for about 50 percent of its grain consumption needs, a figure likely to become larger as population and incomes rise and as the region becomes more urbanized. North Africa's reliance on food imports may further increase as the region's land and water resources are limited and future production increases will have to come primarily from increased input use and higher yields.

The region has frequent droughts, four in the last 7 years — Not only have these droughts caused wide fluctuations in production (18.5 million tons of grain in 1988 and 31.6 million in 1996), they have had major impacts on these countries' economic performance. As for the impact on local economies, the 1995 drought in Morocco caused a 7.6-percent drop in real GDP, a substantial widening of the fiscal deficit, and declining foreign exchange reserves. Conversely, the record agricultural output in 1996 generated GDP growth of nearly 12 percent, recovery in foreign exchange reserves, and a decline in inflation.

Income distribution is not a major threat to food security in the region — Income distribution in the region is less skewed than in others (see tables 4, 6, and 10). The region has the highest per capita consumption of grains in the world. In each country, base (1994-96) grain consumption far exceeds the nutritional requirement, even in the low-income groups. Egypt, with the lowest per capita income and more than half of the region's population, is the only country projected to be unable to maintain current consumption levels by 2007.

Egypt is dependent on imports for about two-fifths of its grain requirements. Dependency on imports to meet wheat requirements is even higher at 55 percent. Between 1988 and 1996, government programs raised procurement prices to stimulate production, and grain self-sufficiency rose from 53 to 62 percent. In the long run, however, total area planted to wheat is not expected to increase significantly due to the limited land and therefore, assuming no major change in technology, the country's import dependency will increase. While Egypt's current foreign exchange position is sufficient to cover its food imports, and exports are projected to grow strongly, foreign capital flows are less certain. In 1995, such flows comprised 33 percent of the import budget. Egypt's ability to import is strongly linked to tourist earnings, oil exports, worker remittances, and Suez Canal rents.

Unlike Egypt, where all crops are produced on irrigated land, Morocco and Tunisia are faced with high production variability, which continues to threaten the food security of the lower income groups who are highly dependent on agriculture for both income and food. Moroccan grain output continues to depend heavily on rainfall. However, even with plentiful rainfall, wheat imports will be essential to meet increasing demand. Most grain producers are traditional farmers, with fields of less than 5 hectares. The annual variability in their production increases their vulnerability to food insecurity. While the private sector—thanks to trade liberalization—is playing an increasingly important role in the wheat import market, the government is still involved in the marketing and pricing of wheat, a staple in the diet, and continues to subsidize wheat flour at the retail level. Although the government pursues its stringent policy on budget deficit control, this subsidy is unlikely to be phased out in the near future because of social concerns.

Tunisia has phased out consumer and input subsidies on a wide range of items, most recently fertilizers and animal feed. Consumer subsidies remain only on certain basic food staples, such as cereals, edible oils, sugar, and milk. Efforts have been made to improve the targeting of subsidies by limiting them to products that are predominantly consumed by the poor. The government has pursued two principal goals in its food subsidy system: 1) to gradually reduce food subsidies and allow prices to more fully reflect market values, and 2) to ensure that food subsidies help only the most needy. As a result, the share of people living at the poverty level, with incomes of less than a dollar per day, averaged less than 4 percent over the last decade.

Algeria's future food security depends on political as well as economic factors. The country's economy grew at 4.6 percent in 1996, or 2.4 percent per capita. This followed 10 years of declining per capita incomes as the economy was adversely affected by weaker oil prices. Continued civil strife, now in its fifth year, portends a poor economic growth outlook. Algeria suffers from high unemployment, estimated at 28 percent, a decline in industrial output, and reduced foreign investment outside of the oil sector due to civil strife. In 1997, a devastating drought reduced grain yields 60 percent from last year. The resulting poor harvest signifies not only that farmers will earn far less income than they did last year, but also that political tension could escalate.

Table 3--Grain and Root Supply and Food Gaps for North Africa

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	18,478	1,019	14,743	2,118	20,679
1989	19,908	984	16,844	1,993	23,598
1990	21,261	984	13,277	2,604	21,234
1991	26,890	1,130	13,219	1,345	23,657
1992	20,765	998	15,013	831	22,712
1993	19,082	981	16,731	418	23,474
1994	24,680	993	19,073	239	25,775
1995	19,207	1,201	19,656	249	30,817
1996	31,599	1,002	19,946	204	32,129
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	21,199	1,077	23,359	***1,976*** / ***0***	30,269
2002	25,975	1,109	24,399	***566*** / ***0***	34,254
2007	27,447	1,142	28,085	***606*** / ***0***	38,084

North Africa:
121.4 million people

Drought again devastates grain output in Algeria, Morocco, and Tunisia, but foreign exchange is sufficient for commercial grain imports to fill the gap.

Regional grain imports in 1997 are almost 50 percent higher than 10 years ago.

Regional grain import-dependency is increasing as land and water resources are limited and populations' incomes are rising.

Table 4--North Africa: Income Distribution in 1995

	Share of income owned by poorest 10%	richest 10%
Algeria	2.8	31.5
Egypt	3.9	26.7
Morocco	2.8	30.5
Tunisia	2.3	30.7

Source: World Development Report 1997

Figure 4--North Africa: Grain Area and Yields

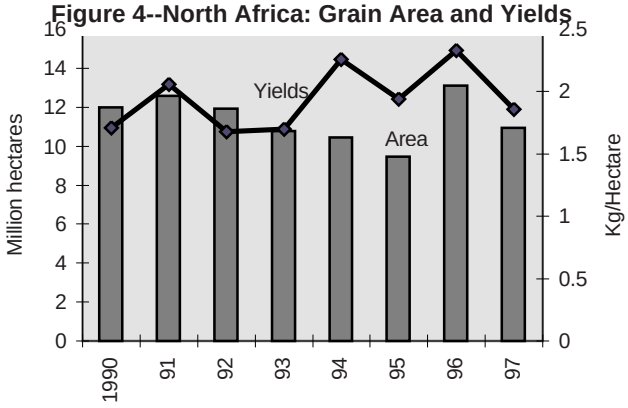


Figure 5--North Africa: Food Supply Sources

Sub-Saharan Africa

In the absence of food aid, average per capita food consumption is projected to decline throughout the next decade. To fill the gap, either annual production has to rise 10 percent more than projected rates or commercial imports have to double from projected levels. [Stacey Rosen]

Sub-Saharan Africa's food security position is highly vulnerable due to large variations in domestic food production, high population growth rates, and limited purchasing power of large segments of populations. This article examines factors affecting long-term food security and reviews results of the model for 37 Sub-Saharan countries, including projections of food gaps—to maintain per capita consumption and meet nutritional requirements—and distribution of food by income group.

Projections of per capita consumption are a direct reflection of the trends in domestic supply—production and commercial imports—and population growth. In the absence of food aid, per capita consumption is projected to decline an average of 0.4 percent per year throughout the projection period. The decline is steepest in Central Africa, at more than 0.6 percent, driven by trends in the Democratic Republic of Congo (formerly Zaire). The smallest decline is expected to be in East Africa. Caloric intake in Sub-Saharan Africa is currently the lowest in the world and any decline from this already low level can have severe implications for the health of the populations of these countries.

Sub-Saharan Africa's nutritional food gap is projected to be larger than the region's food gap to maintain consumption through the next decade (2007). The base (1994-96) consumption levels of these countries, at the aggregate level, are far below minimum nutritional requirements, and a much sharper increase in domestic supplies (from projected levels) is needed—either from production, commercial imports, or food aid imports—to improve the well-being of the populations. The countries where the nutritional gap far exceeds the gap to maintain consumption are Congo, Burundi, Ethiopia, Somalia, Zambia, and Chad.

No short-term food crisis is foreseen — Sub-Saharan Africa's gap between available food supplies and the amount needed to maintain base consumption levels is estimated at 3.7 million tons for 1997. This is about 60 percent higher than 1996 actual food aid receipts of 2.3 million tons. The gap is only 3 percent of regional production, but is about 40 percent of estimated commercial imports. Tanzania, Uganda, and Rwanda have the largest gaps. Together, these three countries account for more than a third of the region's status quo food gap in 1997. **Tanzania's** current gap is estimated at more than 500,000 tons. Grain output of less than 3.5 million tons in 1997 falls below the recent average of roughly 3.8 million tons. A late start to the rainy season and insufficient rains in some areas depressed yields. **Uganda** depends on domestic production to supply nearly all of the country's food requirements. Therefore, with production estimated to fall more than 20 percent in 1997, an unusually large gap of 462,000 tons is the result. Rebel activity in the western and northern regions of the country has contributed to insecurity and displaced farmers. These problems and poorly distributed rainfall have adversely affected the 1997 harvest. In **Rwanda**, output for 1997 is estimated considerably higher than last year as the return of refugees resulted in increased area planted. However, output remains below pre-strife levels of the early 1990's. As a result, the food gap to maintain consumption is estimated at 352,000 tons—very close to last year's food aid receipts.

In the absence of food aid, a decline in per capita consumption is expected in the long term — The region's gap between domestic supplies and base consumption levels is projected to rise to 5.5 million tons in 5 years (2002) and to 8.9 million tons in 10 years. The largest gaps by the end of the projection period will be found in Nigeria, Rwanda, Congo, Angola, and Madagascar. These five countries account for more than a third of the region's food gap to maintain base consumption levels. The countries where the food gap to maintain consumption is projected to be zero or relatively small through the projection period are Central African Republic, Ethiopia, Swaziland, Cote d'Ivoire, Gambia, and Guinea-Bissau.

Sub-Saharan Africa's food gap to satisfy nutritional requirements is projected to rise from 9 million tons in 1997—two and a half times the status quo gap—to 12.6 million tons in 2002 and 15.7 million tons in 2007. Ethiopia, Congo, and Somalia account for more than 40 percent of the nutritional gap in 2007.

Several countries have been selected for discussion based on either the size of the food gaps, an unstable political environment, which is influencing the food situation, or a unique transition situation that makes projections difficult. These countries include Nigeria, Congo, Ethiopia, and Somalia.

While **Nigeria's** gap is large relative to other Sub-Saharan countries, it is very small relative to available food supplies in the country. In 2007, Nigeria's projected gap of 863,000 tons measures less than 3 percent of production. Historically, Nigeria, unlike most countries in the region, has not been a food aid recipient as domestic supplies have been adequate to meet consumption requirements. And, while Nigeria's gap to maintain consumption is the largest

in the region, the country's nutritional gap is projected to be zero through 2007. This means that Nigeria's domestic supplies will be adequate to meet minimum nutritional standards. Therefore, if meeting the nutritional target were used as a measure of food security, Nigeria would be considered one of the least vulnerable countries in the region.

For **Congo**, production growth needed to fill the gap to maintain base consumption is projected at nearly 2.6 percent per year—above the projected rate of 2 percent, but below historical growth. While grain yields are expected to improve upon historical rates, area growth is projected to slow considerably. Despite the increase projected for yields, they will remain among the lowest in Sub-Saharan Africa. Production growth required to fill the nutritional gap is projected at nearly 3.5 percent, well above the growth used in the model. Obviously, the political situation in Congo and the policies the new government puts in place will play a large part in influencing trends. If stability is achieved and incentives are provided to farmers, future growth may be able to match historical growth. If this scenario proves true, the gap to maintain base consumption levels would fall to zero and the nutritional gap would become negligible by 2007.

Ethiopia's nutritional gap is projected to be the largest in Sub-Saharan Africa, meaning that domestic supplies will fall well short—3 million tons—of meeting minimum nutritional requirements by 2007. To fill the nutritional gap, production will have to grow roughly 5 percent per year through the next decade. This is roughly one percentage point higher than the projected growth rate, and much higher than the historical growth rate of 2 percent. Filling the gap with commercial imports would require an unrealistic growth rate of more than 17 percent per year. While the nutritional gap will remain, the country is projected to make progress toward meeting its basic food needs, however. Projected growth rates in production and imports provide ample domestic supplies to maintain base consumption levels in 2007. This is a significant development for Ethiopia, which had relied on food aid throughout the 1980's and early 1990's to meet consumption requirements. The combined impact of people returning to their farms following the end of the war in 1991, favorable weather, and the implementation of policies designed to provide incentives to farmers stimulated output. The higher growth rates achieved in the 1990's are assumed to continue into the projection period. Area is projected to expand 2.3 percent per year through 2007, while yields are assumed to rise almost 2 percent per year. Both of these growth rates exceed those achieved during 1980-96. Import growth is projected at a modest annual rate of 1 percent.

Projections are difficult in **Somalia** given the precarious state of the country. Grain output declined between 1980-96. For the projection period, output is expected to rebound, although slowly, with grain area increasing only 0.35 percent per year and yields rising less than 1 percent. Root crop output is projected to increase 1.44 percent annually. This growth falls short of meeting both consumption targets— maintaining base levels and meeting nutritional requirements. The growth needed to fill the nutritional gap—11 percent per year—appears particularly elusive. Similarly, the growth in imports needed to fill these gaps far exceeds projected growth of under 1 percent per year.

Yield growth is the key to larger domestic food supplies in the future — Historically, most increases in production in Sub-Saharan Africa have stemmed from area expansion. The continuation of this trend is unlikely as the region faces many resource constraints to sustainable agricultural growth, despite its vast and diverse land area. Much of Sub-Saharan Africa's land with crop production potential has poor quality soil.

Long term regional production growth will depend on adoption of new technology to increase yields. Yields in most Sub-Saharan countries fall well below world averages and thus, there is room for improvement, provided there is investment in research and/or extension services. During 1980-96, grain yields declined or increased marginally in about half of the Sub-Saharan countries. For the projection period, yields are expected to rise in all countries and, in most countries, rise at rates exceeding historical levels under the assumption of increased fertilizer use and adoption of new technologies. Therefore, failure to move in this direction may translate into larger gaps than outlined in this article.

Because production is the principal source of domestic supplies in this region, food gaps and/or deficits will widen if production growth fails to keep pace with population growth. For the region as a whole, population growth is projected to outstrip production growth by 0.4 percentage points per year, on average, which is the primary factor accounting for the widening food gaps.

Imports are not likely to increase significantly. Many Sub-Saharan countries face severe financial constraints following years of excessive government expenditures and stagnating export earnings that have limited import capacity. Fiscal mismanagement led to large debt accumulation. For the region on aggregate, external debt as a percent of GNP rose from 31 to 81 percent during 1980-95. This debt as a percent of export earnings jumped from 92 to 242 percent during the same period. Exports of goods and services increased only 2.5 percent per year during 1990-95. This is quite low compared with other developing regions such as Latin America, 7 percent, and South Asia, 12 percent. Because of these developments, the region is highly dependent upon external financial assistance to support imports. In 1995, external financial flows accounted for 30 percent of the region's imports. In some countries such as Mozambique and Lesotho, 70 to 80 percent of the import bill is financed by external assistance. Hence, commercial imports in most countries in the region can expand only marginally and therefore are projected to contribute little to domestic supplies. For the region, the ratio of commercial imports to production is projected at less than 13 percent in 1997 and 11 percent in 2007. The ratio of commercial imports to aggregate food availability is estimated at less than 10 percent throughout the projection period.

Unequal food distribution within countries intensified food insecurity — The review of regional and country averages gives an incomplete picture of the food security situation. A review of income distribution provides an insight to the extent of food shortfalls within a country.

If consumption in all or nearly all income groups falls short of the minimum nutritional requirements, a country's food security position would be considered at risk. Unfortunately, this is the case for most countries in the region. At the aggregate level (all income groups), consumption in 2007 falls below the nutritional target in 27 of the 37 countries in the region. Consumption in 2007 is projected to equal 93 percent of the nutritional target.

In Sub-Saharan Africa, on average, consumption in only the top income group is projected to exceed minimum nutritional requirements in 2007 in the absence of food aid (see figure 6). Consumption in the lowest income group in 2007 is projected at 74 percent of nutritional targets (see table 2 on page 8). It is important to remember that this is a regional average and therefore, individual countries may vary considerably. For example, in Sudan, Uganda, Swaziland, Benin, Ghana, and Guinea-Bissau, consumption in all or nearly all of the income groups in 2007 is expected to exceed the nutritional target. On the other hand, in half of the countries in the region, consumption in 2007 in all income groups falls short of the nutritional target.

These shortfalls can also be used to estimate the number of hungry people (defined as those who cannot meet minimum nutritional requirements). In 2007, the population of Sub-Saharan Africa is projected to be nearly 800 million. The results indicate that 526 million, or 66 percent, will be hungry. Not surprisingly, nearly a third of these people are in the lowest income groups in these countries.

Given that food aid from donors has fallen during the 1990's, these countries must find ways to raise their domestic supplies—principally domestic production—as a first step toward improving the nutritional status of their people. Some steps taken to achieve this goal have yielded positive results. Some countries have begun to realize positive effects of the liberalization policies undertaken in the mid-1980's. In addition, resolution of long-standing civil wars in Ethiopia and Mozambique—which had disrupted agricultural activities for decades—has resulted in increased output. To remove impediments to production and achieve long-term growth in agriculture that exceeds historical trends, significant investment is needed to improve infrastructure and extension services and encourage technology adoption.

El Nino and its impact on Sub-Saharan Food Security

The El Nino weather phenomenon is expected to affect agriculture throughout the world. According to recent satellite data, the El Nino of 1997/98 is likely to be the most severe ever. In Africa, the impact is expected to be greatest in the southern region (and could significantly alter the results included in this assessment). During the 1991/92 El Nino event, a severe drought hit the region, reducing grain output roughly 45 percent, placing millions of people at risk of starvation, increasing demand for food imports, and straining the already weak economies of the region.

El Nino's effects have already been felt strongly in Somalia (in East Africa). Heavy rains since mid-October led to flooding, deaths, destruction of infrastructure, displacement of people, and crop losses. Food prices have increased significantly in the affected areas. In response to the disaster, UN relief organizations air-dropped food.

The worst effects of El Nino are expected to be felt in early 1998, a critical growing stage for the coarse grain crop in southern Africa. Corn is a staple crop in this region. A sharp drop in grain output will generate strong demand for imports. During the 1991/92 drought, commercial grain imports more than doubled while food aid imports tripled from normal levels. Such an increase in demand may spur increased grain prices in 1998 as world coarse grain stocks are very low—about 13 percent below their 1991/92 level.

A positive note for the region is the large exportable surplus in South Africa. Because of a good 1997 harvest, the country has a surplus estimated at roughly 1 million tons. Due to market liberalization, private traders are now permitted to export any amount they desire. Therefore, South Africa may be in a position to supply some neighboring countries that have shortfalls.

Reforms in most countries in the region have liberalized transport sectors, which contributed to improved transport channels. Grain marketing boards have been privatized in many countries and international grain trading companies play a larger role than in the past. The marketing boards and trading companies should facilitate the flow of food within and between countries that is expected to increase as demand for imports grows.

Due to the advanced warning of the onset of this El Nino, many countries in the region have established plans of action. For example, in Zambia the government and private companies have mounted well-organized information campaigns that include brochures, televised discussions, and radio programs that deal with ways to cope with drought. In Zimbabwe, the Grain Marketing Board has set up strategic grain reserves to cover 5 months of consumption and has set up a cash reserve to allow for imports of 3 months of consumption.

Table 5--Grain and Root Supply and Food Gaps for Sub-Saharan Africa

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	52,387	27,720	5,040	3,157	69,261
1989	49,376	29,385	3,922	3,351	69,733
1990	51,790	31,697	4,524	3,586	75,783
1991	57,850	35,384	5,071	4,756	82,098
1992	55,674	37,482	8,065	5,687	83,747
1993	59,449	38,833	8,146	3,485	88,459
1994	62,773	38,830	7,865	3,040	89,657
1995	62,026	39,586	7,140	2,091	87,040
1996	64,409	40,313	8,398	2,254	93,302
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	66,305	41,004	8,568	***3,677*** ***9,009***	92,264
2002	77,503	44,897	9,007	***5,506*** ***12,625***	102,927
2007	88,581	49,549	9,826	***8,884*** ***15,712***	116,017

Sub-Saharan Africa

568 million people in 1997.

The gap between available food supplies and the amount of food needed to meet nutritional targets jumps 74 percent during 1997-2007.

Twenty-six of the 37 countries face gaps to maintain consumption and meet nutritional targets.

While Sub-Saharan Africa will have only 25 percent of the population of the study countries, the region is projected to account for 66 percent of the total nutritional gap.

Sub-Saharan Africa is the only region where the nutritional situation has deteriorated in the last three decades and this trend is expected to continue during the next decade.

Table 6--Sub-Saharan Africa: Income Distribution in 1995

	Share of income owned by poorest 10%	richest 10%
Guinea-Bissau	0.5	42.2
Kenya	1.2	47.7
Nigeria	1.3	31.3
Rwanda	4.2	24.2
Senegal	1.4	42.8
Tanzania	2.9	30.2
Uganda	3.0	33.4
Zambia	1.5	31.3
Zimbabwe	1.8	46.9

Source: World Development Report 1997

Figure 6--Consumption Distribution by Income Group in Sub-Saharan Africa

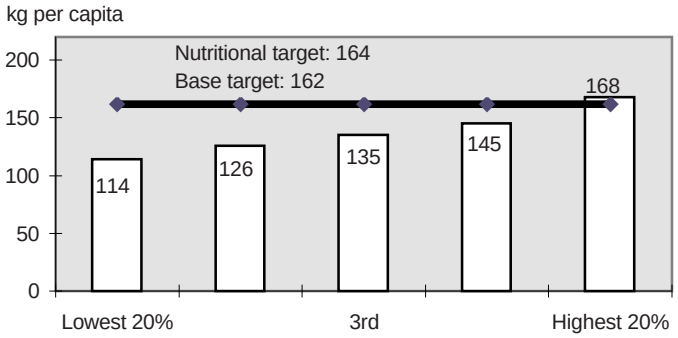
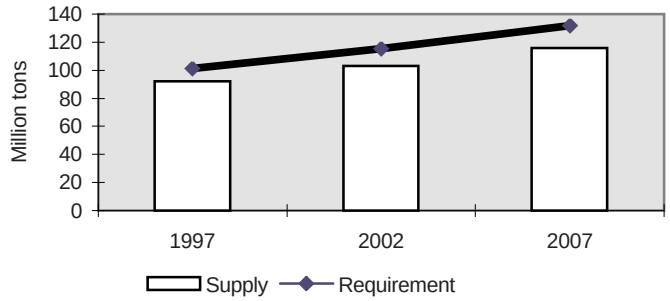


Figure 7--Sub-Saharan Africa: Grain and Root Supply vs Requirement



Asia

Asia has made considerable progress in improving food security. The impressive gains of the region's low-income countries, however, mask food problems in large segments of the population. For these groups, undernutrition is primarily the result of insufficient purchasing power to obtain nutritionally adequate diets. However, the incidence of undernutrition will decline over the next decade. [May Mercado Peters]

This article reports the results of the food security model for nine historically food aid receiving countries in Asia: Indonesia, Philippines, and Vietnam in Southeast Asia; Afghanistan, Bangladesh, India, Nepal, Pakistan, and Sri Lanka in South Asia. It also examines factors influencing estimated food gaps over the next decade.

Asia's per capita food availability has increased considerably since the advent of the Green Revolution. Grain production grew over 2 percent a year in six of the nine countries included in the study. As a result, most countries in the region sustained average annual growth rates in per capita food consumption (as measured by consumption of grains and root crops) of over 1 percent during 1980-96. Despite economic growth and food production gains, South and East Asia are still home to over half a billion chronically undernourished people — accounting for 63 percent of the total (66 country studies). Though projections indicate that the proportion of the population that is undernourished will be decreasing, the absolute number will remain high because of the heavy concentration of the population in this region.

Per capita food availability in the region is projected to stagnate over the next decade (increasing by less than a percent over the next decade), reflecting slower production growth than the historical trend. However, given the region's relatively fast consumption gains in the last three decades, the projected stagnation in per capita consumption, while disconcerting, does not pose an impending crisis. The largest increase in per capita availability is projected to occur in India, 7 percent, while the largest decline is projected to occur in Pakistan at 7.3 percent followed closely by Afghanistan at 7.1 percent. Nepal is also forecast to experience a large decline.

In the short run, the region is facing a serious food problem in North Korea where floods have destroyed the country's crops the last 2 years. While North Korea is not covered in the food security model of this report, information gathered about the country indicates that the situation has become chronic and life threatening. International food assistance is badly needed to avoid widespread famine and death due to starvation (see box 2).

For the region as a whole, the gap between available food supplies and the amount needed to maintain consumption is projected to be 2.1 million tons in 1997. The region's total food gap to maintain consumption is relatively small, less than 1 percent of its domestic supply (commercial imports and production). This suggests that the short-term shortfall is not a major food security threat. Afghanistan, with a gap of 0.9 million tons, will account for about 41 percent of the shortfall. Bangladesh also has a large deficit, 0.5 million tons. These two countries combined account for over 60 percent of the region's projected deficit. India and Vietnam are the only countries in the region estimated to be able to maintain consumption from domestic supplies in 1997.

The current gap between the amount of food needed to meet nutritional requirements and domestic supplies is projected at 5.1 million tons in 1997, more than twice the amount needed to maintain current consumption. Bangladesh accounts for most of the gap (about 99 percent) in nutritional requirements, as the rest of the countries except Nepal and Sri Lanka are able to meet their targets from domestic supplies. The ability to meet nutritional targets from domestic supplies reflects the region's relatively high level of consumption.

Asia's long run food deficit is expected to increase, as the gap between domestic supplies (production plus commercial imports) and current consumption is projected to triple between 1997 and 2007. This trend holds for most countries in the region except India, which in the short and the long run is able to maintain consumption from domestic supplies. This trend is not alarming, however, because the food gap to maintain consumption will be a small proportion of domestic supply over the projection period (1.7 percent). Of the countries studied here, Afghanistan and Bangladesh will remain vulnerable to food insecurity. Per capita consumption in these two countries is projected to decline and their food gap to maintain current consumption is 2.6 million tons in 2007—about 40 percent of the region's needs. Meanwhile, per capita consumption in Pakistan is projected to decrease sharply as the deficit to maintain consumption increases from 50,000 tons in 1997 to 2.2 million tons by 2007.

The gap between available supply and amounts needed to meet nutritional requirements is also projected to continue to increase through 2007, although by a considerably smaller amount. Most countries in the region, despite their inability to maintain consumption levels, will be able to meet nutritional requirements from domestic supplies. The exceptions are Bangladesh, Nepal, Sri Lanka, and Afghanistan, with Bangladesh accounting for 90 percent of the region's nutritional needs in 2007.

Can food gaps be eliminated through increased production? — One way to eliminate the projected food gap in Asia by the end of the projection period is to increase domestic food production. Most countries would be able to eliminate the consumption deficit if they could maintain the same rate of growth in grain production over the projection period that they experienced during 1980-1996. For example, the Southeast Asian countries of Indonesia, Philippines, and Vietnam could maintain consumption if grain output during the projection period would grow at the same rate as during the preceding historical period. In India, if grain production grew at a rate of 2.05 percent per year throughout the projection period—slightly less than its 2.1 percent growth between 1980 and 1996—it would be able to maintain consumption from domestic supplies. The largest exception to this is Pakistan, which would have to increase its production 2.5 percent per year, nearly one percentage point more than during 1980-1996, to eliminate its food gap by the end of the projection period. Historical experience suggests this is not likely.

The main long-term regional concern is the sustainability of domestic production. The region as a whole is densely populated and continued population growth will put pressure on available cropland as urban areas expand. Expansion of cultivated land has stagnated, increasing by less than 1 percent since 1989. In South Asia, area under cultivation has actually declined. As a result, most of the increase in crop production will have to come through increased yields. Grain yields have grown substantially in the region in the past, primarily due to increased irrigation and widespread adoption of improved varieties made available through the Green Revolution. However, yield growth has been slowing recently, raising concerns that growth in grain production will not be able to be sustained at the previous rate. Environmental degradation caused by increased urbanization and industrialization will also make it difficult to maintain current rates of growth in crop yields. For the region to increase food availability, it will need to either accelerate its growth in exports to finance food imports or increase investment in its agricultural sector to increase agricultural production.

The possible exceptions to this are in Sri Lanka, Afghanistan, and Nepal. Nepal has yet to fully exploit all of its potential for expanding production through adoption of Green Revolution technologies. It has the lowest percentage of potentially irrigable land in irrigation and the lowest level of fertilizer use in the region. In Afghanistan and Sri Lanka, civil strife and political instability have led to disruptions in input supplies and cultivation, causing production to stagnate.

Can food gaps be eliminated through commercial imports? — There is a considerable degree of diversity among countries in terms of relying on food imports to increase consumption within the region. In Nepal, the food gap is over 150 percent larger than projected commercial imports, making it unlikely that Nepal will be able to maintain consumption without food aid. Other countries where the food deficit is high relative to commercial imports are Afghanistan, 47 percent of imports, and Bangladesh, 33 percent of imports. Indonesia should be able to eliminate its deficit, which represents less than 1 percent of its projected commercial imports.

Increasing commercial imports to reduce food gaps would require most countries to more than double their food imports by 2007. It should be noted, however, that of the five regions studied here, Asia's projected food import dependency is the lowest, 6 percent compared to about 50 percent in North Africa in 2007. Nevertheless, for some countries increases in imports could create a significant budget pressure. In Pakistan, where per capita food availability is projected to decline 0.6 percent per year, growth in commercial imports would have to be 3.5 percentage points greater than projected. This would increase the country's import dependency to 12 percent by 2007 from 8 percent in 1996. Nepal would have to increase the growth of its food imports the most, an additional 14 percentage points.

In general, most countries in the region have restricted food imports as part of their policy of food self-sufficiency. As a result, they are not traditional food importers, but many, such as India and Pakistan, have the capacity to do so because the share of food imports in these countries' budgets is low. Whether these countries will be able to increase commercial imports will depend on whether a change in policy occurs.

Undernutrition continues in low-income groups — The food security situation in the region is generally favorable in that all countries in the region, except Bangladesh, Nepal, Afghanistan, and Sri Lanka, will be able to maintain consumption above levels needed to meet nutritional targets. However, the situation facing many households and specific segments of the population in the region is not as favorable.

If available food supplies were distributed evenly, nearly all households would be able to maintain nutritionally adequate diets. However, income is not distributed evenly. The poorest 20 percent of the region's population have control over only 8 percent of total income, while the richest 20 percent account for nearly 43 percent of income.[1]

The inequality of income distribution is important to the extent that it affects the amount of resources people have available to obtain nutritionally adequate diets. To get a better understanding of the extent of the undernutrition problem in the region, the gap between per capita food consumption and nutritional requirements was estimated by income group for each country. The estimates indicate that by 2007, per capita food consumption of the poorest 20 percent of the population will fall below recommended nutritional standards in all countries except Indonesia. Individuals in the next income quintile are only slightly better off, with food consumption still below nutritional requirements in a majority of countries. This shows that even in countries where

[1]It should be noted that this income distribution is not as skewed as that in many Sub-Saharan African and Latin American countries.

food availability is not a problem, 20 to 40 percent of the population will lack access to nutritionally adequate diets.

Because of the stagnation in per capita food availability and continued inequality in the distribution of incomes throughout the projection period, household access to food will continue to be a significant problem. By 2007, 570 million people, nearly 30 percent of the region's population, will still not be able to meet nutritional requirements. The undernutrition problem at the end of the projection period will be greatest in India and Bangladesh, which together could have more than 350 million undernourished people, or nearly three-quarters of the people in the region who are unable to obtain nutritionally adequate diets.

