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ABSTRACT

Nine of 11 low and medium income Sub-Saharan African countires studied may face even greater problems feeding their populations if recent trends continue. These countries rely on food imports and, increasingly, on food aid to meet minimum nutritional requirements for their populations. Food production is hampered by droughts which hit about every 3 years. Recurrent food emergencies, such as those recently affecting Ethiopia and the Sahel countries, may raise total food aid in 1990 by five to eight times the actual receipts annually in 1981-83. Improved policies and increased foreign exchange earnings could help about half of the study countries satisfy their consumption needs from domestic production. (A 62-item reference list, a 42-item additional reading list and 53 statistical tables are included.) (Author)

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Foreign Agricultural Economic Report Number 221

Food Aid and the African Food Crisis

Shahla Shapouri
Arthur J. Dommen
Stacey Rosen

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Abstract

Nine of eleven low- and medium-income Sub-Saharan African countries studied may face even greater problems feeding their populations if recent trends continue. These countries rely on food imports and, increasingly, on food aid to meet minimum nutritional requirements for their populations. Food production is hampered by droughts which hit about once every 3 years. Recurrent food emergencies, such as those recently affecting Ethiopia and the Sahel countries, may raise total food aid in 1990 by five to eight times the actual receipts annually in 1981-83. Improved policies and increased foreign exchange earnings could help about half of the study countries satisfy their consumption needs from domestic production.

Keywords: African food crisis, food production, food imports, food aid, food gap, projected food aid needs.

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Preface

This report grew out of research on projected food aid needs in Sub-Saharan Africa undertaken by the Economic Research Service (ERS) on behalf of the Bureau for Africa of the Agency for International Development (AID). AID selected the 11 study countries.

A major effort in the early stages of the project went into assembling a body of data on food aid receipts in the study countries. This data base is believed to be unique in terms of its quality and breadth of coverage.

The research work also required an extensive literature review. Included in this review were subjects such as African production methods and systems, responses to food shortages, and the methodologies for estimating food aid needs of African countries (a field in which research is rapidly filling gaps in the literature).

Cheryl Christensen, Chief, Africa and Middle East Branch, oversaw the preparation of this report. The food aid data base was assembled by Bijan Sopasi, University of Maryland, under contract with ERS. Country data on production and trade and background information were supplied by the following country analysts of the Africa and Middle East Branch: Stephen Haykin for Ethiopia, Somalia, and Sudan; Margaret Missiaen for Mali, Niger, and Senegal; Peter Riley for Mozambique, Zambia, and Zimbabwe; and Lawrence Witucki for Kenya and Lesotho.

The reviewers of the report included, besides the country analysts mentioned above, Gene Mathia, Assistant Director, International Economics Division, ERS; Hannan Ezekiel, International Food Policy Research Institute; a team of specialists on food aid and African agriculture with whom one of the authors met at the headquarters of the Food and Agriculture Organization of the United Nations; and Mary Bohman and Mark Smith of ERS. The contributions of Susan Buchanan, Mary Burfisher, Michael Cullen, Elizabeth Davis, Nadine Horenstein, and Cornelia Miller to early organization of the data base are gratefully acknowledged. Lindsay Mann had principal responsibility within the Information Division, Economics Management Staff. The support staff responsible for typing the report include Betty Acton, Denise Morton, and Alma Young.

Contents

Summary

Nine of 11 low- and medium-income Sub-Saharan African countries studied by the authors may face even greater problems feeding their populations if recent trends continue. These countries rely on food imports and, increasingly, on food aid to meet minimum nutritional requirements of their populations. Food production is hampered by droughts which hit about once every 3 years. Recurrent food emergencies, such as those recen y affecting Ethiopia, Sudan, and the Sahel countries, may cause total food aid shipments in 1990 to be five to eight times as high as actual food aid receipts in 1981-83. Improved policies and increased foreign exchange earnings could help about half the study countries to satisfy their consumption needs from domestic production.

The authors studied domestic food production and consumption, food imports, and food aid receipts in Ethiopia, Kenya, Lesotho, Mali, Mozambique, Niger, Senegal, Somalia, Sudan, Zambia, and Zimbabwe from 1966 to 1983. Using three scenarios (base, optimistic, and crisis), the authors projected food availability and food aid needs to 1990:

- Base. Weather is normal and food production and foreign exchange earnings follow 1966-83 trends. Results--Niger, Sudan, and Zimbabwe will meet domestic food needs without food aid. Other countries will need food aid ranging from 68,000 tons for Niger (9.7 kilograms per person) to 2,621,000 tons for Ethiopia (59.6 kg per person) to meet average per capita caloric requirements fully.

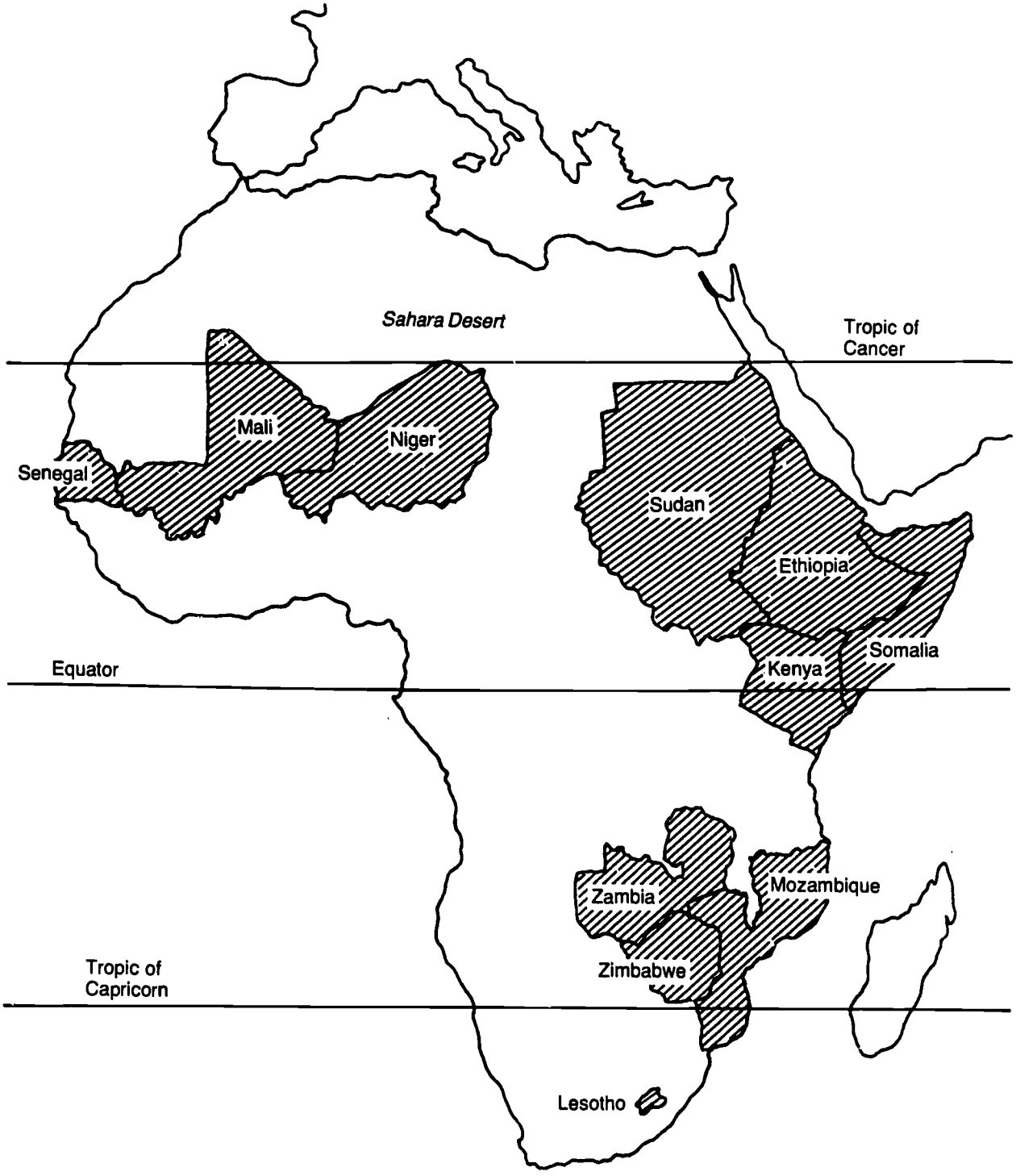
- Optimistic. Policy reforms increase producer prices and growing exports boost foreign exchange earnings. Results--Per capita food availabilities keep slightly ahead of population growth in the 11 countries on average. But wide differences appear between countries in their ability to maintain 1981-83 availability levels, with Mozambique, Ethiopia, and Somalia having large structural food aid needs. To meet nutritional requirements, food aid ranging from 40,000 tons for Zambia (5 kg per person) to 2,272,000 tons for Ethiopia (51.6 kg per person) will be needed.

- Crisis. Food production and imports follow 1966-83 trends until 1989, when 2 successive years of drought reduce production by 30 percent below trend. Results--Per capita attainable food availabilities in the 11 countries decline to 70.9 percent of 1981-83 levels. All 11 countries need emergency food aid to maintain 1981-83 availability levels, and even more to meet average per capita caloric requirements. Minimum total food aid needs range from 191,000 tons for Zimbabwe (17.4 kg per person) to 4,117,000 tons for Ethiopia (93.6 kg per person).

Food supplies in the 11 countries fluctuate significantly because of variable weather, simple agricultural technology, low use of fertilizer and other inputs, and inefficient markets. Poor transportation infrastructure contributes to seasonal and geographical uncertainty of supply.

The 11 countries, severely limited in their ability to import food commercially, have become even more reliant on food aid. Total food aid receipts increased by a relatively high 17 percent per year over the study period.

Study Countries



Food Aid and the African Food Crisis

Shahla Shapouri
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Introduction

Providing adequate food in Sub-Saharan Africa has become an increasingly severe problem in the past decade. Sub-Saharan Africa has been characterized by declining average per capita food production and high year-to-year variability. During 1981-84, numerous African countries experienced drought and other conditions leading to severe food shortages and, in some cases, famine (table 1). The food situation in Sub-Saharan Africa has become a chronic problem which will probably continue unless its root causes are identified and measures taken to reverse the historical trends.

This report investigates the causes of the food crises in 11 selected African countries, analyzes the variability and slow growth in food availability, and examines why domestic resources were not adequate to support diets and prevent per capita food supplies from declining. In this context, we evaluated the role of food aid and made midterm projections of food aid needs under different scenarios.

The 11 countries studied are a sample of a larger population of African countries affected by food shortages in recent years. Not all have been consistent cereals importers in the period studied (1966-83). Some, like Kenya, have been alternately cereals importers and exporters. Sudan has consistently exported cereals, but on balance has been a net cereals importer. Only Zimbabwe was a net cereals exporter for the entire study period.[1] Thus, our conclusions apparently apply to a wider sample of African countries.

Average food available in these countries traditionally is sufficient to sustain nutrition at marginal levels, with significant yearly variations and uneven distribution among income classes, geographic areas, and seasons. Per capita food availability declined in six of the countries and stagnated in four others over 1966-83. Per capita calorie availability is about 2 percent to 32 percent less than that required to provide adequate nutrition, varying more than 10 percent in any 1 year. When uneven food distribution is added to the pattern of food availability, repeated emergency food crises become inevitable.

For Sub-Saharan Africa as a whole, and the 11 study countries in particular, food problems are rooted in poor food production. Past governments have neglected the agricultural sector, resulting in steadily declining per capita food production in nine of the countries we studied. In Ethiopia, Kenya, Mali, Mozambique, and Zambia, declining per capita food production has meant falling per capita food availability, because imports have not compensated for reduced domestic production. High production variability that is associated

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[1]Cereals production and trade data by country are given in appendix tables 1-11.

Table 1--Study countries: Acuteness of food crisis, 1981-84

Country	Prevailing weather conditions	Major effects on food production	Other internal factors affecting economy
Ethiopia	Continued drought 1982-84.	Worst famine in decade, more than 7 million in famine risk; 1984 cereal production 15-20 percent below normal.	Internal conflict.
Kenya	Severe drought in 1983-84 in main food producing areas.	1984-85 cereal production 25 percent below average.	Attempted coup, August 1982.
Lesotho	Drought 1982-84.	40-percent reduction in cereal production.	Labor migration to South Africa.
Mali	Drought of increasing severity, 1982-84; rivers at record lows.	23-percent decline in 1983 cereal output, 1984 harvest even worse.	
Mozambique	Drought 1981-84.	16-percent reduction in cereal output; famine reported regionally.	Insurgency makes people flee rural areas; farmers do not plant.
Niger	1984 rainy season one of driest in century.	Cereal yields half normal.	
Senegal	Drought in 1982-83; some improvement in 1984 rainfall except Fleuve region.	10-percent reduction in food production.	Financial difficulties due to drop in peanut oil prices.
Somalia	Drought in 1982-83.	Cereal production drops alarmingly.	450,000 Ethiopian refugees and border conflict.
Sudan	Main crop areas hit by drought; irrigated output reduced by low river levels.	34-percent decline in cereal production causes food shortages; 5 million at risk.	Influx of more than 1 million refugees; internal conflict; financial crisis.
Zambia	Drought in 1982-84.	20-percent decline in food production.	Financial difficulties due to low copper prices.
Zimbabwe	Drought in 1982-84.	Localized food shortages, but domestic stockpiling and food distribution programs prevent widespread hunger.	Thousands of refugees from Mozambique.

with the predominance of rainfed agriculture in largely semiarid environments generally creates severe production shortfalls, causing food emergencies once every 3 years on average during the study period of 1966-83. Irrigation provides only limited food security: only a small portion of Africa's irrigation potential has been developed, and high maintenance costs limit the contribution of this sector to overall food production.

Varying food production, especially in Ethiopia, Kenya, Mali, Niger, and Sudan, which traditionally do not import much, means varying food availability. Varying food availability, in turn, increases the proportion of a country's population which is vulnerable to an inadequate diet. This situation is especially true in countries where the average per capita diet is already marginal.

The potential for increasing food production exists because most crop yields in these countries are 20-70 percent lower than international averages. Technological improvements, such as adopting new varieties (as seen with corn in Kenya, Zambia, and Zimbabwe), could boost production. Countries with market-oriented agricultural sectors have increased production as food crop prices have increased. Success in increasing total agricultural production (necessary for both export crops and food crops) will require changes in pricing policies and in nonprice factors such as inputs distribution, credit, and marketing facilities.

Lesotho, Mozambique, Senegal, and Somalia relied on food imports for more than 40 percent of their food consumption in 1981-83. Governments' commitment to providing food, especially for urban consumers, has raised food imports as a share of total imports in all 11 countries. Therefore, like most of the other countries in the region, they are faced with tough decisions concerning the allocation of their scarce foreign exchange earnings to increasing food imports.

In all 11 countries, deteriorating domestic economies, combined with global economic factors, have precipitated financial crises. The modest growth of export volumes of 1970-82 was partly offset by an unfavorable trend in world prices which began in the late seventies. Prices for major commodity exports, such as tea, peanut oil, and copper, fell by as much as 15 to 41 percent between 1970 and 1982. In the meantime, commercial food imports, at prices that were not significantly declining, grew twentyfold in some of the study countries.

Declining export earnings and rapid import growth led to balance of payment deficits, largely financed by external borrowing and depletion of foreign exchange earnings. The balance of payments account for the countries as a group changed from a surplus of $179 million in 1970 to a deficit of $882 million in 1982. As interest rates on loans increased, debt-service burdens grew (in the case of Sudan, to twice that nation's export earnings).

In these circumstances, countries have had to choose between increasing food imports and increasing nonfood imports. The general pattern of response has been to increase commercial food imports when export earnings grow. In 5 of the 11 countries, increased export earnings led to a higher than proportional increase in commercial food imports. Countries highly dependent on the import market (Senegal, Mozambique, Lesotho, Somalia, and Zambia) purchased less food proportionally, in the face of a food production shortfall, than did more self-reliant countries.

The patterns of adjusting to food emergencies vary by time, by country, and even by region within a country. For rural people, personal adjustment strategies include drawing down

onfarm grain stocks or herds and substituting famine foods such as wild roots and tubers for regular consumption staples. For subsistence farmers living in drought-affected areas, the critical factor is often transportation. Urban dwellers and others without direct access to food production depend almost entirely on access to market resources. Migrants and refugees depend exclusively on the timeliness and effectiveness of relief efforts.

Given the overall poor performance and volatility of food production and the inability of countries to purchase adequate amounts of required food, external assistance has become very important. Food aid deliveries to these countries increased 17 percent per year between 1966 and 1983. During the sixties, food aid was still in relatively small amounts, generally less than 2 percent compared with domestic production. However, in the seventies and eighties, food aid increased dramatically, equaling as much as 85 percent of domestic food production in Somalia (1981) and 96 percent in Mozambique (1983).

This large infusion of food aid averted widespread loss of life, especially during large-scale disasters. Most food aid received during the drought years contributed significantly to making more food available. During the 1972-74 drought in the Sahelian countries, food aid provided the equivalent of 14 percent of all cereals consumed in Mali, 18 percent in Niger, and 8 percent in Senegal. Again, during the drought years of 1979 and 1980 in Southern Africa, food aid accounted for 11 percent of all cereals consumed in Lesotho, 16 percent in Mozambique, and 13 percent in Zambia. Food aid also added 9 percent and 15 percent, respectively, to available cereals in Sudan and Ethiopia in the 1983-84 drought. During this period, food aid also represented a net addition to the recipient countries' resource base by freeing foreign currency so that commercial food imports could be increased. Food aid has also helped reduce political pressures on governments during severe food shortages.

Many ways exist for assessing short-term food aid needs. Most of these ways incorporate current estimates of food production and financial resources. Such methods are useful in determining food requirements in a particular year, but they cannot integrate these assessments with discussions of long-term policy impediments to increased production. These methods do not very effectively indicate the chronic portion of food needs nor the additional emergency needs. For this study, we developed a medium-term forecasting model which complements short-term analyses by incorporating market behavioral relationships and by separating the effects of chronic and emergency factors under different scenarios.

Many African countries cannot provide adequate food from their own resources; with growing population pressures, these countries face grave problems. Dependence on relief aid is expected to grow in the years ahead, and food aid may be called upon to play a crucial role in preventing per capita consumption from declining further.

Our analysis suggests that if historical trends continue, per capita attainable food availability will decline in all but three of the countries, Niger, Sudan and Zimbabwe. Total food aid must reach about 3.1 million tons by 1990 to prevent the amount of available food per person from dropping below recent levels. That total aid will contribute about 13 percent of the average amount of food available per person in 1990 compared with 8 percent in 1981-83.

However, improved policies (consistent with a 3-percent annual increase in real producer prices) would increase food production, according to our analysis. If the improved production is combined with the removal of foreign exchange constraints (assuming that foreign exchange

earnings rise 5 percent per year) over the remainder of the decade, chronic food gaps would narrow. Under these circumstances, Kenya, Niger, Senegal, Sudan, and Zimbabwe should satisfy their consumption needs at the current level from their domestic resources.

Even with better production performance and improved foreign earnings supporting increased food imports, food supplies would be less than nutritionally adequate. Adequate nutrition implies chronic food needs in all 11 countries; even assuming fair distribution of food supplies, the aggregate need would still amount to about 4.6 million tons (Ethiopia accounting for about half this total).

The effects of variable weather, especially when inadequate rainfall leads to a long period of drought, say 2 years, is much harder to offset than continued historical trends. With the poor performance of the food production sector, and the financial constraints facing imports, the effects of future production shortfalls would be severe and the recent widespread starvation could be repeated. In 1990, Ethiopia's food aid needs would double to 3 million tons just to maintain consumption at recent levels. In all study countries, the need for emergency food aid would grow to about 3.6 million tons in 1990.

Given the growing need for food aid (even under the best circumstances), the question is whether significantly larger quantities of aid will actually benefit the neediest intended recipients. Weak distribution infrastructures and inefficient relief managements must also be considered. Food aid can improve nutritional levels and ease political pressure on governments. However, to improve food availability in these countries over a long-term period, self-help measures must promote agricultural production and policy reform. Food aid could play an important role in this phase as an addition to the resources of the recipient countries for development projects, if its role is well defined and targeted.

Food Availability

The main features of the food supply and demand situation for the 11 study countries as a whole are the following:

- Low longrun average per capita food consumption in quantity terms leaving little margin for absorbing supply shortfalls without human disaster;
- Calorie intakes in most cases well below established norms for adequate nutrition;
- Significant yearly fluctuations in food supplies because of a mix of physical and economic reasons;
- Uneven distribution of food seasonally, geographically, and by population and income group; and
- Great and continuing pressure on food supplies because of high population growth rates, even in those countries, like Zimbabwe, that seemed until recently relatively immune from food shortages.

Definitions

We take food availability to be identical with effective demand for food, in contrast with some authors who use food availability in the sense of aggregate supply, factoring in separately the question of ability to pay for food. Thus, in our terminology, if countries or households do not have the means to acquire food, that food is not available to them.

Data on per capita food consumption are, for the most part, sparse and unrepresentative in the study countries. However, a fairly reliable picture of food availability can be obtained through collection and analysis of data on components of food consumption which are measurable. We will use a number of precisely defined terms to describe these components:

- **Available food production:** The principal element of food availability is available food production, which is the part of total domestic food production allocated to human consumption (waste, seeds, and animal feed are subtracted).

- **Imports:** After domestic food production, food imports rank as the second important contributor to food availability. For our purposes, food imports will be synonymous with commercial food imports. (Food aid will be considered separately.)

- **Changes in stocks:** Changes in central stocks, which are managed by governments, are also considered in deriving the quantities of food availability. These changes do not include changes in village and onfarm stocks and unrecorded food substitutions in the diet under pressure of food shortages. These two factors combined can make up a difference equaling about 15 percent (the average coefficient of variation of food availability from trend for all countries) of total short-term consumption.

- **Attainable food availability:** The sum (with the appropriate signs) of available food production, imports, exports (if any), and changes in stocks is called attainable food availability. This is the part of food availability filled by a country's use of its own resources.

- **Food aid:** Food aid is defined to be food received by a country on grant or concessional terms for purposes of meeting its food needs. The role of food aid varies through time and among countries.

- **Emergency food gap:** Sometimes the purpose of food aid is to address the emergency food gap and it is called emergency food aid. The emergency food gap is due to a sudden and unforeseeable decline in attainable food availability that requires special foreign assistance.

- **Chronic food gap:** Sometimes the purpose of food aid is to fill the chronic food gap and it is called structural food aid. In general, structural food aid is assistance in the form of food provided to countries with insufficient domestic resources to meet foreseeable food needs.

We centered this study on cereals availability as an indicator of food availability. Governments are more concerned with the availability of cereals than with that of other foods because most noncereal food items in the diets of these countries are home-produced or locally traded, with only limited quantities entering recorded trade. Therefore, when production declines, shortfalls in noncereal foods also must be filled by imports or food aid

of cereals. In this situation, the proportion of cereals in the diet may be expected to increase in order to maintain overall consumption levels.

While cereals play a predominant part in the diets of most African countries, there are variations across countries. In the 11 study countries, the proportion of cereals in total food consumption as a source of calories ranges from 34 percent in Mozambique to 76 percent in Lesotho (table 2, col. 1). Cereals contribute more than half the calories in the diet in 9 of the 11 countries and cereals production is closely correlated with the production of other types of food (*53*).[2] Therefore, on the whole, cereals remain a reasonable approximation for measuring food availability in these countries.

Longrun Low Availability

Low per capita food availability has persisted in the study countries because of combined stagnant food production and increasingly high population growth rates. Sub-Saharan Africa as a whole has registered a steady increase in population growth rates (2.1 percent per year in 1950, 2.7 percent in 1965, and 3.1 percent in 1980), which is a key element in the situation (*59*).

In aggregate quantity terms, food availabilities increased in the study countries at rates varying from 0.5 percent annually in Mozambique to 5 percent in Somalia (table 3, col. 4). With negative annual food production growth rates in some of the countries, commercial imports and food aid receipts made up the difference. All but two of the countries had

[2]Italicized numbers in parentheses identify literature cited in the references at the end of the report.

Table 2--Per capita calories available from cereals

Country	Contribution of cereals to calorie consumption	Daily calorie availability: 1966-68	1981-83	Percent of minimum caloric requirement: 1966-68	1981-83	1981
	(1)	(2)	(3)	(4)	(5)	(6)
	Percent	Calories		Percent		
Ethiopia	68	2,346	1,819	100	78	76
Kenya	56	2,079	2,022	89	86	88
Lesotho	76	1,848	2,281	79	98	111
Mali	72	2,012	1,568	86	68	72
Mozambique	34	2,403	1,592	103	68	70
Niger	67	2,265	2,106	97	99	102
Senegal	65	2,158	2,293	92	98	101
Somalia	43	1,780	2,176	73	89	100
Sudan	56	1,982	1,979	85	85	99
Zambia	65	2,246	2,230	96	95	93
Zimbabwe	63	2,498	2,215	107	95	90

Source: Col. 1: (23); cols. 2-5: calculated from appendix tables 1-11; col. 6: World Bank estimates.

positive growth rates of commercial imports between 1966-68 and 1981-83 (table 3, col. 2). Sudan exported sorghum consistently, but only became a net cereals exporter in 1980-83. Zimbabwe's negative growth rate of imports is partly explained by the fact that it has normally been a net exporter of corn, but in recent years its exports have fallen off. Food aid growth rates increased in all 11 study countries (table 3, col. 3).

The extent of nutritional adequacy is measured in terms of per capita calorie availability, which tells a great deal about a country's food situation when compared over time and with other countries. Calories provided by cereals are measured against the norm established by the Food and Agriculture Organization of the United Nations (FAO) of 2,340 calories per capita per day. Calorie supplies from cereals are based on FAO food balance sheet data (*23*).

The calculated per capita calorie availabilities are shown in columns 2 and 3 of table 2 and the percentages of requirements represented by these availabilities in columns 4, 5, and 6.[3]

[3]Because of the difficulty of tracking refugee movements across borders over time, no attempt is made in this study to adjust population data for refugees. Refugees are an especially important factor in the populations of Sudan and Somalia, where they numbered 1,094,000 and 550,000, respectively, in 1986 (*49*).

Table 3--Growth rates and coefficients of variation: Analysis of time series data, 1966-83[1]

Country	Annual growth rates of--			Coefficients of variation of--			
	Food production	Commercial food imports	Food aid	Food availability	Food production	Food production plus commercial imports	Food availability
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Percent			Coefficient			
Ethiopia	1.5	5.9	24.1	1.8	12.0	11.9	12.8
Kenya	1.9	13.8	6.5	3.6	10.5	8.0	13.7
Lesotho	-2.4	12.0	8.7[2]	2.5	25.4	20.1	19.1
Mali	-.5	12.8	9.5[3]	.8	12.5	12.3	7.2
Mozambique	-2.8	7.3	9.0[4]	.5	13.8	11.4	10.8
Niger	2.3	15.0	8.3[3]	3.0	19.7	18.6	15.0
Senegal	.5	4.0	7.2	3.3	23.2	16.7	8.3
Somalia	.6	10.8	34.2	5.0	12.0	16.1	19.6
Sudan	4.2	-1.6	18.6	2.8	19.2	18.3	16.5
Zambia	1.1	6.7	40.8	2.4	14.7	13.7	16.7
Zimbabwe	3.0	-5.6	NA	2.5	27.3	25.9	5.2
11 countries[5]	1.4	6.3	17.1	2.4	15.3	14.1	12.9

NA = Not applicable because of short series.
[1]All cereals combined.
[2]1972-83.
[3]1969-83.
[4]1976-83.
[5]Average weighted by 1983 population.

Source: Cols. 1-4: appendix tables 1-11; cols. 5-7: appendix table 12.

In Mali and Mozambique, people had available on average far fewer calories in 1981-83 than required. World Bank estimates for 1981 are higher for most of the 11 countries (col. 6); one reason may be that the full effects of the drought had not fully affected per capita calorie supplies as early as 1981. The undernutrition which is a function of poverty is self-evident, but how low can the nutritional level decline before mass starvation results?

Based on FAO reports, there are different degrees of malnutrition, ranging from mild to fatal. A healthy person can lose one-fourth of total body weight without permanent body damage; when weight loss increases beyond that point, however, a person is more susceptible to illness and life becomes precarious. The average energy use for an African male adult without doing any exercise is estimated at 1,300 calories per day, which is 50-55 percent of the required level. At this stage, the person is low on energy and sleeps and rests most of the time. If food supplies increase, for example as a result of a new harvest, the person can regain energy without suffering permanent damage. But if the calorie-deficit diet continues, definite signs of starvation will appear. Of course, deficiency in one particular measure, calories, gives an oversimplified picture, because a diet is seldom deficient in one nutrient alone and sufficient in all others. Disease, high mortality rate among children, and low average life expectancy are prevalent in all the study countries (table 4).

High Variability of Availability

The availability of cereals in these countries varies greatly from year to year. The instability of food availability is measured by coefficients of variation. The data for the 11 study countries were adjusted for trend. The results show considerable variability in availability in the period 1966-83, ranging from 5.2 percent in Zimbabwe to 19.6 percent in Somalia (table 3, col. 7). In 8 countries out of 11, the coefficients of variability exceeded 10 percent. The overall average of coefficients of variability for the 11 countries was about 13 percent.

Table 4--Indicators related to life expectancy, 1983

Country	Life expectancy at birth		Mortality rate	
	Male	Female	Infant aged under 1 year	Child aged 1-4
	----Years----		Deaths per 1,000 population	
Ethiopia	43[1]	47[1]	166	37
Kenya	55	59	81	14
Lesotho	51	55	109	14
Mali	43	47	148	31
Mozambique	44	47	109	16
Niger	43	47	139	28
Senegal	44	47	140	28
Somalia	43	46	142	30
Sudan	47	49	117	19
Zambia	49	52	100	19
Zimbabwe	52	60	69	7

[1]1965.

Source: (60, table 23).

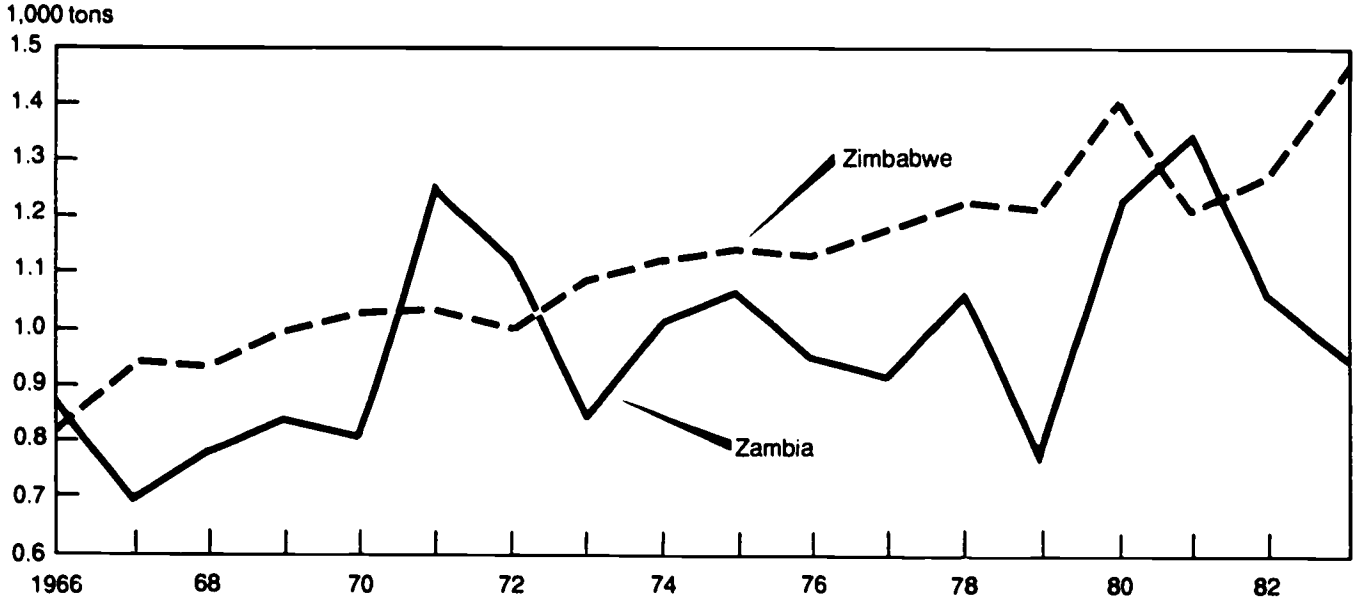
Food availability varies greatly in the study countries because most food production is for home consumption. The high correlation between production and consumption levels, therefore, transfers most of the production variability to the consumption level. Although commercial imports and food aid might have been used to reduce the fluctuation in food availability, food availability varied more in Ethiopia, Kenya, Somalia, and Zambia than did food production. The high variability of food availability may be the result of one or a combination of many factors, such as untimely decisionmaking on imports or requests for food aid, delays due to in-country logistical problems, and financial problems leading to untimely importing procedures. Stock changes are expected to reduce annual fluctuations in availability. But the low level of stocks, in general, leaves a considerable fluctuation in supply in most of the countries (fig. 1).

Even with a significant increase in imports, overall attempts to increase per capita food availability have not been very successful. In 6 of the 11 countries, per capita availability declined between 1966 and 1984, while in 4 others availability did not change significantly (table 5, col. 1). Only Somalia had a significant positive growth rate of per capita availability. This may be partly because Somalia was the largest recipient of food aid on a per capita basis from 1979 to 1982 because of its large refugee population.

The combination of stagnant or declining per capita availability in all countries (except Somalia) and high variability is a major concern. This combination implies that food availability will probably fall below trend quite frequently, and this situation will probably squeeze consumption and lead to a food emergency in the absence of other measures.

Figure 1

Variability of Cereals Availability, Zambia and Zimbabwe



Source: Appendix tables 10 and 11.

The extent and probability that actual per capita availability will fall below trend have been calculated on the basis of our data for the period 1966-83 and are shown in columns 2 and 3 of table 5. Comparing the two probabilities (a shortfall in food availability of 0-5 percent or of more than 6 percent) indicates that in six countries the likelihood of a fall in food availability of 6 percent or more is significantly higher than that of a smaller fall of 0-5 percent below trend.

In Mali and Mozambique, for example, the probabilities of a 6-percent or greater fall are only 11.2 percent and 22.3 percent, respectively. So small a fall, however, would have severe human consequences because of the vulnerability of their populations to malnutrition. In both of these countries, the per capita daily caloric intake is already only 68 percent of the recommended minimum.

Uneven Distribution

Our study countries are characterized by low longrun average food availability and high variability of food availability. However, for those concerned with the adequacy of food supplies to feed people, there is another dimension to food availability--uneven distribution.

Available food is distributed unevenly primarily because income is unevenly distributed. In Africa, surveys of household budgets and food consumption based on the same sample of households are rarely at hand. However, the data compiled by Reutlinger and Selowsky, an aggregate survey of different African countries, showed that per capita income of 77 percent of the population was below the average (*42*). The corresponding nutritional level showed

Table 5--Per capita growth rates and probabilities of availability shortfall: Analysis of time series data, 1966-84[1]

Country	Food availability growth rate[2]	Probability of availability shortfall of-- 0-5 percent below trend	6 percent or more below trend
	(1)	(2)	(3)
	Coefficient	..... Percent	
Ethiopia	-0.65	0	33.4
Kenya	-.13	11.2	33.4
Lesotho	.31	5.6	38.9
Mali	-1.68	50.0	11.2
Mozambique	-2.72	27.8	22.3
Niger	.23	11.2	27.8
Senegal	.59	38.9	22.3
Somalia	1.52	33.4	27.8
Sudan	.08	22.3	33.4
Zambia	-.65	16.7	38.9
Zimbabwe	-.78	33.4	11.2

[1] All cereals combined.
[2] Regression coefficient of time trend.

Source: Calculated from appendix tables 1-11.

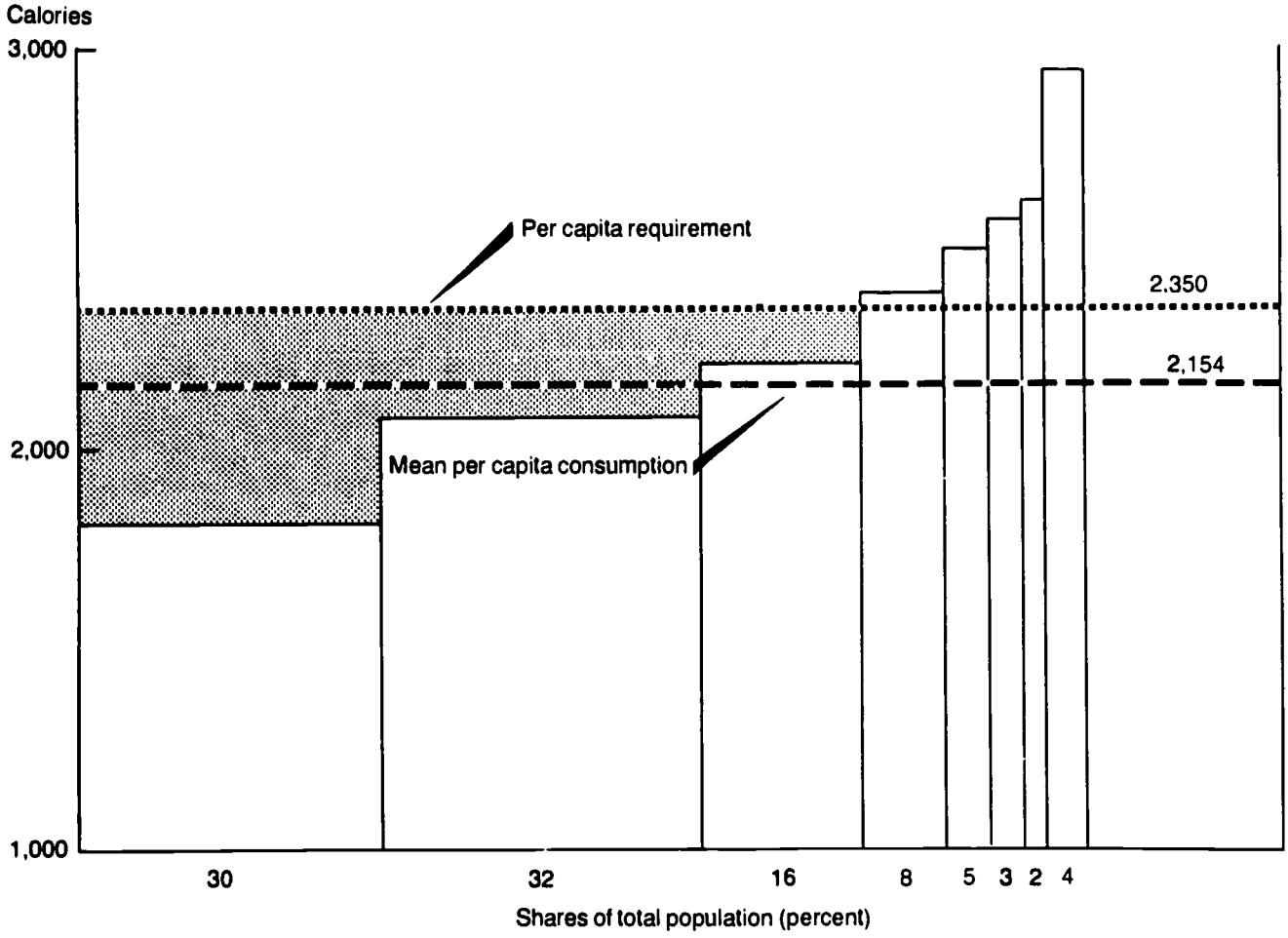
that per capita consumption of 30 percent of the population was 15 percent below the average (2,150 calories per day) and consumption of 32 percent of the population was 3 percent below the average. The highest income group, representing 4.5 percent of the population, consumed 2,978 calories per day, 28 percent higher than the average (fig. 2).[4]

Given uneven distribution of calorie consumption, a 5-percent decline in average per capita food availability (assuming a direct transfer to all income groups) implies that 30 percent of the lowest income group would fall 20 percent below the current average. Average consumption for countries like Mali and Mozambique is significantly lower than the required level, so the impact of even a 5-percent shortfall can be severe.

[4]Reutlinger and Selowsky are concerned with cross-sectional unevenness of income distribution. There is also a time dimension to this unevenness. That is, when drought hits and crops fail, food prices rise, diminishing the purchasing power of those dependent on markets for their food (including livestock herders, who suffer doubly from rising cereal prices and falling prices for their animals). In Sen's terminology, consumers suffer a loss of exchange entitlement of their money, making them more susceptible to inadequate food intake (*44*).

Figure 2

Distribution of Calorie Consumption in Africa



Source: (*42*).

Apart from income, other group distinctions affect nutritional status. An FAO report on nutritional status in Ethiopia indicates that about 10 percent of the Ethiopian population, mostly children, suffers from extreme undernourishment. The Ethiopian Ministry of Health gave slightly different figures showing that the nutritional status of at least 12 percent of the adult population is below 70 percent of requirement and over 40 percent of children in any community show some degree of malnutrition, with 10 percent being severely affected. A 1980 nutritional survey covering a sample of Ethiopian urban areas found that average calorie consumption was 67 percent of required level, ranging from 57 to 96 percent of requirement.

Regional differences in production and consumption influence food supply levels. An example of the former is given in table 6. Many of the governments' efforts in coping with food crises are devoted to overcoming the geographical discrepancy that often exists between food surplus areas and food deficit areas. Areas where there exists clear evidence of lack of adequate food availability in four of our countries are shown in figures 3-6, and drought-prone areas in a fifth are shown in figure 7.

In the Sahel, herders have been identified as the first group falling victim to drought because their normal pattern of production depends critically on timely arrival of the rains. In times of drought, nomads are forced to slaughter their animals for lack of pasture or water. This situation in turn increases short-term meat consumption. However, milk availability in succeeding years declines drastically, affecting nutrition. For a country like Somalia, where as much as three-fifths of the population depend for their subsistence and income on nomadic livestock grazing, the maldistribution of food resulting from a risky normal pattern and type of production becomes serious.

Nutritionists have long pointed out that nutrient availability for subsistence farmers varies seasonally. Relatively few studies are available on food consumption, nutritional status, and labor productivity during the "hungry season" when home-grown produce is minimal or entirely unavailable. A few village studies in West Africa have suggested weight losses for adults of about 10 percent during the hungry season, which is also the season of peak agricultural labor requirements. One important finding by Haswell (comparing her two surveys of 1953 and 1975) is that rural people during the 20 years' interval became more vulnerable during the hungry season because a larger percentage of the calories consumed by family members are now purchased (*29*).

Table 6--Ethiopia: Per capita cereals production by region, 1978/79

Region	Per capita cereals production (kg)
Arsi	580
Bale	218
Gamo Gofa	46
Gojam	201
Gonder	300
Harerge	60
Ilubabor	211
Kefa	215
Shewa	242
Sidamo	53
Welega	134
Welo	86

Source: (27, table 11, p. 142).