Although pegged at 570 million people in 2007, the incidence of undernutrition in Asia will decline from 760 million in 1997. In contrast, the number of people undernourished in Sub-Saharan Africa is expected to increase from 303 million to 526 million in 2007. Nonetheless, the absolute number of undernourished people in low-income Asia will remain higher than in Sub-Saharan Africa at the end of the projection period.

Box 2

North Korea's Deteriorating Food Situation

The food security situation is grave throughout North Korea. The country's cereal deficit for the current marketing year is estimated by the Food and Agriculture Organization of the United Nations to be about 1.2 million tons. The state-run food distribution system (known as PDS) is unable to supply minimum amounts of grain to all of North Korea's population, forcing millions to seek other food sources and risk malnutrition. Estimates of what is being distributed through PDS since the beginning of 1997 range from 100-200 grams per person, substantially less than the recommended daily cereal requirement of about 450 grams. According to a government estimate, half of the country's 10 food distribution areas have ceased operation since June 1997. World Vision International estimates that about 5 million North Koreans, especially children less than 5 years old and adults older than 60 years, are facing possible starvation.

Political changes in the former USSR and in China during the past decade caused a sharp reduction in North Korea's ability to import fuel and food, causing its food supply to drop. Input supply has dropped sharply because the country's manufacturing sector does not have enough fuel to produce chemicals, farm machinery, and other inputs needed for North Korea's large-scale, chemical-intensive agriculture. This situation was exacerbated in the past 2 years by flooding that wiped out some corn and rice fields and also destroyed some farmers' household grain stocks. In 1997, a long summer drought has devastated the important corn crop. With very little grain stocks and a 1997 harvest that will be less than needed to keep the whole population alive, North Korea will need substantial assistance from the international community in the form of food aid to avoid disaster.

The short-run food crisis is indicative of the underlying problems in the country's agricultural sector. Failed farming policies have led to stagnant and declining yields, and food production growth has lagged behind increases in population (see figure 8). The lack of essential inputs will continue to constrain food production. As a result, North Korea will not only need immediate food aid and assistance to cope with its current food crisis, but also solutions to its chronic food problems so that future crisis can be avoided. This means that in the medium to long term, the country will need to address the results of years of agricultural mismanagement as well as the economic problems that have led to faltering production. However, even more serious than North Korea's faltering agricultural production is its inability to buy food in the international market. Purchasing food imports and the materials needed for farm input supplies, require that North Korea develop a trading economy that exports nonagricultural goods for hard currency. To do this, North Korea will have to reduce geopolitical animosities that now form a barrier to its potential trade, restore its credit-worthiness so that normal commercial transactions become possible, and become more efficient in order to compete internationally. [May Mercado Peters and John Dyck]

Figure 8-- Grain Production and Total Imports, North Korea, 1980-97

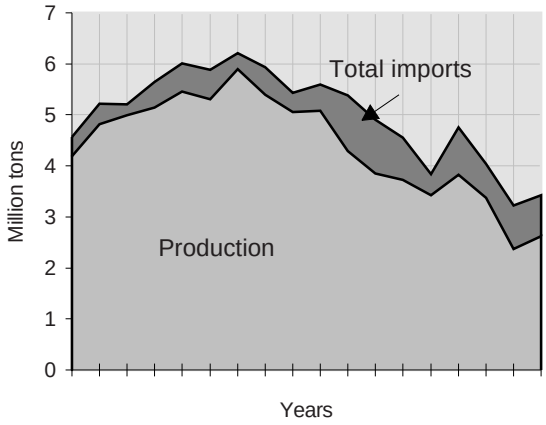


Table 7--Grain and Root Supply and Food Gaps for Asia

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	249,043	14,093	9,965	3,378	249,107
1989	268,008	14,555	9,582	2,756	263,842
1990	263,185	14,080	8,505	2,522	263,438
1991	266,168	14,429	6,648	2,721	264,433
1992	277,257	15,248	10,942	1,859	272,891
1993	282,451	15,075	10,449	1,792	276,091
1994	285,906	15,011	11,790	1,877	275,204
1995	294,835	15,157	19,664	1,495	291,439
1996	298,494	15,231	17,055	1,328	297,862
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	302,931	15,477	18,180	***2,115*** ***5,144***	296,635
2002	331,774	16,361	19,942	***5,582*** ***6,079***	321,628
2007	363,683	17,296	22,847	***6,742*** ***6,874***	353,730

Asia
1,815 million people

By 2007, Asia's population--64 percent of the total--is projected to account for 29 percent of the nutritional food deficit.

Amidst prosperity and growth in the region, some countries such as Bangladesh and Afghanistan, remain food insecure. Current trends indicate a growing number of countries unable to maintain their recent consumption level.

Growing population, rapid urbanization, and industrialization continue to put pressure on the region's fragile resource base.

Table 8--Asia: Income Distribution in 1995

	Share of income owned by poorest 10%	richest 10%
Bangladesh	4.1	23.7
India	3.7	28.4
Indonesia	3.9	25.6
Nepal	3.2	29.8
Pakistan	3.4	25.2
Philippines	2.8	32.1
Sri Lanka	3.8	25.2
Vietnam	3.5	29.0

Source: World Development Report 1997

Figure 9--Asia's Food Gap

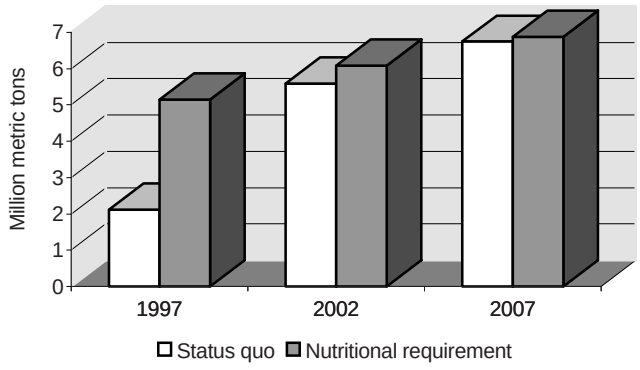
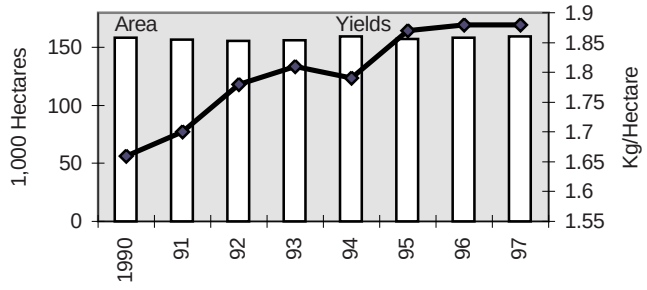


Figure 10--Asia: Grain Area and Yields



Latin America and the Caribbean

The total food gap to maintain per capita consumption for the region's lower income countries is projected to increase over the next decade. This could exacerbate the food security of the low-income population who face inadequate purchasing power. The projections show an increase in the number of people who will not be able to meet their nutritional requirement. [Birgit Meade]

The 11 countries covered in this article have the lowest per capita income among Latin American and Caribbean countries. They are: El Salvador, Guatemala, Honduras, and Nicaragua in Central America, the Dominican Republic, Haiti, and Jamaica in the Caribbean, and Bolivia, Colombia, Ecuador, and Peru in South America. Malnutrition and hunger are prevalent in a number of these countries and, if historical trends in food supply continue, average per capita food consumption is projected to decline about 6 percent in the next decade. The aggregate food gap to maintain per capita consumption is projected to more than double for the 11 countries as a whole by the next decade. For 1997, the food gap of 500,000 tons is about 4 percent of total regional production and 5 percent of commercial imports. By 2007, however, a gap of 1.4 million tons or 9 percent of production and 13 percent of commercial imports is projected.

The nutritional gap, 450,000 tons in 1997, is projected to reach more than 800,000 tons by 2007. Haiti, the poorest country in the Western Hemisphere, accounts for more than one-third of the region's 1997 nutritional gap, which is projected to widen and approach 300,000 tons by 2007.

Food production in the region is not keeping up with population growth. Latin America is a land-rich region, but good quality arable area is nevertheless threatened by rapid urbanization and environmental hazards such as soil erosion, salinity, and drainage, usually caused by poor cropping practices and intensive use. Under these circumstances, if per capita food availability is to be raised, long term increases in domestic supply will have to result from imports that are financed by export earnings.

Import dependency will increase—Import dependency (share of imports in total food supply) of the countries increased from 30 percent in the early 1980's to about 40 percent in 1995-96 and it is projected to continue to grow. This import trend, however, may not be sustainable. Foreign exchange earnings of the countries have improved significantly since 1990. In fact, with the exception of Haiti and Honduras, the range of growth in export earnings of the countries was from 4 to 12 percent annually, well above the 2.5 percent projected annual growth for food imports. However, debt service payments continue to be burdensome, particularly in Haiti, Honduras, Nicaragua, and Jamaica, where the value of debt exceeded the value of their GNP in 1995. In Haiti, the trade deficit reached 70 percent of the total value of imports and in Nicaragua the deficit is almost 50 percent. In 1995, almost half of Haiti's earnings from exports of goods and services had to be spent on debt service, while in Bolivia, Guatemala, and Nicaragua this figure was about one-third. To maintain per capita food consumption in the region, aggregate food imports will need to grow 3.3 percent per year in the next 10 years—almost 1 percentage point higher than projected.

Food security will worsen in lower income countries—Five countries—Bolivia, Guatemala, Haiti, Honduras, and Nicaragua, the lowest income countries of the 11 studied here—face gaps in maintaining consumption and are projected to experience a steady worsening of their food security situation. For Bolivia to maintain its consumption over the next decade, commercial imports have to triple. In Haiti, commercial imports would have to increase at an annual rate of 4 percent—almost 7 times its recent imports growth rate of 0.6 percent. Guatemala has been leading the group with import growth of 3 percent, but 5 percent are necessary to fill the food gap.

Within countries, food distribution remains a major problem—The more difficult dimension of food security in the region is the distribution of food within each country. Highly skewed distribution of income limits purchasing power and access to food for low-income households which, in turn, intensifies food security problems. Compared with other regions of the world, Latin American countries have the highest income inequality and widespread poverty.

This extremely unequal income distribution translates into an equally unequal distribution in access to food. In 1997, roughly 40 million people, or one-third of low-income Latin America and the Caribbean, are estimated to be unable to meet their nutritional requirements. Assuming no change in income distribution it is projected that over the next 10 years food insecurity will expand and threaten also middle income households in the five lowest income countries (Bolivia, Guatemala, Haiti, Honduras, and Nicaragua) and El Salvador.

In the long term, external assistance is not likely to be available. As food aid to the region has steadily declined over the last decade and is likely to continue to do so, further emphasis on increasing and stabilizing export earnings (for example by diversifying exports) will help to reduce food insecurity for a country as a whole. Food insecurity within a country will have to be addressed by targeted assistance and policies that benefit the income prospects of low-income households.

Table 9--Grain and Root Supply and Food Gaps for Latin America and the Caribbean

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	10,181	2,643	3,802	1,611	13,178
1989	10,410	2,623	3,365	1,320	12,208
1990	10,102	2,521	4,005	1,423	12,551
1991	9,725	2,474	4,413	1,817	12,115
1992	10,505	2,372	5,609	1,335	12,776
1993	10,970	2,730	5,727	1,371	12,817
1994	10,579	2,817	7,560	1,002	13,584
1995	10,538	2,970	8,474	434	14,668
1996	10,685	2,902	9,233	294	14,500
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	10,674	2,941	9,301	***502*** ***446***	14,285
2002	11,495	3,058	10,110	***1,050*** ***566***	15,248
2007	12,344	3,177	11,336	***1,440*** ***827***	16,660

Latin America and the **Caribbean**
142 million people

The current El Nino phenomenon is expected to have a strong negative impact on the agricultural sector in a number of countries in the region.

A very unequal income distribution continues to be the major threat to food security for low-income households.

Economic progress has not succeeded in significantly reducing the number of poor.

The number of people unable to maintain their consumption level by 2007 is projected to exceed 60 million.

Table 10--Latin America & Caribbean: Income Distribution in 1995

	Share of income owned by poorest 10%	richest 10%
Bolivia	2.3	31.7
Colombia	1.3	39.5
Dominican R	1.6	39.6
Ecuador	2.3	37.6
Guatemala	0.6	46.6
Honduras	1.5	41.9
Jamaica	2.4	31.9
Nicaragua	1.6	39.8
Peru	1.9	34.3

Source: World Development Report 1997

Figure 11--Latin America's Food Gap

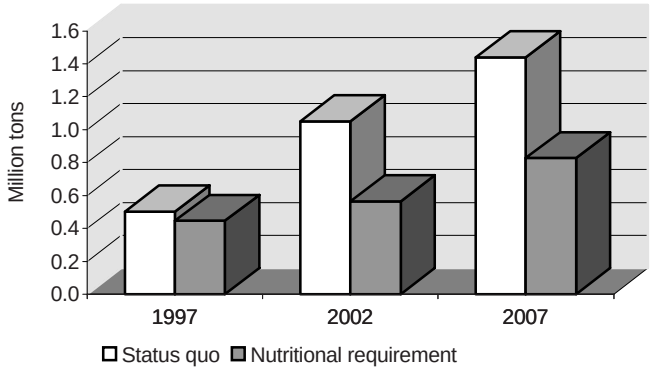
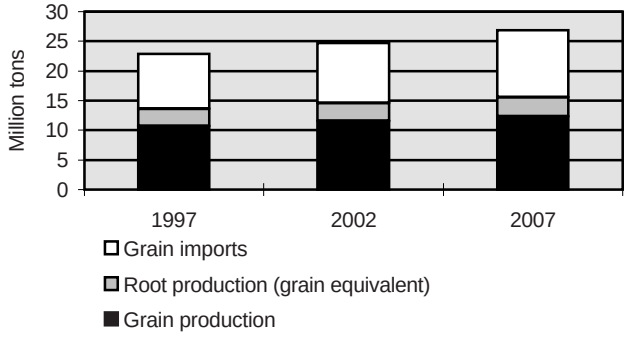


Figure 12--Grain and Root Supply in Latin America and the Caribbean



New Independent States (NIS)

Tajikistan's war-torn economy will likely keep it as the only NIS country with a significant food gap on a consistent basis. In other countries in the region, food consumption is projected to increase because of economic recovery, improved export performance, and higher grain output. [Jay Mitchell]

The aggregate food gap of the five NIS republics (Kyrgyzstan, Tajikistan, and the Caucasus nations of Armenia, Azerbaijan, and Georgia)[2] is forecast at 200,000 tons in 1997. The nutritional food gap is projected at 500,000 tons and is mainly accounted for by Tajikistan. The nutritional gap may be overstated because of the lack of reliable nutrition data, overestimating the contribution of grain and root crops in the diets of the countries. We assume that the composition of diets will remain unchanged over time. Other sources of nutrition, such as meat, dairy, fruits, and vegetables are very important in the diet of NIS countries. In particular, Armenia and Tajikistan, the two countries showing the largest nutritional gap for 1997, consume more fruits and vegetables per capita than most NIS countries, including Russia.

Financial improvement supports food security—Commercial import capacity of the five NIS countries is expected to increase sharply to 2.2 million tons in 1997 due to positive economic growth and rising exports, direct budget support by donor nations and international organizations (such as the IMF and World Bank), and lower per unit costs of importing grain. Only Armenia and Tajikistan are expected to have a significant food gap in 1997, as Kyrgyzstan becomes self-sufficient in grain production and Azerbaijan and Georgia are able to meet any deficit largely through commercial imports.

Grain output for the five countries in this region is forecast to rise 9 percent to 4 million tons in 1997, following a 20-percent rise the previous year. Farmers have reacted to higher domestic grain prices and more attractive sales terms from a growing private grain market by expanding area sown, especially to wheat. Better moisture conditions from higher winter snowfall in the Caucasus nations should raise yields. Root production, less than 10 percent of grain output, is estimated up 17 percent to 300,000 tons (grain equivalent) in 1997.

Long-term food security is projected to improve—The Caucasus countries are likely to raise grain production moderately in the coming decade as area expands due to reduced hostilities, and yields increase as fertilizer and pesticide use rises. Total grain output in the region is projected to rise about 8 percent to 4.3 million tons in 2007, assuming slow progress on returning fallow fields to permanent cultivation in Nagorny-Karabakh (Azerbaijan) and Abkhazia (Georgia). More rapid return of these traditionally fertile lands could contribute to steeper rises in grain output in the coming decade than are forecast here. At the same time, increased hard-currency export revenues, especially by Azerbaijan's growing oil exports, are projected to raise commercial grain imports nearly 30 percent to 2.8 million tons in 2007.

In graphic illustration of the benefits of macroeconomic and structural reform, Armenia and Georgia registered GDP growth in 1996 of 6 and 11 percent, respectively, ranking them at the top of NIS countries, ahead of even the radically-reforming Baltic nations. Both Caucasus nations are in their fourth year of positive economic growth, while Azerbaijan is in its second year of recovery. The food gap to maintain base consumption levels for Azerbaijan, never a large food aid recipient except for one particularly bad year in 1994, is forecast at only 20,000 tons in 1997. Georgia, a large food aid recipient for the past 5 years, is projected to have a negligible food gap for 1997 due to larger harvests and increased commercial import capacity. Armenia, still suffering from the effects of economic sanctions by Turkey and Azerbaijan due to political conflicts, is the only significant candidate for food aid among the Caucasus countries. Its food gap is estimated at about 100,000 tons for 1997, equivalent to about 45 percent of commercial imports and just over 30 percent of production.

Economic growth in the three Caucasus nations is expected to continue for at least 5 years, further boosting import capacity and thus improving the food supply situation. While population growth is forecast to accelerate from its current slow rate, it will likely average only about 0.5 percent annually in the coming decade. Future food gaps of the three Caucasus countries are expected to drop to negligible levels by 2007, as Georgia benefits from an end to its civil war, Armenia gains from a cessation of hostilities with Azerbaijan and relaxation of the trade blockade by Turkey, and Azerbaijan's oil export earnings soar. Azerbaijan's economy is benefiting from accelerating foreign investment, mostly in its oil sector, which is likely to total 5-10 percent of GDP annually in the next decade. While a renewed outbreak of violence in any of the Caucasus nations could raise the need for future food aid, such a scenario is becoming less likely as all three nations enter a period of economic recovery and increased regional integration.

Two consecutive bumper harvests have made Kyrgyzstan largely self-sufficient in food grains, eliminating the food gap for 1997. The Kyrgyz economy grew more than 5 percent in 1996 and similar growth is expected for 1997.

[2]These five countries are vulnerable to food insecurity and have received food aid in recent years.

Table 11--Grain and Root Supply and Food Gaps for New Independent States

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	4,348	--	--	--	--
1989	3,318	--	--	--	--
1990	4,070	--	--	--	--
1991	3,827	--	--	--	--
1992	3,811	528	3,241	479	4,394
1993	3,694	458	2,211	1,159	4,321
1994	3,023	501	1,271	1,524	3,869
1995	3,077	647	1,346	1,119	3,917
1996	3,658	284	1,264	1,061	4,077
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	3,989	338	2,187	***201*** ***519***	4,343
2002	3,998	359	2,507	***187*** ***482***	4,552
2007	4,293	381	2,824	***204*** ***529***	5,075

NIS

27 million people

The food gap is projected to decline to negligible levels for all NIS countries, except Tajikistan, as higher grain production and greater commercial import capacity easily meet domestic food needs.

Tajikistan's war-torn economy will be slow to recover, however, as modest increases in both grain output and commercial imports fail to keep pace with a rapidly expanding population in the coming decade.

Table 12--NIS: Economic (GDP) Growth

	1996	1997-2002
	Percent	
Armenia	2.3	31.7
Azerbaijan	1.3	39.5
Georgia	1.6	39.6
Kyrgyzstan	2.3	37.6
Tajikistan	0.6	46.6

Source: Ecoplan

Figure 13--Tajikistan's Share in Total NIS Food Deficit

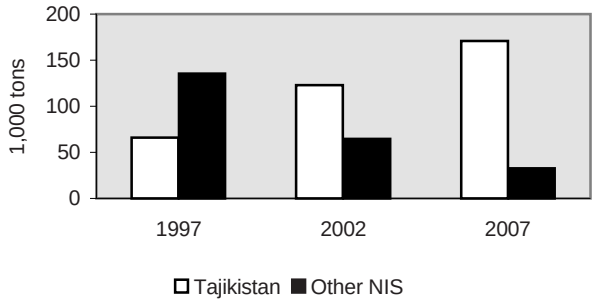
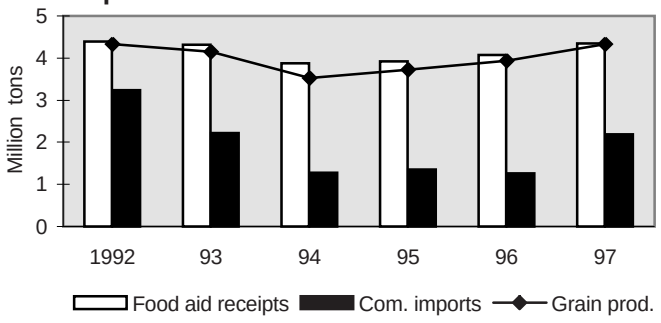


Figure 14--NIS(5) Grain Production and Imports



Kyrgyz grain output is forecast to increase at about 1 percent annually in the coming decade, which exceeds the projected rate of population increase. This should keep Kyrgyzstan largely self-sufficient in food grain supplies.

Tajikistan's food supply situation is projected to remain precarious—The only NIS country likely to consistently have a food gap is Tajikistan. The country's civil war, limited export earnings, and continued economic recession (GDP fell more than 10 percent in 1996 for the fifth straight year) have contributed to Tajikistan's food supply problems. The Food and Agriculture Organization (FAO) has identified more than 10 percent of the population (700,000 persons) as particularly vulnerable and in need of targeted humanitarian assistance for 1997, including food aid. While domestic policies promoting grain self-sufficiency have led to increased wheat area at the expense of cotton, the ability of Tajikistan to meet its food gap through increased production is limited. Multiple factors, including lack of adequate irrigation, insufficient land rotation, lack of land privatization, and low input use, will contribute to Tajikistan's food aid dependency by keeping yields at barely 1 ton per hectare over the next 10 years. Rapid population growth of nearly 2 percent annually is likely to contribute to widening gaps between production and consumption in coming years, with commercial imports unlikely to match this gap.

Tajikistan's food gap to maintain base consumption levels is projected to almost triple to 170,000 tons by 2007; nutritional needs are forecast to reach about 500,000 tons the same year. While the absolute magnitude of future Tajik food gaps should not pose a problem based on past food aid levels (averaging nearly 200,000 tons over the past 2 years and probably higher once unofficial aid from Russia is included), the key concern is targeting food aid for the most vulnerable population. The current government's policies of distributing food aid mainly to cities has left rural regions to settle their own food supply situations despite a rising number of persons displaced by civil strife, orphans, and invalids. Thus, future food aid might be more effective in alleviating hunger if it is increasingly targeted at rural populations and away from the cities, where economic recovery is likely to begin.

World Food Insecurity: A Policy Dilemma

by
Mathew Shane, Terry Roe, Lloyd Teigen, and Munisamy Gopinath[1]

Abstract: Almost 1 billion people live in a state of food insecurity. The income earned by them is only slightly more than 1 percent of world GDP. Even though the resources required to feed these people adequately are small, their food deficit is persistent and difficult to solve. Solutions must involve a radical restructuring of government away from interventionist policies and towards being a facilitator of economic growth and development focusing on overcoming market failures. Resources in support of agricultural research and development (R&D) have been declining worldwide and are undermining the growth in productivity that is required in order to have further declines in real agricultural prices. These lower prices would be one important step towards improving food security by increasing purchasing power of low-income households. Reducing the number of food insecure by half as recommended by the World Food Summit requires serious commitments from both the world food exporters as well as the food-insecure countries themselves.

Introduction

There are almost 1 billion people living in a state of food insecurity, most of them living on less than $2 a day. A small share of world GDP, less than 1 percent, would go a long way towards removing this insecurity. Yet transfers of food, income, or wealth do not appear to provide a permanent solution. Long-term solutions must come from inside the food-insecure countries and result in increased productivity and income for the food insecure.

To accomplish this, a fundamental restructuring of the incentives to save and invest, as well as a reordering of priorities for public investments away from control of markets toward overcoming inadequacies in physical and social infrastructure must be undertaken. Given the radical transformation of thinking required on the part of the leadership of these countries, it is hard to see how this transformation can take place. That is the dilemma. The problem involving a small share of world GDP is so difficult to solve because the root of the problem is not resource availability, but the approach to development of many officials in less developed countries (LDC's).

Public support for agriculture has been declining worldwide. Public R&D expenditures, which were growing by 7 percent a year in the 1970's, have stagnated in the 1990's. This, in spite of the fact that it was public R&D expenditures that caused the productivity growth and led to increased agricultural output over much of the past 25 years. While agricultural output grew more rapidly than population over the past 25 years, the "surplus" was highly precarious. Of the more than tripling of output over that period, almost 90 percent went to feeding increasing populations while only slightly more than 10 percent went to increasing food availability per capita. A small change in productivity growth or other factors affecting supply would have led to a different outcome. In fact, since 1985, world agricultural production has been growing at the same rate as population.

For policy makers, the dilemma rests in a conflict between humanitarian concerns and scarce aid resources. The OECD countries want to assist countries in need, but the conventional remedies of food assistance and policy reform in the most severely affected countries appear inadequate to turn around this situation. Only new thinking and dramatic policy reform will yield positive results in the longer term. How then are we to achieve the pledge by the World Food Summit to reduce the number of food insecure by half?

Food Insecurity and the World Income Distribution

The world's income distribution is highly concentrated at low income levels. More than 4 billion people have incomes of less than $16 per day.[2] More than 3 billion live on less than $8 per day. More than 1 billion live on less than $2 per day and more than 500 million live on less than $1 per day.[3]

[1]Shane is a senior Economist at ERS, USDA. Roe is a Professor, Department of Applied Economics and Director, Center for Political Economy, University of Minnesota. Teigen is a senior Economist, ERS, USDA. Gopinath is Assistant Professor, Department of Agricultural and Resource Economics, Oregon State University.

[2]For the purposes of this paper, our international comparisons are conducted in 1994 purchasing power parity (PPP) dollars. A purchasing power dollar is an international currency that was created to compare how much of the same basket of goods can be purchased in different countries. [3]In the OECD countries, less than 20 percent of the population live on $16 per day or less.

Although it is not clear exactly at what income a person becomes food insecure, few individuals who earn $16 per day or more are food insecure. On the other hand, individuals living on $1 per day or less are almost certainly food insecure. Almost 10 percent of the world's population live on $1 per day or less and almost 20 percent on $2 per day or less. FAO's estimate of the world's food insecure population, at 860 million (FAO, 1997), puts the income of food insecure people at almost $2 per day.

While populations are concentrated at low-income levels, income earned is equally concentrated at the highest income levels. Thus 70 percent of the world's GDP is earned by less than one third of all individuals—those who earn $16 per day or more. The poorest 1 billion only earn 1.3 percent of the world's income and the poorest 500 million only earn 0.3 percent of the world's income.

Since the poor only spend a part of their income on food, the food expenditures of the poorest 1 billion represent only 0.8 percent of the world's GDP while the food spending of the poorest 500 million represents 0.2 percent of the world's GDP.

While the solution to the food insecurity problem appears to be to transfer food, income, or wealth, we argue that this is not the correct solution in the long run.

The World Food Situation

Total world food production grew 2.6 percent per year between 1961 and 1985. On a per capita basis, food production grew only 0.6 percent per year. Between 1985 and 1995, both population and food production growth declined so that they were in approximate balance at 1.7 percent per year. This slowdown in production growth, if it continues, suggests the potential for supply shortages and a worsening of the food insecurity problem.

Factors Influencing Demand

The United Nations projects that population growth will decline from the current 1.5 percent per year to 1.25 percent by 2010. At this rate, total food supplies can keep pace with population growth at current prices and incomes. However, it is not sufficient for production to grow at the same rate as population for the market to equilibrate at constant prices. Income growth generates additional demand pressures. The excess of demand growth over supply is likely to place some upward pressures on real food prices.

A variety of factors could accelerate the movement toward higher world food prices: declines in population growth rates could decline less than projected, income growth in populous countries with high relative food expenditures could be faster than expected, and world agricultural production could slow from present rates.

Of the world's poorest 1 billion people, about 42 percent reside in South Asia, about 24 percent in Sub-Saharan Africa and 16 percent in China, North Korea, and Mongolia. South Asia and Sub-Saharan Africa are the two regions with the largest number of people at considerable nutritional risk. Twenty-five percent of South Asia's population and 51 percent of Sub-Saharan Africa's population live on less than $2 per day. These are also regions with the lowest per capital income growth and the highest population growth rates.

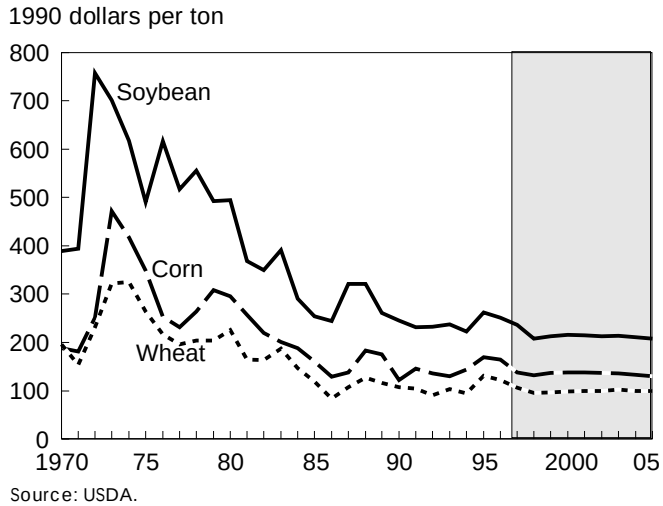
Food Prices and Capacity To Import Food

Rising incomes, stagnant per capita agricultural production, and declining stocks would lead us to expect a trend of increasing real prices. However, price trends have continued to suggest that food has become relatively less scarce over time (figure A-1, Borensztein et al., 1994).[4] A decline in the real price of food in world markets is not sufficient to ensure that food consumption per capita in low-income countries will increase. An increase in food consumption per capita depends on a number of factors, including a country's terms of trade, population growth, and growth in total factor productivity. All of these factors contribute to income and the country's ability to pay. We discuss the implications of these factors next.

Terms of Trade

Suppose a country is a net importer of food. Then, if the price of imported food falls relative to the price of a country's exports (terms of trade), earnings from a constant volume of exports can buy a larger volume of food imports. Unfortunately, this has not been the case for those countries that are at the highest nutritional risk. Many low-income countries rely heavily on exports of primary commodities (if anything at all). The price of some of these commodities has fallen even faster than that of food. Given the ultimate price insensitivity of demand for primary commodities export earnings decreased.[5]

Figure A-1--The pattern of declining real prices is slowing



Source: USDA.

[4]Grilli and Yang (1988) show that the price index of cereals exhibited a downward trend between 1900 and 1987. [5]According to the IMF (1995), non-fuel exports of primary commodities experienced large negative terms of trade effects during the early 1990's. On a regional basis, Sub-Saharan Africa experienced negative terms of trade during the late 1980's and early 1990's.

Compounding the problem for countries with the highest nutritional risk is that growth of exports per capita has not kept pace with the decline in their terms of trade so that foreign exchange earnings per capita have fallen. Burundi, Cote d'Ivoire, Kenya, and Tanzania are among the countries in Africa that have experienced a decline, not only in per capita export earnings, but in total export earnings (IMF, 1995). Thus, not only are the poor growing more dependent on food imports, their governments are less able to provide the foreign exchange to import food.