Figure 3

Kenya: Hunger Areas

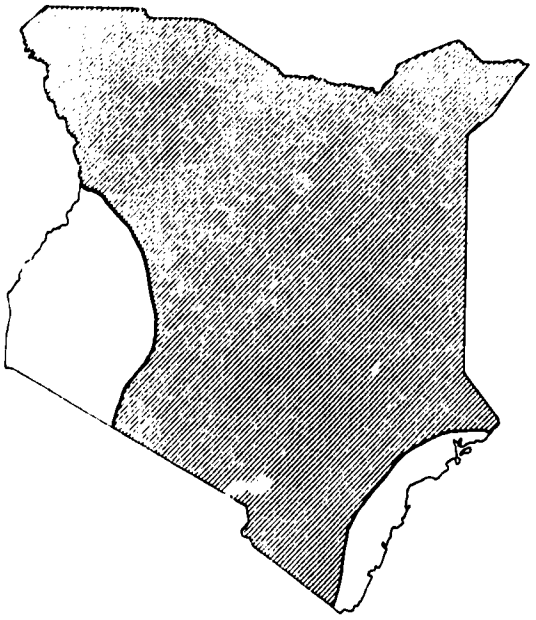


Figure 4

Mali: Hunger Areas

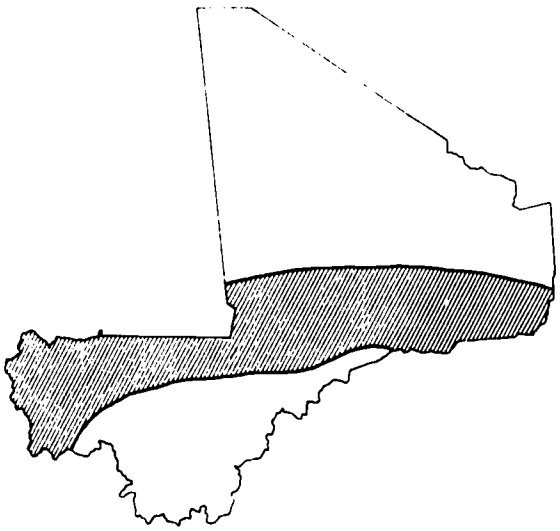


Figure 5

Senegal: Hunger Areas

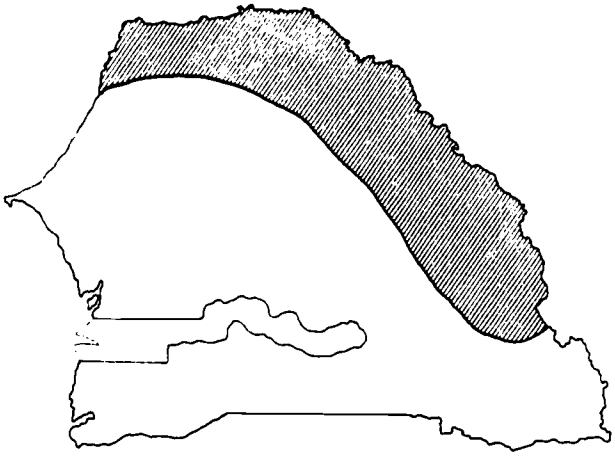


Figure 6

Sudan: Hunger Areas

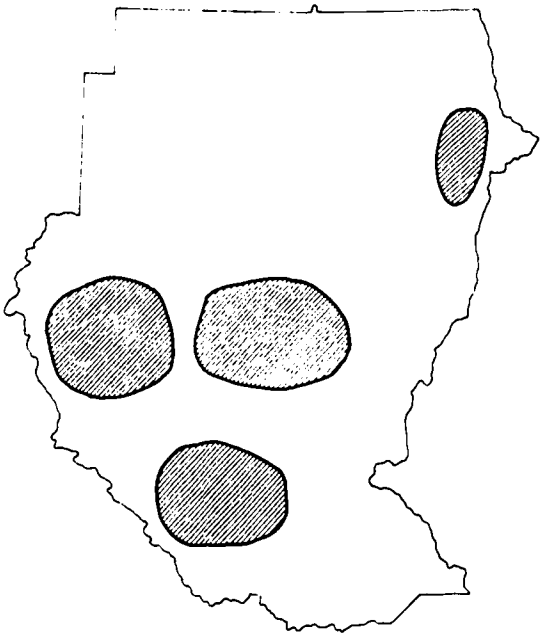
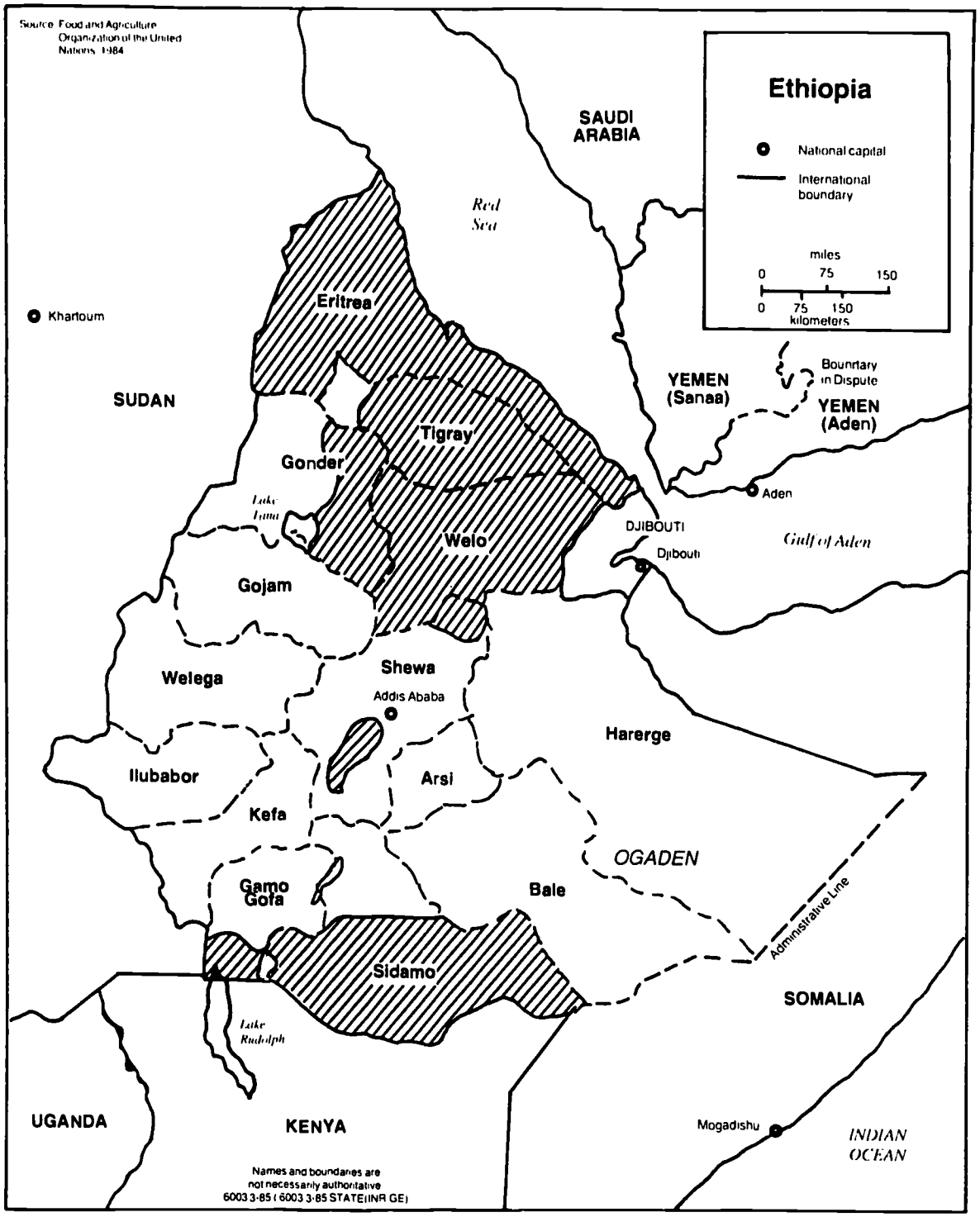


Figure 7

Ethiopia: Drought Areas



Production

Food production in the 11 study countries is primarily oriented to subsistence. The most important cereals produced are millet and sorghum in Mali, Niger, Senegal, and Sudan; corn and sorghum in Somalia; corn in Kenya, Lesotho, Mozambique, and Zambia; corn and wheat in Zimbabwe; and barley, corn, sorghum, teff, and wheat in Ethiopia.

Trends

Food production, while increasing at an annual rate of 1.4 percent (table 3, col. 1), did not keep up with population growth in 1966-83. Up to the early seventies, per capita food production stagnated in most of the countries and began to decline in the latter part of the decade. This situation is the principal factor underlying uncertainty in food availability and overall poor economic performance of the countries. The food production crisis is reflected in the two trends of area and yield performance over the past two decades.

Area

Part of the changes in output of major crops in the period 1966-83 was due to changes in area planted (table 7). While additional land was available for food production, area expansion for most countries meant bringing into production marginal land with lower productivity and more uncertain rainfall, implying lower, more variable crop yields. Thus, we can conclude that although the agriculture of the study countries is generally extensive, inputs and new technology have not been much used.

The large positive growth rates for area of crops in Sudan can be attributed to heavy Saudi Arabian investment in the country's large mechanized farms in recent years. In Ethiopia, Lesotho, Mali, Mozambique, and Senegal, area for most major crops apparently declined. In Lesotho, the fact that returns to farming are far less than wages earned by working in the mining sector in South Africa remains a significant factor behind the migration of rural labor. In Mozambique, internal conflict and lack of incentives for farming, including lack of consumer goods available in markets, were the main features behind the out-migration of labor from the agricultural sector. In the Sahelian countries, as in most of the others, a combination of rural-urban migration, lack of farming incentives, and encroaching deserts were the principal explanations of the trends.

Yield

Though our yield data are especially weak, only Lesotho and Ethiopia had significant positive yield growth rates for their major crops during 1966-83 (table 7). In other countries, yields either stagnated or declined over the same period.

The one notable exception in terms of yield for a major crop is wheat in Zimbabwe, where average yield increased at the rate of 5 percent per year from an already very high base. This reflects the fact that wheat production has been supported in Zimbabwe in line with an import substitution policy, stimulating production by keeping prices high and providing back-up services and credit. Wheat in Kenya, Sudan, and Zimbabwe is produced by commercial farmers in irrigated areas, in contrast to the prevalence of subsistence and rainfed farming for other crops.

Table 7--Area and yield indicators, 1966-68 to 1981-83

Country and commodity	Annual growth rates		Yield range			Ratio of mean yield to world average
	Area	Yield	High	Low	Mean	
	----Percent----		-----Tons per hectare-------			Ratio
Ethiopia:						
Wheat	-3.17	4.81	1.39	0.73	0.93	0.56
Corn	-.94	5.05	2.02	1.00	1.28	.46
Sorghum	-.58	3.74	1.62	.79	1.03	.83
Barley	.50	5.04	1.50	.75	.97	.52
Kenya:						
Wheat	.97	.45	1.76	1.17	1.52	.92
Corn	2.08	.34	1.76	1.04	1.32	.47
Sorghum	-.05	-.19	1.12	.89	1.07	.86
Lesotho:						
Wheat	-8.78	6.36	2.15	.23	.98	.59
Corn	-3.38	.51	1.58	.42	.87	.31
Sorghum	-2.05	-.29	1.45	.28	.79	.64
Mali:						
Corn	-1.01	-2.46	1.11	.50	.76	.27
Rice	-.27	.32	1.55	.66	1.03	.42
Millet	.28	-1.96	.73	.47	.59	.94
Mozambique:						
Corn	-.94	-1.68	.78	.44	.59	.21
Sorghum	-1.10	-1.87	.92	.50	.69	.56
Niger:						
Rice	5.15	-1.38	2.75	.96	1.93	.79
Millet	3.51	-1.56	.54	.31	.43	.68
Sorghum	4.18	-1.89	.65	.28	.42	.34
Senegal:						
Corn	1.78	1.27	1.11	.61	.84	.30
Rice	-1.83	-.50	1.62	.69	1.28	.53
Millet	-.85	1.67	.87	.35	.55	.87
Somalia:						
Corn	1.43	1.39	.99	.50	.81	.29
Sorghum	-1.01	0	.60	.35	.48	.39
Sudan:						
Wheat	4.39	.69	1.46	.72	1.13	.68
Corn	5.92	-1.37	1.03	.42	.62	.22
Millet	4.76	-1.84	.63	.29	.43	.68
Sorghum	5.37	-.73	1.00	.63	.76	.61
Zambia:						
Corn	1.45	.20	1.05	.65	.90	.32
Millet	.30	-.96	.67	.46	.57	.90
Sorghum	.06	-1.60	.69	.43	.59	.48
Zimbabwe:						
Wheat	NA	5.00	5.76	2.25	3.86	2.34
Corn	5.02	-2.05	2.51	.76	1.65	.59
Sorghum	1.24	1.02	.66	.19	.54	.44

NA = Not applicable.

Source: Calculated from ERS data base.

In Lesotho, the positive growth in yields of all crops coincided with a 50-percent decline in area under major field crops during 1966-83. As marginal land was allowed to go out of production, use of inputs, fertilizer, and tractors increased substantially, increasing the returns per hectare of land. The positive growth rate in crop yields in Ethiopia is somewhat questionable, given the quality of the available data. However, even with high growth rates in selected countries like Ethiopia and Zimbabwe, crop yields are still generally 20-70 percent lower than the world average.

Structures Rooted in History

The trend performance of these countries in terms of agricultural and food production is intimately tied to the structure of their agricultural sectors. In part, this structure can be explained in terms of the history of the colonial system of which they formed a part. Most gained their independence in the sixties, with the exceptions of Ethiopia, which has always been independent (except from May 5, 1936, to May 5, 1941, when it was annexed to Italy), Mozambique (1975), and Zimbabwe (1980). The maximum period for economic reforms, if any, in which to evolve has been 25 years or less.

During the British and Portuguese periods in East and Southern Africa, dualism was the main feature of the economy. Modern sectors, either mining or agriculture (especially the exporting of cash crops), were run by firms controlled by foreigners. On the one hand there was a distinct commercial sector (large farms, urban industries, and services), and on the other a peasant sector contributing little to economic growth.

In the French Sudan (now Mali and Niger) during this period, the mercantile economy was developed to cater to the needs of the colonial government. Export crop cultivation, however, fitted into the system of rotational bush fallow and was, therefore, part of the dominant smallholder pattern of agriculture. Even the ambitious irrigation scheme established by the colonial government in Mali and placed under the authority of the Office du Niger, developed from the thirties onwards, operated on a smallholder basis. Only after independence did state farming expand in this scheme to any extent. Colonial rule stimulated urban growth; but conservative colonial fiscal policies limited public expenditures, and the centers of government did not grow particularly large. Thus, agriculture even under colonial regimes remained rooted in subsistence farming.[5]

After being locked for many years into economic patterns constructed to serve external interests, these countries emerged into independence with an inadequate economic infrastructure. Limited educational levels and low standards of well-being and health care are important reasons for low labor productivity. Low labor productivity, in turn, limits agricultural and food production. Economic difficulties have been compounded by political instability and natural disasters.

In these countries, internal conflict stems from cultural and linguistic diversity, making national consolidation very difficult. Since borders sometimes cut across ethnic lines, border disputes are a fact of life. The share of military spending out of public expenditure

[5]For a description of agriculture in the colonial period in these countries, see (*5*, *26*, *28*, *38*, *40*). For a good discussion of the impact on farming and herding populations of social and economic change in a historical context, see (*4*).

increased significantly after independence. Statistics on military spending for Ethiopia, Somalia, and Mozambique (all with continuing wars) are not available; however, in Zimbabwe, Senegal, and Sudan, 20 percent, 16 percent, and 14 percent, respectively, of total public spending was allocated to defense in 1981.

Resource Use

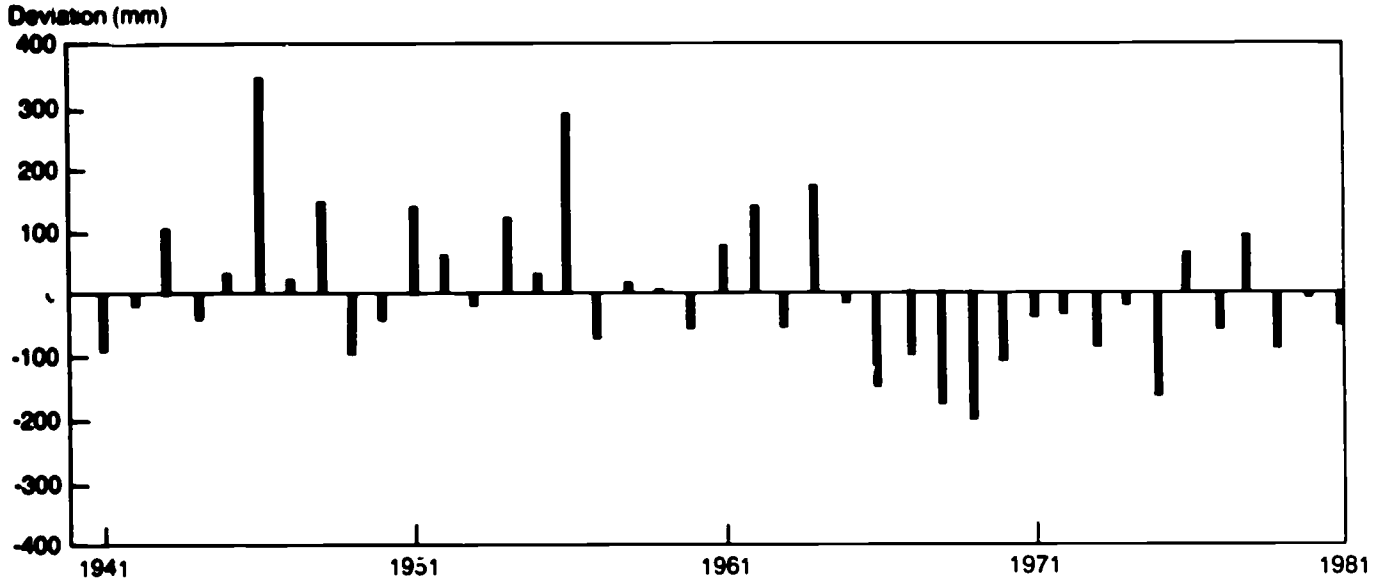
The great variability of the African environment subjects agricultural production in turn to great variability. Drought, in particular, has played such a major role in causing repeated food shortfalls that it deserves treatment in some detail. The Sahel drought of 1968-73, poor years starting in 1977-78 in the Sahel and northeastern Africa, and 4 years (1980-83) of drought in much of the African continent constitute a formidable record. Even more recently, 1984 and 1985 were drought years in one or more of our study countries. The fact that drought years recur periodically is apparent from figure 8, which shows annual deviations from the "long-term" (1941-1981) mean (362 mm) of rainfall observations at El Obeid. Our calculations, based on the last two decades of rainfall data, show that the expected occurrence of drought in a given year was 30 percent, meaning drought can be expected about once every 3 years.

Semiarid Tropical Environment

All these countries, except Lesotho, are in the semiarid tropics, a fact that creates special problems for the agricultural sector. The cropping season is compressed into a very short period and the residual soil moisture tends to evaporate (fig. 9). The beginning and ending of rainy seasons and the distribution of rain in a given geographic area vary greatly each

Figure 8

El Obeid, Sudan: Long-Term Rainfall Pattern



Source (14)

year. The range of crops and crop varieties suited to growing under these conditions is relatively narrow. The semiarid nature of the environment also affects livestock production. Livestock production depends heavily on pastures, and pastures depend on rainfall. In Somalia, and to a lesser extent in Sudan and the Sahelian countries, three-fifths of the population depends on nomadic livestock production.

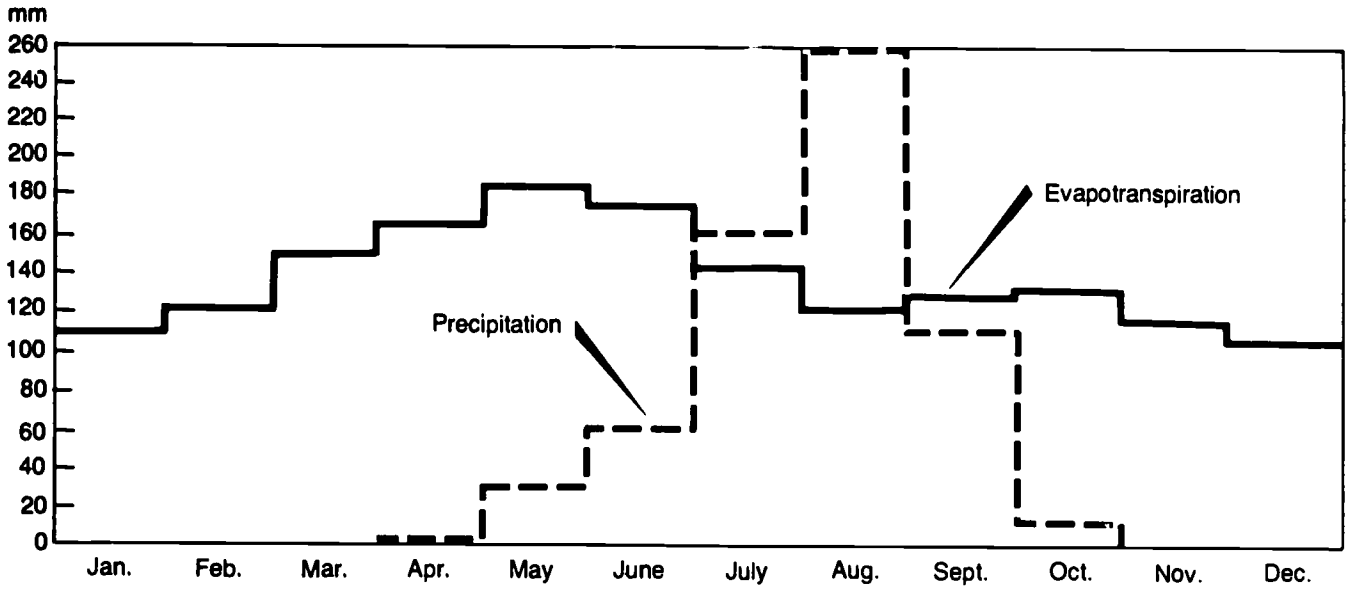
The soils of these countries are, on the whole, light, porous, and shallow, with poor moisture retention capacity. Soils in semiarid West Africa typically have about half the organic matter and water retention capacity of semiarid tropical soils in South Asia. They are chemically and physically very fragile. Aside from moisture loss, they are subject to leaching of nutrients necessary to crop production and to erosion caused by soil compaction, surface crust formation, and runoff (*36*, *39*). Only in the highlands of Kenya and Ethiopia are there to be found sandy loam soils with high organic matter content, good structure, and high moisture retention capacity. The vertisols of the Gezira in Sudan and the basaltic soils of the lowveld in Zimbabwe, highly fertile with efficient irrigation and drainage, are the exceptions.

Labor

Population density is generally low, except in areas like the Kenyan highlands where it is reaching the carrying capacity of the land. Family members provide most of the labor in agriculture, and demand for labor is highly seasonal. Shortages of labor therefore constitute a major bottleneck to production (*12*).

Figure 9

Maradi, Niger: Annual Precipitation and Evapotrans[illegible]n



Source: *(10)*.

Rural labor shortages have been aggravated by urbanization and in some countries out-migration of laborers to other countries (from Sudan to oil-exporting countries of the Middle East, from Mali to Ivory Coast, and from Zambia, Zimbabwe, Mozambique, and Lesotho to South Africa). In Sudan, emigration to the oil-exporting countries has had severe repercussions on the agricultural sector. The labor shortage was especially damaging for labor-intensive crops like cotton. One reason is the inadequacy of returns to labor in agriculture in the rural sector in relation to high urban wages. The ratio of real unskilled wages in agriculture to nonagriculture in Kenya varied from 20 percent to 25 percent over the 1972-83 period.

Inputs and Technology

Capital inputs are not used intensively in the agricultural sectors in the study countries. Although some natural replacement of plant nutrients in the soil occurs under the rotational bush fallow system, there is very little effort to replace nutrients by means of chemical fertilizer, except in Zimbabwe's commercial subsector, in Sudan's Gezira, and to some extent in Kenya (table 8).[6] Use of tractors, and even of draft animals, is uneconomical for most farmers. The hand hoe is still the most common tool for soil tillage, with the exceptions of the highlands (in Kenya and Ethiopia) and areas of heavy clay soils such as the depressions in Kordofan (Sudan) and the low-rainfall areas of Mali and Niger, and in Zimbabwe, where plows are used (*41*).

Crops grown are largely the traditional varieties that have been cultivated in Africa for centuries. Having adjusted to African growing conditions over this length of time, these varieties are extremely hardy, yielding a minimal harvest even with severe moisture deficiency. On the other hand, their yields are also low in good growing conditions.

[6]Because of Sudan's very large overall arable area, fertilizer use in the Gezira does not register as significant.

Table 8--Input use: Land, tractors, and fertilizer, 1981

Country	Arable land	Irrigated land[1]	Tractors per 1,000 hectares	Fertilizer use
	1,000 hectares	Percent	Number	100 grams of nutrient per hectare
Ethiopia	13,220	0.5	0.314	33
Kenya	1,830	2.7	3.607	344
Lesotho	298	na	4.866	151
Mali	2,055	5.6	.419	64
Mozambique	2,850	2.4	2.043	12
Niger	3,450	1.1	.056	10
Senegal	5,220	3.5	.091	47
Somalia	1,100	15.0	1.591	12
Sudan	12,390	15.0	.937	60
Zambia	5,150	.2	.903	166
Zimbabwe	2,600	3.9	7.885	682

na = Not available.
[1]Irrigated land as a percent of arable land.

Source: (18, 22).

African farmers usually obtain sorghum yields of 0.6 ton to 0.9 ton per hectare (ha) and millet rarely yields above 0.5 ton per ha, far below their agronomic potential of 3-4 tons per ha (*1*). Most African farmers still grow traditional open-pollinated varieties of corn, yielding about 1 ton per ha. Rice yields are generally no more than 0.5 ton to 0.8 ton per ha. Yields of wheat south of the Sahara are generally less than 1 ton per ha, and the short-term chances of raising wheat yields seem small because of high temperatures, a short growing season, and pests and diseases; the main exception is Zimbabwe, where average yields of 4-5 tons per ha are the rule in the irrigated, commercial farming subsector. Cassava yields vary greatly, ranging from 3-15 tons per ha.

One exceptional success story is the use of hybrid corn, especially in Zimbabwe and Kenya, with a potential yield of 5-7 tons per ha. The effect of fertilizer use is encouraging, and as a result hybrid corn yields are about 3-3.5 tons per ha in Kenya and 4-5 tons per ha in Zimbabwe. In Zambia, improved seeds cover approximately 50 percent of the corn area.

Size of Operation

Smallholders and peasant producers are the major producers of agricultural commodities in all countries. Zimbabwe and Zambia are the exceptions to this statement. In Zambia in 1978, 625,900 traditional farming households produced 60 percent of the marketed corn crop, with the remaining 40 percent being produced by 1,580 commercial farmers (*61*).

A number of countries embarked on programs of investment in large-scale farming, often owned or managed by the state. These types of operation are still limited in scope, but draw a disproportionate share of farming resources. In Ethiopia, for example, 4 percent of the areas were cultivated under state farms and 2 percent under cooperatives in 1980/81. The cooperative effort was intended to bring the peasant sector within the bounds of the national economic policy. (The effort is now concentrated on resettlement of drought victims.) In 1980/81, the state farm sector absorbed 63 percent of total financial resources available to the agricultural sector, but accounted for only 8.8 percent of crop production; small-scale agricultural production received 10 percent of resources (*46*).

Irrigation

In all of these countries, irrigated areas are very limited (table 8), and consequently the protection against crop failure afforded by irrigation is virtually nonexistent. Perhaps the most favorably situated countries with respect to irrigation potential are Sudan and Mali, which lie astride major rivers. FAO estimates for the percent of arable land irrigated for the 11 study countries are given in table 8. These data show that with the exception of Somalia and Sudan, with 15 percent, these countries have less than 10 percent of their arable land under irrigation. In Zimbabwe, 94 percent of the irrigated area is within the commercial sector, 30 percent of whose crop area is irrigated.

During the sixties and seventies, many countries increased their investment in irrigation, mostly in the modern sector. Despite this significant investment by governments, the overall financial performance of irrigated schemes has been poor. In Sudan, for example, irrigated area in the first half of the seventies increased at the rate of 5.5 percent annually through expansion of the canal network and land preparation, and then in the second half declined at the same rate. By 1980/81, however, the total irrigated cropped area had reached barely 2 million ha, compared with a total command area in the Nile valley of 3.8 million ha. (In Mali, the discrepancy between actual and potential irrigated area is even wider (*7*). Even in

Zimbabwe, only 10,000 ha of a potentially irrigable 100,000 ha in the lower Sabi River valley is irrigated but expansion would be very costly.)

Irrigation schemes in Mali, Senegal, and Sudan are managed mainly by governments, and their productivity is highly dependent on imported inputs. In Sudan, sufficient funds were initially available to procure inputs and machinery and to maintain and operate the heavy infrastructure investments in irrigation. Therefore, output from the irrigated area rose steadily. However, in the later part of the seventies, the output level started to decline. Most of these projects had been encouraged by the availability of donor funding. With the deterioration in the economic situation, a steady flow of financial, physical, and human resources to maintain these schemes became more difficult, and such resources tended increasingly to be diverted to other sectors.

The lack of incentives to the smallholder farmers who made up the producing population of these large-scale irrigation schemes also undoubtedly played a part in the poor ability of these schemes to pay for themselves. In Sudan's Gezira, smallholder production has remained the rule, although the Government plays a large direct role in decisionmaking. Governments tended especially to be the only buyers of the major output of the schemes, and deliberately kept prices paid to producers at a low level. Farmers attempted to increase their income by growing secondary crops like vegetables or raising livestock on the side.

Despite the disappointing performance of the irrigated sector in most of the countries, there have been a few notable successes. Yields in their irrigated sugar production are equal to those of the rest of the world. In Kenya, rice production has been very successful (with yields of about 5 tons per ha per crop) in the Mwea scheme, the only one of the country's six larger irrigation schemes to be self-supporting; each of the five others has incurred deficits in every year since they were established or taken over by the Government.

Investments have been underway in some of the countries on development of river basin projects. Food security ranks high as an objective of most of these projects. Examples of these projects are two dams in the Senegal River valley (in Senegal and Mali), on the Niger River in Niger, and the Bedhera dam in Somalia. Such projects are extremely costly. The estimated cost of development of new irrigated area is anywhere from $10,000 to $20,000 per ha. Even if farmers used the most efficient production techniques, the cost of rice production per ton is estimated to be 20-40 percent higher than the cost of importing rice, as in Senegal in 1981. Given the limited financial capacities of the governments, the wisdom of investing in such schemes is debatable, although longrun cost-price relationships are subject to change.

Only partial water control irrigation offers a chance of protecting food supplies against drought. The limitations of partial water control in securing such supplies was demonstrated in recent years in Mali, a rice-producing but net rice-deficit country. Partial water control projects like Operation Riz Segou and Operation Riz Mopti, in which planting occurs with the onset of the rains and early plant growth is dependent on rainfall even in normal years for the first month or month and a half until the arrival of the floodwater, failed to produce crops. Conversely, in the command area of the Office du Niger, with water control assured by headworks and canals, paddy production actually rose in the recent drought years (table 9).

In the near term, the role of irrigation in providing food security in these countries must necessarily be limited. The small proportion of the irrigable potential so far developed and

the high cost of extending this means that even under good conditions the irrigated sector's contributions to food availability will remain small. In the longer term, irrigation should play a larger role. However, the effects of drought will continue to be felt, as they were in Zimbabwe in 1983 when reduced water impoundment resulted in a 17-percent decline in irrigated crop area.

Research and Extension

Little investigation has been conducted on constraints to production by smallholders and practices in such areas as soils, draft power, labor use, and cropping patterns. Nor has much work been done on the specific crops grown by smallholders, such as millet and sorghum. However, in a few countries such as Zimbabwe there has been a long and successful tradition of agricultural research. Output from the system has been an important factor in the production levels achieved in the commercial sector. However, the research findings have often been unsuitable for smallholders because they do not have the resources of commercial farmers and they have less access to inputs and services.

In Kenya, research efforts in the sixties produced the successful H611 hybrid corn variety. More recently, a new hybrid sorghum variety (Hageen Durra 1) developed in Sudan by the International Center for Research in the Semi-Arid Tropics (ICRISAT) and the U.S. Agency for International Development (AID) over 5 years has yielded 5.2 tons per ha in field trials (*31*). However, it requires fertilizer and pest protection to achieve its full yield potential and farmers will have to purchase new seed each year. Aside from these examples, and possibly a few others, agricultural research in Sub-Saharan Africa has hardly affected food production.

Another neglected research area is the evaluation of net economic benefit from imported inputs. All these countries face foreign exchange constraints which add to the uncertainty over availability of imported inputs. In the case of Sudan, lack of imported fertilizer, fuel for transport, and machinery spare parts were reasons for yields being far below biological potential, especially in the mechanized rainfed subsector. The cost of these inputs raises a question about the feasibility of such forms of production.

The extension services are also poorly geared to support food production under African conditions. The estimates of numbers of farmers per extension worker vary among countries from 500 to 1,500, and these may be concentrated on cash crops. It is difficult to evaluate

Table 9--Mali: Paddy and rice production in the command area of Office du Niger, 1981-85

Year	Paddy rice	Milled rice
	Tons	
1981-82	62,801	28,018
1982-83	56,524	25,386
1983-84	71,434	23,614
1984-85	73,016	31,734

Source: (2).

the effect of extension efforts on agricultural productivity and rural poverty. Farmers on government settlement schemes, who were already favored in terms of the area and quality of their land, have also been favored by a disproportionate access to extension advice. There is also overwhelming evidence that women, who contribute significantly to food production in all African countries, have particularly limited access to extension services, credit, and training.[7]

In sum, when compared with agriculture in Asia and Latin America, the productivity of African agriculture seems alarmingly low. Soil erosion (particularly in the Sahel and Ethiopia), irregular rainfall, and labor bottlenecks are major problems in these countries and continue to defy easy technological solutions.

Productivity in selected regions of these countries could be significantly increased through use of improved farming practices that spread out labor use and raise yields. Even weather conditions are not volatile in every region of these countries: in Ethiopia about half the fertile land is in a region which is favored by relatively stable rainfall, which has 60 percent of the peasant population, which produces 54 percent of total cereal output, which provides 90 percent of the Government's procurement, and which uses almost 95 percent of fertilizer used in the small-farm sector (*55*).

Policies

Food policy is an indicator of governments' efforts to direct the decisionmaking of producers and consumers towards rational use of agricultural and food resources. Yet in Africa conflicting domestic policies and inefficiently implemented policy have been important factors in the disappointing growth of food production and consumption.

Even in the early seventies, the widespread nature of rural poverty and unemployment raised questions about the overall impact government policies were having. International organizations like FAO, the International Labor Organization (ILO), and the World Bank investigated these problems in Kenya, Mali, Zambia, and other countries. Their recommendations generally centered on land reform, smallholder development, and structural readjustment programs. Governments were encouraged to provide a whole range of services. Since then, African governments have intervened heavily in the agricultural sector, particularly by setting producer prices, providing inputs at subsidized prices, and managing the marketing of agricultural commodities through quasi-governmental bodies called parastatals or marketing boards. The form and extent of government intervention in cereals markets have varied by crops and by country (*51*).

Administration of Government Policies

There is a large and growing body of literature examining the record of administration of government policies on food production and economic development in general.[8] Sudan provided an example of ineffective administration directly harmful to the food sector in 1984: Sudan's policy is to export cotton in order to earn badly needed foreign exchange; yet

[7]For a good summing up on this point, see (*50*).

[8]See, for instance, (*56*) and the various primary sources for Kenya, Mozambique, Somalia, and Zambia cited in the chapter notes in (*26*).

marketing of Sudan's cotton crop, following a transfer of responsibility from one institution to another, became a bottleneck, with unshipped cotton piling up in Khartoum while the rest of the economy suffered from lack of foreign exchange.

In Zambia, the many public and private organizations involved in fertilizer distribution have hindered the efficient use of fertilizer by farmers. Fertilizer is distributed to farmers by the provincial Cooperative Marketing Unions, which also procure commodities from farmers. Distribution to the cooperatives is handled by the National Agricultural Marketing Board (NAMBOARD), which also advises the Ministry of Agriculture on fertilizer import quantities, storage, and pricing. Financing of fertilizer imports is handled by the Bank of Zambia and of distribution by private agents banks. Transportation and port authorities in other countries are also involved in a process whose coordination proves so cumbersome that it is a wonder that fertilizer arrives on farmers' fields at the time extension agents recommend (*62*).

Table 10 summarizes information on distribution of fertilizer and other inputs in all the study countries. Even in those countries where such distribution is handled by the private sector, the government often provides credit to farmers for purchase of such inputs, keeping a large measure of economic power in its hands. If all the credit provided goes to a country's large farmers, for instance, the net effect of intervention is to widen income disparities.

Producer Price Policies

In most African countries, producer prices for basic foodstuffs are legally controlled. The major criteria used in the process include the following often conflicting basic elements: cost of production, fair return to the producer, fair price to consumers, import-export parity price, crop profitability, food security, and political acceptability. The relative weights accorded these criteria by the governments of the 11 study countries during the study period are not known precisely, but fair price to consumers and political acceptability were quite important in all the countries.

Table 10--Distribution of agricultural inputs

Country	Fertilizer supply			Seed supply			Chemical supply			Farm equipment supply		
	1	2	3	1	2	3	1	2	3	1	2	3
Ethiopia		x			x			x			x	
Kenya	x			x					x	x		
Lesotho		x				x	x			x		
Mali[1]			x			x			x			x
Mozambique		na			na			na			na	
Niger		x			x			x			x	
Senegal		x			x			x			x	
Somalia		x			x			x			x	
Sudan		x				x			x			x
Zambia			x		x			x				x
Zimbabwe	x			x			x			x		

1 = Private.
2 = Government.
3 = Mixed.
na = Not available.

[1]Supplies come from the Operations de Developpement Rural (ODR). The most effective of these is the quasi-governmental Compagnie Malienne des Textiles (CMDT).

The basic framework for setting official prices to agricultural producers is almost the same among all 11 countries. The linchpins of this framework are the marketing boards which directly administer agricultural price policies in these countries. Because of their sensitive nature, official agricultural prices are usually set at the cabinet level of government. The marketing boards carry out cereals purchasing and selling operations on this basis. This politically dominated system operates largely on the basis of incomplete information and in the absence of any detailed analysis of immediate supply and demand conditions.

Price trends--Official producer prices were historically stable, with slight downward movement in some countries, at least until the early seventies. The argument behind this was to keep wages low and inflation within a manageable range. Only after the oil price shock and the steep rise of cereal prices on world markets in 1973-74 did governments begin to significantly change the levels at which they set producer prices, leading to sudden, large increases in nominal domestic producer prices for major food commodities. The producer price of corn in Zambia, for instance, jumped nearly 50 percent from 1974 to 1976; the producer price of millet in Mali increased 60 percent from 1974 to 1975; and the Kenyan corn price for the 1975 crop was increased by 42 percent, departing from a 10-year pattern of a 4-percent annual increase.

The production response of African farmers to price, however, was tempered by a number of factors. First, only a small proportion of cereal production is marketed, and an even smaller proportion gets into government hands. Second, the incentive effects of producer price increases are muted by a variety of nonprice factors like poor infrastructure, lack of consumer goods for sale in rural areas, and farmers' mistrust of governments.

Available data on effective farm prices and farmer incomes are weak. Such evidence as exists, however, shows a long-term decline in farmer terms of trade.[9] Such a decline probably persists despite recent increases in nominal producer prices.

As supporting evidence, producer prices deflated by the consumer price index (CPI), reflecting the rural-urban terms of trade, indicate that real prices have declined or stagnated for all major commodities. For example, the 160-percent increase in sorghum prices

in Sudan during 1977-83 compares with a 330-percent rise in the CPI. The 24-percent increase in official prices for paddy rice in Senegal in 1976-83 compares with an 85-percent rise in the CPI. The impact of negative terms of trade on production is not measurable in the short term. But the longrun consequences are declining returns to agriculture leading to high urban migration, which is a problem in all the countries.

Price comparisons--To evaluate the direction of price policy interventions and policy incentives, we compared domestic and international prices using official exchange rates. The relative changes of domestic and world prices show that before 1973 the decline in world prices narrowed the difference between the two sets of prices. When world prices suddenly

[9]Barter terms of trade definitely declined for Malian farmers in the decade 1967-77 (*9*). For Somali farmers, Jamal suggests a 20-percent decline in income terms of trade between 1970 and 1978 (*35*). For Kenya, however, Jabara finds a steady increase in income terms of trade between 1964 and 1972 and attributes this to rising productivity in the expanding smallholder sector in this period (*34*).

rose in the midseventies, domestic prices were relatively lower (fig. 10). From the price comparison, it seems these countries' commodities have been valued, at one time or another, quite differently from their world-market value.

Recently in some countries (Kenya and Zimbabwe, especially) producer prices have increased more than international prices. These increases overstate the positive protection policy of governments because the world prices are not adjusted for transportation costs. For bulky commodities such as grain, such costs may be as high as 25 percent of the producer price (as in Kenya, based on shipping charges of $38 per ton from U.S. Gulf ports to East Africa). In addition, many of the countries are landlocked, increasing the cost of transport even further (table 11).

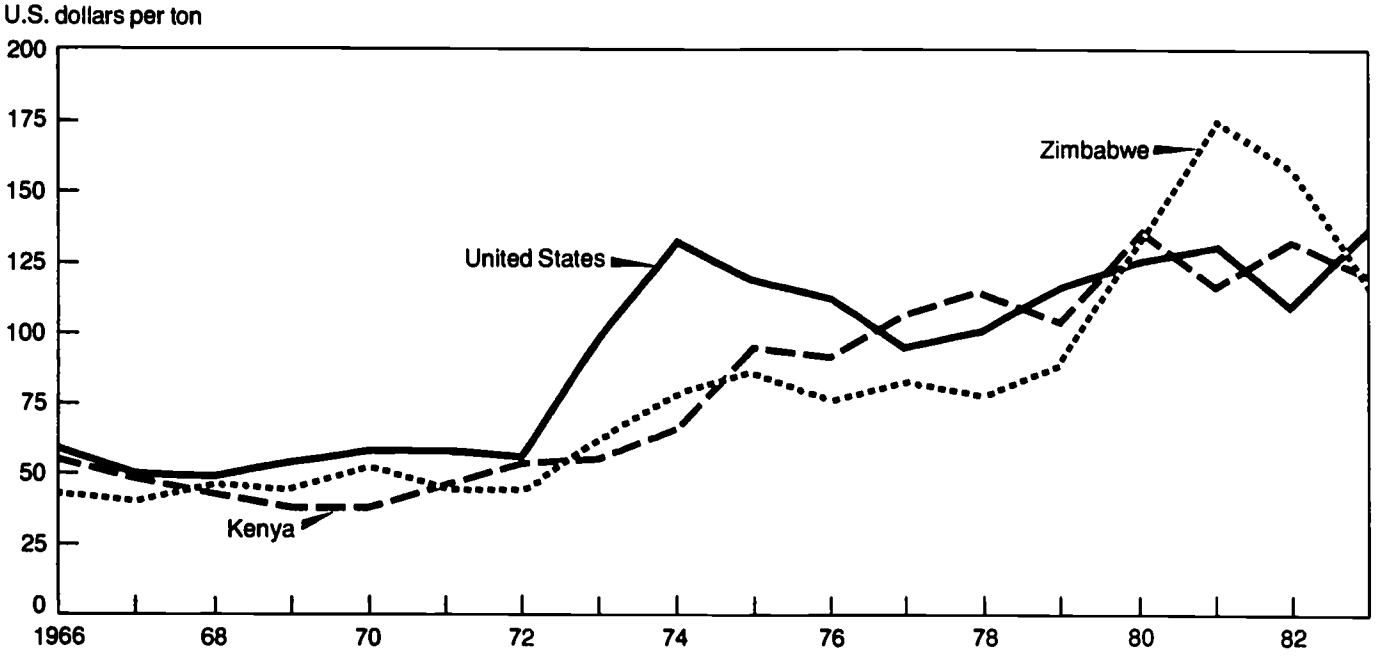
Marketing and Marketing Policies

In general, governments and parastatals seek to stabilize producer prices and protect urban consumers through ensuring a supply of basic food at affordable prices. However, the stated objectives of governments are not as valuable for our analysis as are the effects these marketing policies and institutional arrangements have on producers and consumers. To identify the effects of government marketing policies, one must know the linkages within the system, especially between prices and marketing institutions in these countries.