Population

Population growth has been declining worldwide and is projected to continue to decline. Between 1960 and 1977, populations grew almost 2 percent per year. Between 1978 and 1995, the growth rate had declined to 1.5 percent. Projections are always somewhat harzardous, but the UN and Bureau of the Census project the world population growth rate will decline to slightly more than 1.2 percent by 2010.

The decline in population is not uniform throughout the regions of the world. In Sub-Saharan Africa, population growth rates increased from 2.5 percent a year between 1960 and 1977 to almost 3 percent between 1978 and 1995. Projections for the region suggest continuing high population growth rates of 2.5 percent a year through 2010. Unfortunately, the regions with the highest population growth rates are also the ones with the largest food insecure populations. It is also the case that the lowest income groups within any country are also those with the highest population growth rates.

Growth in Factor Productivity

The decelaration in the growth rate of agriculture's total factor productivity (TFP) is international in nature, and associated with a decline in public and private R&D and the decline in real agricultural prices. The declining growth in TFP will cause agriculture to lose resources to the rest of the economy and will likely lead to a reduction of output growth. In the face of rising populations, world agricultural production per capita will fall, and may lead to rising world food prices. Increasing real food prices are unlikely to be a problem for the approximately 1 billion people with the majority of the world's income. However, for the remaining population, a rise in food prices can lead to considerable nutritional risk.

Changes in the rate of growth in agriculture's TFP has contributed to the slowdown in agricultural production growth. Recent evidence suggests that the productivity advantage of agriculture in major food exporting countries is declining relative to nonagricultural sectors (Gopinath, Roe, and Shane, 1996). Furthermore, the growth rate for total factor productivity has fallen in recent years. Evidence from the United States and other OECD countries suggests that agricultural R&D influences agriculture's total factor productivity growth. Declines in the growth of expenditures on R&D may thus slow agricultural productivity growth.

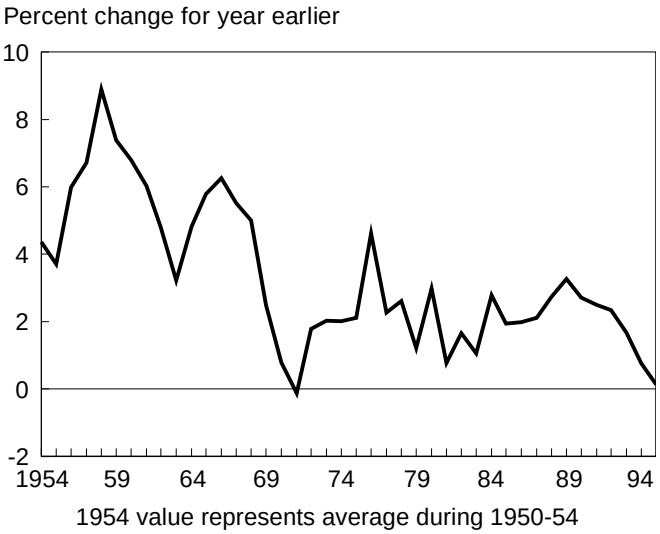
While there is considerable annual variation, annual rates of growth in TFP in the United States, France, Germany, and the UK appear to be falling. U.S. agriculture's TFP grew rapidly during 1949-1968 (figure A-3). Since then, the rate of growth in TFP flattened out. If these declining patterns continue, the long-term decline in real agricultural prices is likely to turn around.

U.S. TFP is explained by investments in public and private R&D, rural infrastructure, and by the embodied technological advances in material inputs (Gopinath and Roe, 1996, figure A-2 and A-3). In the 1950's and 1960's, investments in rural infrastructure played a dominant role in TFP growth while public and private R&D played a larger role in later years.

While detailed estimates are not available for other exporting countries, it appears likely that they follow a similar pattern. The decline in TFP growth is associated with a decline in the growth of public R&D expenditures. Alston and Pardey (1966, p. 47) state: "During the 1980's, research expenditures in developed countries grew at only one-quarter the rate experienced during the 1960's; for developing countries the rate of growth slowed to around 2.7 percent per annum during the 1980's, as compared with 7.0 percent during the 1960's." Private sector R&D spending has increased in proportion to public sector spending. In the 1990's, the public sector spent $0.79 for every dollar spent by the private sector, while in earlier periods the public sector spent $1.06 for every dollar of private R&D (Alston and Pardey, p. 56).

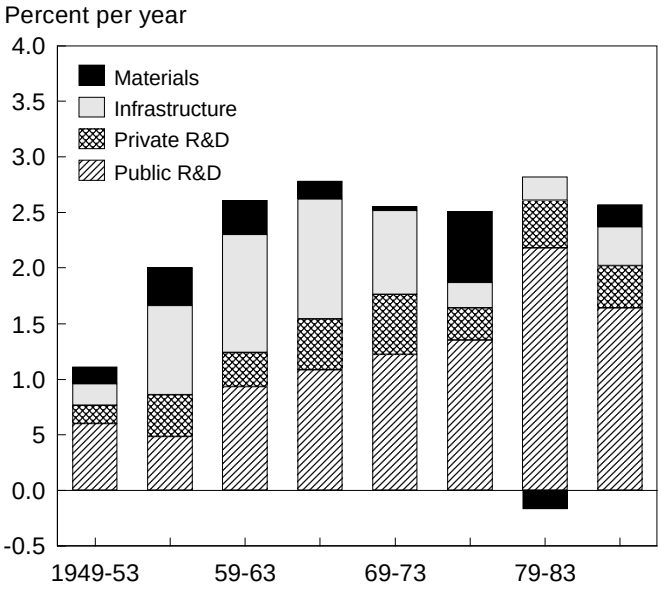
If the efficiency gains in the non-agriculture sector of the major food exporting countries do not spill over to the least developing countries, the rise in real prices of food are unlikely to be matched by a rise in their real incomes, further exacerbating the nutritional status of the poor.

Figure A-2--Growth in U.S. public expenditures on agricultural R&D has declined since the 1950's*



*Public expenditure on agricultural R&D is measured in 1992 dollars.
Five-year moving average.
Soure: Alson and Pardey (1996) and USDA.

Figure A-3--Contributions to agricultural TFP growth in the United States



Source: Gopinath and Roe, 1996.

What Can Policy Do?

We can characterize the lowest income countries of Africa and Asia where food insecurity is concentrated in the following way: overall income and agricultural production have been growing, but at a slower rate than population growth. Thus per capita incomes and per capital agricultural production have been falling. Furthermore, these countries have been highly inward-oriented so that total trade as a share of GDP has been falling. This pattern is dramatically different than that of the OECD countries and the fast growing newly industrialized countries, where per capita incomes and trade as a share of GDP grew rapidly, and agricultural production per capita increased. The real issue is what explains these differences and what can be done in the low-income, food insecure countries to reverse this long term pattern of decline. Although no short answer will suffice, there are some broad characterizations that point at a solution. Indeed, the economic history of countries such as South Korea, China, and Chile imply that solutions are possible.

In the short term, providing food, income or wealth transfers is possible and plausible. However, food insecurity and poverty are a sign that the economic system is not working well. Providing transfers can help overcome inadequacies in the short run, but cannot overcome the fundamental problems of poor and food insecure economies. Indeed, no externally imposed solutions can accomplish this. Only radical transformations of these systems can alter the negative path that these economies have been on for the past 25 years or more.

Let us focus on Sub-Saharan Africa. Over the past 25 years, per capita income and per capita agricultural production declined at the same time agricultural output and GDP increased by almost 2 percent per year. Can trade and investment policies raise economic growth rates in Sub-Saharan Africa enough to affect the individuals at nutritional risk? Using a dynamic computable general equilibrium framework for Sub-Saharan Africa, we show that trade liberalization and removing the bias in investment policies alone are not enough to turn around the situation in Sub-Saharan Africa.

Based on the simulations, trade liberalization adds 0.6 percent to per capita income growth rates. This policy change causes resources to move toward export sectors such as cocoa and nuts. The combination of trade liberalization and pro-agricultural investment in rural public goods adds 1.0 percent to the base growth rate of real income per capita. Real per capita income growth of only 1 percent a year helps the situation from getting worse, but is not sufficient to significantly reverse the nutritional situation. More fundamental remedies are required. What might these be?

Countries such as South Korea, China, and Chile, which have gone from low rates of economic growth to high rates, underwent a fundamental transformation in the approach of government to economic development. Government policy went from one of intervening in markets to create rent-seeking opportunities to facilitating development by creating institutions and reversing market failures. Measures included formation of specialized financial institutions, organized commodity and futures markets, and government organizations to provide marketing information to purchasers. These countries also went through a transformation from being inward oriented to being outward or even export oriented. The net effect of this transformation was to dramatically increase investment opportunities. The response to those opportunities was an approximate doubling of domestic savings rates from less than 15 percent of GDP to more than 30 percent of GDP (table A-1). In addition, the government's change from being a bottleneck to being a facilitator of economic activity opened the domestic economy to large amounts of direct foreign investments. Thus from both domestic and foreign sources, there was a huge increase in investable resources. The opening of the economy to international forces also opened the domestic economy to technological transfer and increasing productivity growth. The total effect of these changes has created 5 to 10 percent extra growth in GDP per year. It is this kind of a growth change that is needed to overcome the food insecurity problem in low-income countries.

Implications for Food Security

Given this perspective, what is the likelihood of dramatic changes in food insecurity as proposed by the World Food Summit? Trade liberalization is already a major and complicated step. It necessitates numerous and often politically unpopular changes in policy: the removal of protection of inefficient industries, short-run increases in food prices, and refocusing the tax system on income, value-added, or sales taxes and away from foreign trade taxes. This places pressure on the wealthy and politically influential. Yet, trade liberalization alone will not provide food security to those nutritionally deprived in the 1990's especially if the long-term downward trend in real food prices is reversed.

Table A-1--Developing Countries: Trade Orientation and Economic Performance (annual percent change)

	1974-85	1986-92
Strongly outward-oriented		
Real GDP growth	8.0	7.5
Real per capita GDP growth	6.1	5.9
Total savings / GDP	30.3	34.0
Total fixed investment / GDP	30.1	28.8
Capital-output ratio	1.3	1.4
Total factor productivity	2.6	3.8
Stongly inward-oriented		
Real GDP growth	2.3	2.5
Real per capita GDP growth	-0.3	-0.1
Total savings / GDP	13.7	10.9
Total fixed investment / GDP	16.3	14.1
Capital-output ratio	2.0	2.8
Total factor productivity	-0.4	0.3

Note: Developing countries are classified as "strongly outward-oriented" if trade controls are nonexistent or minimal, and "strongly inward-oriented" if overall incentive structure strongly favors production for domestic market.

Source: World Development Report, 1994, p. 76.

Combining trade liberalization with removing the government policy bias against agriculture will similarly not solve the problem in spite of the fact that this requires even more politically unpopular changes in policy.

Changes of the magnitude that will solve the problem involve a rethinking of the fundamental approach of government. However, the situation that is evolving in many of these countries is clearly unacceptable. Populations who are already poor and food insecure are faced with the prospect of becoming poorer and even more food insecure. Surely under these circumstances, leadership, in at least some of these countries, will see the appropriate path to a brighter future and be willing to make the hard choices necessary to make it happen.

References

Alston, Julian and Philip Pardey (1996). *Making Science Pay*, AEI Press, Washington D.C.

Borensztein, E., M.S. Khan, C. M. Reinhart, and P. Wickham (1994). *The Behavior of Non-Oil Commodity Prices*, Occasional Paper 112, IMF, August.

Delgado, Christopher L. and John W. Mellor (1997). "A Structural View of Policy Issues in African Agricultural Development: Reply," *American Journal of Agricultural Economics*, 69(2):389-391.

Gopinath, Munisamy, Terry Roe and Mathew Shane (1996). "Agricultural Competitiveness: The Case of the U.S. and Major European Countries", Staff Paper, USDA/ERS, Commercial Agricultural Division, Washington, D.C.

Gopinath, Munisamy and Terry Roe (1996). "Sources of Sectoral Growth in an Economy-Wide Context: The case of U.S. Agriculture," *Journal of Productivity Analysis*, Forthcoming, 1997.

Gopinath, Munisamy, Terry Roe and Erinc Yeldan. "Level Versus Rates Effects on Sectoral Growth: A Cross Country Analysis," Working Paper, Department of Applied Economics, University of Minneapolis, St. Paul, 1996.

Govindan, Kumaresan, Munisamy Gopinath and Terry Roe (1996). "Growth Accounting, Supply Response and Factor Returns in General Equilibrium: The Case of Indonesia," *Journal of Asian Economics*, 7(1):77-95.

Grilli, Enzo R. and Maw Cheng Yang (1988). "Primary Commodity Prices, Manufactured Goods Prices, and the Terms of Trade of Developing Countries: What the Long Run Shows," *The World Bank Economic Review*, 2(1):1-48.

International Monetary Fund (1995). *World Economic Outlook*, Washington, D.C.

International Food Policy Research Institute (1996). 2020 *Vision*, Washington, D.C.

Kelley, Allen C. and Robert M. Schmidt (1994). "Population and Income Change: Recent Evidence," IBRD Discussion Paper, No. 249.

Meadows, Dennis L. et al. (1972). *The Limits to Growth*, Universe Books, New York.

Rajapatirana, Sarath and Asad Alam (1993). "Trade Policy Reform in Latin America and the Caribbean in the 1980s", World Bank Working Paper, WPS 1104, Washington, D.C.

Teigen, Lloyd (1996). "Estimating Income Distribution Profiles Using the Gamma Function", Working Paper, USDA/ERS, Washington, D.C.

UNDP (1995). *Human Development Report 1995*, New York.

World Bank (1996a). *World Development Report*, Washington, DC.

World Bank (1996b). *Commodity Markets and the Developing Countries*, Washington, D.C.

Yeldan, Erinc, Terry Roe, and Sherman Robinson (1996). "Trade Liberalization, Accumulation and Growth in An Archetype Model of Africa, South Asia, East Asia and Latin America," Background paper prepared for the *IFPRI 2020 Vision Conference*.

Yen, Steven and Terry Roe (1989). "Estimation of a Two-Level Demand System with Limited Dependent Variables," *American Journal of Agricultural Economics*, 71(1):85-98.

Can Regional Policy Initiatives Help Achieve Food Security in Southern Africa?

by
Michael A. Trueblood[1]

Abstract: This article reviews three different regional policy options that might be used to address food insecurity for the Southern African countries. The options that are explored are a regional strategic grain reserve, a food import insurance program, and a free trade zone. Compared with other regions, these options are particularly attractive due to a common staple (white maize), very high national (but not regional) production variability, and strong regional institutional ties. Some preliminary analysis is provided; questions are highlighted for future research.

Food security is a high priority issue for nearly all governments around the world. Food security can be defined as "access by all people at all times to enough food for an active and healthy life" (World Bank, 1986). This definition encompasses both the supply (aggregate availability) and the demand (access) dimensions. Numerous policy instruments have been proposed to address food insecurity and find alternatives to relying on food aid. This article examines some regional policy initiative proposals (as opposed to national level proposals) for the Southern Africa region that focus on the supply dimension. The options that are examined include establishing a regional strategic grain reserve, implementing an international food import insurance program, and establishing a free trade zone.

The Southern Africa region is particularly well-suited to regional food security initiatives for the following reasons: 1) the countries share in common a staple food commodity, white maize (which is not widely traded on the world market); 2) grain production tends to be highly volatile at the national level but not at the regional level; 3) there are fairly strong regional institutions already established, namely the Southern Africa Development Community (SADC) (created in 1980) and the Southern Africa Customs Union (SACU) (created in 1910);[2] and 4) much of the warfare in the region has finally ceased (although peace remains fragile in Angola). Furthermore, with the recent change of government in South Africa, which led to its joining SADC, many observers now believe that there is much greater hope of achieving the food security goals set forth by SADC members in the early 1980's.

[1]An agricultural economist with the Marketing and Trade Economics Division, ERS, USDA. [2]The SADC countries now include Angola, Botwsana, Lesotho, Mauritius, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe. The SACU countries are confined to South Africa, Namibia, Botswana, Lesotho, and Swaziland.

This article briefly reviews the root causes of food insecurity in Southern Africa. Then different policy options are examined that address the problems of food insecurity in the region. For each option, preliminary economic analysis is provided when available. Further research needs are identified in the summary.

Assessing the Problem

The countries in the Southern Africa region are among the most food-insecure countries in the world. Most of these countries have very low per capita incomes and display low average nutritional levels.

Generally speaking, food supplies come from two primary sources, production and trade. Grain production has been increasing in Southern Africa, but it has not kept pace with population growth, leading to declining per capita production. Grain production in this region is also distinguished by its relatively high variability. This means that in a down year many people are vulnerable to hunger and sometimes even famine.

Many trade-related factors contribute to variable food supplies. These factors include volatile food import prices, unstable export earnings, and high debt service obligations from previously accumulated debts. Although real grain prices have been declining for decades, price variability has increased in the past 20 years for these commodities. It is expected that price volatility will increase even more in the coming years as major grain exporters continue with policy changes that result in lower stock holdings.

Strategic Regional Grain Reserve Option

One policy option to address food security is the creation of a regional strategic grain reserve. The option has been considered in previous studies for different geographic regions (for example, the Sahel by McIntire, 1981) and has the

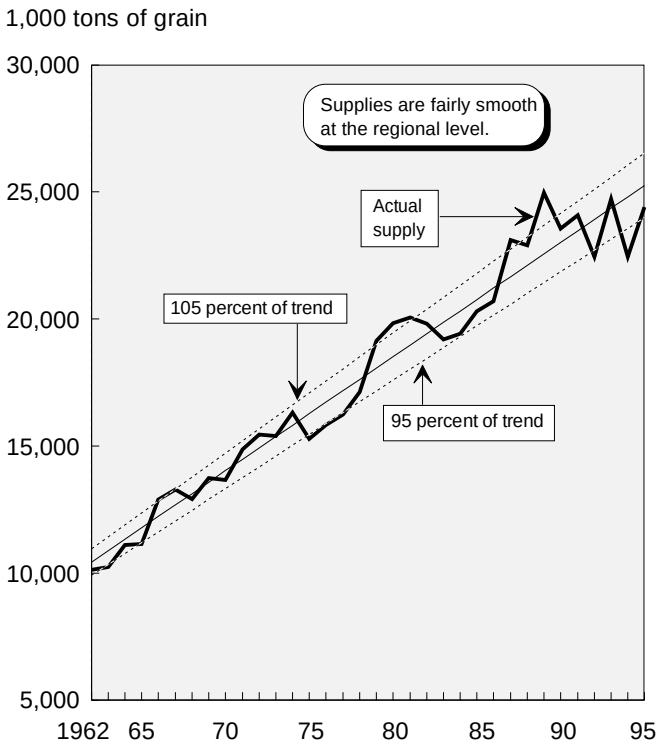
appeal of its direct food tangibility. In addition, this proposal has appeal for the Southern African region, whose consumers have in common similar tastes favoring white maize as a staple crop. As white maize is not widely traded outside of the region, it would appear to be a good candidate for a reserve. Furthermore, this buffer stock option has the merit that regional production variability is proportionally smaller than country level variability (see table B-1).

Unlike most earlier proposals, this policy proposes that a regional buffer stock be created as opposed to national level buffer stocks. There are two mechanisms discussed in the literature: quantity-based rules and price-based rules that determine when stocks are bought and sold. Given the regional dimension of this proposal, it makes more sense to think in terms of quantity-based trigger rules (that would avoid problems with exchange rates and inflation). Precedents for analyses of quantity-based trigger mechanisms include Walker, Sharples, and Holland (1976) and Reutlinger, Eaton, and Bigman (1976).

At the regional level, it is clear that grain supplies have been relatively smooth, rarely deviating outside of 5 percent of the trend use (see figure B-1). This suggests that it should be possible in principle to better stabilize national level grain supplies, which have been much more volatile. The challenge, however, is to devise a grain stocking arrangement for each country that can achieve this objective.

For the purpose of demonstration, one type of storage rule is discussed below. Let us first define supply as random production plus a trend level of imports. Now suppose that historically each country had abided by the following interannual grain storage rule:

Figure B-1--SADC Grain Supply Trend



Source: USDA data base.

If supply is:

greater than 120 percent of trend supply, then store amounts greater than 120 percent of trend supply;

less than 80 percent of trend supply, then release grain to reach the 80- percent level of trend supply;

Table B-1--Cereal Balance Information, Southern African Countries, 1993-1995

	Production	Net imports *	Food aid imports	Utilization**	Population	Per capita util.	Production coefficient of variation
	---------- 1,000 MT ----------				--Millions--	-- Kg/cap --	1962-1995
Country							
Angola	294	468	247	762	9.80	78	0.257
Botswana	48	148	8	176	1.43	123	0.698
Lesotho	164	188	31	344	1.94	177	0.261
Mauritius	2	230	1	232	1.12	207	0.933
Malawi	1,585	400	154	1,934	9.73	199	0.241
Mozambique	869	435	315	1,302	17.35	75	0.230
Namibia	85	108	0	178	1.58	112	0.310
South Africa	12,160	-1,210	0	11,101	40.29	276	0.309
Swaziland	88	80	9	168	0.94	179	0.918
Tanzania	3,791	170	59	3,932	27.99	141	0.512
Zambia	1,292	203	25	1,512	9.19	165	0.371
Zimbabwe	2,043	49	9	2,229	10.98	203	0.371
Region	22,420	1,269	858	25,540	132	193	0.243

* Negative values indicate exports.

** Utilization = Production + imports + beginning stocks.

Sources: USDA, FAO for Botswana, Mauritius, and Namibia.

between 80-120 percent of trend supply, then do nothing.

In this rule it is assumed that each country commits to a trend level of imports. This is a simple modification of the rule discussed by Newberry and Stiglitz (1981, pp. 406-409), in that imports are also considered as a source of supply. This means that production variability is what drives supply variability and therefore stock decisions. Other scenarios could be considered using other stocking rules, such as allowing wider or narrower bands to act as trigger mechanisms.

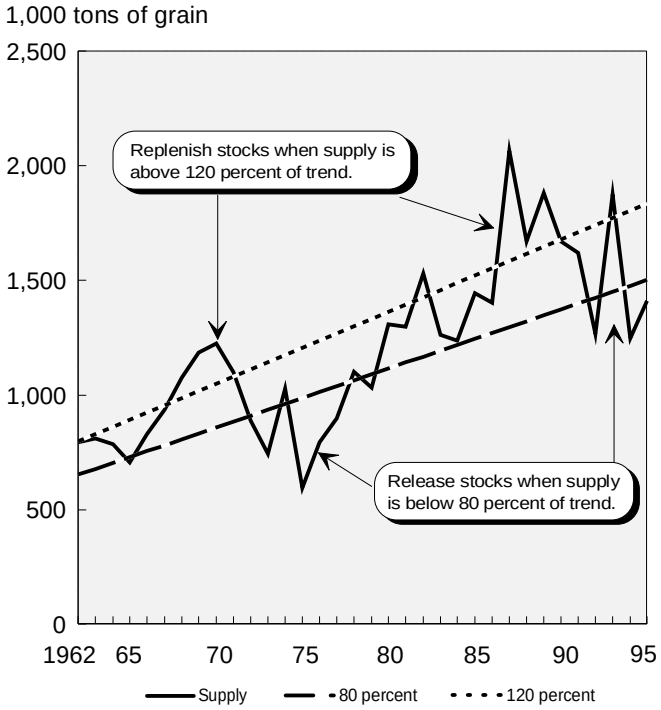
With the benefit of historical data, we can compare the results of these storage rules with the actual data, thereby providing important counterfactual analysis.[3] Figure B-2 shows how the stocking rules are applied in the case of Zambia. When grain consumption levels, driven by production levels, exceed the upper bound trend, then a country contributes to the regional grain reserve. When consumption levels fall below lower bound trends, then the country withdraws from the regional grain reserve. It is clear that these stocking rules do lead to smoothed consumption at the aggregate level, which presumably would lead to less price volatility and individual consumption variability.[4]

Developing a cost-sharing arrangement for such a scheme has proven to be difficult in the past. To develop a cost-sharing mechanism under the program, the individual country's costs and benefits have to be estimated. Previous studies have compared the welfare effects to producers, consumers, and governments. In the case of a region, that would entail making the calculations within and across countries. Earlier studies (McIntire, 1981; Reutlinger, 1984) have found that while the buffer stock program is overall beneficial to a country, it is not as beneficial as other food security programs. Furthermore, benefits can be high if consumers are very unresponsive to price changes (such as in the case of staple foods), but costs typically rise sharply at higher levels of food security (Houck and Ryan, 1979). Buccola and Sukume (1987), for example, found that holding large grain stocks was prohibitively expensive for the case of Zimbabwe.

Food Import Insurance Option

An import insurance program is another approach to achieve food security. The rationale for this program is that international grain prices are subject to wide fluctuations. Food security is at risk when grain prices reach their upswing

Figure B-2--Zambia's Stocking Rules--A Hypothetical Scenario



Source: USDA data base.

peaks, which inhibits each country's capacity to import the necessary grain volumes, and domestic production in a given year is low. This proposed policy mechanism could be implemented by a regional or international organization and is basically a financial program.

Suppose again that a set of policy rules were adopted by each government for a self-financing program. For the sake of example, let the rules be as follows:

If import needs:

exceed the threshold of 1 standard deviation above trend level imports, then receive reimbursement of actual costs exceeding the threshold costs;

fall below the threshold of 1 standard deviation below trend level imports, then pay into a fund the actual costs below the threshold costs;

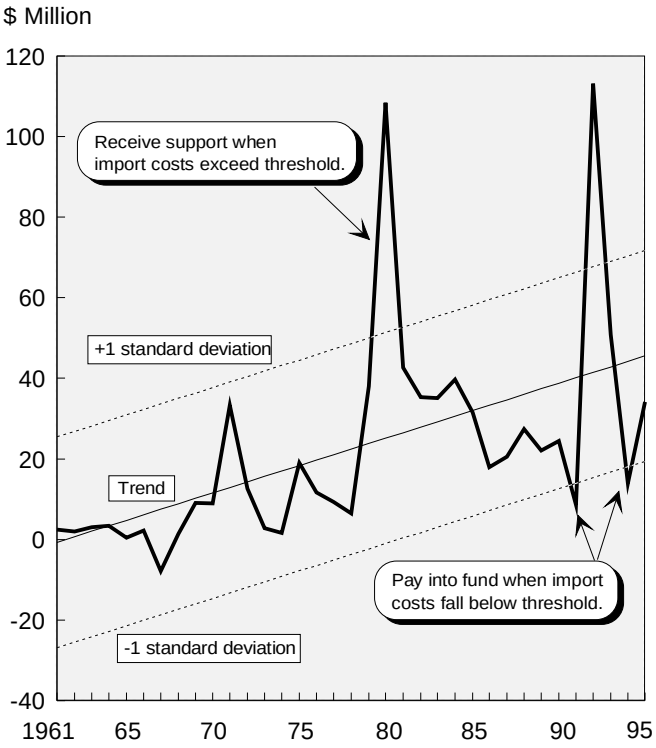
are between plus or minus one standard deviation, then do nothing.[5]

An example of this rule is shown for the country of Zambia in figure B-3. Table B-2 and figure B-4 show the results of the rule for the region had it been adopted historically. As a counterfactual exercise, the results suggest that nearly every country would have saved millions of dollars on its food import bills, although some more than others. Our analysis shows that the exporting countries (South Africa and

[3]Houck and Ryan (1979) distinguish three categories of stocking models. The model presented here is in the tradition of Waugh (1967) of identifying appropriate stock levels based upon historical time series analysis. The other model categories are simulation models (a good example for three Southern African countries is Pinckney (1993)) and dynamic programming optimization models (a thorough treatment can be found in Gardner, 1979).[4]This implies that some countries would need to absorb to some extent the peaks and valleys (but less than without the buffer policy option). In reality, there would need to be more complex policy interaction between stocks and trade, such as that considered by Reutlinger, Eaton, and Bigman (1976). This type of interaction will be considered in a later study.

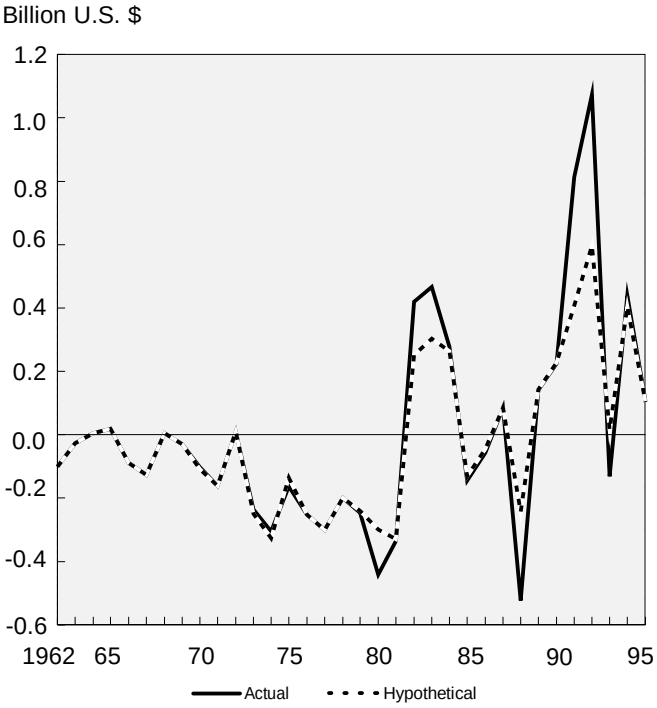
[5]Recall from statistical theory that about 67 percent of sampling variation of a normal distribution falls between plus and minus one standard deviation.

Figure B-3--Hypothetical Import Rules to Zambia



Source: FAO data base.

Figure B-4--Total Import Costs for SADC Region, Actual and Hypothetical



Source: FAO data base and own calculation.

Table B-2--Comparison of Accumulated Import Cost Savings with Insurance Program, SADC Countries

	Actual imports, 1962-1995 *	Hypothetical imports, 1962-1995 *	Savings, 1962-1995	Share of regional benefits, 1962-1995
	----------	$U.S. Million ----------		Percent
Country				
Angola	845.0	841.2	3.8	0.6
Botswana	304.3	300.0	4.3	0.6
Lesotho	357.5	354.4	3.1	0.5
Mauritius	601.2	600.6	0.6	0.1
Malawi	401.9	376.5	25.4	3.8
Mozambique	1,191.5	1,148.3	43.2	6.5
Namibia	252.1	245.8	6.3	0.0
South Africa	-5,366.6	-5,513.8	147.2	22.1
Swaziland	157.3	157.2	0.2	0.0
Tanzania	700.7	634.3	66.4	10.0
Zambia	712.5	635.3	77.2	11.6
Zimbabwe	-48.0	-336.2	288.2	43.3
Region	109.3	-556.5	665.8	100.0

* Negative values in parentheses are exports.

Zimbabwe) would gain the most, although Mozambique, Tanzania, and Zambia would also gain substantially.

Free Trade Area Option

Some analysts have also suggested that a free trade zone could go a long way towards solving food security. The rationale is that with a free trade zone, when one country experiences a production shortfall which leads to high prices, then a nearby country with a surplus (and low prices) would export their surplus to the other country, assuming that it is profitable to do so after considering transportation and transaction costs. A free trade zone would lower the trade barriers, which would increase the likelihood of nearby suppliers being able to profitably export their surpluses.