Producer behavior--Where commercial subsectors exist to produce food crops, such as in Zimbabwe and Zambia, farms that market their crops commercially are obviously the ones which are most affected by government-set prices and production and marketing regulations of

Figure 10

Corn Prices: Kenya, Zimbabwe, and United States, 1966–83



various kinds. This sector generally responds effectively to the price at which the government agrees to purchase all quantities offered for sale.

The marketing behavior of traditional producers is more complicated because they consume or market most of their crops through informal channels. Therefore, the effective prices at which they sell could be higher or lower than the government-set price. When the free market price drops in relation to official prices because of a good harvest (more so if the prices are announced prior to planting), farmers are better off selling their crops to government agents. Nonprice factors, including transportation, may change farmgate prices by as much as 20 percent (*43*). In Kenya, after the poor 1979-80 harvest, the Government increased the number of purchasing agents in local markets and paid transportation and drying costs for corn, raising the effective price by 43 percent. Conversely, when the free market price rises due to a poor harvest, any surplus will be mostly channeled to the unofficial market. Other factors such as the availability of consumer goods at the village level are also important in increasing the quantity of the marketed surplus.

Marketing restrictions enforced by law (as in Kenya and Ethiopia) which prohibit the purchase and movement of crops often encourage the smuggling of products and often have negative effects on the efficiency of agricultural production, representing a discriminatory tax on surplus-producing areas. Also, uniform national prices transfer the burden of transportation costs of producers in remote areas to those near urban centers.

Table 11--Representative cereal transport costs, 1984

Country of destination and port of landing	Destination and transport mode	Estimated cost of land transport[1]	Average transit time, vessel to destination
		Dollars per ton	Days
Mali:			
Abidjan, Ivory Coast	Bamako by road	67-90	8-15
Abidjan, Ivory Coast	Timbuktu by rail and road	169	21
Dakar, Senegal	Bamako by rail	54-62	7
Niger:			
Cotonou, Benin	Niamey by rail and road	87	15
Apapa, Nigeria	Niamey by road	132-160	5-8
Sudan:			
Port Sudan	Khartoum by road	30	na
	Nyala by road	49	na
Zambia:			
Dar es Salaam, Tanzania	Lusaka by rail	150	10
Zimbabwe:			
Beira, Mozambique	Harare by rail	26	10-14
Durban, South Africa	Harare by rail and road	43	10-14

na = Not available.
[1]Including bagging.

Source: (33).

Finances of parastatals--In theory, the differences between official producer prices and consumer prices, minus transportation, storage and administration costs, determine the revenues of the parastatals or marketing boards. If the country is exporting or importing crops, the differences between border prices and domestic prices could add to or reduce their revenues.

In practice, the handling of the budget follows the pattern of governments in other fields. When the cost exceeds the revenue, which is typical in a given year, costs are recovered through the government budget. The main reasons for cost increases are uncertainty over procurement quantities, handling and storage costs, and the costs of input and consumer price subsidies.

After prices have been set in advance, without clear knowledge about market supply conditions, the volume of cereals that will be procured at these prices is uncertain. Marketings tend to vary more from year to year than does production. In Kenya and Zambia, for instance, during the study period inter-annual rates of change for marketings were higher than inter-annual rates of change for production 13 times out of 17, and in Zimbabwe 12 times out of 17 (table 12). If producer prices in general have been set too low or if weather during the cropping season is bad, quantities procured will be low and demand at declared prices will have to be satisfied by imports. If the price is high in relation to supply and demand, quantities sold to parastatals will increase. Quantities in excess of domestic sales must either be stored or exported.

The optimum target of the parastatals is to procure adequate quantities of the crop, but not to have an unmanageable surplus that may have to be sold to prevent spoilage. The low level of procurement usually increases the per unit overhead cost, and unexpected increases in quantities purchased overtax the storage capacity. In countries where a large proportion of production is traded, because of the uniform prices maintained throughout the year, there is no incentive for farmers to store grain. In 1977/78, 2 years of large harvests filled Kenya's central storage to capacity. Although the marketing board failed to get timely approval for exports, the surplus stock was eventually exported, mostly at a loss to the marketing board.

The financial problems of parastatals also significantly affect production. In 1979/80 in Kenya, payments to farmers lagged about 6 months, reducing real producer prices by an estimated 7 percent (14-percent inflation rate), and limiting farmers' future investments because of lack of capital to purchase needed seeds and inputs.

The uniform pricing and purchasing policies in some cases encourage production of bulky products in remote areas away from principal consumption centers, increasing transportation costs. In Zambia, the cost of transportation from the Eastern Province, near the Malawi border, to the nearest consumption center was 58 percent of the producer price in 1973/74. In Kenya, the National Cereals and Produce Board (NCPB) was unable to recover the costs of expanding its buying center network after 1980, a move which greatly increased its accessibility by smallholders, by passing those costs along to consumers (*34*).

Because food crops procured by marketing boards are mainly marketed in urban areas, the marketing boards face a financial squeeze between producer and consumer prices, particularly in countries like Zimbabwe and Kenya wher commercial farmers constitute a strong lobby. (For producer-retail price margins in Kenya over the study period, see fig. 11.) For example, in Zimbabwe during the early eighties, producer prices for corn were set

Table 12--Corn production, marketings, and changes, Kenya, Zambia, and Zimbabwe, 1966-83

Year	Kenya				Zambia				Zimbabwe			
	Production	Marketings	Change from previous year: Production	Change from previous year: Marketings	Production	Marketings	Change from previous year: Production	Change from previous year: Marketings	Production	Marketings	Change from previous year: Production	Change from previous year: Marketings
	1,000 tons		Percent		1,000 tons		Percent		1,000 tons		Percent	
1966	1,270	133	--	--	860	387	--	--	900	525	--	--
1967	1,451	226	14.2	69.9	850	381	-1.2	-1.5	1,518	876	68.7	66.9
1968	1,633	322	12.5	42.5	780	257	-8.2	-32.5	798	424	-47.4	-51.6
1969	1,600	292	-2.0	-9.3	780	264	0	2.7	1,572	961	97.0	126.6
1970	1,400	194	-12.5	-33.6	650	132	-16.7	-50.0	980	628	-37.7	-34.6
1971	1,500	240	7.1	23.7	928	384	42.8	190.9	1,547	1,112	57.9	77.1
1972	1,300	379	-13.3	57.9	950	586	2.4	52.6	2,240	1,400	44.8	25.9
1973	1,700	458	30.8	20.8	800	399	-15.8	-31.9	957	550	-57.3	-60.7
1974	1,600	335	-5.9	-26.8	1,062	588	32.8	47.4	2,091	1,337	118.5	143.1
1975	1,600	451	0	34.6	950	559	-10.5	-4.9	1,743	1,007	-16.6	-24.7
1976	1,900	557	18.7	23.5	1,070	750	12.6	34.2	1,710	959	-1.9	-4.8
1977	2,195	543	15.5	-2.5	980	696	-8.4	-7.2	1,658	941	-3.0	-1.9
1978	2,205	425	.5	-21.7	950	582	-3.1	-16.4	1,616	877	-2.5	-6.8
1979	1,895	238	-14.1	-44.0	700	336	-26.3	-42.3	1,160	512	-28.2	-41.6
1980	1,450	242	-23.5	2.5	800	383	14.3	14.0	1,625	819	40.1	60.0
1981	1,750	435	20.7	79.5	1,206	693	50.7	80.9	2,767	2,013	70.3	145.8
1982	2,200	592	25.7	36.1	975	590	-19.1	-14.9	1,786	1,391	-35.4	-30.9
1983	2,340	618	6.4	4.4	1,010	531	3.6	-10.3	1,023	620	-42.7	-55.4

-- = Not calculated.

Source: ERS data base.

significantly higher than consumer prices. Taking advantage of the price differential, many farms sold all of their crop to the marketing board at a high price, and quantities for home consumption and onfarm storage were purchased at retail level. The costs of the producer subsidy placed heavy pressure on the marketing board and increased the government's costs.

The total subsidy cost of agriculture in Zimbabwe increased by thirteenfold during the 5 years 1977-82 and forced the government to decrease subsidy and increase consumer prices even further on staple food items like corn. The price of corn at the retail level increased by 50 percent in 1983 from a constant nominal level during most of the seventies (102 to 152 Zimbabwe dollars per kg).

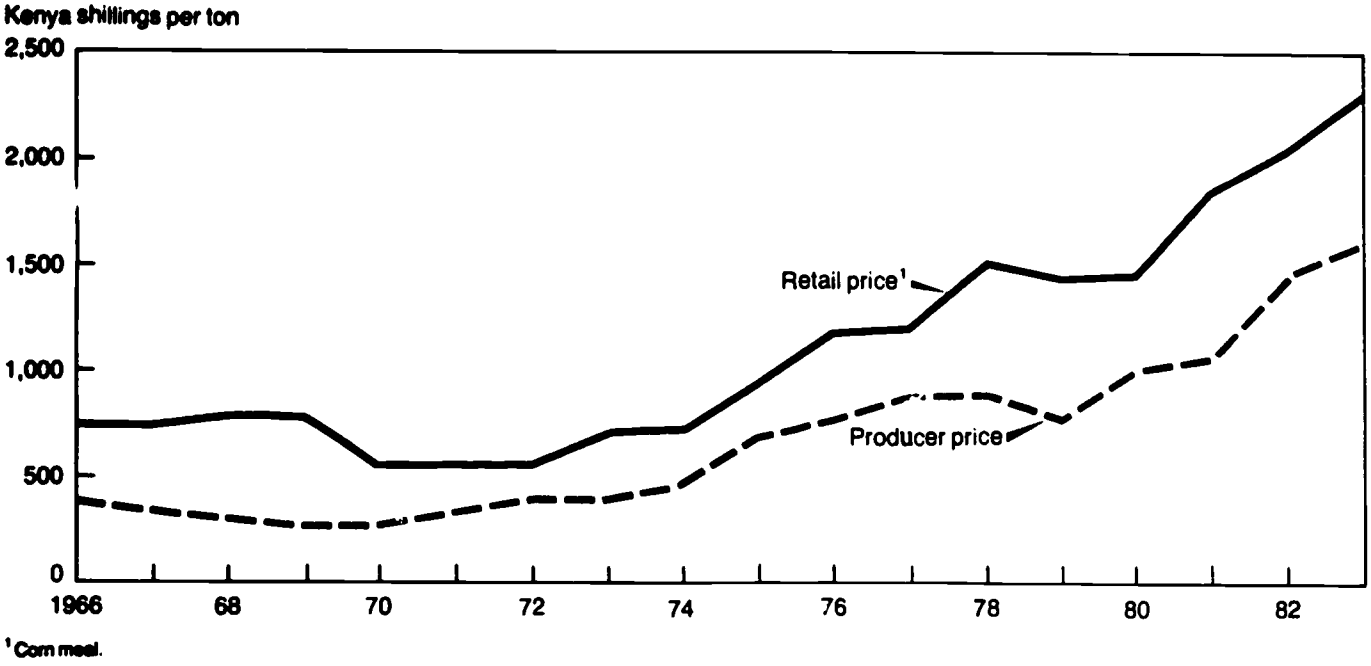
In Zambia in 1978/79, when the producer price of corn was raised 40 percent to provide more incentive for production, the total subsidy cost to the government amounted to 33 million kwacha, equaling the value of all the corn the marketing board purchased from farmers. Substantial subsidies have been given until recently for production inputs. The large farmers were usually the major beneficiaries of the subsidized inputs.

Where most urban demand is satisfied thr[illegible]h official market channels, consumer food prices are subsidized in varying degrees. The subsidy costs are absorbed through parastatal losses and government budget deficits. However, government subsidies of consumer prices generally have only a limited benefit for consumers. Subsidized foods are mostly available in urban areas, in fact. Those who have access to subsidized grain provided by the marketing board are able to sell it in the open market, especially in years when the differential between government and free market prices is significant.[10]

[10]Such recipients may not be so fortunate, however, if the grain they purchase at these subsidized prices is of the worst quality (as frequently happens when producers are given a quota of grain to sell to a parastatal at a fixed, uniform price) or that is in the poorest condition (as happens when parastatals rotate their stocks periodically).

Figure 11

Kenya: Corn Producer-to-Retail Price Margins, 1966–83



[1]Corn meal.

All these sources of costs impose a heavy burden on governments and their development plans. The debt of the Office des Produits Vivriers du Niger (OPVN) in Niger as of September 1982 was 9.4 billion CFA francs and the estimated loss in the year 1982/83 alone was about 1.5 billion CFA francs. This is equivalent to about one-tenth of total government spending for capital investment.

Responsiveness of Production to Price

The effectiveness of price incentive policies to stimulate production of a particular crop versus overall agricultural production in Africa is somewhat unclear. Given the general characteristics of the agricultural system in these countries, farmers' expected price response may be hypothesized in three categories:

1. Farmers respond quickly and normally to price increases. Many studies in Africa and elsewhere indicate that traditional farmers respond positively to relative price changes (*15*).

2. Marketed production of subsistence farmers is inversely related to price. This hypothesis follows the argument that farmers have limited money obligations and commodities that they can purchase do not vary significantly. Therefore, increased production leads to increased consumption, and the remainder is sold in as large quantities as necessary to generate required income.

3. The price response is not significant because of technical constraints. The argument is that the limited available inputs, storage, and weak marketing links erode the effect of expected price response.

Estimation

Supply responses to price by producers are not readily available or easy to estimate. Government administration of agricultural policies has direct and immediate effects on production which must be weighed against the incentive effects of high producer prices.

Different specifications were used mainly to identify evidence of positive producer price elasticities and to determine if these price elasticities were high enough for governments to use pricing policies to increase production significantly.

In estimating price response, we made two important distinctions. First, we distinguished between planting decisions and marketing decisions. Farmers' decisions with respect to these two operations are not necessarily identical in response to a given supply incentive, and most of the previous research in this area indicates more variation in sales than in production. Second, we distinguished between total production response and area response. By breaking down the supply variable for each major cereal to area and yield, we expected to get more refined responses to price. However, given the weakness of data, we report both sets of coefficients to examine the consistency and stability of supply/price relationships.

We measured producer price expectations in terms of deflated prices. We used the consumer price index (CPI) to represent the cost to the farmer because of the scarcity of data on prices paid by producers. If prices paid to producers are announced after the planting decision, we used a 1-year lag price (as is the case in Kenya, Zambia, and Zimbabwe). If prices are announced after crop planting, we used a current price as the explanatory variable.

We also used the following variables:

- o Dummy variable to represent drought years (this variable carries a value of 1 during the years of drought).
- o Lagged dependent variables (supply, area, officially marketed supply) carry the effect of changes over time, not specifically measured by other variables (for example, management practices and habits, fixed assets).
- o Yield lagged 1 year to show uncertainty in production decisions.

We did not estimate cross price effects because of high price correlation among commodities caused by government manipulation of all commodity prices.

For the regression model, the structural equations (for one crop) with the hypothetical signs of parameters under different scenarios are shown as follows:

Dependent variable	Independent variables
Total production	+ Total production lagged 1 year + deflated price - dummy variable
Area	+ Area lagged 1 year + deflated price - dummy variable + yield lagged 1 year
Officially marketed supply	+ Marketed supply lagged 1 year price + deflated price - dummy variable

The overall producer response toward changes in price varied by commodity and country. When different model specifications were used, the size of the coefficient varied, not uniformly in all cases. When we used area as a dependent variable instead of quantity of output, the size of the price coefficient (with a few exceptions) was smaller because quantities of all other inputs tend to vary with land per unit of harvested area. Because of lack of data, we estimated marketed supply for only three countries, Kenya, Zambia, and Zimbabwe. In these countries, a relatively significant part of production, 20 percent or more, was marketed.

Table 13 presents a summary of our analysis, and appendix table 13 presents the complete details.

Here are our principal findings:

1. Price elasticities (the percent change in production or area induced by a 1-percent change in price), with few exceptions, are positive and statistically significant. The highest shortrun price elasticity with respect to production is 1.09 for rice in Mali, and the highest area price response is 0.9 for corn in Zimbabwe. The area response to price of rice in Mali is insignificant because the rice-producing area in Mali is strictly limited in the short run by land preparation requirements, although the yield response is large and significant, reflecting greater labor input per ha.

Table 13--Price elasticities of production and marketed surplus

Country and crop	Range of price elasticities--			
	Of production		Of area	
	Shortrun	Longrun	Shortrun	Longrun
Production:				
Ethiopia--				
Wheat	0.53*	0.72	0.76*	1.26
Corn	.47*	.67	.38*	.38
Millet and sorghum	.28	.35	.28	.51
Teff	.28	.28	.11	.37
Barley	.19	.31	-.03	--
Kenya--				
Wheat	.46*	1.12	.29*	1.07
Corn	.40*	1.05	.17*	.66*
Millet	.39*	.63	.35	.68
Sorghum	.07	.07	-.02	--
Lesotho--				
Corn	-.25	-.25	.16*	.16
Sorghum	.13	.15	.15	.15
Mali--				
Corn	-.04	--	.07	.13
Rice	.34*	.34	.23*	.23
Millet and sorghum	.35*	.35	.20*	.20
Niger--				
Millet	.14*	.21	.09	.14
Sorghum	.11	.17	.29*	.88
Senegal--				
Rice	.32	.32	.46*	.46
Millet	.11	.14	.40*	.40
Somalia--				
Corn	.10*	.13	.08	.16
Sorghum	.03	.04	.14*	.14
Sudan--				
Wheat	.34*	1.17	.28*	1.17
Corn	.31*	.94	.23	.30
Sorghum	.22*	.33	.33*	.34
Zambia--				
Corn	.61*	.71	.31*	.57
Millet and sorghum	.21*	.33	.06	.21
Zimbabwe--				
Wheat	.34*	.92	.40*	1.30
Corn	.36*	.36	.92*	1.09
Sorghum	.43*	.49	.21*	.36
Marketed surplus:				
Kenya--				
Corn	1.13	NA	NA	NA
Zambia--				
Corn	1.69	NA	NA	NA
Zimbabwe				
Corn	1.42	NA	NA	NA

-- = Negligible or not significant.
NA = Not applicable.
* = Significant at 90-percent level.

Source: Appendix table 13.

2. The magnitude of the longrun price elasticities is in most cases much larger than the shortrun responses. This finding suggests that there is a considerable longrun potential for increasing production if real prices are increased.

3. Crops produced mainly for home consumption, like millet and sorghum in contrast to wheat, rice, and corn, show smaller price coefficients in the same country. The only exception to this, sorghum in Zimbabwe, is produced for an industrial use, beer brewing.

4. In countries where larger crop transactions take place through official channels, the magnitude of the price response with respect to marketed quantities is significantly larger than the total supply response.

The price response for marketed quantities in Zimbabwe and Zambia, where an average of 60 percent and 50 percent, respectively, of corn production is marketed through official channels, is significantly higher than the corresponding total supply response. In Zambia, the shortrun price elasticity for marketed quantity of corn is 1.69, while the total supply response is only 0.61. In Zimbabwe, the corn production response is 0.36 and the response of marketed quantities to price is 1.42. In Kenya, where smaller quantities are marketed through official channels, the size of the response of marketed quantity to price (1.13) is smaller compared with Zambia and Zimbabwe, but still large in relation to that of total production.

The overall effect of official producer prices, according to this analysis, is limited in scope and varies significantly among countries and crops according to how and by whom they are produced. In several of the study countries, governments procure only a small fraction of production of certain crops, and free market prices may have ranged higher or lower than the official prices in our time series.

Finally, while a strong positive price response by producers of cereals is good when it leads to increased food production, localized labor shortages may mean that increased cereal production will occur at the expense of production of other crops in the absence of technological change. If area planted to cereals expands at the expense of nonfood cash crops, this may benefit the country's food supply and the nutritional status of the population. If, however, it expands at the expense of other, less profitable food crops (such as peanuts in Mali), the nutritional effects engendered by the strong positive price response may not be unequivocally beneficial.

Share of Imports in Consumption

After food production, food imports are generally the second largest source of food availability in African countries. In our study countries, food imports have assumed particular importance because of the slow growth of food production and its volatility.

Trends of Import Dependency

All 11 countries had positive growth rates of food imports in 1966-83 except Sudan and Zimbabwe (table 3). Food import volume has increased as much as tenfold to twentyfold during 1966-83. The magnitude of food imports growth in countries like Niger and Somalia stems from an initially very low base. However, the accelerating growth rates of food imports in many of our 11 study countries and the decline this implies in their food self-sufficiency

are alarming. If we define the ratio of available food production to food availability to be a country's self-sufficiency ratio, we see that 9 of our 11 countries experienced a decline in their self-sufficiency ratios between 1966-68 and 1981-83 (table 14). For example, Lesotho produced 99 percent of its food availability in 1966-68, but only 47 percent in 1981-83. For low- and medium-income countries facing mounting demands for food from their populations and relying on export earnings from a relatively few commodities, this is not an encouraging trend from the point of view of their food security.[11]

Because of the continued commitment of providing food for urban consumers, the share of food imports in total imports rose in most of these countries. In Somalia, as the worst case, despite increased concessional loans, the value of commercial food imports increased by 19 percent per year during 1966-82, and the value of commercial imports as a percent of total imports peaked at 57 percent (table 15). In Sahelian countries, the share of food imports in total imports was higher in the seventies than in the early eighties because of the severe drought in that region.

With slow production growth, imported cereals are purchased even in rural areas. In Sudan, wheat is increasingly consumed in both urban and rural areas. A 1981 survey in Senegal indicated that consumption of imported rice has become significant in rural areas; rice is a supplement to the millet-based diet, and imported rice apparently compensates for inadequate domestic supplies, especially in poor rainfall years.[12]

These changes have been favored by the fact that the imported foods (wheat and rice) are generally easier to prepare and cook than domestically produced cereals. Commercially milled rice is easier to prepare than millet and sorghum. Wheat is easily baked by commercial bakers, making it easily consumed. Such changes in consumption patterns have been particularly marked in the heavy importing countries like Somalia. Thus, the average urban diet has changed towards consumption of food items like wheat and rice, away from locally produced cereals like millet and sorghum (table 16).

[11]See appendix tables 1 to 11 for cereal import data by country.
[12]Country growth rates for imports of wheat and rice are given in appendix table 14.

Table 14--Self-sufficiency ratios[1]

Country	1966-68	1981-83
	Ratio	
Ethiopia	0.95	0.90
Kenya	1.23	.94
Lesotho	.99	.47
Mali	1.17	.96
Mozambique	.93	.56
Niger	1.03	.94
Senegal	.98	.65
Somalia	.81	.42
Sudan	.81	1.00
Zambia	1.03	.85
Zimbabwe	1.20	1.29

[1]Defined as the ratio of available food production to food availability.

Source: Appendix tables 1-11.

In some countries, like Zimbabwe and Niger, food imports are still at relatively low levels. The ominous feature for these countries is the accelerating trend of import growth (even in countries with relatively high self-sufficiency ratios), which is likely to become even more pronounced if food production lags further behind population and income growth, especially in urban areas. In Zimbabwe, this consideration weighs in the government's reluctance to implement drastic land reforms.

Table 15--Commercial food imports and total merchandise imports, 1966-83

Country	Annual growth rate of value of--		Value of commercial food imports as a percent of total imports	
	Merchandise imports	Commercial food imports	1980-82	Historical high point, 1966-82
			Percent	
Ethiopia	11.00	15.28	10.23	13.5
Kenya	13.78	9.67	5.07	13.5
Lesotho	18.16	20.36[2]	37.13	37.8
Mali	14.76	15.33	16.50	55.3
Mozambique	na	na	na	na
Niger	21.25[1]	22.80[3]	11.57	19.9
Senegal	12.80[1]	10.85	25.17	36.4
Somalia	16.45	19.46	43.30	57.1
Sudan	11.82	13.19	20.40	25.5
Zambia	6.30	6.77[4]	10.00	12.4
Zimbabwe	11.64	NA	3.73[5]	5.3

na = Not available.
NA = Not applicable, net food exporter.
[1]Incomplete data series, 1968-82.
[2]Incomplete data series, 1966-80.
[3]Incomplete data series, 1968-80.
[4]Incomplete data series, 1969-81.
[5]Incomplete data series, 1975-82.

Source: (24).

Table 16--Changes in taste and ratio of cereal imports to domestic cereal production, 1966-68 and 1981-83

Country/principal imported cereal	Consumption of main imported cereals as a percentage of subsistence cereals		Ratio of cereal imports to cereal production	
	1966-68	1981-83	1966-68	1981-83
	Percent		Ratio	
Ethiopia (w)	20	19	0.01	0.02
Kenya (w)	6	13	.01	.08
Lesotho (w)	44	35	.14	1.18
Mali (w)	2	5	.01	.09
Mozambique (w, r)	25	43	.08	.37
Niger (w, r)	2	10	.01	.07
Senegal (w)	5	12	.33	.55
Somalia (w, r)	14	63	.14	.65
Sudan (w)	15	22	.10	.04
Zambia (w)	6	11	.07	.16
Zimbabwe (w)	9	13	.06	.02

w = Wheat.
r = Rice.

Source: ERS data base.

Burden of Food Import Bill

The general picture of growth in the value of food imports is almost the same across countries, with varying degrees of growth that show no sign of slackening. The increasing share of food imports means food imports are competing with imports of essential raw materials and capital goods. The food imports' share of total imports is relatively large for most of these countries, and governments have often tended to postpone other imports during severe food production shortfalls. Imports of luxury items are already restricted in almost all of these countries, although there are exceptions. Therefore, reducing imports means reducing imports of essential raw materials, with consequent ramifications for the economy as a whole. Where the food sector is directly dependent on imported inputs like petroleum products or spare parts, as is the case in the irrigated subsector in Sudan and in the commercial subsector in Zimbabwe, forced restriction on nonfood imports can be immediately felt.

How large should or could the overall budget allocation for the food sector be? The political risk involved in food shortages, especially in urban areas, is a threatening factor for governments. On the other hand, because of slow economic growth, budget pressures limit government spending. In countries like Ethiopia, Mali, and Mozambique, reduced consumption would come at the expense of severe social and human costs. The political risk in attempting to increase prices is real. The 1985 strike in Sudan was partly a result of a move to reduce consumer price subsidies; a subsequent raise in the subsidies failed to save the government.

The reality of the financial burden of the food import bill in these countries can be seen when the value of currency spent on food imports is compared with export earnings. In countries like Lesotho and Somalia, foreign currency earned through exports can hardly cover the food import bill (in 1980-82 the value of food imports was more than export earnings). In Senegal and Sudan during the same period, about 50 percent of export earnings went to pay the food import bill. With a decline in the flow of capital to these countries, a higher allocation of hard currency to pay for food means a slowing down of other activities in the economy, including productive activities, such as industrialization.

In all the countries, industrial sectors still depend heavily on imported materials. The economic cost of underutilization of their capacity is twofold: loans plus interests to finance the development of the industrial sector should be paid; and underutilized capacity means lost production. Sudan's heavy investment in textile manufacturing resulted in capacity of over 110 percent of need, and this now operates at about 25 percent of capacity because of financial stringencies. According to a report by the World Bank, this is typical of underutilization of manufacturing capacity in the country (*58*).

Roots of the Unfavorable Financial Position

During the seventies poor trade performance was the main reason for slow economic growth throughout Africa. Many factors, such as the oil price hike, slow demand growth for primary commodities, and domestic trade and exchange rate policies, contributed to severe terms of trade loss and growing balance of payments deficits.

Export Performance

Like most African countries, these countries have export sectors based on a single, or at most a very few, primary commodities. These primary commodities, often agricultural

commodities like coffee, cotton, and peanuts, account for a significant proportion of gross domestic product (GDP) and of government revenue, as well as of export earnings; moreover, they represent a livelihood for a large segment of the rural population.

Trade data (table 17, cols. 3 and 4; 57) show that in terms of volume of exports, the countries registered fairly respectable performances in the sixties and even in the seventies, with the notable exception of Mozambique, which was wracked by civil war. In addition to commodities, exported labor services are a very important source of foreign currency earnings in Lesotho, Mozambique, and Sudan. Any changes in the economies of the labor importing countries (members of the Organization of Petroleum Exporting Countries (OPEC) and Republic of South Africa) could significantly change the level of their earnings and their economic performances.

The modest growth of export volumes during the sixties and seventies, however, was in part offset by an unfavorable trend in world prices for these exports which began in the seventies (table 18). These trends of prices received, coupled with higher prices paid for oil, a major import in all these countries, left them facing unfavorable terms of trade (table 19).

These countries faced unfavorable terms of trade despite the good market potential for some of these commodities, such as meat exports (from East Africa to Middle East oil producers). The livestock sector is sensitive to the occurrence of drought. For example, Mali's greatest agricultural resource, until 1972, was livestock, 5 million cattle and 10 million sheep and goats. During the drought of 1972-73, much of the nation's herd was depleted, by some estimates as much as 50 percent. In the cases of other commodities, other nonprice factors contributed to a drop in export earnings, as for example increases in domestic demand, a switch to cereal production, and the spread of the plant disease "rosette" in Mali and Niger, which led to a drop in peanut exports.

Table 17--Export performance, 1966-82

Country	Major export commodity	Contribution of (1) to total exports: 1980	Average annual real growth rate in total export volume[1]: 1960-70	1970-82	Coefficient of variation: Volume	Value
	(1)	(2)	(3)	(4)	(5)	(6)
		Percent			Coefficient	
Ethiopia	Coffee	64	3.7	1.3	15.1	18.1
Kenya	Coffee	22	7.5	-3.3	12.7	22.6
Lesotho	Wool	na	na	na	25.1	45.1
Mali	Cotton	67	2.9	6.6	42.1	69.7
Mozambique	Cashews	na	6.0	-13.3	na	na
Niger	Uranium ore	84	5.9	20.8	43.3	15.0
Senegal	Peanuts	13	1.4	-1.8	22.5	20.3
Somalia	Livestock	na	2.5	9.1	26.5	39.8
Sudan	Cotton	40	2.1	-5.1	24.1	22.6
Zambia	Copper	na	2.3	-.5	7.4	20.3
Zimbabwe	Tobacco	16	na	na	39.8	31.9

na = Not available.
[1]Changes in price-weighted sum of volumes.

Source: (47, 57).

The policies of these countries toward agricultural exports have taken various forms, such as low producer prices, export taxes (either in the form of direct taxation or overvalued currencies), and sometimes discouragement of investment. Various arguments are made to justify these policies. The reasons are a combination of the need to industrialize by promoting import substitution, and the need to control inflation rates.

Table 18--Export price trends

Commodity	Average annual growth rate[1]	
	1961-70	1970-82
	Percent	
Copper	9.5	-7.2
Corn	-.2	-4.2
Beef	6.8	-4.1
Peanut meal	.6	-4.1
Peanut oil	.1	-4.0
Tea	-4.5	-2.8
Sugar	-5.3	-2.7
Cotton	-1.7	-1.9
Tobacco	3.0	-1.2
Coffee	.3	1.8
Petroleum[2]	-2.6	20.1

[1]Prices derived from the ratio of international prices to the index of prices of manufactured exports from industrialized countries. Both series are expressed in dollars; inflationary trends common in both sets of prices are consequently eliminated.
[2]For comparison purposes.

Source: (57).

Table 19--Terms of trade, 1970-82

Country	Terms of trade				Average annual growth rate of terms of trade, 1970-82
	1970	1979	1981	1982	
	Index (1980 = 100)				Percent
Ethiopia	156	139	68	74	-4.9
Kenya	99	108	87	87	-.4
Lesotho	na	na	na	na	na
Mali	118	107	107	102	-1.5
Mozambique	111	104	95	84	-2.0
Niger	169	112	82	89	-5.1
Senegal	100	110	101	89	-.3
Somalia	154	116	105	111	-3.4
Sudan	96	98	100	85	-.6
Zambia	262	118	80	72	-9.0
Zimbabwe	na	81	111	105	na

na = Not available.

Source: (57).

Balance of Payments

Deteriorating domestic economies and global factors have led to widespread financial crises in all of these countries (table 20). The balance of payments deficit for these countries as a whole increased from $179 million in 1970 to $882 million in 1982. The major struggle for these countries, therefore, is to achieve a sustainable current account position while at the same time avoiding sharply reduced imports.

Balance of payment deficits were largely financed by external borrowing and depletion of foreign exchange reserves. The willingness of these countries to follow the monetary expansionary path and the ability of the financial system to finance it added to the impact of the economic crisis. The internationalization of financial markets and the increased mobility of capital (OPEC surplus, transformed into spending by another country) has made this process possible.

The increase in amount and burden of debt in the early eighties caused a shortening in terms and hardening of the conditions for borrowing. This type of borrowing, even at higher rates, was still attractive because no conditions, in terms of policy reforms, were attached. For some, the debt burden became excessive and forced them to enter into multilateral debt negotiations when they failed to meet their debt service obligations. Debt service, especially, was a burden for the larger countries such as Kenya and Sudan (table 21).

In Kenya, outstanding debt (both medium- and long-term) grew by more than 60 percent during 1979-82. Since then, despite slow growth of investment and loans, the rate of external debt increased from 25 percent of GDP, in 1979-82 to 40 percent of GDP and the cost of servicing loans rose to 20.6 percent of export earnings. In Sudan, from 1970 to 1983, public debt ballooned from $300 million to $5.7 billion, and other obligations (such as military debt and privately held debt) were estimated to have risen to $7 billion. By 1984, Sudan faced an outstanding debt of about 10 times export earnings and an import bill of about 4 times export

Table 20--Export earnings, imports, debt service, and international reserves

Country	Annual growth rate, 1966-68 to 1981-83, of-- Exports	Annual growth rate, 1966-68 to 1981-83, of-- Imports	Ratio of export earnings to imports, 1982	Imports covered by gross international reserves, 1982
	Percent		Ratio	Days
Ethiopia	9.42	11.00	0.69	95
Kenya	10.89	13.78	.65	42
Lesotho	15.55	18.15	.08	40
Mali	15.66	14.80	.62	10
Mozambique	2.90[1]	4.30[1]	na	na
Niger	18.60	18.90	.84	12
Senegal	8.27	12.05	.53	2
Somalia	12.12	16.76	.36	25
Sudan	7.42	11.82	.28	10
Zambia	3.89	5.87	.80	13
Zimbabwe	11.56	11.64	.89	33

na = Not available.
[1]Incomplete series, 1966-76 is the period covered.

Source: (32).

earnings. This situation led to severe shortages of agricultural inputs, including fuel. The current account deficit increased to about 10 percent of GDP.

Factors Affecting Governments' Decision to Import

Because governments in most of these countries are the major importer of food, explicit attention must be paid to their behavior, especially if shortrun food availabilities are to be projected.

Recognizing the limitations of data and expected variation in behavior of governments in the different countries, we attempted to develop a standard import model in which the basic data are available. A simple least squares regression is used to measure the relationship between quantity of commercial food imports (dependent variable) and total grain production, foreign exchange earnings, quantity of food aid, and world food prices (independent variables).

The uncertainty which surrounds decisionmakers' behavior in a given year makes it necessary to use two different specifications of the model: a 1-year lag and current quantities of production and foreign exchange revenues are used as explanatory variables. The two scenarios allow us to assess the responsiveness of governments' actions in importing, especially in concurrent production shortfalls and adverse variations in foreign export revenues. The sign and magnitude of the coefficient indicate how internal instability in production and external instability in foreign revenue earning prospects would translate into food availability.

In the present model, we hypothesized that the countries respond to a production shortfall by increasing commercial import quantities. Variations in foreign exchange inflow are expected to work through government control mechanisms; when foreign exchange receipts are high, governments are hypothesized to increase the quantities of commercial imports to demonstrate economic prosperity. The treatment of food aid in estimating trade behavior is somewhat uncertain. Countries are expected to substitute food aid for imports as a means of obtaining

Table 21--Debt service ratios

Country	Debt service as a percentage of--			
	Gross national product		Exports of goods and services	
	1970	1983	1970	1983
	Percent			
Ethiopia	1.2	1.4	11.4	11.5
Kenya	1.8	5.5	5.4	20.6
Lesotho	.4	1.9	na	2.5
Mali	.2	1.3	1.3	6.1
Mozambique	na	na	na	na
Niger	.6	5.6	3.8	na
Senegal	.8	1.9	2.8	na
Somalia	.3	1.2	2.1	13.1
Sudan	1.7	1.2	10.7	11.2
Zambia	3.5	4.0	5.9	12.6
Zimbabwe	.6	8.1	na	31.6

na = Not available.

Source: (60).

budget relief. They also may use food aid, however, to supplement commercial imports to improve the diet of their population. Finally, a rise in world food prices is expected to lead to reduced imports.

The results in table 22 show that in those countries which historically have had low import dependency import elasticities with respect to production were greater than one. Those countries were Ethiopia (which imported 1 percent of its food supply at the beginning of the study period and 5 percent at the end of the study period), Kenya (5 and 11 percent), Mali (1 and 14 percent), Niger (1 and 9 percent), and Sudan (8 and 10 percent). The only exception in this group was Zimbabwe (8 and 6 percent), which had a relatively low import elasticity with respect to production (-0.73), reflecting the larger storage capacity in that country and a government policy of purposefully maintaining large buffer stocks of cereals, which reduce production-induced variations in cereal imports. On the other hand, those countries with a historically high import dependency showed noticeably smaller import elasticities with respect to production. Those countries included Lesotho (13 and 56 percent at the beginning and end of the study period, respectively), Mozambique (8 and 38 percent), Senegal (27 and 40 percent), Somalia (23 and 53 percent), and Zambia (6 and 21 percent).

Increased foreign exchange earnings led to positive responses in terms of cereal imports in all the countries, as was expected. But the magnitude of this response differed considerably among countries. Mozambique, Senegal, and Zimbabwe showed the lowest response--0.50, 0.14, and 0.21, respectively. On the other hand, in Ethiopia, Kenya, Mali, Sudan, and Zambia, a 1-percent increase in foreign exchange earnings led to a greater than 1-percent change in cereal imports, other factors remaining equal. Thus, even in those countries that have relatively minor import dependency, relaxed financial constraints lead to increased imports.

Food aid did not greatly influence commercial imports during the study period. With the exception of Ethiopia, where the import elasticity with respect to food aid was -0.61, the sizes of elasticities were quite small, ranging from -0.07 in Somalia to +0.23 in Senegal. These results appear to indicate that the low, unstable impact of food aid on imports is due to the large interannual variability of quantities received by the countries. This variability results in part from the fact that food aid allocations were usually made on an emergency basis. World prices did not appear to affect import levels significantly.

Table 22--Cereal import elasticities

Country	Percent change in cereals imports due to a 1-percent change in--			
	Production	Foreign exchange	Food aid	World price
Ethiopia	-1.15	1.70	-0.61	na
Kenya	-2.39	1.22	-.02	na
Lesotho	-.23	.51	.03	-1.02
Mali	-2.87	1.26	.13	na
Mozambique	-.53	.50	.15	na
Niger	-1.07	.86	.01	na
Senegal	-.37	.14	.23	-.38
Somalia	-.82	.82	-.07	na
Sudan	-2.30	1.04	-.04	na
Zambia	-.87	1.44	-.02	na
Zimbabwe	-.73	.21	na	na

na = Not available.

Source: Estimations based on ERS data base.

Adjusting to Food Shortages

In Sub-Saharan Africa certain traditional means of coping with exceptional food shortages exist which partially offset the variations and decline in consumption. Two such adjustment mechanisms discussed here are storage and food substitution, both short term in nature.

Storage as a Means of Stabilizing Consumption

Food storage for purposes other than speculation takes place at two different levels. First, national governments attempt to maintain stocks of cereals as security against food shortages. Second, farmers or communities of farmers hold stocks at the farm and village level for consumption later in the year and as insurance against crop failure the following year.

Central Level

Governments of all the study countries have one or a combination of national policy objectives in holding cereals stocks at the central level (table 23). The stock programs impose three initial requirements: a stock of food, storage facilities, and a managerial bureaucracy. In many cases the intention is to build the reserve stock through domestic purchases, although the actual mix between domestic food and imported food depends on the size of surpluses produced, the ability of the national government to organize procurement, and the availability and cost of imports.

Table 23--Cereal stock policies and practices, 1981-83

Country	Objectives of stock policies and practices: A	B	C	D	E	F	Actual stocks, 1981-83	Share[1]
							1,000 tons	Percent
Ethiopia		x		x			175	3.2
Kenya	x	x	x	x		x	494	17.5
Lesotho	x	x					0	0
Mali		x	x			x	0	0
Mozambique			x				0	0
Niger	x	x	x	x			47	3.9
Senegal	x	x	x	x			37	2.9
Somalia	x	x	x				365	61.8
Sudan	x	x		x			317	10.0
Zambia		x	x			x	28	1.9
Zimbabwe	x	x	x	x	x		941	47.6

Notes:
A = To maintain supplies to domestic markets.
B = To meet emergencies.
C = To stabilize prices.
D = To meet public distribution programs.
E = To meet international commitments such as food aid or long-term contracts.
F = Strategic considerations.

[1]Percent of 1981-83 cereals availability represented by stocks.

Source: Objectives from (25); stock data from ERS country analysts in the International Economics Division, Africa and Middle East Branch.

In calculating the desired level of emergency reserves, planners are constrained by the existing storage capacity in the country and the cost of expanding this capacity. Three factors are important in this connection: total costs of maintaining stocks, the need to renew stocks at regular intervals, and the need to harmonize pricing policies with food storage policy objectives. Considering these three factors, the opportunity costs of accumulating and maintaining large quantities of food in central storage may be very high.

Village Level

Field reports indicate storage capacity at farm and village levels in African countries is significantly larger than that at the central level. This is not surprising, given the predominantly rural population and the subsistence nature of agricultural production in these countries.

As a mechanism for adjusting consumption, food storage is best evaluated in terms of the capacity and length of time for which the food actually stored can sustain the population concerned. Several attempts have been made in Africa to arrive at this sort of estimate.