One of the important premises of free trade, though, is profitability after considering transportation and transactions costs. In the Southern Africa region, transportation infrastructure is weak, making intra-regional trade expensive (table B-3). Koester (1986) showed that the region's transportation and handling costs per ton nearly equaled the value of the bulk grain shipments per ton, making it very difficult to profitably import grain in many countries. This continues to be a major problem for the region since it implies that most countries have to rely on domestic supplies of white maize (which are unstable). Research in South Africa shows that consumers are unwilling to purchase blended white and yellow maize—which are available on the world market—without a substantial price discount (Missiaen, 1995).

With the advent of peace, many new infrastructural projects are currently being built (or re-built) (Economist, 1997). This holds promise that transportation costs will begin to go down over time. The U.S. Agency for International Development (AID) is currently sponsoring research that is estimating some of the transportation costs in the region, which will be useful for conducting updated studies of trade

Table B-3--Road Density, Selected Countries

	Kilometers per million persons, 1992
SADC:	
Angola	NA
Botswana	1,977
Lesotho	452
Mauritius	1,549
Malawi	NA
Mozambique	343
Namibia	2,722
South Africa	1,394
Swaziland	NA
Tanzania	142
Zambia	795
Zimababwe	1,406
Others:	
Uruguay	2,106
Tunisia	2,080
Turkey	5,514
Portugal	6,130
Hungary	7,756
Greece	10,341
France	13,008
United States	14,453

Source: World Bank, World Development Report 1995, Table 32.

profitability (for an analysis of East African transportation costs see AID, 1996).

Perhaps more importantly, the SADC countries have, in fact, signed a trade protocol in the past year. The treaty includes freer trade in nearly all agricultural commodities (as well as non-agricultural trade) and honors previously existing bilateral trade treaties. This treaty comes after many countries in the region recently have undertaken many domestic and trade reforms (AID, 1996b). South Africa is perhaps the best example of this, since it has abolished many parastatals (including the Maize Marketing Board in April 1997) in its effort to join GATT and the WTO.

Summary and Outlook

This article highlighted three major regional policy proposals that address food security on the supply (food availability) side. Each proposal could have numerous variations, which leaves many possible options for further analysis open.[6]

Each proposal has numerous logistical and economic questions that will be researched further over the coming year. Among the factual and logistical questions are:

- What is the grain storage capacity in each country?
- What are the costs of building and maintaining new facilities (if necessary)?
- What are the transportation costs among the countries for trade?
- What are the current grain policies and trade barriers?
- Who would implement the suggested program(s)?
- Who would enforce the policy arrangements?

Among the economic questions are:

- Which policy initiative is most cost-effective, and how do those costs compare with traditional food aid?
- What are the welfare effects for producers, consumers, and governments for each country for each proposal?
- Do any of these proposals invite rent-seeking behavior?
- What types of arrangements are likely to entice regional cooperation (or conversely what arrangements might induce sabotage)?
- How would the costs and benefits be apportioned?

The last two questions are particularly important. Economic theory suggests that countries will participate in a new arrangement if their expected position is at least as good as the current arrangement (according to the Pareto efficiency principle). If a particular country expects to be worse off while the group is better off, then, in principle, it is possible to compensate the country for its losses. Koester argues, after surveying the successes and failures of other regional arrangements, that the successful arrangements were those that divided the benefits fairly evenly (Koester, 1986).

In summary, each of the regional policy options discussed in this article—strategic grain reserve, food import insurance, and a free trade zone—has the potential to contribute significantly to food security in the Southern Africa region. Which option or combination of options can reach this goal most effectively will be the subject of future research.

References

Buccola, Steve and Chrispen Sukume. "Optimal Grain Pricing and Storage Policy in Controlled Agricultural Economies: Application to Zimbabwe", *Food Security for Southern Africa* (eds. M. Rukuni and C. Eicher). Harare, UZ/MSU Food Security Project, Department of Economics and Extension, University of Zimbabwe, 1987.

Economist. "An African Success Story." June 14, 1997, p. 47.

Gardner, Bruce. *Optimal Stockpiling of Grain.* Lexington Books: Lexington, MA, 1979.

Koester, Ulrich. *Regional Cooperation to Improve Food Security in Southern and Eastern African Countries*. Washington, DC: International Food Policy Research Institute, Research Report 53, 1986.

Konandreas, P., B. Huddleston, and V. Ramankura. *Food Security: An Insurance Approach*. Washington, DC: International Food Policy Research Institute, Research Report No. 4, 1978.

[6]One could, for example, analyze the effect of different bounds for the strategic regional reserve option or calculate the costs and benefits of different rules for the import insurance program.

McIntire, John. “Food Security in the Sahel: Variable Import Levy, Grain Reserves, and Foreign Exchange Assistance,” Washington, DC: International Food Policy Research Institute, Research Report #26, 1981.

Missiaen, Margaret. “South Africa: Ag Reforms in the Face of Drought,” *Agricultural Outlook.* Washington, DC: U.S. Department of Agriculture, Economic Research Service, July 1995, pp. 26-29.

Newberry, David and Joseph Stiglitz. *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk.* Oxford, England: Clarendon Press, 1981.

Pinckney, Thomas C. “Is Market Liberalization Compatible with Food Security? Storage, Trade, and Price Policies for Maize in Southern Africa,” *Agricultural Policy Reforms and Regional Market Integration in Malawi, Zambia, and Zimbabwe* (eds. A. Valdes and K. Muir-Leresche), Washington, DC: DC: International Food Policy Research Institute, 1993.

Reutlinger, Shlomo. “Project Food Aid and Equitable Growth: Income Transfer Efficiency First,” *World Development 9* (1984): 901-911.

Reutlinger, S., D. Eaton, and D. Bigman. “Should Developing Nations Carry Grain Reserves?” *Analyses of Grain Reserves: A Proceedings* (eds. David Eaton and W. Scott Steele). Washington, DC: U.S. Dept. of Agriculture, Economic Research Service report No. 634, August 1976.

U.S. Agency of International Development. *Comparative Transportation Cost Analysis in East Africa: Executive Summary*. Washington, DC: AID, Office of Sustainable Development, Bureau for Africa, SD Publication Series, Technical Paper No. 21, June 1996.

U.S. Agency of International Development. C*omparative Analysis of Structural Adjustment Programs in Southern Africa*. Washington, DC: AID, Office of Sustainable Development, Bureau for Africa, SD Publication Series, Technical Paper No. 23, June 1996b.

Waugh, Frederick. “Reserve Stocks of Farm Products,” *Selected Writings and Agricultural Policy and Economic Analysis*: Frederick V. Waugh (eds. J. Houck and M. Abel), reprinted. Minneapolis, MN: University of Minnesota Press, 1984.

Walker, R., J. Sharples, and F. Holland. “Grain Reserves for Feed Grains and Wheat in the World Grain Market,” *Analyses of Grain Reserves: A Proceedings* (eds. David Eaton and W. Scott Steele). Washington, DC: U.S. Dept. of Agriculture, Economic Research Service report No. 634, August 1976.

World Bank. *Poverty and Hunger: Issues and Options for Food Security in Developing Countries.* Baltimore: Johns Hopkins University Press, 1986.

Resources, Sustainability, and Food Security

by
Keith D. Wiebe[1]

The notion of food security has expanded in recent years from a relatively static focus on food availability to one that recognizes longer term concerns about access and resources. At the same time, economists have been working to incorporate changes in the quality and quantity of natural and other resources into measures of national income and wealth. A review of recent data suggests the potential for improved analysis of sustainable resource use and food security.

Resources and Food Security

Food security is generally defined in terms of "access by all people at all times to sufficient food for an active and healthy life" (World Bank, 1986; World Food Summit, 1996). This represents a significant advance over earlier definitions that focused on global food availability, yet careful consideration of food security requires moving beyond even access to food and recognizing the choices that households and regions face when incomes fall short (Dasgupta, 1993). Of special interest are the tradeoffs that low incomes force between meeting current consumption needs and protecting the resources needed to meet consumption and other needs over the longer term.

Resources can be classified in a variety of ways. Natural resources (e.g. land and water), produced resources (e.g. roads and factories), and human resources (e.g. skilled and unskilled labor) are generally recognized, if not always easy to measure. Social resources are comprised of the institutions and cultural patterns on which functioning societies are based (Serageldin, 1996).

Resources are critical to food security because they determine the ways in which individuals, households, and countries gain access to food through production and exchange. These relationships are illustrated in the right-hand side of figure C-1. Resources are also related to food security in a second significant way. Once individuals or groups have engaged in production and exchange, they can allocate the resulting income, along with their remaining stock of resources, to consumption and investment. Consumption and investment in turn affect the quality and quantity of the human and other resources that are available in subsequent periods. These concepts are illustrated in the left-hand side of figure C-1.

Recognizing the tradeoff between consumption and investment in other resources is particularly important in poor countries and households, where small increases or decreases in the level of consumption can have large effects on health and nutritional status. Proximity to a minimum consumption threshold, representing the "sufficiency" component of food security, highlights the tradeoff between alternative forms of investment that poor households may face. Specifically, households with insufficient income may be forced to choose which forms of investment will be curtailed, and thus which types of resources will be degraded or depleted over time. For example, resource-poor households may be forced to cultivate their land intensively, thereby degrading it over time, in order to generate enough income to avoid undernourishment in the short run (Perrings, 1989; Mink, 1993). Alternatively, they may accept a certain degree of undernourishment rather than deplete their natural or produced resources. In fact, while simplistic notions of food security imply that the former strategy would be preferred, evidence (e.g. Sen, 1981; de Waal, 1989) suggests that many resource-poor households choose the latter.

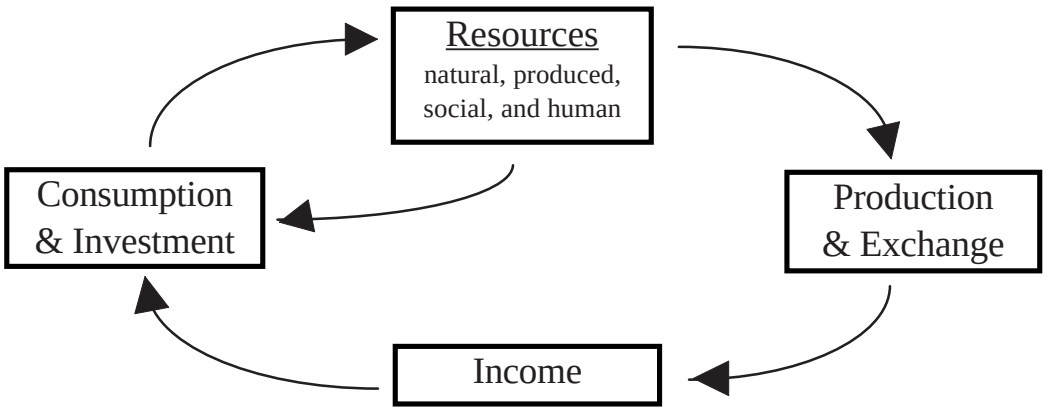
This is why it is necessary to incorporate resources into a full understanding of food security. Consumption that is maintained at sufficient levels only by irreversible degradation or depletion of natural, produced, and/or social resources will not be sustainable "at all times," and can hardly be described as part of a food-secure livelihood strategy in the long run. Likewise, protection of natural and other resources that is achieved only at the expense of necessary consumption levels, and thus minimum standards of human health, will not be sustainable in the long run either.

Trends in Food Availability and Access

As discussed in the Overview of this report, the gap between the amount of food available (i.e. production plus commercial imports) and the amount of food needed to maintain either status-quo or nutritionally adequate consumption levels is projected to increase in most of the 67 countries studied in this report over the next 10 years. The total "food gap to maintain consumption" is projected to grow from 8 million tons in 1997 to 18 million tons in 2007, most of it in

[1]An agricultural economist with the Resource Economics Division, USDA.

Figure C-1--The Role of Resources in Food Security



Source: Maxwell and Wiebe (forthcoming).

Sub-Saharan Africa and Asia. The total "nutritional food gap" is projected to grow from 15 million tons in 1997 to 24 million tons in 2007, also primarily in Sub-Saharan Africa and Asia.

Among the factors contributing to these growing food gaps are low yields for food crops (table C-1), which limit production's role in meeting food needs. Sub-Saharan African yields for cereals (1 ton per hectare), roots and tubers (8 tons per hectare), and pulses (0.5 tons per hectare) are well below world (and even developing-country) averages. While yields are higher in South Asia, access to food is limited by lower per-capita incomes (at $350 per year), and a larger share of the population (43 percent) lives in poverty. Low incomes limit poor countries' ability to compensate for production shortfalls through commercial imports. The consequences of the resulting food gaps are evident in indicators of consumption in developing countries. About 43 percent of Sub-Saharan Africa's people are chronically undernourished, compared with 22 percent in South Asia and 12-16 percent in other developing areas. The greatest numbers of chronically undernourished people live in Asia (Pinstrup-Andersen and Pandya-Lorch, 1997).

Food production, access, and consumption are important components of current food security, but it is also essential to consider the longer term interactions between food security and sustainable resource use. Recognizing the urgency of immediate consumption concerns, for example, it is not surprising that gross savings rates in Sub-Saharan Africa are less than half those in the East Asia and Pacific region. Low savings rates may reflect the short-term priority of consumption over investment in other resources, but maintenance of natural and other resources remains critical to food security over the long term. It is important to note that the gross savings rates reported in table C-1 fail to reflect changes in the stocks of many natural, human, and other resources that are associated with sustainability and food security, ranging from deforestation and carbon dioxide emissions to institutional decline and malnutrition-related disease.

Economists have begun trying to better incorporate such changes into measures of national income. For example,

Table C-1--Selected Indicators of Food Availability and Access

Indicator	Low- and Middle-Income Economies							HIE	World
	SSA	EAP	SA	ECA	MENA	LAC	All		
Production									
Cereals yields *(tons/hectare, 1996)*	1.0	3.2	2.2	1.7	na	2.5	2.6	3.3	2.9
Roots & tubers yields *(tons/hectare, 1996)*	8.0	11.0	15.3	12.7	na	11.6	11.6	17.6	13.0
Pulses yields *(tons/hectare, 1996)*	0.5	0.9	0.6	1.4	na	0.7	0.7	1.6	0.8
Income									
GNP per capita *($/capita, 1995)*	490	800	350	2,220	1,780	3,320	1,090	24,930	4,880
Poverty *(% living on < $1/day, 1993)*	39	26	43	na	4	24	29	na	na
Consumption & investment									
Undernourishment *(% chronically undernourished, 1992)*	43	16	22	na	12	15	21	na	na
Gross savings *(% of GDP, 1995)*	16	38	20	na	na	19	22	21	21
Genuine savings *(% of GNP, 1993)*	-1	21	6	na	-2	6	9	14	na

Notes: SSA = Sub-Saharan Africa; EAP = East Asia and Pacific; SA = South Asia; ECA = Europe and Central Asia; MENA = Middle East and North Africa; LAC = Latin America and Caribbean; HIE = High-Income Economies; na = not available.

Sources: FAO (1997), Pinstrup-Andersen and Pandya-Lorch (1997), World Bank (1997a and 1997b).

adjusting estimates of savings to reflect changes in the value of natural and human resources yields the "genuine savings" data presented in table C-1. Genuine savings rates in Sub-Saharan Africa and the Middle East and North Africa are negative (as they have been for the past several decades), while rates in East Asia and the Pacific are high and rising (World Bank, 1997b). These trends suggest the need to look beyond short-term indicators of food availability and access to explore the longer term links between food security and resource use.

Resource Trends in Developing Economies

In general, resource priorities change as economies evolve. In low-income economies, priority is typically given to issues related to the management of natural resources for poverty alleviation and food security (UNEP, 1997). As economies grow, priority may shift to include resource problems associated with industrialization and urbanization, such as air and water quality and the treatment and disposal of waste. While analysis of local and national resource-use and food-security decisions requires disaggregated data, broader patterns are revealed in regional data reported by the World Bank and other sources. This section presents a brief overview of selected data from these sources to illustrate some of the resources and processes depicted in figure C-1.

Natural resources. Selected indicators of natural resources are presented in table C-2. About 11 percent of global land area is currently used as cropland, ranging from 6 percent in the Middle East and North Africa to 45 percent in South Asia. Cropland per capita ranges from 0.1 hectare in East Asia and the Pacific to 0.6 hectares in the low- and middle-income economies of Europe and Central Asia. In recent decades, cropland area has increased at 0.3 percent annually worldwide, and as high as 1.3 percent annually in Latin America and the Caribbean. This increase often represents expansion of cultivation onto marginal lands, such as those with shallow soils or steep slopes. Permanent pasture has remained relatively constant in area, indicating that the majority of the net increase in cropland area has come at the expense of areas formerly under forest or woodland cover. Deforestation has occurred most rapidly, in percentage terms, in East Asia and the Pacific and in Latin America and the Caribbean. Nationally protected areas have increased relatively rapidly in recent decades, although it is difficult to assess the true effectiveness of such protection. In any case, Rosegrant, Ringler, and Gerpacio (1997) argue that land conversion will slow in the next two decades, and will not threaten global food supplies in the foreseeable future.

Even if the rate of land conversion for agriculture slows in the coming decades, land already used for agricultural production is also subject to increasingly intensive production, which can lead to degradation via nutrient depletion and soil erosion. For example, Bumb and Baanante (1996) report that in many countries of Sub-Saharan Africa, soil nutrients are removed at rates 3 to 4 times those of nutrient replenishment, while Lal (1995) estimates that soil erosion has reduced crop yields in Sub-Saharan Africa, relative to what they would have been otherwise, by about 6 percent. Crosson (1997) counters that erosion-induced on-site productivity losses are actually quite low, less than 0.5 percent per year, although concern may still be justified where soil erosion has significant off-site effects, as well as in particular areas where soil losses are higher. Scherr and Yadav (1996) identify a number of such "hot spots" where land

Table C-2--Selected Indicators of Natural and Produced Resources

Indicator	Low- and Middle-Income Economies							HIE	World
	SSA	EAP	SA	ECA	MENA	LAC	All		
Natural resources									
Cropland *(hectares/capita, 1994/95)*	0.3	0.1	0.2	0.6	0.2	0.3	0.2	0.4	0.3
Water use *(% of annual renewable water, various years)*	1	8	12	19	73	2	6	11	7
for agriculture *(% of annual renewable water, various years)*	1	7	11	9	65	1	5	4	5
Cropland *(% of total land area, 1994)*	7	12	45	13	6	7	11	12	11
Permanent pasture *(% of total land area, 1994)*	34	34	10	16	24	29	27	24	26
Forest *(% of total land area, 1990)*	24	26	14	35	4	49	29	35	30
Nationally protected areas *(% of total land area, 1994)*	6	6	4	4	3	7	5	12	7
Cropland *(annual % change in area, 1965-89)*	0.7	0.3	0.2	0.1	0.1	1.3	0.5	0.2	0.3
Permanent pasture *(annual % change in area, 1965-89)*	0.0	-0.2	-0.4	0.0	0.0	0.5	0.1	-0.1	0.0
Forest *(annual % change in area, 1965-89)*	-0.4	-0.7	0.3	0.2	0.2	-0.5	-0.4	-0.1	-0.2
Nationally protected areas *(annual % change in area, 1972-90)*	1.9	14.0	10.7	7.3	6.9	8.0	5.6	7.1	6.3
Produced resources									
Irrigation *(% of cropland, 1989)*	1	10	28	5	6	2	6	3	5
Fertilizer consumption *(kg/arable hectare, 1992/93)*	15	206	74	57	64	52	79	112	87
Mechanization *(tractors/1,000 arable hectares, 1994)*	1		14*	18	na	12	8	31	19
Energy use *(tons of oil equivalent/capita, 1994)*	0.2	0.6	0.2	2.6	1.2	1.0	0.8	5.1	1.4
Fuelwood and charcoal *(% of total energy used, 1989)*	66	10	25	1	1	13	13	1	5

* Average for Asia as a whole.

Notes: SSA = Sub-Saharan Africa; EAP = East Asia and Pacific; SA = South Asia; ECA = Europe and Central Asia; MENA = Middle East and North Africa; LAC = Latin America and Caribbean; HIE = High-Income Economies; na = not available.

Sources: FAO (1997), World Bank (1992, 1995, and 1997a).

degradation poses a significant threat due to soil erosion, nutrient depletion, deforestation, salinization, and other processes. They report that degradation of agricultural land and permanent pasture is most extensive in Africa (65 percent and 31 percent, respectively), while degradation of forest and woodland is most extensive in Asia (27 percent).

Water is abundant globally but scarce in many regions (UNEP, 1997). Only 7 percent of annually renewable freshwater is used worldwide each year. As Rosegrant (1997) explains, however, increased use is difficult because most of the remainder is lost to evaporation or flooding, or is distributed unequally relative to population or across seasons. In contrast to land resources, Rosegrant, Ringler, and Gerpacio (1997) argue that rapid growth in water demand, in combination with the high cost of developing new water sources, could threaten future growth in food production. Agriculture currently accounts for the majority of water used in most low- and middle-income regions.

One final component of natural resources is the earth's atmosphere, a global resource that is being modified by human activities on an unprecedented scale. Most notable are emissions of carbon dioxide from the combustion of fossil fuels, which are associated with global warming and its possible effects on the location, productivity, and variability of agricultural production. Given the potential for farmers to adapt over time, global warming is not expected to constitute a threat to food production on a global scale, although some resource-poor regions, particularly those in tropical latitudes, may suffer reductions in food availability and access (Darwin et al., 1995; Schimmelpfennig et al., 1996).

Produced resources. Selected indicators of produced resources are also presented in table C-2. South Asia has the highest proportion of cropland irrigated (28 percent), while the East Asia and Pacific region applies fertilizer most intensively (206 kilograms per hectare). Sub-Saharan Africa lags in irrigation (one percent of cropland), fertilizer use (15 kilograms per arable hectare), and agricultural mechanization (one tractor per 1,000 hectares of arable land). Per-capita energy use varies by a factor of 10 from Sub-Saharan Africa and South Asia to the Europe and Central Asia region, which uses energy at about half the level of the high-income economies. Even more dramatic are differences in the share of energy derived from fuelwood and charcoal, ranging from 1 percent in the low- and middle-income economies of Europe and Central Asia and the Middle East and North Africa to 25 percent in South Asia and 66 percent in Sub-Saharan Africa. Different patterns of energy use contribute to different forms of resource degradation. Fuelwood and charcoal burning contribute to deforestation, for example, while fossil fuel combustion releases carbon dioxide and other gases and solids that may affect climate.

Social resources. Indicators of social resources are important for food security in two basic ways. First, they indicate the potential for future economic growth and income generation, and thus the ability to command sufficient access to food. And second, they indicate the ability of society to compensate its members when they experience shortfalls in production, availability, or access to food. Table C-3 presents indicators of factors that affect political and economic activity, as well as indicators associated with public goods and services such as health and education. Health expenditures (both public and private) are lowest in the East Asia

Table C-3--Selected Indicators of Social and Human Resources

Indicator	Low- and Middle-Income Economies							HIE	World
	SSA	EAP	SA	ECA	MENA	LAC	All		
Social resources									
Health expenditures *($/capita, 1990)*	24	11	21	142	77	105	41	1,860	329
Water supply *(% of population with access, 1990)*	47	72	74	90	70	76	na	96	73
Sanitation *(% of population with access, 1990)*	35	85	15	85	59	69	na	86	60
Female primary education* *(% of age group enrolled, 1993)*	65	116	87	97	91	na	99	103	99
Male primary education* *(% of age group enrolled, 1993)*	78	120	110	97	103	na	110	103	109
Democracy index *(rank, 1994; least democratic = 1)*	2	na	3	4	1	5	na	6	na
Obstacles to economic activity *(rank, 1997; worst = 1)*									
Property rights/corruption	1	na	3	3	2	1	na	5	na
Taxes	2	na	2	1	3	5	na	1	na
Human resources									
Population *(millions, mid-1995)*	583	1,706	1,243	488	272	478	4,771	902	5,673
Population growth *(annual % change, 1990-95)*	2.6	1.3	1.9	0.3	2.7	1.7	1.6	0.7	1.5
Urban population growth *(annual % change, 1980-95)*	5.0	4.2	3.4	1.6	4.2	2.8	3.3	0.7	2.5
Labor force in agriculture *(% of total labor force, 1990)*	68	70	64	23	36	25	58	5	49
Adult literacy *(%, 1995)*	57	83	49	na	61	87	70	na	na
Life expectancy *(years, 1995)*	52	68	61	68	66	69	65	77	67
Disease burden *(disability-adjusted life years lost due to malnutrition-related causes, per 1,000 population, 1990)*	87	9	52	2	29	19	na	1	28

* Enrollment may exceed 100% because of the inclusion of students younger or older than the standard primary-school age group.

Notes: SSA = Sub-Saharan Africa; EAP = East Asia and Pacific; SA = South Asia; ECA = Europe and Central Asia; MENA = Middle East and North Africa; LAC = Latin America and Caribbean; HIE = High-Income Economies; na = not available.

Sources: World Bank (1993 and 1997a).

and Pacific region, at $11 per capita. Access to clean water is lowest in Sub-Saharan Africa, while South Asia suffers the lowest access to sanitation services. Male enrollment in primary education is near complete everywhere except in Sub-Saharan Africa, but female enrollment lags in most regions.

Table C-3 also includes data on the State's performance in relation to political and economic participation. The democracy index is an ordinal ranking based on a variety of indicators described in the World Bank's 1997 *World Development Report* (1997a, p. 112), and ranges from a low in the Middle East and North Africa to a high (relative to other low- and middle-income economies) in Latin America and the Caribbean. The *Report* also presents results from a survey of business people on obstacles to economic activity. Property rights and corruption were identified as the principal obstacles in Sub-Saharan Africa and in Latin America and the Caribbean, while taxes were identified as the principal obstacle in Europe and Central Asia. (Infrastructure was identified as the principal constraint in South Asia and the Middle East and North Africa.)

Human resources. Selected indicators of human resources are also presented in table C-3. World population was 5.7 billion in mid-1995, about half of it located in Asia. Annual population growth rates vary widely across low- and middle-income economies, ranging from 0.3 percent in Europe and Central Asia to 2.6 percent in Sub-Saharan Africa and 2.7 percent in the Middle East and North Africa. Global population growth has slowed more than previously expected, to 1.5 percent per year, due to faster than expected fertility declines in South Asia and Sub-Saharan Africa (United Nations, 1996). Urban populations are growing particularly rapidly, especially in Sub-Saharan Africa, East Asia and the Pacific, and the Middle East and North Africa. Nevertheless the bulk of the labor force in the most heavily populated regions (i.e. Asia and Sub-Saharan Africa) remains in agriculture, suggesting the importance of improved agricultural performance to simultaneously increase rural incomes and urban food supplies.

In addition to indicators of quantity, table C-3 also presents crude indicators of the quality of human resources. Poverty and the burden of malnutrition-related disease are relatively high in Sub-Saharan Africa and South Asia, while life expectancy and adult literacy rates are relatively low. Similar patterns are evident in child stunting (low height for age) and wasting (low weight for height) (World Bank, 1993). The levels of these indicators are both consequences and, through their impact on labor productivity, potential causes of continuing pressure on natural and other resources in these regions (Dasgupta, 1993; Mink, 1993).

Implications for Sustainability and Food Security

The data presented in the previous section provide only a general sense of the ways in which resource indicators supplement indicators of food availability and access to provide a longer-term perspective on food security. Because of the close and reciprocal links between access to resources and access to food, it is difficult to devise a uniquely satisfactory scheme for distinguishing resource categories. Likewise, just as measures of food availability and access are insufficient to capture the notion of food security, it is impossible to equate any one resource indicator (or even any one resource category) with the notion of food security as a whole. In fact, food security is indicated not just by the quality of human resources, but rather by the extent and composition of all resources to which individuals, households, and countries have access.

The pitfalls of relying too heavily on any single resource indicator as a measure of food security are readily apparent. In Asia, for example, India and Bangladesh have the largest projected status-quo food gaps for 1997 (see statistical tables 43 and 44) and the highest shares of total land used as cropland (57 percent and 74 percent, respectively; World Bank, 1997a). The apparent correlation between these two indicators weakens in Sub-Saharan Africa, however, and fails entirely in Latin America and the Caribbean. Ethiopia and Rwanda have Sub-Saharan Africa's largest projected status-quo food gaps for 1997 (see statistical tables 10 and 13), but while Rwanda has the region's highest cropland-to-total land ratio (47 percent), Ethiopia's ratio (11 percent) is about average. Among Latin American and Caribbean countries, Haiti has one of the largest projected status-quo food gaps for 1997 (see statistical tables 57 and 61) and the second-highest cropland-to-total land ratio (33 percent), but Peru, where the food gap to maintain consumption is projected to reach half a million tons by 2007, has a cropland ratio of just 3 percent—less than half the regional average. Similar contradictions are apparent for other regions and resource indicators, suggesting the need for more sophisticated measures of the relationship between resources and food security.

One promising approach is to move beyond conventional quantity measures of individual resources, such as total land area (which is subject to wide variations in land quality), towards measures that reflect both the quality and quantity of multiple resources simultaneously. As noted previously, economists have begun trying to better incorporate changes in resource stocks into measures of national income and wealth. Table C-4 presents recent World Bank estimates of the contributions of different resource categories to wealth. Agricultural land accounts for most of the value of natural resources in most areas (Dixon and Hamilton, 1996). The share of total wealth represented by human resources is consistently high across regions, between 60 and 79 percent everywhere except in the Middle East, although total wealth varies widely. Estimates of genuine savings rates, which reflect changes in the value of human and natural resources, as well as produced resources, also vary widely (table C-1). Low genuine savings rates indicate the potential for deepening food security problems in some areas, particularly in Sub-Saharan Africa.

Such estimates are admittedly preliminary, but they offer interesting parallels between the analysis of resources and the analysis of food security. Just as the concept of food

Table C-4--Sources of Wealth

Region	Total wealth	Natural resources	Produced resources	Human resources	Natural resources	Produced resources	Human resources
		1,000 dollars per capita, 1994			Percentage of total wealth, 1994		
Sub-Saharan Africa							
East and Southern Africa	30	3	7	20	10	25	66
West Africa	22	5	4	13	21	18	60
East Asia	47	4	7	36	8	15	77
South Asia	22	4	4	14	16	19	65
Europe and Central Asia	na	na	na	na	na	na	na
Middle East and North Africa							
Middle East	150	58	27	65	39	18	43
North Africa	55	3	14	38	5	26	69
Latin America and Caribbean							
South America	95	9	16	70	9	17	74
Central America	52	3	8	41	6	15	79
Caribbean	48	5	10	33	11	21	69
High-Income Economies							
North America	326	16	62	249	5	19	76
Pacific OECD	302	8	90	205	2	30	68
Western Europe	237	6	55	177	2	23	74

na = not available.
Source: World Bank (1997b).

security has evolved in recent years from a relatively static focus on food availability to incorporate longer term concerns about access, so has interest grown in developing economic and environmental indicators that move beyond current income to reflect longer term changes in the quality and quantity of natural and other resources. While these two processes emerged from different concerns—the former primarily with hunger at the household and local levels, the latter largely with environmental degradation at the national and global levels—they are closely related.

Specifically, both represent components of an integrated problem in resource management, in which natural, produced, social, and human resources can be used in various ways to achieve a variety of objectives, including food security (World Bank, 1997b). At the core of this problem is the concept of sustainability. Serageldin (1996) distinguishes degrees of sustainability based on whether resources are seen as substitutes or complements to one another. "Strong sustainability" requires that each kind of resource remains intact, based on the assumption that resource categories are complements rather than substitutes. By contrast, "weak sustainability" maintains the total value of resources, regardless of its composition, implying that resource categories are substitutes rather than complements, and that individual resources (and even resource categories) can be depleted without threatening wealth as a whole.

Serageldin (1996) proposes a "sensible" middle approach that requires both the maintenance of total wealth and concern with the composition of wealth, recognizing that different resource categories are both substitutes and complements, and that critical levels of each category should be defined and maintained. Such a definition begins to sound very much like evolving definitions of food (and livelihood) security, which increasingly recognize the need to meet both food and non-food requirements in order to sustain human and other resources over time. In its shared attention to critical thresholds, tradeoffs, and sustainability over the long term, the convergence between these areas of research offers promise for improved understanding of the relationship between sustainable resource use and food security in the future.

References

Bumb, Balu, and Carlos Baanante. 1996. *The Role of Fertilizer in Sustaining Food Security and Protecting the Environment to 2020*. Food, Agriculture, and Environment Discussion Paper No. 17. Washington, DC: International Food Policy Research Institute.

Crosson, Pierre. 1997. "Land Degradation and Food Security." Presentation at the International Symposium on Global Challenges in Ecosystem Management, Toronto, Canada, 25-26 July 1997.

Darwin, Roy, Marinos Tsigas, Jan Lewandrowski, and Anton Ranses. 1995. *World Agriculture and Climate Change: Economic Adaptations*. Agricultural Economic Report No. 703, Economic Research Service, U.S. Department of Agriculture.

Dasgupta, Partha. 1993. *An Inquiry into Well-Being and Destitution.* Oxford: Clarendon Press.

de Waal, Alex. 1989. *Famine that Kills: Darfur, Sudan, 1984-85*. Oxford: Clarendon Press.

Dixon, John A., and Kirk Hamilton. 1996. "Expanding the Measure of Wealth." *Finance and Development* 33(4): 15-18. December.

FAO (Food and Agriculture Organization of the United Nations). 1997. FAOSTAT Database <http://apps.fao.org>. 27 August.

Lal, Rattan. 1995. "Erosion-Crop Productivity Relationships for Soils of Africa." *Soil Science Society of America Journal* 59(3): 661-667.

Maxwell, Daniel, and Keith Wiebe. Forthcoming. "Land Tenure and Food Security: A Conceptual, Empirical, and Methodological Review." Land Tenure Center Research Report, University of Wisconsin-Madison.

Mink, Stephen D. 1993. *Poverty, Population, and the Environment*. World Bank Discussion Paper No. 189. Washington, DC.

Perrings, Charles. 1989. "An Optimal Path to Extinction? Poverty and Resource Degradation in the Open Agrarian Economy." *Journal of Development Economics* 30.

Pinstrup-Andersen, Per, and Rajul Pandya-Lorch. 1997. "Food Security: A Global Perspective." Plenary paper prepared for the 23rd International Conference of Agricultural Economists, Sacramento, California, August 10-16.

Rosegrant, Mark W. 1997. *Water Resources in the Twenty-First Century: Challenges and Implications for Action*. Food, Agriculture, and Environment Discussion Paper No. 20. Washington, DC: International Food Policy Research Institute.

Rosegrant, Mark W., Claudia Ringler, and Roberta V. Gerpacio. 1997. "Water and Land Resources and Global Food Supply." Paper prepared for the 23rd International Conference of Agricultural Economists, Sacramento, California, August 10-16.

Scherr, Sara J., and Satya Yadav. 1996. *Land Degradation in the Developing World: Implications for Food, Agriculture, and the Environment to 2020*. Food, Agriculture, and Environment Discussion Paper No. 14. Washington, DC: International Food Policy Research Institute.

Schimmelpfennig, David, Jan Lewandrowski, John Reilly, Marinos Tsigas, and Ian Parry. 1996. *Agricultural Adaptation to Climate Change: Issues of Longrun Sustainability*. Agricultural Economic Report No. 740. Economic Research Service, U.S. Department of Agriculture.

Sen, Amartya. 1981. *Poverty and Famines*. Oxford: Clarendon Press.

Serageldin, Ismail. 1996. *Sustainability and the Wealth of Nations*. Environmentally Sustainable Development Studies and Monographs Series No. 5. Washington, DC: The World Bank.

UNEP (United Nations Environment Programme). 1997. *Global Environment Outlook*. New York: Oxford University Press.

United Nations. 1996. "World Population Growing More Slowly But Could Still Reach 9.4 Billion by 2050." Press Release, Population Division, Department for Economic and Social Information and Policy Analysis, November 13.

World Bank. 1997a, 1995, 1993, and 1992. *World Development Report*. Oxford University Press.

World Bank. 1997b. *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development*. Environmentally Sustainable Development Studies and Monographs Series No. 7. Washington, DC: The World Bank.

World Bank. 1986. *Poverty and Hunger: Issues and Options for Food Security in Developing Countries*. Washington, DC: The World Bank.

World Food Summit. 1996. *Rome Declaration on World Food Security and World Food Summit Plan of Action*. Rome, 13-17 November.

Income Inequality and Food Security

by
May Mercado Peters and Shahla Shapouri[1]

Income inequality is one of the major contributing factors to poverty and food insecurity in low-income countries. The objective of this study is to measure income inequality among countries and discuss the factors that could affect income inequality as they relate to food security. An improved understanding of these relationships will aid in projections of consumption as well as in the formulation of policies to reduce undernutrition. Income inequalty was measured by calculating the gini coefficient for a cross-section of 82 countries.

Introduction

Lack of access to food due to inadequate purchasing power has been identified as the prime cause of food insecurity. Even in countries where national per capita income is relatively high, including some in Southeast Asia and Latin America, the inequality in the distribution of income causes a substantial proportion of their populations to live in poverty and suffer from problems associated with chronic undernutrition. Projections of food availability and access in low-income countries, such as India, Pakistan, Cote d'Ivoire, Nigeria, and El Salvador, show that if food supplies were distributed evenly, all households would be able to meet their nutritional requirements. In these countries, a small reduction in income inequality, even in the absence of growth, can lead to substantial declines in poverty (Bruno, Ravallion, and Squire, 1996) and undernutrition. This article will attempt to measure the degree of income inequality; identify the key factors affecting income inequality; and link the relationship between these factors and the food security situation of developing countries. The findings of this paper can be used to explain how income inequality within a country evolves during the growth process. And, by knowing how the distribution of income will change, projections of the demand for food and the food security outlook can be improved.

Measurement of the Degree of Income Inequality

Income inequality is measured by calculating a Gini coefficient (measure of income inequality) for 82 countries using 1995 data (range of Gini is zero—complete equality—to one—perfect inequality). Of the 82 countries used in the analysis, 62 are developing countries from North Africa, Sub-Saharan Africa, Asia, Latin America, and the Caribbean. High-income countries include 17 OECD countries and 3 Asian newly industrialized countries (table D-1).

A broad range of income inequality is observed among the low-income countries analyzed (table D-2). The Gini coefficients range from a low of 0.27 in countries such as Bangladesh, Madagascar, Malawi, and Rwanda to a high of 0.54 in Guatemala. The degree of inequality also varies by region, with Asia having the lowest rate of inequality of 0.31 among low-income regions, while the average for the 13 Latin American and Caribbean countries, at 0.46, is the highest. The 17 OECD countries, while having significantly higher per capita incomes than the other countries, also exhibit significant variation in income inequality, with an average Gini coefficient of 0.32. Despite this variation, the Gini coefficients for the high-income countries are generally lower than the coefficients for the low-income countries.

Factors Affecting Income Inequality

While the Gini coefficient measures the degree of income inequality, it provides very little insight into the factors that determine it and cause it to change. A broad examination of personal income clearly suggests that income distribution is determined by the distribution of resources and assets among people and the prices received for their services. The change in the distribution of income from the rich to poor will happen when there is a change in the factors that affect the quantity, value, and productivity of assets controlled by the poor (Adelman and Morris). A recent USDA-ERS paper analyzed the significance of three broad groups of variables that could fit into this transfer principal: economic development and technology factors, economic growth variables, and socioeconomic factors. The question is, how can these factors can influence income inequality?

Economic Development and Technology Factors—Economic development, which is often measured by per capita income, is cited in the literature as one of the major determinants of income inequality. A widely held view is that economic growth at least in early stages of the development process causes income inequality to increase to the detriment of the poorest segments of the population. This is based in large

[1]Agricultural economists with the Market and Trade Economics Division, USDA.

The Gini Coefficient as a Measure of Income Inequality

The Gini coefficient has been used in nearly all research testing the relationship between income inequality and income (Braun). It is derived from the Lorenz curve, and represents the area between the diagonal and the Lorenz curve (figure D1). The Gini coefficient ranges from 0 to 1, with 1 indicating perfect income inequality. As a measure of inequality, the Gini index is more sensitive to changes in income shares in the middle of the distribution than to changes in shares at the upper or lower ends. Thus relatively small changes in its value can reflect substantial changes in the share of income received by the poorest households.

The cross-country income distribution published by the World Bank (1996) was used to calculate the Gini index for each country. The formula used was

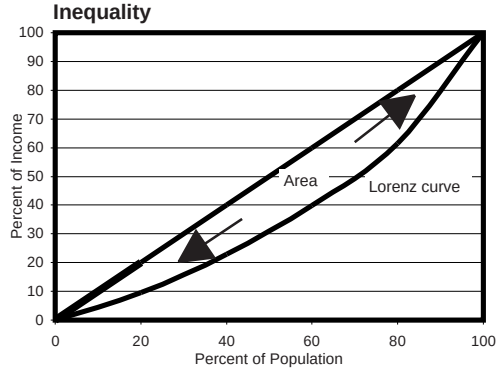
$$G_o = (2 * \text{cov} (Y_t, F (Y)) / Y)$$

where,

G_o = Gini index of income inequality
Y_t = mean income in U.S. dollars in tth quintile
F (Y) = cumulative distribution of income
Y = mean income in U.S. dollars.

Note: Further information concerning the derivation of the Gini formula used can be found in the articles by Lerman, et al., 1985.

Figure D-1-- Measuring Degree of Income Inequality



part on a conjecture made by Kuznets. He hypothesized that when national income was low, economic growth would cause income inequality to increase, but at some point during the growth process a point would be reached where continued growth would cause income inequality to begin to decline, forming an inverted U-shape. Inequality is low when national income is low because nearly everyone is living at or near the subsistence level. In the initial stages of the growth process, rapid population growth, urbanization, and industrialization lead to increased income inequality, but as the process continues, social and political factors emerge which then act to reduce income inequality.

Another development indicator is the size of the agriculture sector in relation to the rest of the economy. This is because in the early stages of the economic development, the size of the agricultural sector is large and most of the poor live in rural areas (as is true for most African countries for example). As the economic growth process progresses, labor, along with other resources, shift out of agriculture into the higher growth and higher wage sectors. This shift could cause the income/wage gap between agriculture and the high growth sectors to widen and as a consequence, income inequality to increase. At later stages of the development process (take the United States for example), agricultural productivity will converge with that of the high growth sectors, causing income inequality between the two sectors to decline (Adelman and Robinson). At this point, when the agriculture sector's size relative to the rest of the economy is small, the convergence of incomes is likely to have little effect on the overall distribution of income in the economy. As a result, one would expect a negative relationship between the relative size of the agricultural sector to the rest of the economy and income inequality.

Another significant variable is productivity of the agriculture sector. The agricultural sector in most low-income countries employs over half of the labor force. An improvement in agricultural productivity brought about by increased investment will raise incomes in the agricultural sector, thereby reducing income inequality.

Economic Growth Variables—The rate of economic growth also affects income inequality. This is because with more rapid rates of economic growth, the absorption of labor into the higher growth sectors occurs at faster rates. Unless a country is at a very low level of development, one would expect income inequality to be lower in those countries which are growing the fastest.

Another influential variable is the degree of openness to trade. This is because in developing countries trade protection lowers the return to the most abundant factor of production—labor—and increases it for the less abundant resource—capital. Therefore, with more open economies, income inequality will likely be lower.

Socioeconomic and Political Factors—Socioeconomic and political factors will have an important effect on the distribution of income in a country. The influence of the degree of social development on income inequality can be seen by comparing Sri Lanka to Brazil. Per capita income in Brazil is five times greater than per capita income in Sri Lanka. However, the degree of social development in Sri Lanka is much higher than in Brazil (Geyndt, 1996), and, in turn, the level of income inequality in Sri Lanka is much lower.

Political stability, which is closely related to economic growth and the food security situation in a country, is also very important. Political instability not only creates econom-

Table D-1--List of Countries Included in the Analysis and their Gini Coefficients

NORTH AFRICA		**EAST AFRICA**		**LATIN AMERICA**	
Algeria	0.36	Burundi	0.39	Bolivia	0.46
Egypt	0.36	Ethiopia	0.29	Colombia	0.47
Morocco	0.36	Kenya	0.51	Costa Rica	0.36
Tunisia	0.37	Rwanda	0.27	Dominican Rep.	0.46
CENTRAL AFRICA		Somalia	0.53	Ecuador	0.46
Cameroon	0.34	Sudan	0.53	El Salvador	0.46
Central African Republic	0.40	Tanzania	0.53	Guatemala	0.54
Congo (fka Zaire)	0.53	Uganda	0.30	Haiti	0.46
WEST AFRICA		**SOUTHERN AFRICA**		Honduras	0.53
Benin	0.40	Angola	0.40	Jamaica	0.38
Burkina Faso	0.40	Lesotho	0.51	Nicaragua	0.46
Cape Verde	0.34	Madagascar	0.27	Panama	0.52
Chad	0.40	Malawi	0.27	Peru	0.42
Cote d'Ivoire	0.34	Mozambique	0.51	**OECD**	
Gambia	0.34	Swaziland	0.51	Australia	0.36
Ghana	0.34	Zambia	0.40	Belgium	0.27
Guinea	0.51	Zimbabwe	0.51	Canada	0.33
Guinea-Bissau	0.51	**ASIA**		Denmark	0.32
Liberia	0.53	Afghanistan	0.40	Finland	0.30
Mali	0.39	Bangladesh	0.27	France	0.34
Mauritania	0.39	India	0.29	Germany	0.31
Niger	0.39	Indonesia	0.30	Italy	0.32
Nigeria	0.39	Nepal	0.28	Japan	0.27
Senegal	0.39	Pakistan	0.29	Netherlands	0.27
Sierra Leone	0.53	Philippines	0.37	New Zealand	0.37
Togo	0.39	Sri Lanka	0.28	Norway	0.29
		Vietnam	0.33	Spain	0.26
		NIC (other)		Sweden	0.28
		Hong Kong		Switzerland	0.36
		Korea		United Kingdom	0.37
		Singapore		United States	0.35

Table D-2--Regional Averages

Region	Number of countries	Avg Gini index	Avg GNP/cap 1995 U.S. dollars	Population in rural area 1995 Percent	1996 Freedom House Index
North Africa	4	0.36	1,298	49	5.6
Sub-Saharan Africa	36	0.42	393	71	4.9
Asia	9	0.31	439	74	4.8
Latin America	13	0.46	1,221	47	3.3
Developing Countries	62	0.41	656	65	4.6
OECD	17	0.32	22,279	20	1.2
New Industrialized States	3	0.36	15,600	9	3.3
All	82	0.39	6,083	54	3.8

The Freedom House Index (FHI) data came from "Freedom in the World: Annual Survey of Political Rights and Liberties, 1995-1996," published by Freedom House, New York. The FHI measures the degree of political freedom in a country. The index takes into account political rights and civil liberties in different countries of the world. It ranges from 1 to 7, with 1 representing the most free and 7 the least free.

ic hardship, but it places a disproportionate share of the burden on the poor—the segment of the population most vulnerable to food insecurity. For example, local wars and breakdown of law and order have disrupted the economies of Somalia and Rwanda, leading to impoverishment, famine, and widespread malnutrition.

Implication of Income Inequality On Food Security

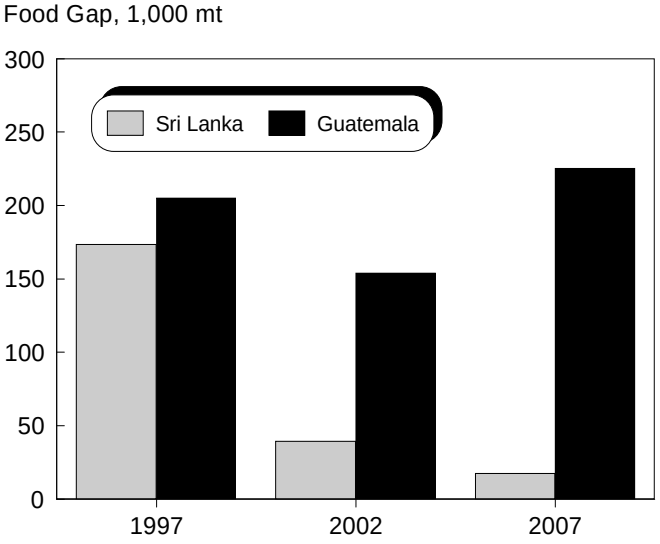
Food security is not directly determined by changes in income, but by the effect a change in income has on people's access to food. Access to food, and consequently, consumption of food, is more sensitive to changes in income the higher the income elasticity is for food. The income

elasticity for food tends to be highest for the segments of the population with the lowest incomes. As a result, a change in the distribution of income that leaves per capita income unchanged, but causes income inequality to increase, will cause food consumption of the segments of the population which are most food insecure to fall. However, as household incomes increase, the incidence of poverty and undernutrition should fall and the rate at which the demand for food increases can also be expected to slow down.

Statistics relating some of the important determinants of income inequality to poverty and food security for selected countries are shown in table D-3. The relationship of income inequality to the incidence of poverty and food security can be seen by comparing the situations in the Latin American countries of Peru and Costa Rica. Both countries have similar per capita incomes, but Peru has a much higher degree of income inequality than Costa Rica. As a result, the percentage of the population living below the poverty line in Peru, 49 percent, is much higher than in Costa Rica, 19 percent. A similar result is found by comparing the Sub-Saharan African countries of Nigeria and Kenya. Both have similar incomes, but because income inequality in Kenya is higher, the percentage of the population living below the poverty line is also much higher than in Nigeria.

Comparing Sri Lanka with Guatemala shows the importance of human development and investment in the agricultural sector to the reduction of poverty and food insecurity. Both countries have similar levels of income in terms of purchasing power parity. In Sri Lanka, investment in agriculture and education is much higher than in Guatemala (World Bank Development Report, 1997). The fertility rate in Sri Lanka is 2.3 births/woman compared to 4.7 in Guatemala; the percentage of the population living below the poverty line is lower in Sri Lanka, 22 percent versus 53 percent in Guatemala. Consequently, the food gap is much higher in Guatemala than in Sri Lanka (figure D-2).

Figure D-2--Food Gap of Sri Lanka and Guatemala



Source: USDA.

In summary, income inequality compounds the problems of food insecurity in low-income countries. Various economic, social, and political factors operating within an economy influence the distribution of income in that economy. These factors are important, particularly in developing countries, which are not only confronted with income distribution problems, but face very low per capita incomes and declining food consumption. They emphasize the importance of increasing the rate of economic growth in conjunction with investing to increase the productivity of the agriculture sector and promoting human capital development. Investing in these areas should stimulate economic growth and raise the incomes of the poor relatively faster than other income groups. It will also lead to the reduction of poverty and increase access to food, thereby reducing the main cause of chronic undernutrition.

References

Adelman, Irma and C.T. Morris. 1973. *Economic Growth and Social Equity in Developing Countries*. Stanford, California: Stanford University Press.

Adelman, Irma and Sherman Robinson. 1989. "Income Distribution and Development" in *Handbook of Development Economics, Volume II*. Edited by H. Chenery and Srinivasan, T.N. _____: Elsevier Science Publishers B.V.

Bruno, Michael, Martin Ravillion, and Lyn Squire. 1996. "Equity and Growth in Developing Countries, Old and New Perspectives on the Policy Issues." *Policy Research Working Paper, No. 1563*. The World Bank. Washington, D.C.

Braun, Denny. 1988. "Multiple Measurement of U.S. Income Inequality," *The Review of Economics and Statistics*. Vol. 70, No. 3

The Food and Agriculture Organization (FAO). 1996. Agrostat computer database. The United Nations FAO, Rome, Italy.

Geyndt, Willy de. 1996. "Social Development and Absolute Poverty in Asia and Latin America." World Bank Technical Paper No. 328. The World Bank, Washington, D.C.

Lerman, Robert I. and Shlomo Yitzhaki. 1985. "Income Inequality Effects by Income Source: A New Approach and Application to the United States," *Review of Economics and Statistics*. Vol. 67, No.1.

_____. 1996 and 1997. *The World Development Report*. The World Bank, Washington, D.C.

_____. 1996. The World Bank "STARS" computer database. The World Bank, Washington, D.C.

Table D-3--Agricultural and Economic Indicators, Selected Countries

Country	Per captia income GNP 1995	Per captia income PPP 1995	Gini index* 1995	Iliteracy rate 1995	Agricultural land irrigated 1994	Fertilizer use 1994	Ag share of GDP 1995	Population living below poverty line	Total food gap** (nutritional)	Food gap** lowest 20% of population	Children undern. 1995
	$US	$US		Percent	Percent	kg/ha	Percent	Percent	1,000 tons	1,000 tons	Percent
Asia											
Bangladesh	240	1,380	0.27	62	33.9	108	30	48	5,456	1,593	67
India	340	1,400	0.29	48	28.3	80	27	53	0	0	63
Sri Lanka	700	3,250	0.30	10	29.2	113	22	22	97	63	48
Indonesia	980	3,800	0.28	16	15.2	85	18	15	0	0	46
Latin America and the Caribbean											
Peru	2,310	3,770	0.42	11	41.0	51	7	49	466	202	11
Guatemala	1,340	3,340	0.54	44	6.5	96	25	53	483	165	n.a.
Costa Rica	2,610	5,850	0.36	5	23.8	38	15	19	n.a.	n.a.	2
Dominican Rep.	1,460	3,870	0.46	18	16.9	64	15	20	86	36	10
Sub-Saharan Africa											
Kenya	280	1,380	0.51	22	1.5	31	24	50	745	304	22
Congo (fka Zaire)	120	490	0.53	n.a.	0.1	0.5	n.a.	n.a.	2,211	679	n.a.
Tanzania	120	640	0.53	32	4.3	11	52	51	1,028	364	28
Nigeria	260	1,220	0.40	43	0.7	12	33	29	692	672	43
North Africa											
Egypt	790	3,820	0.36	49	100.0	243	16	8	0	0	10
Tunisia	1,820	5,000	0.37	33	7.8	18	15	4	0	0	8

* Calculated using World Bank data, 1996.

** Results of the 1997 ERS Food Security Assessment Model.

Source: World Bank. World Bank Development Indicators, 1997 and World Development Report 1997.

Statistical table 1--Algeria (North Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,037	529	5,045	41	3,853
1989	1,993	469	7,764	11	6,526
1990	1,619	470	4,741	26	3,930
1991	3,730	519	4,190	19	4,620
1992	3,348	470	4,688	15	4,706
1993	1,563	476	5,482	18	4,388
1994	994	407	6,939	24	5,616
1995	1,843	737	5,719	17	7,677
1996	3,603	351	5,500	0	6,764
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,128	503	7,909	***0*** ***0***	7,504
2002	2,513	519	7,630	***0*** ***0***	8,130
2007	2,619	534	8,805	***0*** ***0***	9,200

Grain output for 1997 is estimated at less than a third of last year's level due to unfavorable weather. However, commercial imports will compensate for the shortfall.

Statistical table 2--Egypt (North Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	9,240	219	6,556	1,477	9,054
1989	9,890	231	6,832	1,211	9,483
1990	11,787	226	6,076	2,003	10,281
1991	12,016	273	6,440	1,026	10,872
1992	12,329	232	6,545	482	10,620
1993	13,205	223	6,717	230	11,248
1994	13,510	262	8,886	180	12,949
1995	14,953	196	7,658	215	13,955
1996	15,155	283	8,981	202	14,790
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	15,335	248	9,357	***0*** ***0***	15,049
2002	15,257	255	10,430	***566*** ***0***	15,362
2007	15,936	261	11,911	***606*** ***0***	16,712

Food subsidies have supported very high levels of consumption in Egypt. Therefore, despite projections for stagnating production, domestic supplies will be adequate to meet minimum nutritional requirements. However, consumption in only the highest income group will exceed base levels in 2007.

Statistical table 3--Morocco (North Africa)

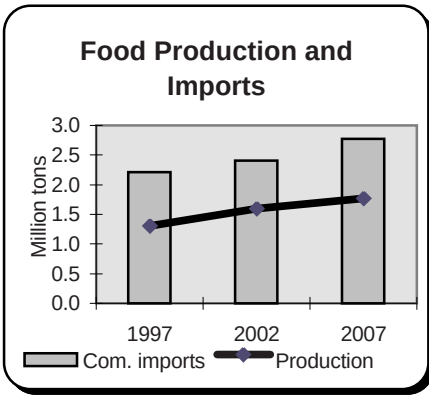
Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	7,917	53	1,385	237	5,815
1989	7,404	53	1,130	227	5,901
1990	6,254	64	1,390	204	5,135
1991	8,636	65	1,758	203	5,794
1992	2,933	65	2,860	234	4,948
1993	2,753	59	3,531	124	6,014
1994	9,530	62	1,673	13	5,398
1995	1,800	74	3,602	0	6,059
1996	9,990	86	3,965	2	7,813
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	3,685	75	3,879	***1,976*** ***0***	5,138
2002	6,867	78	3,933	***0*** ***0***	7,813
2007	7,391	81	4,600	***0*** ***0***	8,782

Grain output for 1997--adversely affected by poor growing conditions--is estimated at about a third of the 1996 bumper crop. Commercial imports, while large, do not compensate for the shortfall and the status quo food gap rises to nearly 2 million tons. In the longer term, domestic supplies are adequate to prevent food gaps.

Statistical table 4--Tunisia (North Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	284	218	1,757	363	1,957
1989	621	230	1,119	543	1,689
1990	1,601	224	1,070	371	1,888
1991	2,508	272	831	96	2,370
1992	2,155	231	920	100	2,439
1993	1,561	222	1,001	46	1,824
1994	646	261	1,576	22	1,812
1995	611	195	2,678	18	3,126
1996	2,851	282	1,500	0	2,763
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,051	249	2,213	***0*** ***0***	2,577
2002	1,339	258	2,407	***0*** ***0***	2,949
2007	1,501	266	2,768	***0*** ***0***	3,390

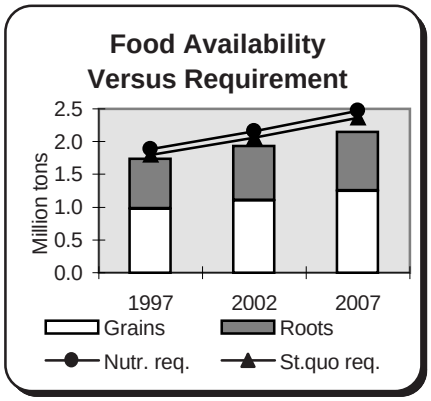
Despite a significant drop in grain output from last year's record, domestic supplies are more than adequate to prevent food gaps. The nutritional situation remains strong throughout the projection period as average consumption levels are more than 2 times greater than the nutritional target.



Statistical table 5--Cameroon (Central Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	855	612	77	8	1,259
1989	880	616	52	0	1,273
1990	826	755	107	10	1,413
1991	950	747	29	13	1,472
1992	868	755	1,478	1	2,829
1993	878	784	600	2	1,983
1994	892	778	89	2	1,481
1995	1,140	749	117	4	1,700
1996	1,240	708	251	4	1,873
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,090	768	205	***58*** ***144***	1,741
2002	1,245	829	220	***134*** ***232***	1,929
2007	1,413	894	244	***218*** ***331***	2,144

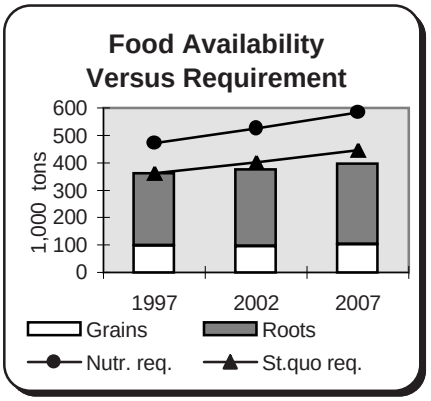
The food gap to maintain consumption as a share of aggregate food availability increases from zero to 10 percent between 1997-2007. Production growth required to close the food gaps is close to 3 percent per year; this is roughly one percentage point higher than expected output growth.



Statistical table 6--Central African Republic (Central Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	133	237	28	0	366
1989	125	235	22	4	353
1990	123	258	32	4	384
1991	129	270	22	3	389
1992	93	281	25	5	365
1993	93	279	24	6	361
1994	85	271	43	1	360
1995	105	253	28	0	345
1996	100	250	34	0	340
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	109	264	36	***0*** ***109***	363
2002	108	279	36	***27*** ***150***	375
2007	119	295	36	***49*** ***185***	398

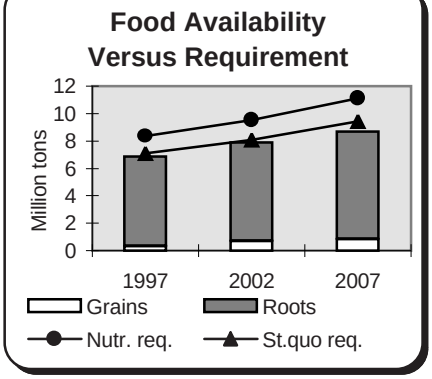
Historically, production supplied nearly all of the consumption requirements. With assumed growth rates of 1.3 percent per year in production and near zero for imports, food supplies will fall well short of meeting nutritional targets. Production growth would need to rise to nearly 4 percent per year--far outstripping historical and projected rates.



Statistical table 7--Congo, Democratic Republic (Central Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,051	6,139	384	57	6,117
1989	1,038	6,345	236	109	6,161
1990	1,011	6,594	318	86	6,412
1991	1,229	6,869	164	129	6,778
1992	1,408	7,113	238	27	7,198
1993	1,567	7,329	246	31	7,511
1994	1,545	6,387	223	86	6,940
1995	1,452	6,208	333	35	6,771
1996	1,565	6,378	252	8	6,930
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,445	6,566	303	***205*** ***1,464***	6,885
2002	1,912	7,196	319	***179*** ***1,613***	7,896
2007	2,147	7,876	357	***573*** ***2,220***	8,697

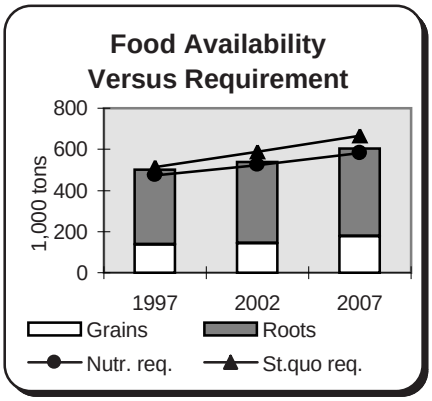
Domestic food supplies will fall well short of meeting nutritional requirements. The nutritional gap is projected at more than 6 times the size of commercial imports in 2007. Historically, production growth stemmed from area expansion, and this is not expected to continue in the projection period.