A survey of 127 farming households in Niamey, Tahoua, and Zinder departments in Niger, for example, found that onfarm storage capacity is such that after a good harvest the equivalent to 160 percent of annual consumption was stored (*11*). One published official estimate for Niger suggests that onfarm storage capacity approaches 1 million tons (*8*), about 60 percent of a normal year's cereals production. Interviews with farmers in Somalia found that 25-75 percent of the sorghum harvest was stored. However, this relatively large initial amount stored is mostly used through household consumption during the course of the year, settlement of obligations, barter for necessities, and cash sales at higher prices later in the year (*6*).

Food Substitution as a Means of Stabilizing Consumption

The knowledge of food substitution in African countries suffers from a lack of research because of the failure to collect reliable data and because of the limited usefulness of existing data for drawing inferences at the national level because of marked regional diet differences. Most urban consumption surveys have been conducted as a basis for constructing consumer price indexes, which reflect only cash transactions. In rural areas, studies in this area usually explore relationships between consumption and income, rather than focusing on the food consumption behavior and substitution which is our interest here.

When cereals are in short supply, consumption of other types of foods should increase where possible. Meat, milk, fish, vegetables, fruits, and root crops are types of foods which normally supplement cereals in the diet and whose supply is sometimes expandable. A survey of the sedentary population of the Senegal Valley showed, for instance, that as milk consumption decreased with the progress of the dry season, consumption of fish caught in the receding river waters increased, compensating for protein intake in the diet. The data on supplies of these foods are, however, particularly weak.

When untimely rain disrupts the crop plantings, people in Africa often engage in vegetable gardening around wells which usually still have water in them. Root crops, especially cassava, merit special attention because they are drought-resistant. Although cassava requires heavy moisture in the soil for growth 2-3 months after planting, its harvesting date is flexible anywhere between the 6th and 18th month after planting; thus, it can be harvested in a drought year. Because of its bulk and perishability, cassava is usually consumed near

the place of production and thus hardly enters into recorded trade at all. It is a crop with 30-40 percent dry matter, however, and can be a valuable crop locally in times of drought.

The supplies of such supplementary foods obviously will not hold out in the event of a catastrophic drought. First, pressures on such sources of consumption become unsustainable. Second, production of such foods itself suffers. Meat and milk disappear when drought has dried up pastures. Fish disappear when rivers and lake beds dry up.

Famine Foods

The second aspect of food substitution is the recourse to foods not normally consumed except in emergencies. Dieterlen and Calame-Griaule give a list of so-called "famine foods" in the Dogon country of Mali; most are gathered rather than cultivated.[13] In western Sudan, the wild grasses absade and kreb are eaten in times of famine. Similar examples can be found in other countries.

This type of food consumption cannot be satisfactorily recorded, short of direct surveys, so as to shed light on the nutritional well-being of African peoples. Such surveys are complicated enough at the best of times, and almost impossible to organize in times of a real food crisis. Yet the only way to verify statements by African governments that their people face starvation is by inspecting their storehouses to determine whether they are in fact empty and by observing people's eating habits to see if they are in fact subsisting on "famine foods."

Role of Food Aid

Food aid became an important global phenomenon in the aftermath of World War II, when large stockpiles of food accumulated, notably in the United States. U.S. food surpluses were initially sent to Europe. Later, they were sent to developing countries like South Korea, Taiwan, and Israel to help them meet their demand for food and as a means of developing their agricultural sectors.

Background

The United States overall has been a primary provider of food aid, both bilaterally to recipient governments and through multilateral organizations like the United Nations World Food Program (WFP). The original legislation providing U.S. food aid on a continuing basis was the Agricultural Trade Development and Assistance Act of 1954 (P.L. 480). The intent of this legislation was to curb the cost of stockpiling farm surpluses, to continue U.S. aid efforts to Europe and less developed countries, and to increase the purchasing power of U.S. trade partners who lacked sufficient foreign exchange to buy U.S. farm exports.

[13]Such "famine foods" include sorrel seeds (cultivated); wild seeds of sanavonu *(Digitaria marginata)*, sanavonu ana *(Digitaria longiflora)*, sanavonu ya *(Digitaria adscendens)*, emme sono dummu *(Sporobolus coromandelianus)*, emme sono dummu pilu *(Eragrostis turigida)*, dogo toro emme *(Panicum aphanoncurum)*, dunu nu *(Rhybchosia caribae)*, emme emmele (*Panicum longijubatum*), kenie geu *(Chloris pilosa)*, numi *(Cyperus esculentus)*, and dogo poli *(cerathoteca sesamoides)* (*13*).

Amendments to P.L. 480 in 1966 deleted references to U.S. farm surpluses and made more explicit the intent to use U.S. food to combat hunger and malnutrition (the Food for Peace program). Further changes in the legislation embodied in the International Development and Food Assistance Act of 1975 emphasized the direction of the program in moving U.S. food aid to countries that faced urgent food needs.

The 1975 legislation also provided that 75 percent of title I shipments be directed to countries having an annual per capita GNP of $300 or less "and affected by inability to secure sufficient food for their immediate requirements through their own production or commercial purchase from abroad." In 1977 the GNP limit was raised to $550 in 1976 dollars. The limit was later pegged to the cut-off point for International Development Association (IDA) loan eligibility; the level is now $790 in 1983 dollars. The 1977 legislation also added the title III Food for Development program (*54*).

Food shipments under title I consist of concessional sales and are conditional on the recipient countries' efforts to attain a "greater degree of self-reliance, including efforts to meet their problems of food production and population growth." Title II food shipments are "to meet famine or other urgent or extraordinary relief requirements; to combat malnutrition, especially in children; to promote economic and community development in friendly developing areas; and for needy persons and nonprofit school lunch and preschool feeding programs." The major activity under title II is carried out under the auspices of voluntary U.S. agencies, such as Cooperative for American Relief Everywhere (CARE) and Catholic Relief Services, and of multilateral organizations like WFP.

Through time, with the decline in U.S. agricultural surpluses, the U.S. Government encouraged other developed governments to assume a larger responsibility for providing food aid. For the donor countries, prior to 1972, food aid deliveries could be arranged conveniently because of the continuing existence of excess production capacity. The world food production shortfall of 1973-74 caused world food prices to rise 147 percent between 1972 and 1974. With increases in transportation costs due to the escalation of oil prices and increases in the commercial demand for grain (livestock numbers had expanded substantially in the Soviet Union, Japan, Eastern Europe, and China), the question of the size of the food aid program and its cost became more important.

During the late seventies, another major development which had significant implications for allocating food aid lay in the changes in U.S. agricultural policy. With increased U.S. Government storage of grain, and its attendant costs, policy shifted towards controlling production and finding outlets for commercial exports. The promotion of commercial exports was partly a response to European protectionist agricultural policies. The problems of international agricultural trade protection and international foreign policy rivalry are never very far from matters concerning food aid. Thus, allocating food aid among recipients has been significantly affected by political considerations.

Another development during this period was more emphasis on the use of food aid for human relief. From World War II to 1972, U.S. humanitarian relief was never more than 30 percent of the total food donations in any one year. However, by the seventies the relief element in total food aid had risen to about 70 percent of all food donated.

In the sixties, most food aid went to Asia and Latin America. Sub-Saharan Africa, however, assumed an increasingly prominent role as a recipient of food aid beginning in the seventies,

and by 1982/83 was absorbing as much food aid as Asia, with seven times the population, as FAO figures show (fig. 12, *19*). The 1968-73 drought in the Sahel and the Ethiopian famines of 1973-74 and 1984-85, with the humanitarian response from the developed countries which these crises engendered, gave strong impetus to this trend.

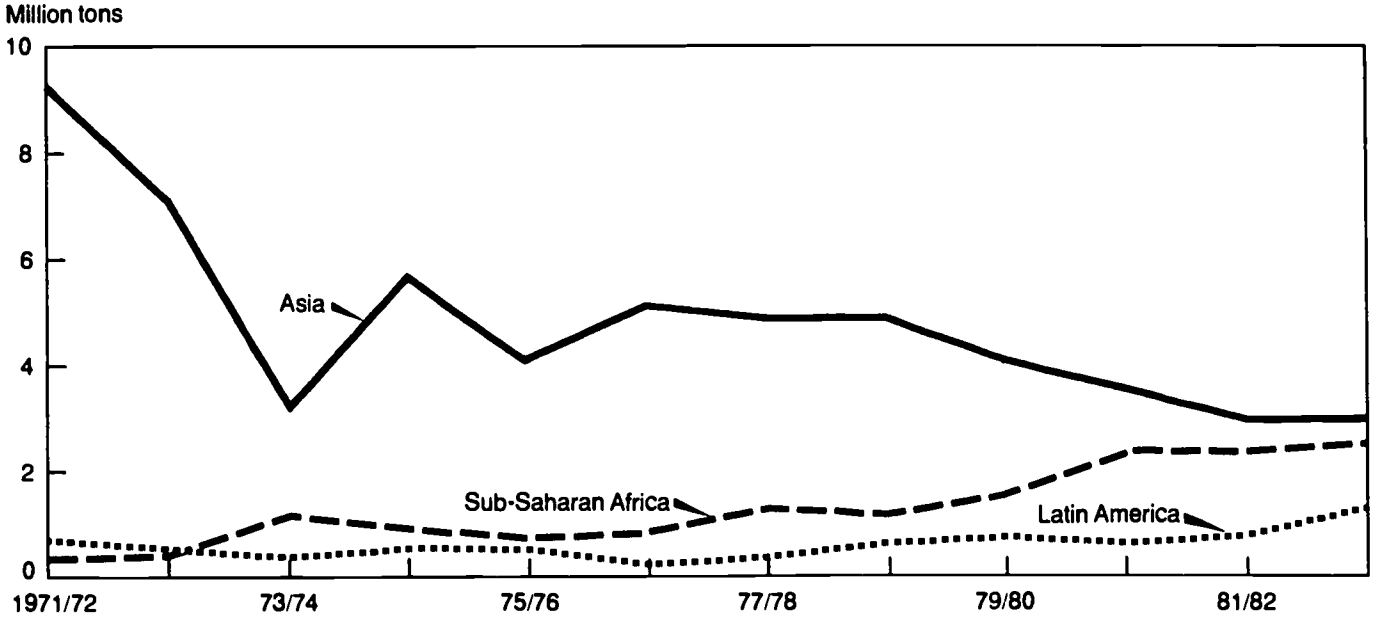
Many countries participated in providing food aid to these 11 countries. The United States and European countries were the major contributors of food aid. Through time, their share for different countries has varied significantly. Overall, the U.S. share of food aid declined through time (table 24). This decline in part is a consequence of the overall increase in food aid shipments. For example, in 1970, the total cereals food aid donated to these countries was 44,000 tons, with the United States providing 98 percent. In 1983, these countries received almost 1.3 million tons and the United States provided 42 percent of total cereals food aid or 560,000 tons.

Share of Food Aid in Consumption

Data show positive growth rates of aggregate cereal food aid received by all the 11 study countries between 1966-68 and 1981-83 (table 3, col. 3). Despite positive growth rates over the full study period, aid flows have fluctuated considerably in the short term. A closer look at the coefficients of variability in table 3 reveals considerable variability in food availability even with food aid factored in. Moreover, in Ethiopia, Kenya, Somalia, and Zambia, the observed variability in food availability has been higher with food aid than without. In Somalia, the coefficients of variation actually increase as one moves from production to total availability from all sources. These findings raise questions about the timely arrival of food aid to fill food production shortfalls.

Figure 12

Destination of Cereals Food Aid



Source: *(19)*

Table 24--Portion of recipients' food aid (tonnage) from the United States, 1966-83

Year	Ethiopia	Kenya	Lesotho	Mali	Mozambique
			Percent		
1966	96.73	100.00	--	--	--
1967	46.67	100.00	--	--	--
1968	0	100.00	--	--	--
1969	0	--	0	0	--
1970	97.66	100.00	--	0	--
1971	100.00	100.00	--	0	--
1972	100.00	100.00	100.00	4.60	--
1973	23.08	85.71	89.80	37.01	--
1974	54.89	--	100.00	55.51	--
1975	20.38	0	100.00	6.07	0
1976	16.67	12.64	94.64	1.19	0
1977	30.53	6.92	100.00	100.00	17.13
1978	32.97	14.75	86.29	52.94	33.57
1979	42.80	4.14	100.00	25.67	51.54
1980	33.19	82.00	61.52	19.59	59.72
1981	11.79	67.19	97.75	0	9.12
1982	1.19	47.46	56.86	6.86	6.77
1983	2.31	60.13	55.81	20.15	14.62
1981-83 average	5.10	58.26	70.14	9.00	10.17

	Niger	Senegal	Somalia	Sudan	Zambia
			Percent		
1966	--	100.00	100.00	100.00	100.00
1967	--	100.00	100.00	100.00	--
1968	--	--	100.00	--	--
1969	0	81.31	55.56	0	--
1970	0	100.00	8.85	0	100.00
1971	--	100.00	10.11	C	100.00
1972	4.11	20.29	0	0	100.00
1973	70.14	33.89	0	62.16	5.66
1974	60.84	51.72	0	85.55	--
1975	7.42	6.80	17.52	30.80	13.79
1976	25.30	29.92	11.99	2.78	.99
1977	8.33	10.75	3.15	86.07	33.73
1978	46.78	47.88	52.17	84.77	0
1979	1.06	32.58	68.34	79.04	69.18
1980	80.00	54.45	67.78	89.14	75.09
1981	27.54	42.02	65.76	81.29	70.79
1982	28.55	28.37	38.10	55.18	44.43
1983	100.00	58.78	85.49	44.91	45.82
1981-83 average	52.03	43.06	63.12	60.46	53.68

-- = No food aid received from any country.

Source: Calculated from ERS data base.

On a per capita basis, the food aid received by these countries has on average steadily increased since 1966 (table 25). However, there have been marked variations among countries. Mali and Niger both show very heavy per capita food aid in 1974, the final year of the Sahel drought of 1968-74. This high level of aid may reflect the desperate food need following 5 years of drought to reestablish stocks, but it may also reflect in part the donors' pipeline being put in place to deliver such aid to remote, landlocked regions. The only other country to have received such heavy food aid per capita was Somalia in 1980-81. Nevertheless, this level was rapidly being approached in 1983 by Sudan, the most populous of the study countries.

Before 1977, only Ethiopia, Kenya, and Sudan had received P.L. 480 title I food donations among our study countries (table 26). Sudan's food aid receipts started climbing significantly in 1977. Some 90 percent of this has been structural food aid. In Somalia, the second major recipient of food aid in terms of total volume, 70 percent of total allocated aid was under title II because of the border conflict and refugee problem, and the rest was under title I. In Zambia and Senegal, the share of U.S. title I food aid ranged from 31 to 100 percent of total food aid received in a given year. In Lesotho, Mali, and Niger, all food aid donated by the United States was under title II.

Growth of Food Aid Dependency and Allocation Criteria

Over the period 1966-83, food aid receipts by the 11 countries increased at an average annual rate of 17.1 percent (table 3, col. 3). This rate accelerated in the most recent decade. While total food imports into the 11 countries grew by nearly 50 percent between 1966-68 and 1971-73 and then again by 60 percent between 1971-73 and 1981-83, the volume of food aid multiplied more than eightfold between 1971-73 and 1981-83 (table 27). For some countries, the rate of growth of food aid has been even higher, because their food aid receipts in 1971-73 were nonexistent or negligible.

Not only has the rate of food aid receipts increased markedly in recent years, so has the study countries' dependence on food aid for their supplies. Columns 7, 8, and 9 of table 27 indicate the 11 study countries had a food aid dependency of 1.0 percent at the beginning of the study period. By 1971-73, this was still only 1.2 percent (in spite of the Sahel drought). But by the end of the study period food aid dependency had gone up to 7.4 percent.

What has determined food aid allocations among countries is not known with certainty, since each donor country has its own policies and criteria. A long-term relationship, like that between France and the Sahelian countries, is apt to establish a pattern of priorities in food aid allocations.

Criteria such as shortage of foreign currency and nutritional need in recipient countries are often advanced by donor countries to justify their allocation of food aid. To see how food aid receipts in the 11 study countries measure up in terms of criteria such as these, we plotted the countries according to their per capita calorie availability in relation to the FAO-recommended minimum level of 2,340 calories per day and their per capita foreign currency earnings in 1981-83 (fig. 13). Ranking of the countries by calorie availability would suggest that Ethiopia and Mali should have received the largest allocations of food aid, while Zambia, Zimbabwe, and Lesotho should have received the lowest. As our data indicate, Somalia, Mozambique, Sudan, Senegal, and Zambia received the largest per capita allocations of cereals food aid in this period (28, 19, 16, 14, and 14 kg, respectively), while Ethiopia and Mali were among the lowest recipients (4 and 7 kg, respectively).

Table 25--Per capita food aid, 1966-83

Year	Ethiopia	Kenya	Lesotho	Mali	Mozambique	Niger
			Kilograms			
1966	1.19	20.16	0	0	0	0
1967	.13	.12	0	0	0	0
1968	.06	.26	0	0	0	0
1969	.36	0	2	0.61	0	4.92
1970	.50	.20	0	6.00	0	3.85
1971	.13	.25	0	3.82	0	0
1972	.37	.14	13.18	8.23	0	1.78
1973	.24	.11	17.82	16.77	0	11.88
1974	3.53	0	4.75	31.67	0	43.35
1975	1.32	.37	6.25	8.69	.21	8.69
1976	1.04	.62	9.33	1.45	6.13	18.30
1977	1.78	.89	7.75	.03	11.41	.77
1978	2.07	.40	9.54	7.25	7.53	7.44
1979	2.47	1.07	12.08	2.97	10.25	3.76
1980	2.88	7.41	35.38	1.49	13.35	.98
1981	3.47	11.87	19.07	5.58	12.29	2.60
1982	5.60	8.39	10.93	6.85	15.08	10.19
1983	3.09	7.43	15.36	7.59	28.51	.29
Average:						
1966-83	1.68	3.32	9.08	6.06	5.82	6.60
1981-83	4.05	9.23	15.12	6.67	18.63	4.36

Year	Senegal	Somalia	Sudan	Zambia	Zimbabwe	11 countries[1]
			Kilograms			
1966	4.76	0.76	3.17	0.16	0	2.75
1967	13.51	.27	1.31	0	0	1.39
1968	5.98	0	0	0	0	.57
1969	7.46	.22	1.85	0	0	1.58
1970	4.12	3.21	.73	.24	0	1.71
1971	3.65	4.79	.64	.05	0	1.21
1972	4.70	4.29	.83	.11	0	3.06
1973	11.74	4.29	2.50	1.18	0	6.05
1974	19.17	3.33	2.28	0	0	9.83
1975	6.13	13.92	1.85	1.21	0	4.42
1976	4.88	15.37	.90	4.06	0	5.64
1977	14.41	13.82	4.16	8.20	0	5.75
1978	24.06	14.79	5.99	2.26	0	7.39
1979	8.19	19.07	9.16	15.22	0	7.66
1980	15.93	46.29	10.17	29.11	1.30	14.94
1981	18.04	42.33	12.89	17.83	1.05	13.05
1982	11.00	29.08	14.25	10.02	.66	10.77
1983	14.15	12.43	20.17	15.06	1.23	10.84
Average:						
1966-83	10.66	12.68	5.16	5.82	.24	6.04
1981-83	14.40	27.95	15.77	14.30	.98	11.56

[1]Population-weighted average.

Source: Calculated from ERS data base.

Table 26--Shares of U.S. food aid from P.L. 480 title I and title II

Year	Ethiopia		Kenya		Lesotho		Mali		Mozambique		Niger	
	Title I	Title II	Title I	Title II	Title I	Title II	Title I	Title II	Title I	Title II	Title I	Title II
	Percent											
1966	38.3	61.7	85.9	14.1	--	--	--	--	--	--	--	--
1967	0	100.0	0	100.0	--	--	--	--	--	--	--	--
1968	--	--	0	100.0	--	--	--	--	--	--	--	--
1969	--	--	--	--	--	--	--	--	--	--	--	--
1970	0	100.0	0	100.0	--	--	--	--	--	--	--	--
1971	0	100.0	0	100.0	--	--	--	--	--	--	--	--
1972	0	100.0	0	100.0	0	100.0	0	100.0	--	--	0	100.0
1973	0	100.0	0	100.0	0	100.0	0	100.0	--	--	0	100.0
1974	0	100.0	--	--	0	100.0	0	100.0	--	--	0	100.0
1975	0	100.0	--	--	0	100.0	0	100.0	--	--	0	100.0
1976	0	100.0	0	100.0	0	100.0	0	100.0	--	--	0	100.0
1977	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0
1978	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0	0	100.0
1979	0	100.0	0	100.0	0	100.0	0	100.0	4.5	95.5	0	100.0
1980	0	100.0	69.8	30.2	0	100.0	0	100.0	64.7	35.3	0	100.0
1981	0	100.0	91.2	8.8	0	100.0	--	--	0	100.0	0	100.0
1982	0	100.0	95.2	4.8	0	100.0	0	100.0	0	100.0	0	100.0
1983	0	100.0	98.4	1.6	0	100.0	0	100.0	0	100.0	0	100.0

Year	Senegal		Somalia		Sudan		Zambia		Zimbabwe	
	Title I	Title II	Title I	Title II	Title I	Title II	Title I	Title II	Title I	Title II
	Percent									
1966	0	100.0	0	100.0	100.0	0	0	100.0	--	--
1967	0	100.0	0	100.0	99.4	.6	--	--	--	--
1968	0	100.0	--	--	--	--	--	--	--	--
1969	0	100.0	0	100.0	--	--	--	--	--	--
1970	0	100.0	0	100.0	--	--	0	100.0	--	--
1971	0	100.0	0	100.0	--	--	0	100.0	--	--
1972	0	100.0	--	--	--	--	0	100.0	--	--
1973	0	100.0	--	--	100.0	0	0	100.0	--	--
1974	0	100.0	--	--	86.6	13.4	--	--	--	--
1975	0	100.0	0	100.0	0	100.0	0	100.0	--	--
1976	0	100.0	0	100.0	0	100.0	0	100.0	--	--
1977	0	100.0	0	100.0	77.3	22.7	97.2	2.8	--	--
1978	0	100.0	37.3	62.7	96.4	3.6	--	--	--	--
1979	0	100.0	51.5	48.5	95.4	4.6	82.0	18.0	--	--
1980	49.1	50.9	38.2	61.8	69.0[1]	7.6[1]	80.3	19.7	0	100.0
1981	31.0	69.0	34.6	65.4	98.8	.2	100.0	0	0	100.0
1982	76.3	23.7	81.9	18.1	99.9	.1	100.0	0	0	100.0
1983	76.8	23.2	76.0	24.0	57.9[2]	25.2[2]	53.5	46.5	0	100.0

-- = No food aid from any country.
[1]In 1980, 23.4 percent of Sudan's food aid from the United States came under a third category.
[2]In 1983, 16.9 percent of Sudan's food aid from the United States came under a third category.