Statistical table 8--Burundi (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	318	377	16	6	606
1989	268	375	11	3	545
1990	360	380	19	3	650
1991	385	389	33	1	692
1992	258	399	18	6	562
1993	249	389	0	28	549
1994	185	339	34	78	528
1995	170	356	40	5	457
1996	140	366	52	3	487
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	230	365	42	***11*** ***268***	503
2002	247	396	43	***49*** ***344***	540
2007	313	428	43	***61*** ***395***	604

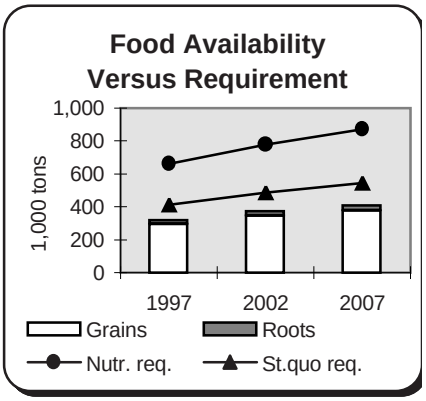
Output for 1997 is estimated to be much improved from recent years due to an improved security situation, increased supply of fertilizer, and favorable weather conditions. As a result, domestic supplies will be nearly sufficient to maintain per capita consumption levels.



Statistical table 9--Eritrea (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	182	23	0	0	204
1989	122	23	0	0	144
1990	72	23	0	100	194
1991	72	23	0	253	346
1992	198	23	0	39	259
1993	73	23	0	235	330
1994	298	23	192	63	575
1995	153	23	29	62	266
1996	132	23	111	72	337
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	184	24	118	***95*** / ***344***	319
2002	244	26	111	***115*** / ***409***	373
2007	278	28	110	***138*** / ***466***	407

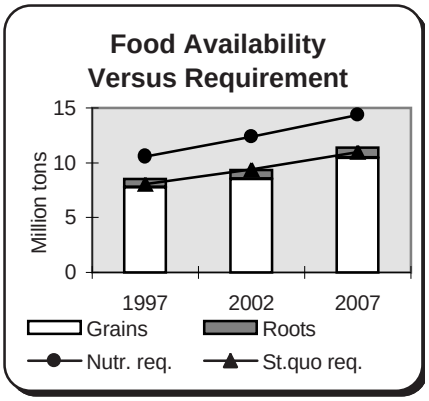
Given limited production and import capacity, domestic supplies will fall short of preventing a decline in per capita consumption or meeting nutritional targets. While grain output is projected to rise much faster than it did historically--2.9 percent per year versus 1 percent--it will not be sufficient to fill the nutritional gap.



Statistical table 10--Ethiopia (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	4,519	681	608	472	5,721
1989	5,001	707	0	678	5,841
1990	5,052	734	0	808	6,037
1991	4,876	748	0	1,046	6,129
1992	5,342	746	487	543	6,535
1993	5,363	705	0	942	6,451
1994	5,960	725	336	687	7,089
1995	7,075	725	248	403	7,721
1996	6,775	725	16	354	7,169
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	8,515	758	209	***0*** / ***2,059***	8,507
2002	9,334	846	215	***75*** / ***3,025***	9,343
2007	11,489	945	224	***0*** / ***3,004***	11,380

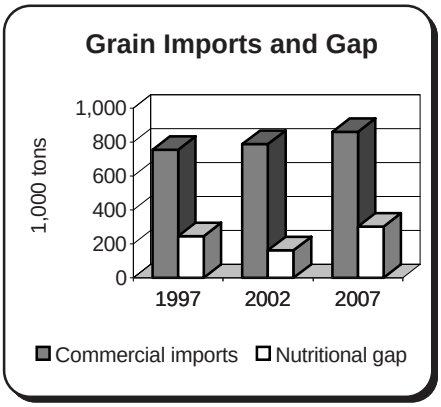
While reliance on external sources to maintain per capita consumption levels will be negligible throughout the projection period, the nutritional situation is projected to deteriorate. Consumption in all income groups falls short of the nutritional target in 2007.



Statistical table 11--Kenya (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	3,453	452	0	86	3,396
1989	3,399	513	71	89	3,625
1990	2,723	485	296	65	3,764
1991	3,033	480	136	186	3,817
1992	3,085	500	359	288	3,809
1993	2,220	524	312	236	2,986
1994	3,520	524	1,080	111	4,307
1995	3,130	541	291	56	3,986
1996	2,730	549	668	32	3,716
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	3,030	555	753	***256*** / ***245***	3,876
2002	3,599	602	788	***174*** / ***162***	4,463
2007	4,025	652	860	***316*** / ***302***	4,951

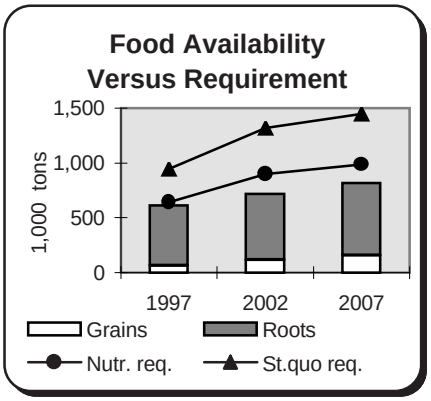
Kenya's future production gains will depend on improvements in yields as there is little potential for area expansion to productive land. Grain yields are already among the highest in the region and are projected to grow around 1.4 percent annually. A moderate boost in output will close both food gaps.



Statistical table 12--Rwanda (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	274	553	15	2	710
1989	262	552	13	10	699
1990	269	629	15	15	778
1991	254	739	19	11	871
1992	267	673	0	90	893
1993	188	598	53	90	807
1994	149	499	0	272	829
1995	154	480	0	244	760
1996	124	605	8	326	975
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	184	549	3	***352*** / ***46***	610
2002	280	602	3	***630*** / ***200***	718
2007	354	661	3	***662*** / ***191***	817

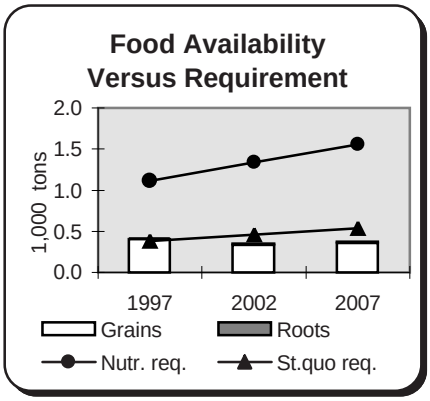
While a jump in area stimulated production in 1997, output remains below pre-strife levels as agricultural activity continues to be hindered by the slow return of refugees and lack of inputs. Despite high projected growth rates, output does not recover to late 1980-levels until 2004 and the food gaps widen considerably.



Statistical table 13--Somalia (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	639	15	114	81	786
1989	513	16	103	95	662
1990	477	16	97	100	622
1991	257	16	77	132	428
1992	202	14	38	312	507
1993	162	14	125	75	322
1994	228	12	115	13	306
1995	268	14	81	12	310
1996	393	14	153	12	495
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	380	14	119	***0*** / ***697***	415
2002	295	15	128	***112*** / ***991***	352
2007	322	16	133	***166*** / ***1,190***	374

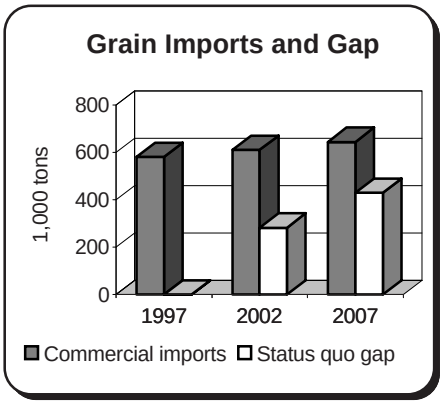
While estimated output for 1997 is up from the lowest points of the civil war, it remains well below that of the late 1980's. Projections of production are based on the low levels of the mid-1990's; however, if the most recent trends hold, the status quo gap could fall to negligible levels, but the nutritional gap would remain significant.



Statistical table 14--Sudan (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	5,137	67	385	270	4,053
1989	2,467	45	182	360	3,411
1990	2,119	36	120	513	2,961
1991	4,488	50	488	711	4,764
1992	5,307	51	334	286	4,594
1993	3,087	48	427	293	4,181
1994	5,152	50	811	134	5,044
1995	3,307	50	450	64	3,787
1996	5,057	50	399	40	4,968
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	5,257	51	581	***0*** / ***0***	5,126
2002	5,057	54	611	***283*** / ***0***	4,960
2007	5,531	57	645	***430*** / ***0***	5,404

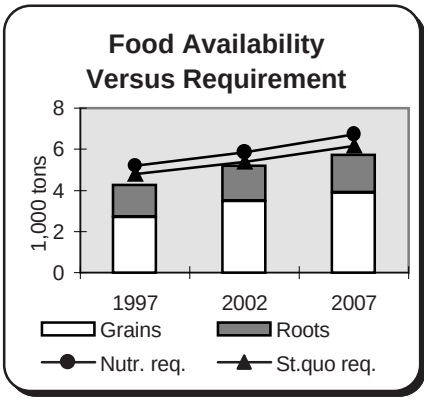
In order to maintain per capita consumption, production would need to grow 2.2 percent per year, slightly above the projected rate of 1.7 percent. If growth matches the historical rate of nearly 3 percent, the gap could be closed. With Sudan's highly variable production, any fall below trend will result in a drop in per capita consumption.



Statistical table 15--Tanzania (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	3,531	1,616	40	89	3,840
1989	4,470	1,628	24	28	5,107
1990	3,565	1,966	43	34	4,482
1991	3,540	1,736	111	18	4,798
1992	3,390	1,648	154	36	4,569
1993	3,700	1,593	150	47	4,609
1994	3,350	1,681	228	108	4,574
1995	4,323	1,451	194	25	4,776
1996	3,815	1,438	48	22	4,373
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	3,465	1,569	172	***508*** / ***929***	4,268
2002	4,515	1,694	169	***187*** / ***661***	5,195
2007	5,041	1,828	175	***444*** / ***987***	5,726

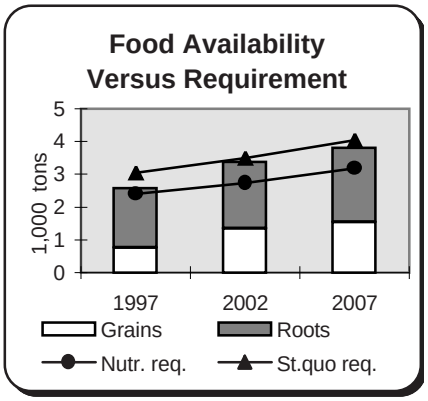
The late start to the rainy season coupled with insufficient rains in some areas, resulted in lower yields. Consequently, grain output is estimated down about 10 percent from the 1994-96 average. The food gap to maintain consumption is estimated at more than 3 times commercial imports.



Statistical table 16--Uganda (East Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,500	1,802	0	24	2,794
1989	1,535	1,906	0	49	2,902
1990	1,520	1,858	0	74	2,848
1991	1,460	1,834	0	30	2,699
1992	1,666	1,765	0	40	2,745
1993	1,794	1,886	36	46	2,949
1994	1,900	1,593	0	60	2,702
1995	2,020	1,826	10	41	3,018
1996	1,950	1,842	27	20	3,007
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	1,500	1,827	14	***462*** / ***0***	2,584
2002	2,400	2,030	13	***103*** / ***0***	3,382
2007	2,744	2,254	14	***241*** / ***0***	3,804

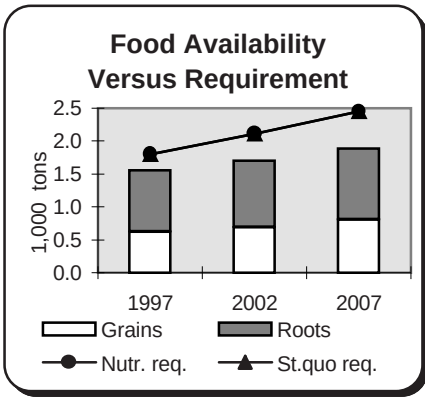
Poorly distributed rainfall coupled with rebel activity is resulting in an estimated 20 percent drop in grain output in 1997 and a relatively large food gap to maintain consumption. Uganda remains one of the least nutritionally vulnerable countries in the region; consumption in all income groups is projected to meet nutritional targets in 2007.



Statistical table 17--Angola (Southern Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	237	587	137	109	1,013
1989	287	618	101	139	1,094
1990	227	617	210	124	1,126
1991	346	633	162	142	1,224
1992	452	714	200	116	1,424
1993	317	707	103	222	1,295
1994	261	887	173	229	1,496
1995	302	897	185	224	1,549
1996	473	934	255	228	1,823
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	488	934	222	***237*** ***239***	1,559
2002	537	1,008	248	***412*** ***415***	1,700
2007	628	1,087	281	***558*** ***562***	1,890

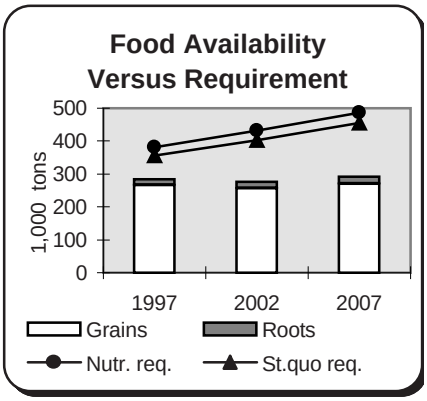
Production has increased since the end of the war as NGO's and UN agencies have been successful in providing seeds and tools. However, other vital inputs and machinery limit production. Lack of purchasing power means that consumption in all income groups will fall short of base consumption levels in 2007.



Statistical table 18--Lesotho (Southern Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	233	11	173	43	313
1989	189	12	138	34	295
1990	214	13	167	36	362
1991	148	14	195	37	329
1992	75	16	169	45	230
1993	151	17	183	32	239
1994	243	17	168	15	382
1995	106	18	155	28	220
1996	233	18	220	30	409
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	183	18	186	***4*** ***147***	284
2002	173	20	193	***49*** ***211***	277
2007	193	21	200	***76*** ***259***	292

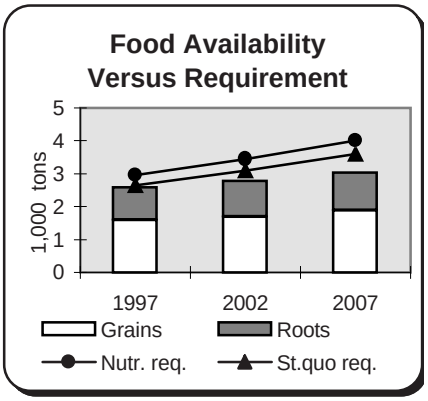
The 1997 grain harvest is estimated down about 20 percent from last year's above average crop. The combination of dry weather during a critical growing stage and an early frost adversely affected the crop. Due to relatively large commercial import capacity, however, the food gap to maintain consumption is not large.



Statistical table 19--Madagascar (Southern Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,573	886	2	88	2,195
1989	1,645	919	76	51	2,308
1990	1,700	926	99	38	2,386
1991	1,553	932	28	54	2,200
1992	1,715	916	73	59	2,392
1993	1,812	952	77	34	2,492
1994	1,670	972	123	20	2,411
1995	1,780	970	131	21	2,517
1996	1,830	987	123	28	2,588
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,880	1,006	137	***54*** ***365***	2,593
2002	2,004	1,079	148	***313*** ***676***	2,776
2007	2,215	1,158	164	***551*** ***973***	3,039

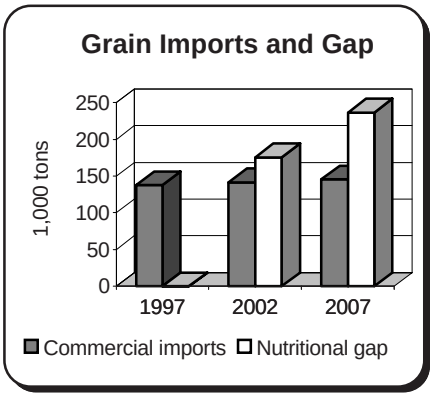
The nutritional gap as a share of aggregate food availability is projected to rise from 14 to 32 percent between 1997-2007. Historically, grain output has been characterized by slow growth and this is projected to continue. Production needs to rise 3.7 percent per year to close the nutritional gap--more than 2 times the projected growth.



Statistical table 20--Malawi (Southern Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,368	102	0	344	1,642
1989	1,531	108	0	347	1,809
1990	1,373	108	90	65	1,451
1991	1,629	116	0	285	1,902
1992	670	105	0	605	815
1993	2,016	128	493	67	2,777
1994	1,093	118	196	284	1,332
1995	1,628	124	198	105	1,624
1996	1,733	131	8	222	1,990
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	2,045	129	138	***0*** ***0***	1,944
2002	2,016	141	141	***212*** ***176***	1,923
2007	2,261	155	146	***277*** ***237***	2,142

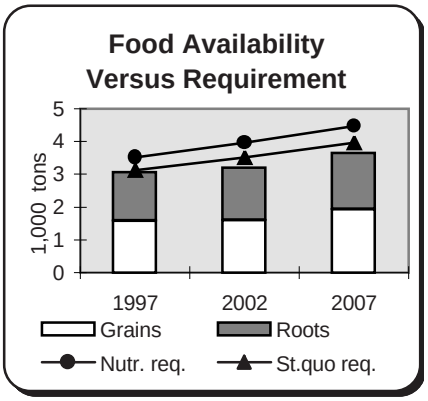
Despite gains in yields, growth in grain output is projected to slow from historical levels of 3 percent per year due to a slowdown in area expansion. To maintain consumption levels, production would need to increase 3.2 percent per year, well above the projected rates of 2.5 percent.



Statistical table 21--Mozambique (Southern Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	526	1,324	8	615	2,351
1989	568	1,356	0	560	2,351
1990	706	1,674	0	523	2,694
1991	544	1,355	0	664	2,294
1992	278	1,193	123	929	2,426
1993	715	1,292	297	356	2,578
1994	756	1,238	214	304	2,402
1995	1,080	1,322	276	251	2,771
1996	1,163	1,726	133	302	3,266
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,552	1,471	215	***54*** ***452***	3,061
2002	1,541	1,592	232	***307*** ***754***	3,197
2007	1,870	1,722	250	***321*** ***828***	3,647

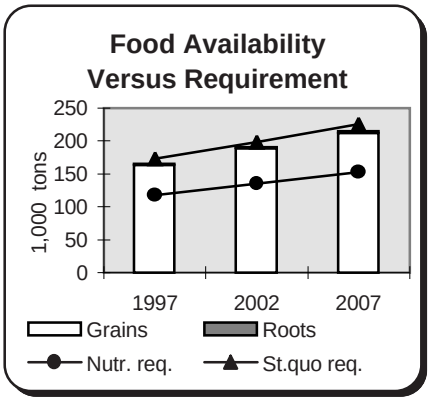
Grain output continues the post-war upward trend. Despite improvements, the food gaps are projected to grow, particularly the nutritional gap. Average per capita consumption in 2007 is projected at only 80 percent of the nutritional target, and for the lowest income group, this number falls to 53 percent.



Statistical table 22--Swaziland (Southern Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	155	3	80	16	235
1989	115	3	81	7	181
1990	85	2	84	4	160
1991	158	2	89	5	233
1992	59	2	57	40	143
1993	78	2	71	10	140
1994	104	2	100	1	188
1995	81	2	84	12	161
1996	85	2	71	6	145
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	85	2	97	***8*** ***0***	165
2002	102	2	108	***8*** ***0***	191
2007	107	2	128	***11*** ***0***	215

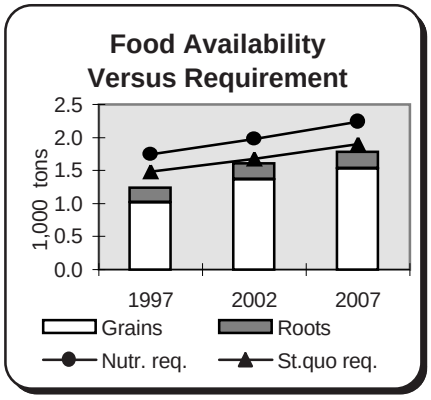
Although grain production growth is projected to slow relative to the historical period, output and commercial imports will be adequate to meet nutritional targets and nearly sufficient to maintain per capita consumption levels.



Statistical table 23--Zambia (Southern Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,997	152	55	118	1,990
1989	1,797	198	125	6	2,172
1990	1,195	214	38	110	1,510
1991	1,309	219	1	56	1,243
1992	597	220	8	715	1,006
1993	1,759	222	342	11	2,085
1994	1,195	218	54	12	1,325
1995	929	213	78	74	788
1996	1,563	218	254	58	1,918
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,162	222	142	***239*** ***503***	1,242
2002	1,600	239	137	***72*** ***371***	1,604
2007	1,808	256	141	***112*** ***451***	1,787

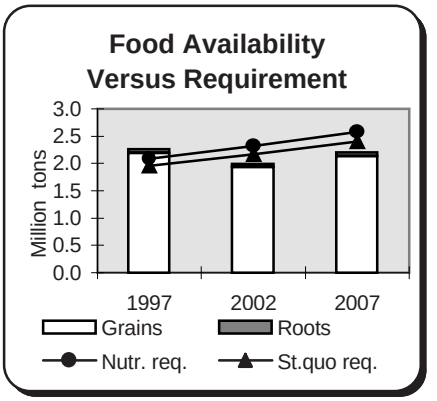
Grain production for 1997 is estimated down nearly 30 percent from last year's above-average harvest as a result of excessive precipitation and inadequate supply of fertilizers. Consequently, both the status quo and nutritional gaps are larger in 1997 than any time in the projection period.



Statistical table 24--Zimbabwe (Southern Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	2,927	42	74	10	2,337
1989	2,487	43	35	17	1,650
1990	2,758	45	64	54	2,794
1991	2,139	47	0	41	1,354
1992	675	52	583	896	1,342
1993	2,249	57	586	16	2,089
1994	2,614	58	86	5	2,977
1995	1,194	64	117	4	443
1996	2,911	65	310	0	2,802
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	2,685	64	182	***0*** ***0***	2,260
2002	2,425	67	201	***169*** ***321***	1,997
2007	2,676	70	220	***207*** ***375***	2,197

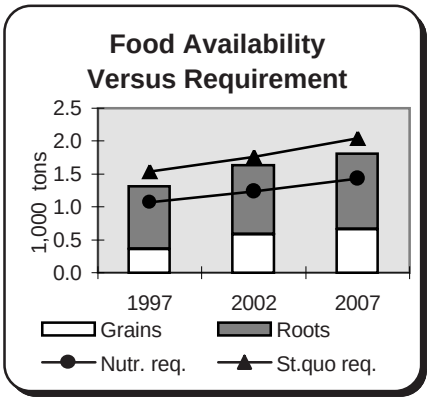
Despite a decline from last year, output in 1997 is estimated to be sufficient to prevent a decline in per capita consumption. For the projection period, however, output would need to rise 2.5 percent per year to maintain per capita consumption, significantly higher than the projected rate of 1.7 percent.



Statistical table 25--Benin (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	551	655	116	19	1,029
1989	557	719	82	13	1,044
1990	522	717	146	9	1,056
1991	524	802	138	7	1,117
1992	602	782	161	19	1,199
1993	635	843	106	26	1,229
1994	635	868	74	15	1,202
1995	776	946	87	18	1,409
1996	941	948	117	9	1,551
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	645	955	110	***220*** ***0***	1,312
2002	963	1,045	115	***135*** ***0***	1,630
2007	1,074	1,143	133	***238*** ***0***	1,806

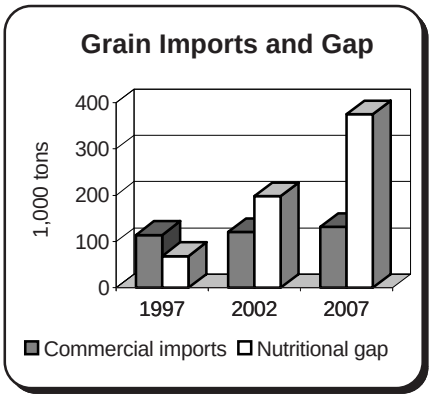
While domestic supplies will be more than adequate to meet nutritional requirements, they will not be sufficient to prevent a decline in per capita consumption. If historical production trends continued, the status quo gap would be eliminated. However, annual output growth is projected to slow to 1.9 percent.



Statistical table 26--Burkina Faso (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	2,067	44	86	65	1,967
1989	1,901	28	95	51	1,722
1990	1,547	20	34	124	1,442
1991	2,220	21	184	42	2,138
1992	2,438	25	127	31	2,222
1993	2,515	22	115	27	2,291
1994	2,453	19	104	19	2,191
1995	2,265	23	84	37	2,015
1996	2,402	23	127	26	2,186
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	2,465	22	114	***69*** ***69***	2,129
2002	2,705	23	120	***198*** ***198***	2,329
2007	2,940	24	131	***375*** ***375***	2,530

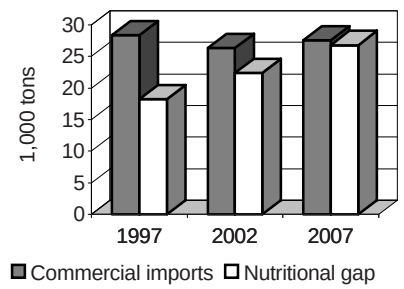
A continuation of historical production growth--2.7 percent per year--would almost eliminate the projected food gaps. However, output growth is projected to slow as gains in yields and area will be minimal.



Statistical table 27--Cape Verde (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)		Aggregate availability of food
			---1,000 tons ---			
1988	16	5	0	76		94
1989	7	5	0	72		81
1990	10	5	0	76		88
1991	4	3	0	76		80
1992	10	2	88	45		140
1993	12	2	13	58		81
1994	9	1	24	64		95
1995	10	2	27	50		85
1996	10	2	27	46		81
Projections				**Food gap**		
				SQ	NR	(w/o food aid)
1997	10	1	28	***56***	***18***	36
2002	18	1	26	***65***	***22***	39
2007	20	1	28	***74***	***27***	41

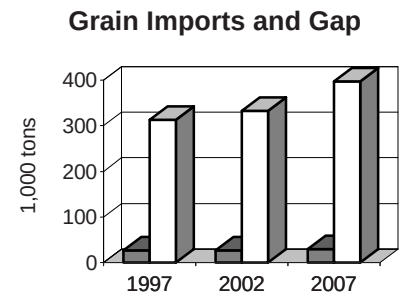
A relatively large long run food gap also is projected based primarily upon limited commercial import capacity, the dominant source of supply. This country is highly dependent upon food aid to maintain per capita consumption.



Statistical table 28--Chad (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)		Aggregate availability of food
			---1,000 tons ---			
1988	815	234	30	21		991
1989	716	210	0	36		855
1990	536	240	0	33		710
1991	794	233	0	67		982
1992	836	220	51	0		971
1993	671	187	58	17		806
1994	846	186	23	15		932
1995	779	189	24	11		861
1996	803	189	25	15		896
Projections				**Food gap**		
				SQ	NR	(w/o food aid)
1997	776	195	26	***82***	***313***	838
2002	925	211	27	***70***	***333***	978
2007	1,022	226	29	***102***	***397***	1,075

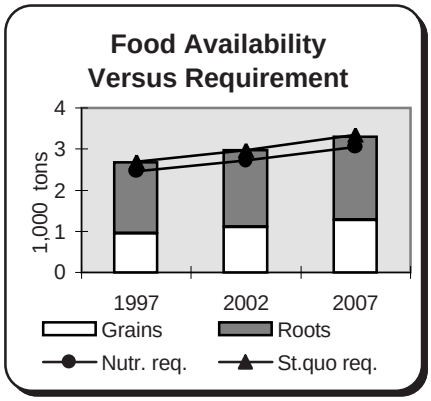
Production growth is projected to slow even from historically low levels. Given the country's limited import capacity, this translates into growing food gaps. By 2007, Chad's nutritional gap will equal nearly 40 percent of aggregate food availability.



Statistical table 29--Cote d'Ivoire (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,039	1,479	539	19	2,388
1989	1,067	1,541	543	26	2,460
1990	1,036	1,486	495	59	2,412
1991	1,096	1,531	572	36	2,520
1992	1,024	1,707	448	41	2,471
1993	1,072	1,660	594	45	2,615
1994	1,078	1,669	433	56	2,448
1995	1,149	1,669	677	30	2,711
1996	1,155	1,669	540	47	2,637
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,190	1,724	613	***16*** ***0***	2,670
2002	1,361	1,870	682	***4*** ***0***	2,971
2007	1,529	2,027	782	***38*** ***0***	3,303

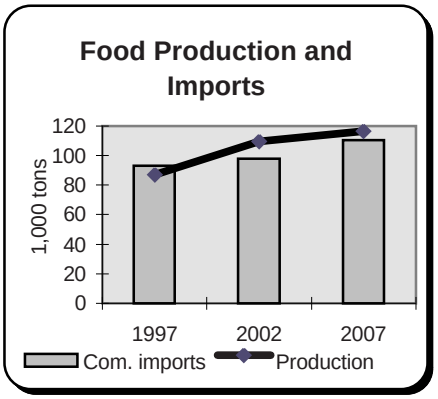
Despite the fact that production growth is projected to slow relative to historical rates due to a cut in area expansion, the long run food gap will be negligible. Growth in production and import capacity will provide adequate food supplies.



Statistical table 30--Gambia (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	96	2	97	12	192
1989	121	2	36	13	157
1990	100	2	77	14	178
1991	108	2	80	10	184
1992	87	2	78	6	155
1993	93	2	66	11	157
1994	101	2	85	2	174
1995	101	2	64	4	156
1996	101	2	94	4	186
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	85	2	93	***14*** ***0***	165
2002	108	2	98	***9*** ***0***	189
2007	114	2	111	***12*** ***0***	208

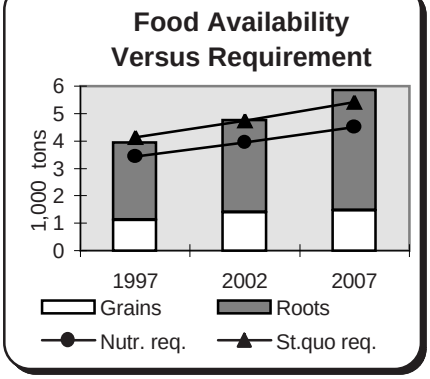
In the long run, per capita consumption will be supported at near-base levels as production and commercial imports will provide adequate food supplies.



Statistical table 31--Ghana (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,095	1,290	213	47	2,079
1989	1,255	1,553	171	73	2,420
1990	813	1,184	244	76	2,033
1991	1,375	1,690	197	215	2,783
1992	1,198	1,799	323	75	2,792
1993	1,582	1,969	252	126	3,182
1994	1,498	2,382	401	101	3,334
1995	1,670	2,817	318	36	3,722
1996	1,670	2,817	325	40	3,807
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,600	2,829	394	***191*** ***0***	3,947
2002	2,042	3,359	438	***0*** ***0***	4,752
2007	2,337	4,384	513	***0*** ***0***	5,866

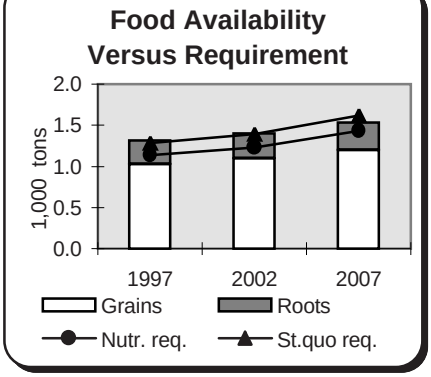
Per capita consumption is expected to grow in the long run mainly due to a projected increase in per capita production of grains as area and yields grow markedly. Food supplies will exceed minimum nutritional requirements.



Statistical table 32--Guinea (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	489	150	220	42	772
1989	412	175	237	25	722
1990	475	198	241	12	791
1991	581	232	236	30	933
1992	672	255	284	30	1,094
1993	744	254	251	46	1,141
1994	819	280	324	29	1,316
1995	726	298	375	5	1,260
1996	726	242	348	7	1,196
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	843	283	371	***0*** ***0***	1,312
2002	902	305	382	***0*** ***0***	1,403
2007	1,007	328	401	***79*** ***0***	1,530

A relatively small food gap to maintain per capita consumption emerges in the long run due to declining per capita grain production and imports. Historical grain production growth of 3.5 percent per year was driven by strong area and yield gains, both of which are projected to slow through 2007.



Statistical table 33--Guinea-Bissau (West Africa)

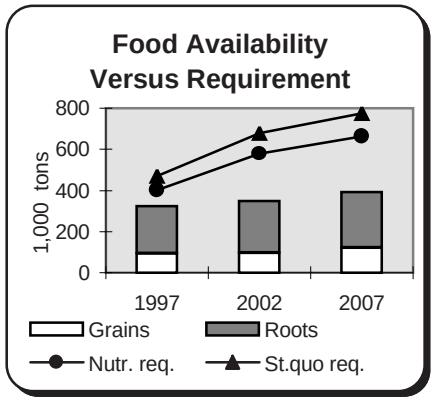
Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	133	26	43	10	198
1989	154	24	30	21	217
1990	152	23	38	9	209
1991	172	21	42	21	241
1992	125	22	72	9	215
1993	134	22	60	9	211
1994	154	21	64	2	226
1995	152	21	60	2	218
1996	150	20	54	6	215
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	194	21	61	***0*** ***0***	254
2002	186	22	64	***0*** ***0***	250
2007	203	23	68	***6*** ***0***	269

While food supplies are sufficient, on the aggregate level, to meet nutritional targets, consumption in the lowest income group will fall short of the target due to inadequate purchasing power.

Statistical table 34--Liberia (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	179	214	70	33	466
1989	168	214	35	118	500
1990	126	170	2	69	337
1991	120	170	31	143	437
1992	61	191	0	142	378
1993	39	209	1	138	374
1994	30	224	0	119	367
1995	30	224	26	104	377
1996	36	224	143	117	507
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	60	231	52	***157*** ***87***	323
2002	73	249	49	***344*** ***243***	347
2007	112	269	45	***400*** ***284***	391

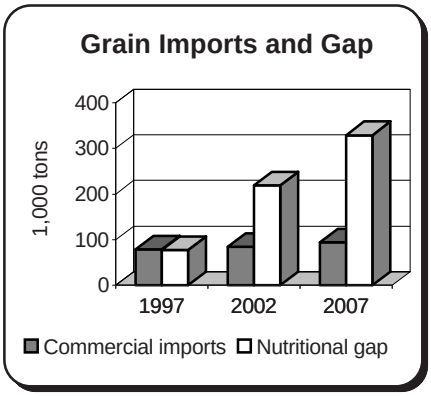
An improvement in the security situation has contributed to an increase in output for 1997. The longer term food gaps, however, are based on the prior years' low output. If peace continues and normal farming activity resumes, output will increase at rates higher than the projected rates and the food gaps would fall commensurately.



Statistical table 35--Mali (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	2,076	5	80	78	2,058
1989	1,760	5	68	57	1,676
1990	1,807	7	29	47	1,683
1991	2,245	8	184	51	2,280
1992	1,714	6	63	35	1,608
1993	1,965	9	53	29	1,828
1994	2,234	7	22	16	2,028
1995	2,050	8	83	11	1,918
1996	2,062	8	110	5	1,982
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	2,250	8	78	***0*** ***78***	2,035
2002	2,437	9	84	***127*** ***219***	2,207
2007	2,710	9	94	***223*** ***329***	2,456

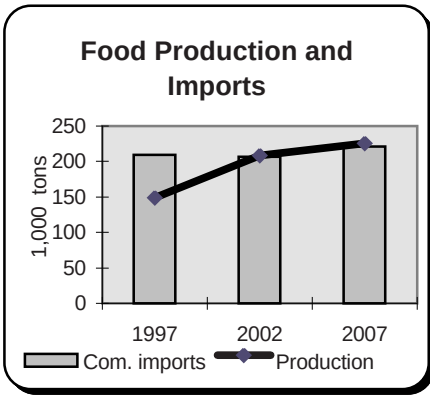
While output in 1997 is estimated to be large enough to prevent a decline in per capita consumption, this will not be the case in the longer term. Grain output--projected to grow just over 2 percent per year through 2007 --would need to grow nearly 3 percent per year to close the food gaps; between 1980-96, growth was less than 2 percent.



Statistical table 36--Mauritania (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	158	2	141	85	357
1989	152	2	107	89	321
1990	85	2	62	116	246
1991	96	2	274	50	400
1992	103	1	163	45	294
1993	158	1	187	63	391
1994	204	1	172	22	380
1995	210	1	175	25	395
1996	100	1	214	27	327
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	148	1	210	***42*** ***7***	339
2002	207	1	207	***42*** ***2***	389
2007	224	1	221	***69*** ***24***	418

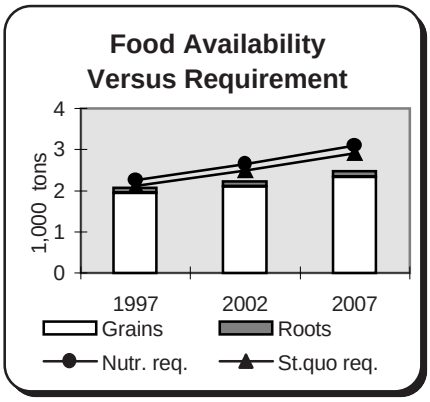
A moderate long run food gap to maintain per capita consumption is projected as per capita grain production and imports stagnate or decline; the nutrition-based food gap is negligible. If grain production and imports increase slightly above projected rates, these gaps could be eliminated.



Statistical table 37--Niger (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	2,368	107	25	102	2,230
1989	1,797	106	29	46	1,662
1990	1,596	108	22	91	1,495
1991	2,290	110	88	45	2,165
1992	2,227	111	95	28	2,102
1993	2,119	112	91	31	2,002
1994	2,190	114	92	39	2,039
1995	2,153	114	70	27	1,983
1996	2,196	114	310	6	2,256
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	2,320	117	167	***55*** ***191***	2,063
2002	2,502	124	167	***268*** ***427***	2,226
2007	2,787	133	171	***447*** ***634***	2,467

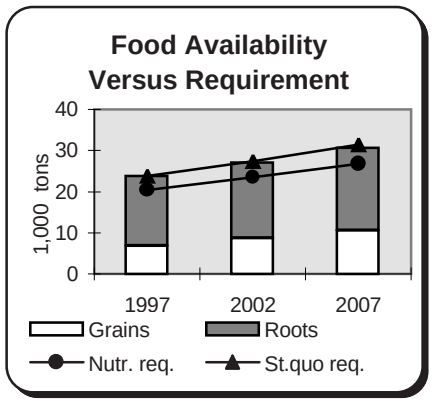
Yields are projected to increase marginally through 2007, keeping them among the lowest in the world and holding production growth to 2 percent per year. To eliminate the food gaps, output would need to grow at an unprecedented 3.2-3.5 percent. Consumption in all income groups in 2007 falls short of the nutritional target.



Statistical table 38--Nigeria (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	9,050	7,428	491	0	10,092
1989	8,700	8,147	503	0	10,628
1990	15,045	9,831	423	0	17,609
1991	16,131	12,885	735	1	19,439
1992	16,348	14,684	976	0	20,958
1993	17,278	15,544	1,448	0	22,743
1994	17,747	16,269	922	0	23,218
1995	17,910	16,436	1,062	0	23,427
1996	16,185	16,465	1,475	0	22,676
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	16,490	16,950	1,304	***46*** ***0***	23,806
2002	21,497	18,428	1,399	***299*** ***0***	27,128
2007	24,828	20,021	1,581	***863*** ***0***	30,625

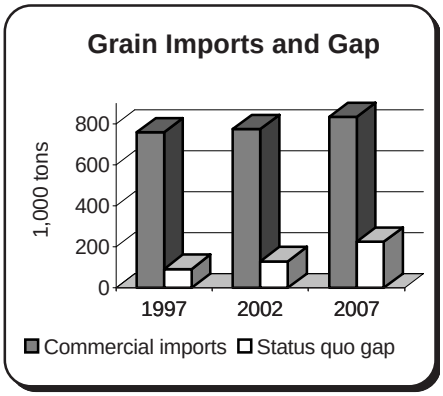
Nigeria's food gap to maintain consumption, although large relative to other countries in the region, is small relative to overall food availability--less than 3 percent in 2007. Therefore, if production grows marginally faster than projected levels of 2.4 percent, the gap would fall to zero.



Statistical table 39--Senegal (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	813	25	479	56	1,252
1989	1,015	26	503	71	1,430
1990	912	29	669	47	1,503
1991	900	14	552	65	1,342
1992	817	20	524	71	1,286
1993	1,029	19	558	38	1,440
1994	900	31	564	18	1,404
1995	1,005	23	661	9	1,283
1996	1,000	23	816	11	1,710
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	875	27	759	***93*** ***0***	1,444
2002	1,080	28	776	***130*** ***0***	1,626
2007	1,190	29	835	***225*** ***69***	1,770

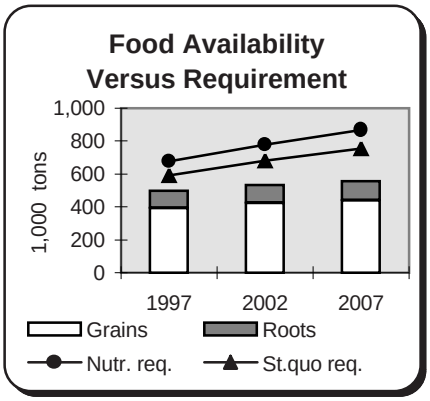
Per capita consumption is projected to decline as slower yield growth holds output growth to 1.8 percent per year. Base consumption levels could be maintained if production growth could rise to 3.1 percent or if import growth accelerates from 1.7 to 2.7 percent.



Statistical table 40--Sierra Leone (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	342	48	75	42	460
1989	345	48	93	43	480
1990	264	50	135	20	420
1991	268	50	115	66	443
1992	315	48	114	29	394
1993	321	44	116	29	438
1994	270	104	238	30	587
1995	193	93	234	46	549
1996	260	118	143	117	611
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	225	107	221	***93*** ***180***	499
2002	274	112	212	***147*** ***248***	534
2007	294	116	215	***200*** ***312***	557

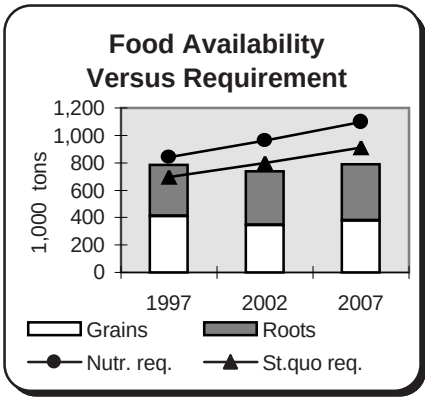
The food security situation has deteriorated in the last couple of years due to civil strife. Food supplies have tightened and the price of rice--the staple crop--has risen sharply. While production is estimated to rise in 1997, fighting and continued insecurity could hinder agricultural activities, reduce output, and spur an increase in the food gap.



Statistical table 41--Togo (West Africa)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	492	326	140	11	708
1989	550	363	117	11	775
1990	389	293	109	16	543
1991	427	391	88	14	651
1992	492	420	155	4	826
1993	611	387	55	11	796
1994	405	260	59	8	466
1995	450	435	68	4	703
1996	600	417	137	4	866
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	660	374	89	***0*** ***56***	786
2002	588	391	93	***59*** ***223***	738
2007	655	408	95	***120*** ***307***	789

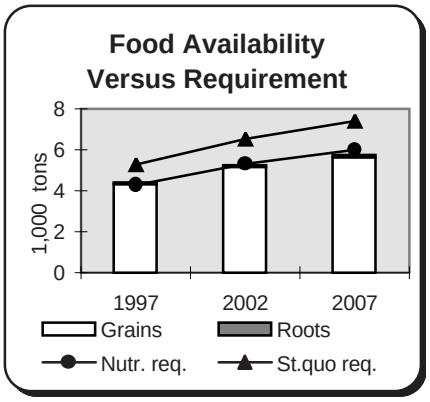
The nutritional status of the country is projected to deteriorate markedly by 2007. The nutritional gap, as a share of aggregate food availability, jumps from 7 to near 40 percent between 1997-2007. In 2007, consumption is projected to equal only 71 percent of the nutritional target.



Statistical table 42--Afghanistan (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	3,332	84	1,704	416	5,402
1989	3,218	78	1,489	173	4,850
1990	2,980	86	1,399	41	4,403
1991	2,830	86	871	56	3,741
1992	2,830	91	912	108	3,835
1993	2,930	96	977	71	3,962
1994	2,910	102	1,447	151	4,490
1995	3,170	108	2,568	127	5,849
1996	2,650	90	1,076	194	3,906
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	2,600	103	1,865	***874*** ***0***	4,417
2002	3,559	111	1,787	***1,277*** ***47***	5,261
2007	4,005	120	1,831	***1,663*** ***270***	5,739

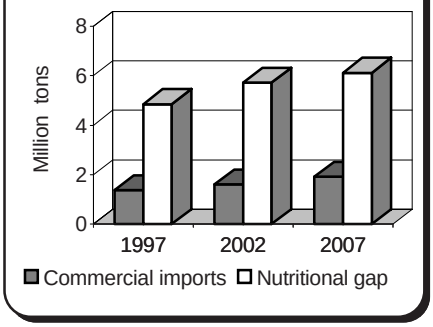
Civil strife continues to hinder agricultural production activities in Afghanistan. However, in areas where fighting has ended, normal economic activities have resumed and food production is increasing.



Statistical table 43--Bangladesh (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	16,617	450	1,555	1,457	19,269
1989	18,797	401	1,001	1,216	20,027
1990	18,903	387	89	1,452	19,863
1991	19,362	422	157	1,469	20,174
1992	19,563	454	777	719	20,606
1993	19,219	446	325	745	19,903
1994	18,125	457	96	858	18,393
1995	19,104	467	1,745	825	20,202
1996	19,847	460	1,857	743	21,706
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	19,899	476	1,382	***451*** ***4,853***	20,411
2002	21,096	515	1,600	***918*** ***5,710***	21,791
2007	22,900	557	1,923	***899*** ***6,122***	23,849

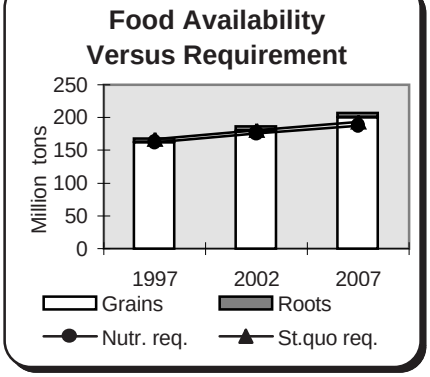
Intense population pressure in Bangladesh has led to soil and water degradation, and loss of biodiversity calling into question sustainability of current growth in food production.



Statistical table 44--India (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	147,987	4,966	2,461	392	143,792
1989	162,242	5,024	458	456	153,684
1990	156,694	5,029	88	217	152,394
1991	155,744	5,248	0	187	152,927
1992	165,337	5,597	1,262	351	159,036
1993	168,530	5,239	67	336	158,825
1994	171,080	5,847	0	271	159,270
1995	174,620	6,009	0	313	164,712
1996	176,170	6,009	0	257	170,159
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	180,700	6,156	0	***0*** ***0***	167,817
2002	200,592	6,671	0	***0*** ***0***	186,609
2007	222,495	7,226	0	***0*** ***0***	207,402

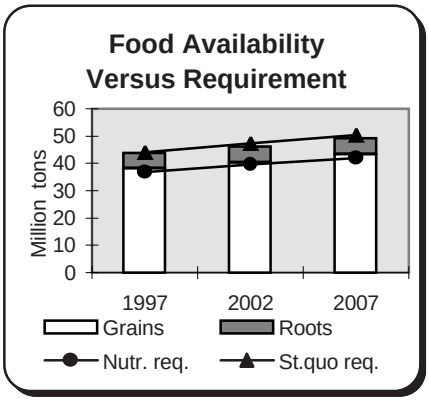
India, the world's second most populous country, also has the world's highest concentration of people living in poverty. If food supplies were distributed equally, everyone in India would have been able to meet their nutritional requirements in 1997.



Statistical table 45--Indonesia (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	34,272	5,540	1,682	69	34,968
1989	34,366	6,098	2,129	39	37,323
1990	34,042	5,649	1,810	46	36,256
1991	36,750	5,673	2,760	59	37,780
1992	36,968	5,934	3,155	41	39,286
1993	35,715	6,169	3,075	52	38,806
1994	38,433	5,641	5,154	15	38,813
1995	38,874	5,689	8,388	12	44,565
1996	40,100	5,766	6,346	18	43,952
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	39,570	5,757	7,442	***186*** ***0***	43,904
2002	41,738	5,899	8,088	***1,078*** ***0***	46,266
2007	44,145	6,042	9,103	***976*** ***0***	49,307

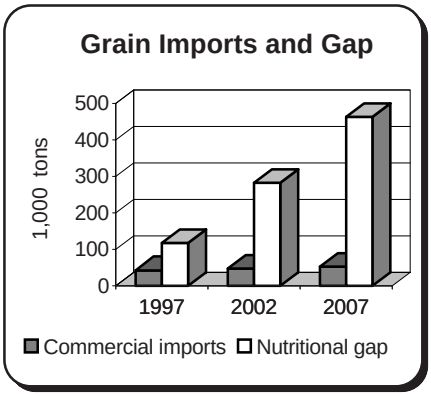
In Indonesia, sustained economic growth (real income increase) since 1970 has led to a reduction in the percentage of its population living in poverty from 60 percent to 15 percent.



Statistical table 46--Nepal (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	4,210	164	71	18	3,972
1989	4,541	175	11	8	4,194
1990	4,674	186	20	1	4,314
1991	4,437	201	4	8	4,079
1992	4,003	198	41	18	3,694
1993	4,075	199	15	44	3,775
1994	4,427	210	49	26	4,151
1995	4,445	223	11	43	4,148
1996	4,585	237	57	33	4,295
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	4,685	232	43	***69*** ***117***	4,288
2002	5,132	254	47	***228*** ***283***	4,702
2007	5,603	278	53	***402*** ***464***	5,140

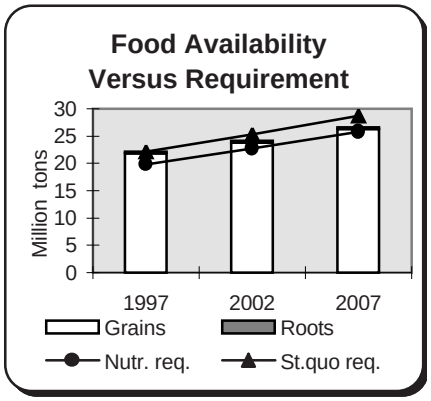
Nepal's economy is dependent on agriculture, with almost 90 percent of its population living in rural areas. As a result, raising agricultural productivity is essential for increasing incomes and reducing food insecurity.



Statistical table 47--Pakistan (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	17,669	203	110	498	16,270
1989	19,407	218	1,678	499	18,540
1990	19,445	261	1,673	380	19,972
1991	19,390	248	603	373	18,171
1992	20,458	279	1,813	236	19,194
1993	21,915	301	2,831	67	21,901
1994	20,537	331	1,817	103	20,845
1995	22,773	339	2,679	18	22,646
1996	23,027	337	2,083	15	22,234
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	23,150	344	2,455	***51*** ***0***	22,112
2002	25,275	367	2,811	***1,215*** ***0***	24,126
2007	27,717	392	3,337	***2,169*** ***0***	26,594

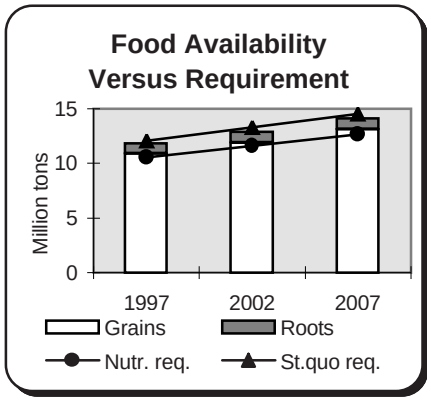
Per capita income in Pakistan has increased by 70 percent (in real terms) over the past two decades. This has contributed to the reduction of the country's poverty rate from 50 percent in mid-1980's to 33 percent in the early 1990's.



Statistical table 48--Philippines (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	10,521	923	1,320	137	10,394
1989	10,197	902	1,763	59	10,035
1990	11,527	913	2,625	109	11,080
1991	10,426	902	1,642	48	10,821
1992	11,000	901	1,956	53	10,253
1993	11,480	924	2,140	52	11,042
1994	11,343	907	2,380	44	11,199
1995	11,587	925	2,786	17	10,690
1996	11,750	930	3,882	11	12,719
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	11,500	933	3,459	***263*** ***0***	11,827
2002	12,425	965	3,929	***451*** ***0***	12,863
2007	13,298	998	4,654	***387*** ***0***	14,116

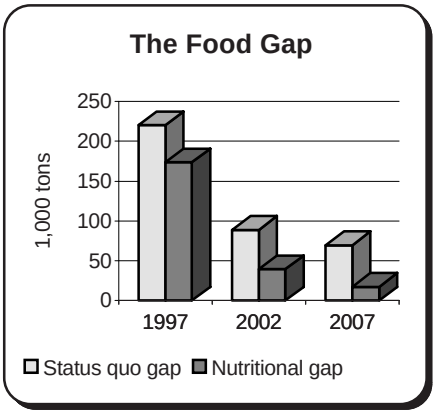
Recent rice shortages have caused the Government of the Philippines to rethink its policy of food self-sufficiency. The country is now placing greater importance on commercial imports to meet its food needs.



Statistical table 49--Sri Lanka (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,576	212	659	272	2,621
1989	1,625	188	928	231	2,752
1990	1,678	173	700	201	2,555
1991	1,691	162	421	439	2,563
1992	1,649	140	813	249	2,638
1993	1,748	141	803	338	2,839
1994	1,905	140	590	346	2,956
1995	1,679	138	1,022	120	2,919
1996	1,565	138	1,279	57	2,851
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,615	141	1,064	***220*** ***174***	2,641
2002	1,886	148	1,091	***89*** ***40***	2,920
2007	1,995	154	1,174	***69*** ***18***	3,109

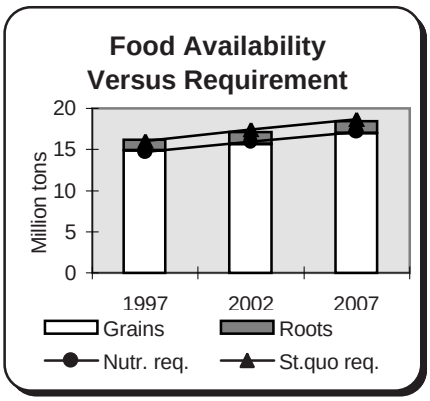
Sri Lanka has a strong human resource base and is endowed with natural resources that are increasingly threatened by rapid urbanization and environmental problems (deforestation and air and water pollution).



Statistical table 50--Vietnam (Asia)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	12,859	1,552	403	119	12,421
1989	13,615	1,472	123	75	12,438
1990	13,242	1,394	99	75	12,600
1991	15,538	1,488	190	80	14,177
1992	15,449	1,654	214	84	14,351
1993	16,839	1,561	216	87	15,037
1994	17,146	1,376	256	64	15,086
1995	18,583	1,259	466	21	15,709
1996	18,800	1,264	475	0	16,040
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	19,000	1,335	470	***0*** ***0***	16,194
2002	20,027	1,430	589	***327*** ***0***	17,090
2007	21,478	1,530	771	***176*** ***0***	18,476

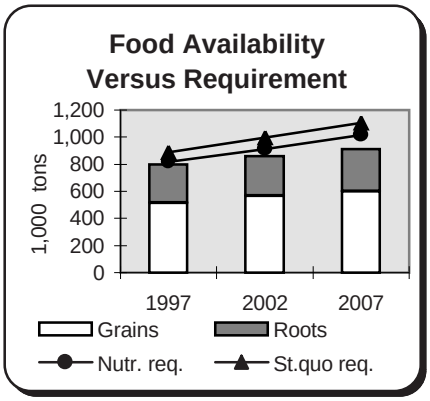
While still one of the region's poorest countries, the success of Vietnam's "doi moi" program has turned its economy around and provides a reason for optimism about the country's future growth.



Statistical table 51--Bolivia (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	609	354	103	95	746
1989	703	312	178	96	756
1990	692	288	0	235	711
1991	760	309	143	238	876
1992	780	291	130	243	866
1993	1,055	318	89	205	959
1994	875	268	155	176	833
1995	825	272	274	67	825
1996	935	293	237	75	885
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	945	283	240	***90*** ***17***	799
2002	1,053	296	252	***134*** ***53***	861
2007	1,137	310	275	***192*** ***102***	911

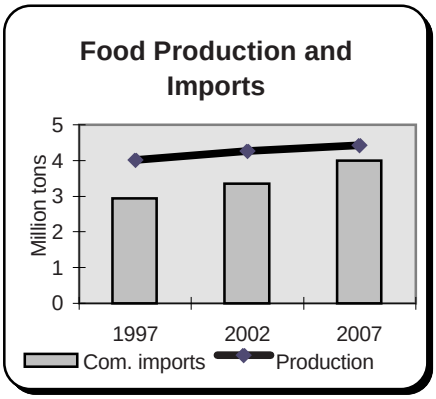
Bolivia's food gap is projected to increase steadily during the next decade. To eliminate this gap grain production has to grow 2.6 percent annually or food imports need to grow 5.7 percent.



Statistical table 52--Colombia (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	3,256	1,013	926	12	3,917
1989	3,286	1,117	771	7	4,015
1990	3,351	1,150	952	1	4,248
1991	3,035	1,053	791	8	3,472
1992	2,963	1,037	1,590	17	4,206
1993	3,142	1,250	1,694	31	4,178
1994	3,126	1,257	2,373	15	4,533
1995	2,891	1,236	2,572	0	4,928
1996	2,899	1,176	2,740	0	4,636
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	2,779	1,237	2,935	***9*** ***0***	4,879
2002	2,996	1,271	3,358	***0*** ***0***	5,389
2007	3,123	1,306	3,994	***0*** ***0***	6,042

Aggregate food supply is projected to continue to be sufficient. The projected 2-percent growth will be mainly driven by growth in commercial grain imports, which are expected to grow 3.5 percent.



Statistical table 53--Dominican Republic (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	379	88	405	228	593
1989	357	105	622	9	567
1990	323	101	682	6	596
1991	343	85	731	14	442
1992	390	88	785	7	408
1993	370	68	972	7	576
1994	369	69	924	3	476
1995	396	87	1,018	1	659
1996	370	86	891	0	487
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	340	82	1,066	***0*** ***0***	601
2002	397	85	1,130	***0*** ***0***	648
2007	413	87	1,262	***0*** ***0***	735

Commercial imports of grains and roots are three times the domestic production, and import capacity is projected to increase by 2.4 percent per year, enough to ensure sufficient food supplies.

Statistical table 54--El Salvador (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	787	8	0	199	733
1989	772	10	0	249	722
1990	795	10	72	84	693
1991	699	11	368	86	937
1992	953	15	141	131	825
1993	858	14	212	79	764
1994	690	32	467	7	915
1995	873	30	391	13	856
1996	841	30	420	0	904
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	860	31	463	***0*** ***0***	955
2002	872	34	504	***56*** ***0***	973
2007	923	36	562	***81*** ***0***	1,047

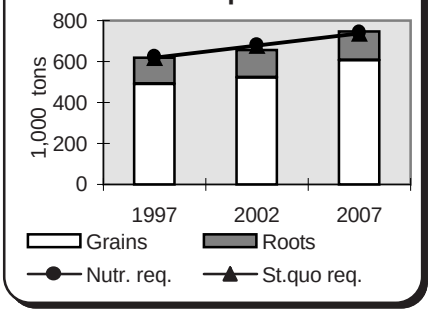
Even though the aggregate food gap projected for 2007 is relatively small, it may leave 40 percent of the population unable to maintain their consumption level. Slow grain production growth of 1 percent and skewed distribution of purchasing power are to blame. Imports are not expected to grow enough to make up the difference.

Statistical table 55--Ecuador (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	544	107	483	90	827
1989	593	111	432	38	729
1990	726	116	365	98	748
1991	857	104	416	45	791
1992	932	128	346	14	627
1993	939	113	271	12	557
1994	909	137	321	32	519
1995	914	123	377	1	560
1996	837	120	573	8	737
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	911	129	474	***0*** ***2***	618
2002	966	135	533	***18*** ***26***	656
2007	1,054	140	613	***0*** ***0***	746

Ecuador is expected to be able to produce and import enough grain and roots to have sufficient supplies to avert food gaps.

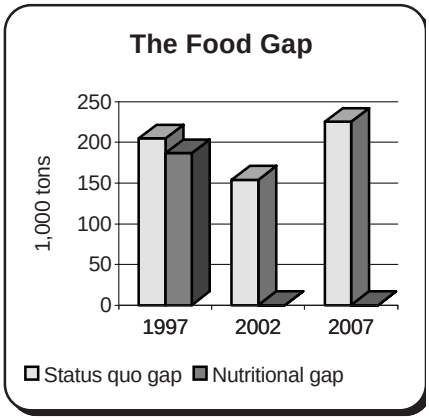
El Nino is expected to affect Ecuador, which might lead to a food gap in the coming year.



Statistical table 56--Guatemala (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,460	13	0	281	1,262
1989	1,342	13	35	163	1,063
1990	1,398	16	185	171	1,195
1991	1,355	14	176	252	1,306
1992	1,454	16	280	109	1,310
1993	1,400	16	275	151	1,276
1994	1,353	17	430	144	1,349
1995	1,443	17	462	30	1,338
1996	1,461	17	484	25	1,242
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,311	18	524	***205*** ***187***	1,163
2002	1,618	20	578	***154*** ***0***	1,416
2007	1,767	22	677	***225*** ***0***	1,563

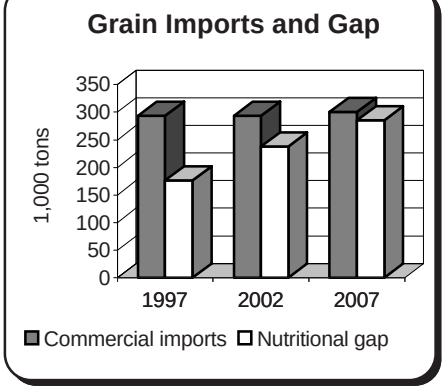
El Nino is to blame for 1997 production losses which lead to substantial food gaps.
The long-run food gap is projected to remain high unless grain production growth accelerates to 2.7 percent to fill the status quo gap or imports increase at an annual rate of 5.3 percent. Income distribution is among the most eskewed in the world.



Statistical table 57--Haiti (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	330	218	149	49	653
1989	350	223	43	195	706
1990	350	224	254	42	778
1991	330	225	218	55	722
1992	320	231	268	75	793
1993	340	223	217	114	804
1994	330	224	159	117	718
1995	345	224	328	81	883
1996	345	224	341	86	895
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	355	231	293	***91*** ***176***	772
2002	372	250	294	***144*** ***238***	802
2007	409	270	300	***183*** ***285***	855

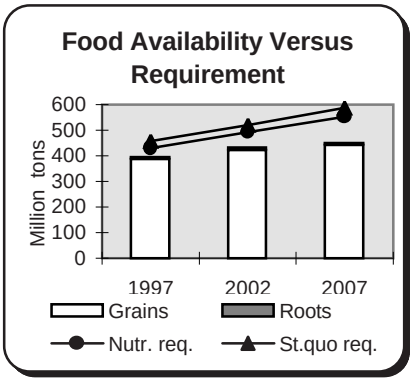
Food production growth would need to be twice its projected level to fill the food gap and imports would need to grow 7 or 8 times faster than projected--hard to realize with limited foreign exchange and exports projected to decline rather than increase by 2007.



Statistical table 58--Honduras (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	526	6	94	71	401
1989	619	7	31	134	444
1990	684	8	88	84	437
1991	693	7	100	160	467
1992	710	8	73	64	392
1993	690	8	66	149	413
1994	617	7	250	73	476
1995	780	7	233	42	435
1996	744	8	202	58	404
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	730	8	250	***48*** ***23***	396
2002	827	8	270	***75*** ***46***	432
2007	892	9	304	***120*** ***87***	451

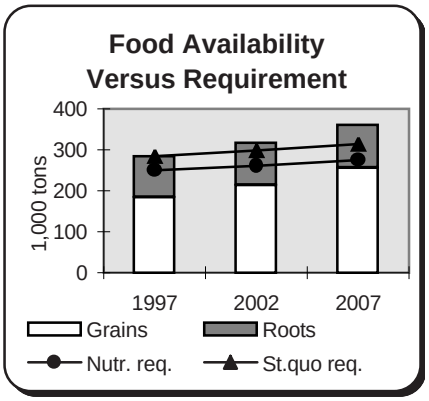
Agricultural production is expected to decline this and the coming year as a result of the El Nino phonomenon. Commercial imports are projected to be insufficient to close the food gap. The very uneven income distribution in Honduras exaccerbates poverty of low-income households.



Statistical table 59--Jamaica (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	4	69	82	365	345
1989	4	58	200	165	237
1990	2	68	172	163	219
1991	3	72	131	323	364
1992	4	84	251	201	346
1993	5	92	298	157	378
1994	5	97	304	53	262
1995	5	102	268	49	223
1996	5	102	460	0	355
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	5	101	385	***0*** / ***0***	285
2002	5	102	423	***0*** / ***0***	317
2007	5	104	475	***0*** / ***0***	360

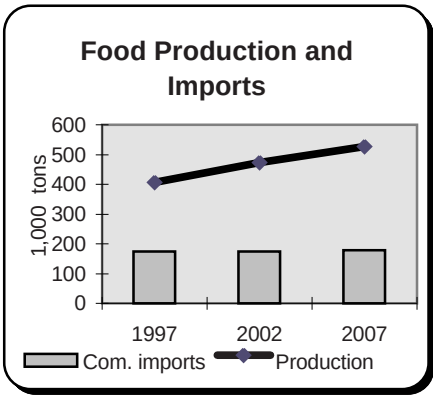
Even though food supplies are projected to be sufficient in the long run, the households making up the lowest income quintile will not be able to maintain their consumption level or reach the nutritional requirement.



Statistical table 60--Nicaragua (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	396	20	152	54	570
1989	430	20	84	57	450
1990	357	20	33	141	439
1991	409	20	1	145	451
1992	427	20	61	97	451
1993	485	21	85	55	466
1994	290	21	156	34	468
1995	383	21	155	43	517
1996	510	21	175	43	644
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	385	22	175	***60*** / ***41***	485
2002	449	23	174	***82*** / ***61***	535
2007	501	25	179	***112*** / ***88***	582

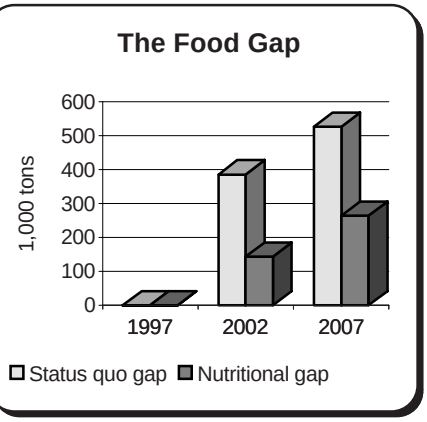
Grain production is projected to grow insufficiently to keep pace with 2.5 percent population growth and fill the food gap by 2007. Commercial imports would have to grow more than 4 times the projected 0.8 percent to fill the gap.



Statistical table 61--Peru (Latin America and the Caribbean)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,890	748	1,407	167	3,130
1989	1,954	647	971	209	2,519
1990	1,424	521	1,202	398	2,488
1991	1,241	574	1,339	492	2,289
1992	1,572	454	1,684	377	2,552
1993	1,686	607	1,549	410	2,446
1994	2,015	686	2,021	348	3,036
1995	1,683	850	2,396	108	3,444
1996	1,738	824	2,710	0	3,311
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	2,053	799	2,497	***0*** / ***0***	3,331
2002	1,941	834	2,594	***386*** / ***143***	3,218
2007	2,122	869	2,694	***527*** / ***264***	3,366

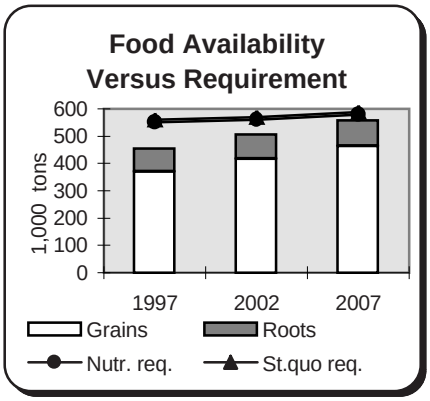
The long-run food gap could be closed if domestic grain production increased at an annual rate of 2 percent or imports could grow at 2.3 percent. This might be possible if the assumption of only 1.5 percent real export growth per year turns out to be overly pessimistic.



Statistical table 62--Armenia (New Independent States)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	331	--	--	--	--
1989	169	--	--	--	--
1990	246	--	--	--	--
1991	295	--	--	--	--
1992	302	62	508	117	575
1993	313	72	223	277	575
1994	238	77	79	366	548
1995	263	87	111	279	555
1996	333	82	135	200	550
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	355	85	232	***106*** / ***97***	456
2002	388	89	245	***64*** / ***55***	506
2007	421	94	269	***33*** / ***23***	557

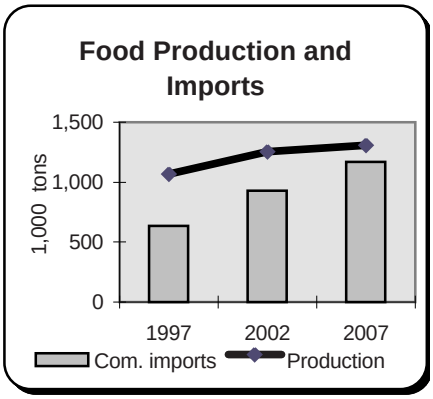
Higher grain production is projected to reduce the food gap to insignificant levels by 2007.



Statistical table 63--Azerbaijan (New Independent States)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,335	--	--	--	--
1989	822	--	--	--	--
1990	1,349	--	--	--	--
1991	1,327	--	--	--	--
1992	1,269	30	674	6	1,114
1993	1,084	29	692	58	1,062
1994	1,004	29	111	424	911
1995	1,075	39	368	187	976
1996	1,124	40	363	187	1,049
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	1,023	42	635	***21*** / ***79***	1,136
2002	1,208	45	928	***0*** / ***0***	1,458
2007	1,260	47	1,170	***0*** / ***0***	1,726

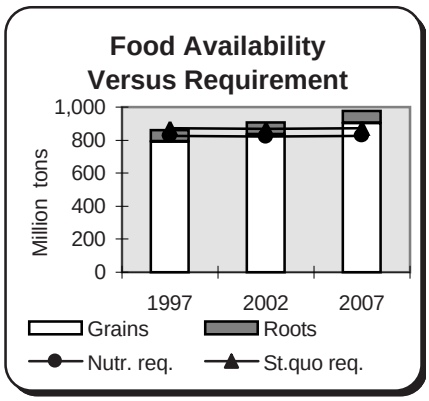
Rising oil exports will allow Azerbaijan to easily finance its food import requirements in the coming decade.



Statistical table 64--Georgia (New Independent States)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	676	--	--	--	--
1989	464	--	--	--	--
1990	658	--	--	--	--
1991	567	--	--	--	--
1992	493	41	556	194	971
1993	412	37	325	585	972
1994	482	58	236	569	857
1995	522	69	374	281	871
1996	552	70	299	381	878
Projections				**Food gap**	
				SQ / NR	(w/o food aid)
1997	652	72	606	***8*** / ***0***	861
2002	659	74	613	***0*** / ***0***	908
2007	713	75	636	***0*** / ***0***	978

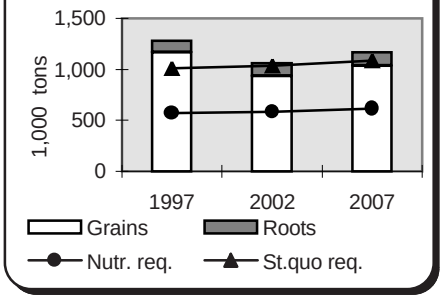
Rapid economic growth will eliminate the food gap in Georgia, the largest NIS food aid recipient during 1992-96.



Statistical table 65--Kyrgyzstan (New Independent States)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	1,664	--	--	--	--
1989	1,593	--	--	--	--
1990	1,535	--	--	--	--
1991	1,369	--	--	--	--
1992	1,510	362	379	91	744
1993	1,600	291	134	156	729
1994	1,059	310	199	61	691
1995	983	431	85	165	814
1996	1,408	70	1	154	941
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	1,708	116	158	***0*** ***0***	1,282
2002	1,466	125	161	***0*** ***0***	1,062
2007	1,596	136	167	***0*** ***0***	1,169

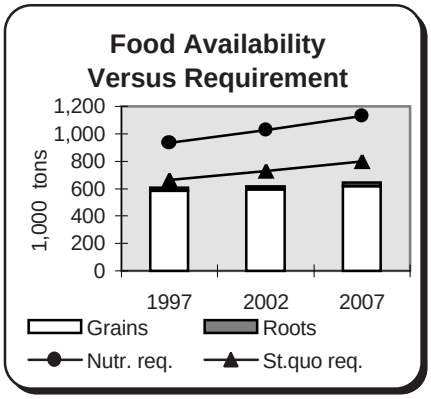
Higher wheat production has made Kyrgyzstan self-sufficient in food grains and have helped to eliminate the country's food gap.



Statistical table 66--Tajikistan (New Independent States)

Year	Grain Production	Root Production (grain equiv.)	Commercial Imports (grains)	Food aid receipts (grains)	Aggregate availability of food
			---1,000 tons ---		
1988	342	--	--	--	--
1989	270	--	--	--	--
1990	282	--	--	--	--
1991	269	--	--	--	--
1992	237	32	1,124	71	990
1993	285	28	838	82	983
1994	240	27	646	104	862
1995	234	21	409	206	700
1996	241	22	466	139	658
Projections				**Food gap**	
				SQ NR	(w/o food aid)
1997	251	24	556	***66*** ***343***	607
2002	277	26	560	***123*** ***427***	617
2007	303	29	581	***171*** ***506***	644

With an economy devastated by war and rapid population growth, Tajikistan's fod gap is expected to widen in the coming decade.



Appendix 1--Country list, per capita nutritional requirement, share of grain and root crops in diet

Country	Per capita nutritional requirement *	Share of grain in diet	Share of root crops in diet	Country	Per capita nutritional requirement *	Share of grain in diet	Share of root crops in diet
	Kg. grain eq	Percent	Percent		Kg. grain eq	Percent	Percent
Asia				**East Africa**			
Afghanistan	194	78.4	1.5	Burundi	120	21.2	27.9
Bangladesh	207	82.6	1.4	Eritrea	194	77.2	4.1
India	169	63.1	1.8	Ethiopia	176	70.8	5.0
Indonesia	181	63.5	6.2	Kenya	145	51.3	7.9
Nepal	195	76.3	3.0	Rwanda	109	17.8	27.6
Pakistan	138	58.3	0.8	Somalia	109	45.4	0.9
Philippines	149	53.2	3.7	Sudan	141	57.2	0.6
Sri Lanka	154	57.9	2.1	Tanzania	165	45.5	23.8
Vietnam	192	71.9	6.9	Uganda	115	18.7	25.4
Latin America							
Bolivia	142	42.2	8.3	**Southern Africa**			
Colombia	86	32.3	1.8	Angola	155	32.2	31.4
Dominican Rep.	81	29.4	3.1	Lesotho	202	77.1	3.4
Ecuador	84	33.1	3.4	Madagascar	187	55.4	21.0
El Salvador	132	56.6	1.4	Malawi	181	70.2	3.9
Guatemala	134	60.2	0.4	Mozambique	193	39.2	37.2
Haiti	128	41.0	11.7	Swaziland	130	49.6	1.3
Honduras	112	49.0	0.3	Zambia	206	68.3	10.3
Jamaica	99	30.9	9.9	Zimbabwe	179	64.6	1.9
Nicaragua	121	49.6	1.6				
Peru	127	41.4	7.6	**West Africa**			
Former Soviet Union				Benin	188	38.2	34.4
Armenia	151	58.4	7.0	Burkina Faso	198	76.1	0.8
Azerbaijan	157	63.9	4.1	Cape Verde	133	51.1	2.2
Georgia	152	63.5	2.0	Chad	172	53.9	12.1
Kyrgyzstan	127	50.3	4.6	Cote d'Ivoire	172	37.1	28.8
Tajikistan	154	64.3	2.4	Gambia	133	50.8	0.9
				Ghana	187	29.9	42.9
North Africa				Guinea	149	46.0	12.5
Algeria	175	59.1	2.2	Guinea-Bissau	163	59.5	6.6
Egypt	175	66.5	1.8	Liberia	163	37.6	28.9
Morocco	186	55.1	2.1	Mali	185	72.1	0.5
Tunisia	147	50.8	1.5	Mauritania	144	55.9	0.5
				Niger	230	71.5	3.7
Central Africa				Nigeria	172	42.4	25.4
Cameroon	135	37.0	18.2	Senegal	162	58.0	1.1
Central Afr. Rep.	138	19.6	36.6	Sierra Leone	153	53.6	6.5
Congo (fka Zaire)	174	15.9	56.3	Togo	195	48.5	26.9

* Based on FAO's minimum caloric requirement and total share of grains and root crops in the diet.

APPENDIX 2—FOOD SECURITY MODEL: DEFINITION AND METHODOLOGY

The food security assessment model used in this report was developed at the USDA-ERS for use in projecting food availability and access, and the food gap (previously called food needs) in 66 low-income countries through 2007. The reference to food includes grains and root crops. These two food commodity groups account for as much as 80 percent of all calories consumed in the study countries. Root crops are generally not traded, while the bulk of all food imports of these countries, commercial or food aid, is in the form of grains.

Food security of a country is evaluated based on the gap between projected domestic food availability (produced domestically and imported commercially) and a consumption requirement. Although food aid is expected to be available during the projection period, it is not included in the projection of food availability. It should be noted that while projection results will provide a baseline for the food security situation of the countries, they depend on assumptions and specifications of the model. Since the model is based on historical data, it implicitly assumes that the historical trend in key variables will continue in the future.

Food gaps are projected using two consumption criteria:

1) *Status quo target*, where the objective is to maintain average per capita consumption of the recent past. The most recent 3-year average (1994-96) is used for the per capita consumption target in order to eliminate short-term fluctuations.

2) *Nutrition-based target*, where the objective is to maintain the minimum daily caloric intake standards recommended by the UN's Food and Agriculture Organization (FAO). The caloric requirements (based on total share of grains and root crops) used in this assessment are those necessary to sustain life with minimum food-gathering activities. They are comparable to the activity level for a refugee—they do not allow for play, work, or any activity other than food gathering.

The status quo measure embodies a "safety-net" criterion by providing food consumption stability at recently achieved levels. The nutrition-based target assists in comparisons of relative well-being. Comparing the two consumption measures either for countries or regions provides an indicator of the need depending on whether the objectives are to achieve consumption stability and/or to meet a nutritional standard. Large nutrition-based needs relative to status quo needs, for example, mean additional food must be provided if improved nutrition levels are the main objective. In cases where nutrition-based requirements are below status quo consumption needs, food availability could decline without risking nutritional adequacy, on average. Both methods, however, fail to address inequalities of food distribution within a country.

Structural framework for projecting food availability in the aggregate and by income group

Projection of Food Availability—The simulation framework used for projecting aggregate food availability is based on partial equilibrium recursive models of 66 lower income countries. The country models are synthetic, meaning that the parameters that are used are either cross country estimates or are estimated by other studies. Each country model includes two commodity groups, grains and root crops. The production side of the model is divided into yield and area response. Crop area is a function of 1-year lag return (real price times yield), while yield responds to input use. Commercial imports are assumed to be a function of domestic production, world commodity price, and foreign exchange availability. Foreign exchange availability is a key determinant of commercial food imports and is the sum of the value of export earnings and net flow of credit. Foreign exchange availability is assumed to be equal to foreign exchange use, meaning that foreign exchange reserve is assumed constant during the projection period. Countries are assumed to be price takers in the international market, meaning that world prices are exogenous in the model. However, producer prices are linked to the international market via commercial food imports.

Food availability is defined as the sum of grains and root crop availability. For each commodity group (c), food availability (FA) is defined as domestic supply (DS) minus nonfood use (NF). n is country index and t is time index.

$$FA_{cnt}=DS_{cnt}-NF_{cnt} \quad (1)$$

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

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

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

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

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

$$PR_{cnt}=AR_{cnt}*YL_{cnt} \quad (4)$$

$$YL_{cnt}=f(LB_{cnt}, FR_{cnt}, CU_{cnt}, T_{cnt}) \quad (5)$$

$$RPY_{cnt}=YL_{cnt}*DP_{cnt} \quad (6)$$

$$RNPY_{cnt}=NYL_{cnt}*NDP_{cnt} \quad (7)$$

$$AR_{cnt}=f(AR_{cnt-1}, RPY_{cnt-1}, RNPY_{cnt-1}, Z_{cnt}) \quad (8)$$

where AR is area, YL is yield, LB is rural labor, FR is fertilizer use, CU is capital use, T is the indicator of technology change, DP is real domestic producer price, RPY is yield times real price, NDP is real domestic producer substitute

price, *NYL* is yield of substitute commodity, *RNPY* is yield of substitute commodity times substitute price, and *Z* is exogenous policies.

The commercial import demand function is defined as:

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

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

The real domestic producer price is defined as:

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

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

Projections of food availability (consumption) by income group—Inadequate economic access is the most important cause of chronic undernutrition among developing countries and is related to the level of income. Estimates of food gaps at the aggregate or national level fails to take into account the distribution of food consumption among different income groups. Lack of consumption distribution data for the countries is the key factor preventing estimation of food consumption by income group. An attempt was made to fill this information gap by using an indirect method of projecting calorie consumption by different income groups based on income distribution data[1]. It should be noted that this approach ignores the consumption substitution of different food groups by income class (the plan is to improve this aspect of the model in the future). The procedure uses the concept of the income/consumption relationship and allocates the total projected amount of available food among different income groups in each country (income ditributions are assumed constant during the projection period).

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

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

where *C* and *Y* are known average per capita food consumption (calorie consmption) and per capita income (all quintiles), C_o is total food consumption, *P* is the total population, *i* is income quintile, *a* is the intercept, *b* is the consumption income propensity, and *b/C* is consumption income elasticity (point estimate elasticity is calculated for individual country). To estimate per capita consumption by income group, the parameter of *b* was estimated based on cross country (66 low-income countries) data for per capita calorie consumption and income. The parameter *a* is estimated for each country based on the known data for average per capita calorie consumption and per capita income.

Historical Data

Historical supply and use data for 1980-96 for most variables are from a USDA database. Data for grain production in 1997 for most countries are based on a USDA database as of October 1997. Food aid data are from the UN's Food and Agriculture Organization (FAO), and financial data are from the International Monetary Fund and World Bank. Historical nonfood-use data, including seed, waste, processing use, and other use, are estimated from the FAO *Food Balance* series. The base year data used for projections are the average for 1994-96, except export earnings that are 1993-95.

Endogenous variables:

Production, area, yield, commercial import, and domestic producer price.

Exogenous variables:

Population—data are UN population projections.
World prices—data are USDA/baseline projections.
Stocks—assumed constant during the projection period.
Seed use—projections are based on area projections using constant base seed/area ratio.
Industrial use—projections are based on extrapolation of historical trends.
Food exports—projections are either based on the population growth rate or extrapolation of historical trends.
Inputs—Fertilizer and capital projections are, in general, an extrapolation of historical growth.
Agricultural labor—projections are based on UN population projections, accounting for urbanization growth.
Net foreign credit—net real flow of foreign credit is assumed constant during the projection period.
Value of exports—projections are based on World Bank (*Global Economic Prospects and the Developing Countries*, various issues), IMF (*World Economic Outlook*, various issues), or an extrapolation of historical growth.
Export deflator or terms of trade—World Bank (*Commodity Markets—Projection of Inflation Indices for Developed Countries*).
Income—projected based on World Bank report (*Global Economic Prospects and the Developing Countries*, various issues) or extrapolation of historical growth.
Income distribution—World Bank data. Income distributions are assumed constant during the projection period (Shahla Shapouri).

[1]The method is similar to the method used by Shlomo Reutlinger and Marcelo Selowsky in "Malnutrition and Proverty", World Bank, 1978.

Appendix 3--Country indicators

Region and country	Population 1997	Population growth rate	Grain production: Growth 1981-96	Grain production: Coefficient of variation 1981-95	Root production growth 1981-96	Projected growth in supply	Macroeconomic indicators: Per capita GNP 1995	Macroeconomic indicators: Per capita GNP growth 1995	Macroeconomic indicators: GDP growth 1995	Export earnings growth 1995	Months of import coverage in reserves 1995	Debt service ratio 1995
	1,000		------Percent------				U.S. $	------ Percent-----			Number	Percent
North Africa												
Algeria	29,830	2.2	-1.3	43.9	5.6	2.4	1,600	1.2	4.4	--	5.0	38.7
Egypt	64,792	1.9	5.0	5.3	2.4	1.6	790	0.5	2.4	-0.8	11.8	14.6
Morocco	30,391	2.1	3.9	51.1	5.0	1.9	1,110	-8.7	-6.9	19.7	3.6	32.1
Tunisia	9,183	1.8	2.8	63.2	5.1	2.5	1,820	1.5	2.4	17.5	2.1	17.0
Central Africa												
Cameroon	14,678	2.9	0.5	8.0	1.6	2.0	650	-0.4	4.2	24.8	0.1	20.1
Central African Rep.	3,342	2.1	1.8	16.7	-1.4	1.2	340	-0.5	4.1	24.7	9.0	6.8
Congo (fka Zaire)	47,440	2.0	3.5	8.3	2.4	2.0	120	-5.9	--	4.5	--	--
West Africa												
Benin	5,902	3.4	4.4	10.6	5.4	1.9	370	6.4	--	--	3.2	8.4
Burkina Faso	10,891	2.5	6.6	13.7	-5.9	1.7	230	1.5	4.5	26.9	7.1	11.1
Cape Verde	462	3.0	11.8	89.1	-0.9	1.9	960	2.4	--	--	--	--
Chad	7,166	2.7	3.8	18.8	1.2	1.9	180	2.3	5.5	--	4.2	5.9
Cote d'Ivoire	15,150	2.6	3.9	7.4	2.4	2.1	660	17.8	6.6	38.0	1.5	23.1
Gambia	1,248	3.6	3.8	16.9	0.0	1.8	320	-3.6	3.2	-50.0	5.3	14.0
Ghana	18,101	2.3	3.2	22.2	6.7	4.3	390	1.7	4.4	--	4.3	23.1
Guinea	7,495	1.1	3.5	9.8	1.2	1.8	550	1.9	4.6	13.0		25.3
Guinea-Bissau	1,179	2.4	9.3	16.1	2.6	1.7	250	2.1	1.7	-28.1	2.5	66.9
Liberia	2,257	7.0	-6.0	40.7	9.2	2.7	--	--	--	--	--	--
Mali	9,945	3.0	6.5	13.9	-0.1	2.1	250	3.2	6.4	--	4.0	12.6
Mauritania	2,411	3.2	12.9	47.1	-0.6	1.7	460	2.2	4.6	--	1.7	21.5
Niger	9,389	3.0	2.2	16.0	1.7	2.0	220	1.0	3.2	--	2.6	19.8
Nigeria	107,129	3.1	0.2	18.2	10.3	2.4	260	1.3	2.3	24.4	1.5	12.3
Senegal	9,404	3.4	2.2	20.1	3.3	1.7	600	7.9	10.3	--	1.9	18.7
Sierra Leone	5,004	4.4	-2.6	11.3	4.6	1.0	180	-2.8	-9.2	-63.5	2.7	60.3
Togo	4,736	3.6	4.8	16.1	0.2	1.6	310	7.5	8.2	29.0	3.6	25.7
East Africa												
Burundi	6,053	1.8	-1.1	19.6	1.9	2.8	160	-5.9	-3.8	-1.9	8.7	27.7
Eritrea	4,142	5.9	1.0	--	1.3	2.0	--	--	--	--	--	--
Ethiopia	58,733	2.7	2.0	11.0	1.3	4.0	100	2.7	4.9	13.7	7.0	13.6
Kenya	28,803	2.2	1.1	14.8	2.3	2.0	280	4.2	4.4	16.7	1.2	25.7
Rwanda	7,738	12.9	-2.5	14.6	-1.6	3.2	180	19.7	23.0	36.4	4.7	--
Somalia	9,940	3.1	-1.8	37.1	0.5	1.2	--	--	--	--	--	--
Sudan	32,041	3.1	2.9	39.0	-5.0	1.6	--	--	--	6.0	--	--
Tanzania	29,461	1.4	1.4	12.6	0.3	2.0	120	1.0	4.0	23.1	1.5	17.4
Uganda	20,605	2.2	2.6	6.0	1.3	2.5	240	8.1	11.2	8.7	3.8	21.3

See note at end of table.

Continued--

Appendix 3--Country indicators--continued

Region and country	Population 1997	Population growth rate	Grain production Growth 1981-96	Grain production Coefficient of variation 1981-95	Root production growth 1981-96	Projected growth in supply	Macroeconomic indicators Per capita GNP 1995	Macroeconomic indicators Per capita GNP growth 1995	Macroeconomic indicators GDP growth 1995	Export earnings growth 1995	Months of import coverage in reserves 1995	Debt service ratio 1995
	1,000		------Percent------				U.S. $	------ Percent-----			Number	Percent
Southern Africa												
Angola	10,624	2.7	-1.9	19.3	4.5	2.2	410	13.0	6.3	16.9	--	12.5
Lesotho	2,008	1.9	1.2	30.2	9.2	1.6	770	7.4	10.0	--	5.4	6.0
Madagascar	14,062	2.9	1.4	3.1	2.1	1.8	230	-1.3	1.8	-10.3	1.1	9.2
Malawi	9,609	1.7	3.0	21.7	0.2	2.4	170	11.3	13.5	--	1.5	25.9
Mozambique	18,356	2.7	1.4	24.7	0.4	2.7	80	-0.9	4.3	12.7	--	35.3
Swaziland	1,032	3.3	2.5	30.8	0.0	2.4	1,070	0.1				
Zambia	9,350	2.1	2.0	31.7	4.6	2.2	400	-5.5	-3.1	--	--	174.4
Zimbabwe	11,423	1.4	1.1	37.4	5.4	1.7	540	-2.9	-1.8	--	--	25.6
Asia												
Afghanistan	23,738	4.7	-3.6	7.9	-0.5	1.9	--	--	--	--	--	--
Bangladesh	125,340	1.9	2.2	4.0	0.3	1.8	240	2.7	4.4	19.2	4.2	13.3
India	967,613	1.6	2.9	5.2	2.9	2.1	340	4.4	6.1	22.7	5.2	27.9
Indonesia	209,774	1.5	2.0	3.3	1.7	1.2	980	5.7	8.1	13.4	3.0	30.9
Nepal	22,641	2.5	3.2	8.3	7.2	1.8	200	1.0	3.3	-4.4	4.9	7.8
Pakistan	132,185	2.3	2.2	4.8	6.0	2.0	460	2.1	4.4	8.4	2.1	35.3
Philippines	76,104	2.2	2.5	4.5	0.4	1.7	1,050	3.1	4.8	31.6	2.6	16.0
Sri Lanka	18,762	1.1	0.9	9.1	-4.6	1.3	700	3.6	5.4	18.3	4.2	7.3
Vietnam	75,124	1.6	0.9	5.0	-1.9	1.5	240	--	9.5	39.5	0.0	5.2
Latin America												
Bolivia	7,295	1.8	3.1	15.2	0.6	1.7	800	1.4	3.7	6.7	6.7	28.9
Colombia	37,418	1.6	-3.5	6.2	0.0	2.0	1,910	1.5	5.3	16.3	5.0	25.2
Dominican Republic	8,228	1.7	0.1	9.7	2.5	1.9	1,460	3.0	2.5	20.9	0.7	7.8
Ecuador	11,691	2.0	0.7		0.0	1.8	1,390	-1.0	2.3	12.7	3.4	26.7
El Salvador	5,935	1.8	2.7	10.4	9.0	1.5	1,610	4.8	6.9	18.2	3.2	8.9
Guatemala	11,558	2.5	2.0	4.3	1.7	2.2	1,340	3.5	3.0	41.7	2.4	10.6
Haiti	6,851	1.8	-1.8	8.3	0.4	1.3	250	2.2	4.5	34.1	1.6	45.2
Honduras	5,751	2.6	3.1	12.0	4.3	1.9	600	0.9	3.9	25.9	1.5	31.0
Jamaica	2,616	0.8	-6.4	60.2	3.2	2.1	1,510	-0.5	0.5	18.6	2.0	17.9
Nicaragua	4,386	2.7	1.7	16.1	4.2	1.8	380	17.7	4.2	47.7	1.2	38.7
Peru	24,950	1.7	2.0	13.9	0.8	1.2	2,310	6.2	7.2	22.4	8.6	15.3
Former Soviet Union												
Armenia	3,466	0.1	2.0	53.6	0.8	1.9	730	30.8	6.9	25.5	--	2.9
Azerbaijan	7,736	0.8	2.0	52.7	0.8	2.7	480	-13.6	-13.0	-10.3	--	--
Georgia	5,175	-0.9	2.0	52.6	0.8	1.7	440	-5.5	-5.0	-8.9	--	--
Kyrgystan	4,540	0.2	2.0	51.8	0.8	1.2	700	-7.1	-6.3	20.3	--	4.8
Tajikistan	6,014	1.7	2.0	51.2	0.8	1.3	340	-15.9	-12.5	34.0	--	--

-- = data unavailable or not applicable due to inconsistent data set.

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