Source: ERS data base.

Table 27--Food imports and food aid dependency[1]

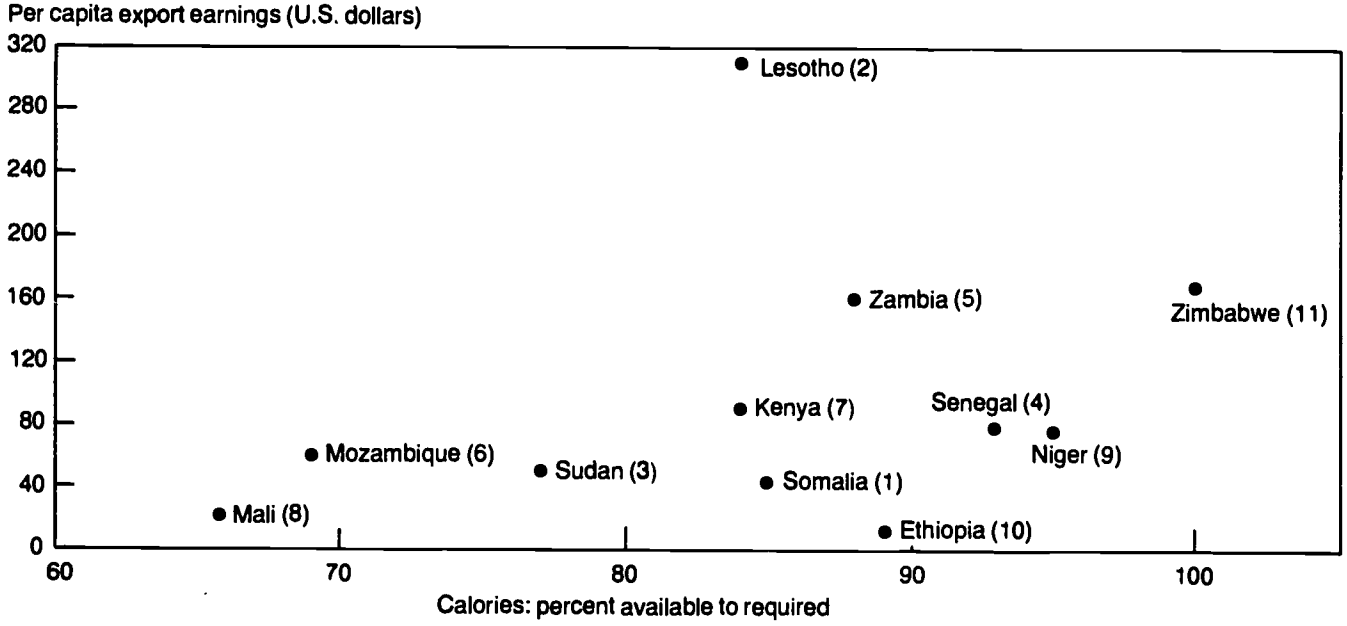
Country	Commercial food imports			Food aid			Food aid dependency[2]		
	1966-68	1971-73	1981-83	1966-68	1971-73	1981-83	1966-68	1971-73	1981-83
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	1,000 tons						Percent		
Ethiopia	33.0	31.3	79.9	5.7	6.6	212.2	0.1	0.2	3.7
Kenya	27.0	53.0	212.0	67.2	2.0	177.3	4.8	.1	7.4
Lesotho	29.0	50.7	178.3	0	11.4	29.0	0	5.9	10.7
Mali	14.0	47.7	95.0	0	50.4	54.5	0	5.9	6.1
Mozambique	66.0	115.7	196.7	0	0	142.3	0	0	17.5
Niger	8.3	13.3	79.3	0	19.1	30.3	0	3.0	3.0
Senegal	234.7	270.7	427.3	31.6	30.1	93.2	5.1	4.6	9.1
Somalia	35.0	74.3	176.3	1.0	15.4	168.8	.4	5.1	30.9
Sudan	161.0	203.0	126.3	18.8	19.3	305.8	1.1	1.0	11.7
Zambia	63.0	205.0	172.7	.2	2.0	90.6	0	.2	8.1
Zimbabwe	85.0	49.7	36.7	0	0	7.8	0	0	.6
Total	756.0	1,114.4	1,780.5	124.5	156.3	1,311.8	1.0[3]	1.2[4]	7.4[5]

[1]3-year averages.
[2]Defined as a 3-year moving average of the percentage of food availability accounted for by food aid.
[3]Average weighted by 1968 population.
[4]Average weighted by 1973 population.
[5]Average weighted by 1983 population.

Source: Appendix tables 1-11.

Figure 13

Nutritional Status and Earnings, 1981-83 Averages



Numbers in parentheses indicate ranking in terms of food aid receipts.

When we compared food aid receipts and domestic food production, we found that variations in domestic production accounted for less than 20 percent of the variation in food aid. Mozambique and Mali were exceptions to this finding; production variations accounted for 56 percent of the variation in Mozambique and 36 percent in Mali.

These tests indicate that criteria of a foreign policy or strategic nature, in a mix that varies by case, are apparently important as determinants of how effective each country's demand for food aid is (*37*).

The Impact of Food Aid

Food aid may be expected to have both short-term and long-term effects in the recipient country. In this context, we will review the short-term impact of food aid on nutrition, finances, production, and other indirect effects.

On Consumption

A major role of food aid has been to avert widespread short-term loss of life in the face of especially large-scale disasters such as the 1973-74 drought in the Sahelian countries. During the drought period, food aid provided the equivalent, in aggregate terms, of 14 percent of food consumption in Mali, 18 percent in Niger, and 8 percent in Senegal. Again, during the 1979-80 drought in Southern Africa, food aid contributed 11 percent of food consumption in Lesotho, 16 percent in Mozambique, and 13 percent in Zambia. Food aid also added 9 percent and 15 percent, respectively, to food availabilities in Sudan and Ethiopia in the recent drought. These figures are not insignificant measures of the direct impact of food aid on consumption, in aggregate.

On Production

African governments historically have neglected the food sector; whether food aid indirectly helped them to overcome the consequences of this neglect is very difficult to demonstrate conclusively. The magnitude of the direct effect of food aid on domestic food production in the recipient country is very sensitive, in theory, to the proportion such food represents in relation to domestic production (*16*).

The importance of food aid has varied in African countries. During the sixties, food aid represented a relatively minor quantity in relation to domestic food production, generally less than 2 percent (table 28). However, in the seventies and eighties, cereal food aid grew in relation to domestic production, reaching proportions of 85 percent in Somalia and 96 percent in Mozambique (in aggregate terms).

To examine the trend of food aid and domestic production during the seventies and early eighties, we focused on three countries with distinct characteristics: Senegal, Sudan, and Kenya.

- Senegal has had a high historical import dependency, varying from 20 percent to 40 percent over time, and has been a major recipient of food aid: food aid has represented as much as 23 percent of food production in 1 year.

- Sudan has been almost self-sufficient overall in grain, occasionally exporting sorghum and regularly importing wheat. Sorghum is a major source of foreign exchange

earning, and wheat is a growing item in the country's diet. Food aid wheat increased to about 16 percent of total cereal production and almost twice domestic wheat production.

- o Kenya, depending on weather conditions, has been both an exporter and an importer of grain. Although Kenya's agricultural sector is strong, the country has shown a growing dependency on food aid in recent years.

The indexes of the major food item in each country, the respective producer price deflated by CPI, and the food aid received are shown in figure 14. The main similarity among countries is the almost flat shape of prices through time. In Kenya, food production movements largely follow price movements; food aid has increased substantially, especially between 1979 and 1981. Given the short trend period of aid in the country, food aid has not greatly affected Kenyan food production.

Almost all the food aid received by Sudan has been wheat from the U.S. title I program. Sudanese wheat is mainly grown in irrigated areas. In the late seventies, wheat area stagnated and then declined in response to the extreme shortages of inputs because of a foreign exchange shortage, transport problems, and lack of management on the irrigated schemes. Inadequate and artificially set producer prices and many other major economic and financial problems could be reasons for declining wheat production. The large quantity of wheat as food aid (almost twice as much as domestic production) and the importance of wheat in the Sudanese diet, however, may have allowed the Sudan Government to ignore the predictable consequences of a 50-percent decline in domestic production from a peak of 317,000 tons in 1978 to 162,000 tons in 1983.

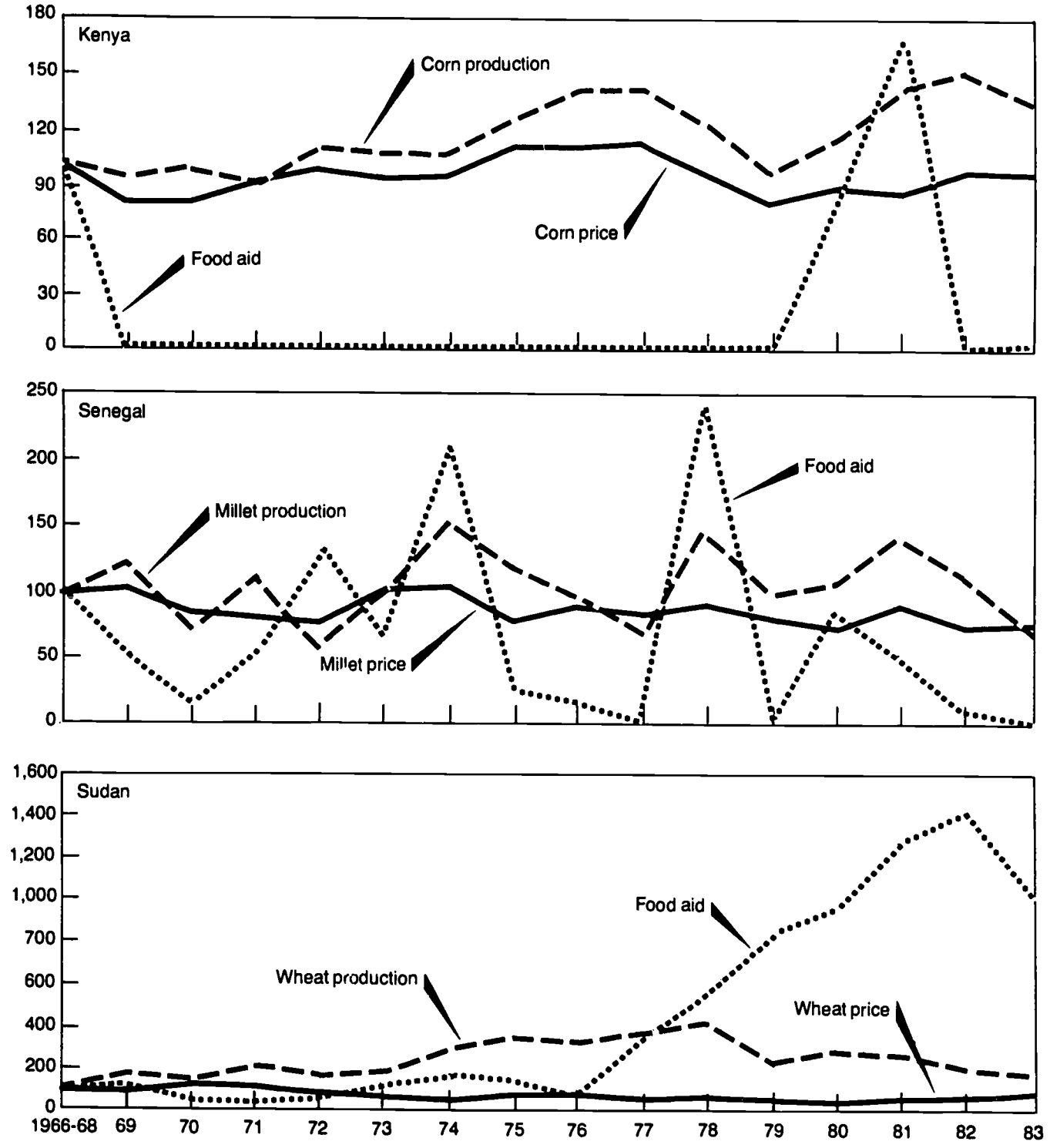
Table 28--Food aid represented as a percentage of domestic food production

Year	Ethiopia	Kenya	Lesotho	Mali	Mozambique	Niger	Senegal	Somalia	Sudan	Zambia	Zimbabwe
					Percent						
1966	0.60	11.09	0	0	0	0	2.51	1.10	3.17	0.06	0
1967	.06	.06	0	0	0	0	8.93	.32	1.38	0	0
1968	.03	.12	0	0	0	0	2.81	0	0	0	0
1969	.17	.00	.98	.31	0	2.83	5.74	.27	1.94	0	0
1970	.25	.11	0	2.71	0	1.60	2.06	3.93	.49	.13	0
1971	.07	.14	0	1.93	0	0	2.96	7.06	.41	.02	0
1972	.22	.09	10.14	4.50	0	.94	2.84	6.70	.58	.05	0
1973	.15	.06	11.81	11.31	0	6.73	14.21	4.70	2.01	.57	0
1974	2.34	.00	2.16	20.00	0	37.13	14.79	3.77	1.50	0	0
1975	.69	.23	4.93	4.15	.33	5.26	3.08	17.70	1.17	.53	0
1976	.70	.35	9.41	.77	11.60	17.08	3.10	23.74	.52	1.66	0
1977	1.30	.47	3.73	.02	18.31	.40	10.17	23.74	2.48	3.72	0
1978	1.58	.22	4.44	4.21	12.17	3.38	23.12	23.61	3.55	1.13	0
1979	1.23	.69	6.23	1.43	18.50	1.87	4.41	33.52	5.03	10.49	0
1980	1.80	6.12	23.12	.83	28.51	.45	13.23	85.13	8.14	17.99	.47
1981	2.17	8.73	11.61	4.12	24.38	1.20	15.74	85.00	8.56	7.76	.25
1982	3.77	5.45	8.84	4.33	32.51	5.00	6.95	52.30	6.94	5.49	.23
1983	2.07	4.76	14.33	4.85	96.51	1.99	11.03	22.56	16.19	8.24	.78
Average:											
1966-83	1.07	2.15	6.21	3.64	13.49	4.77	8.21	21.95	3.56	3.21	.10
1981-83	2.67	6.32	11.60	4.43	51.14	2.73	11.24	53.29	10.56	7.16	.42

Source: Calculated from ERS data base.

Figure 14

Kenya, Senegal, and Sudan: Comparative Price Indices



In Senegal, with the longest history of structural food aid, food aid as a share of production ranged from 2 to 23 percent. The deflated producer price and production of millet showed almost the same patterns as other countries: stagnant producer price and stagnant production with some variations, probably due to weather variation. Whether food aid had a major role in the government's support of food production is difficult to answer. The overall share of food aid in total food imports ranged from 6 to 30 percent. Given the security role of food aid and the higher growth of food aid compared with commercial imports, food aid may have constituted an incentive to Senegal's Government to ignore the seriousness of the problems facing the agricultural sector.

Financial Relief Impact of Food Aid

Food aid should represent a net addition to the recipient country's resource base. According to our data, food aid has successfully freed foreign currency for commercial food imports, especially in years with large production shortfalls. But its financial relief effect may be much deeper than merely commodity substitution, particularly if donors underwrite the costs of internal transportation.

If food aid is essentially substitutable for commercial imports, the share of food aid in total food imports becomes an important indicator. Food aid has increased systematically as a share of total food imports in Kenya, Mozambique, Somalia, Sudan, and Zambia (table 29). In Ethiopia, Mali, and Niger, on the other hand, which were all victims of food crises in the

Table 29--Food aid as a percentage of total food imports (tonnage)

Year	Ethiopia	Kenya	Lesotho	Mali	Mozam-bique	Niger	Senegal	Somalia	Sudan	Zambia
					Percent					
1966	39	86	0	0	0	0	7	5	29	1
1967	9	3	0	0	0	0	20	2	9	0
1968	8	21	0	0	0	0	9	0	0	0
1969	30	0	4	23	0	70	10	2	14	0
1970	17	8	0	64	0	63	5	19	9	1
1971	7	5	0	35	0	0	6	12	4	0
1972	78	2	21	43	0	51	7	21	6	0
1973	35	4	26	64	0	71	16	24	16	6
1974	63	0	11	49	0	78	17	18	17	0
1975	57	7	13	16	1	23	8	26	23	4
1976	34	15	13	5	34	84	10	39	12	19
1977	28	100	11	0	55	6	15	37	36	37
1978	30	9	10	66	31	56	23	81	62	13
1979	32	12	11	28	36	22	9	40	54	33
1980	24	26	21	22	39	13	15	71	58	41
1981	55	41	13	28	52	19	20	53	60	60
1982	71	33	7	30	85	37	12	36	72	18
1983	34	77	8	32	79	2	17	46	77	21
Average:										
1966-83	36.17	4.94	9.39	8.06	22.89	33.06	12.56	29.56	31.00	14.11
1981-83	53.33	50.33	9.33	30.00	72.00	19.33	16.33	45.00	69.67	33.00

Source: ERS data base.

early seventies (that resulted in a sharp step up of food aid) the trend is less clear. During the last few years, food aid quantities increased substantially in relation to commercial imports in all drought-affected countries. During 1981-83, Sudan, Ethiopia, Mozambique, and Kenya received at least twice as much food aid as commercial imports. In other countries, the proportion of food aid in relation to imports varied, ranging from 20 percent to 120 percent of commercial imports.

The Indirect Impacts of Food Aid

Food aid and other cereal imports can substitute for local food and contribute to changing tastes. In recent years, wheat, more than half of all food aid, has become increasingly important in the African diet. Over 75 percent of wheat is imported, while per capita consumption has doubled during the last 10 years. With total cereal consumption stagnant, the share of locally produced cereals has decreased.

Another important issue is the potentially adverse impact of food aid competing with local production for limited marketing facilities. Although the accumulated consequences of such competition have not been studied, the distribution of food aid has probably hampered marketing activities because of poor management, infrastructure bottlenecks, and other limitations in these countries.

Estimating Food Aid Needs

Considerable efforts have been devoted in recent years to the problem of estimating food aid needs. Much of this research has focused on African countries because of their large food aid needs in recent years.

A Review of Existing Methodologies

Most attempts to project food aid needs have centered on projecting the food gap under varying scenarios, incorporating assumptions about financial capability, stock changes, and other factors. In some cases, a stochastic variable is added to the model to simulate the unpredictable effect of weather on production (*20*). Models of this type result in short-term projections of food aid needs. Three models use this method.

FAO Method

Among the most frequently cited estimates of food aid needs are those produced by the Food and Agriculture Organization of the United Nations (FAO). A country's food aid requirement in cereals is calculated as its cereal import requirement less the amount the country will probably import commercially. The cereal import requirement is calculated as the difference between estimated utilization and the sum of current domestic production and available stocks (*21*).

The domestic production estimate is based on the most reliable available information and is modified and refined as more information becomes available in the course of the crop year. Wheat, rice, and coarse grains utilization is estimated individually.

In Eastern and Southern Africa, the utilization of each type of cereal is calculated as the quantity needed to meet "actual requirements" of the marketing boards plus a provision

for distribution for relief programs. In West Africa, a different approach is followed. For cereal crops which are produced domestically, the estimates are based on government and other figures for average per capita consumption in a normal period multiplied by estimated population in the current year. Allowance is made for seed requirements, animal feed, industrial uses, exports, losses, waste, and stock adjustments. For those cereal crops not produced domestically, the trend level of imports is used to estimate utilization.

It will, thus, be seen that in eastern and southern African countries the estimates calculated by FAO are sufficient to meet effective demand only, and per capita consumption is allowed to continue to decline from levels which are already below the minimum nutritional needs established by the joint FAO/World Health Organization (WHO) expert group. In West Africa, using this methodology, consumption requirements are calculated on the basis of per capita consumption rates which are also below this minimum level.

ERS Method

The "status quo" method used in producing the *World Food Needs and Availabilities* report of the Economic Research Service (ERS), USDA, is an effort to measure short-term levels of commercial food imports and food aid requirements to support consumption in a country at current per capita levels. In this instance, the target level of consumption is taken as that level needed to maintain consumption at the average level of the last 3-4 years. A variant on this method takes a measure of nutritional well-being as the target level (*52*).

ERS country analysts tabulate basic food data, based on the best available information on actual or forecast domestic production, actual or targeted beginning stocks, net imports or forecast commercial import capacity, actual or targeted ending stocks, and actual or forecast population. The methodology includes feed use and standard conversion factors applied to milled cereals. Total use minus domestic production is the status quo import requirement.

The key contribution of the ERS methodology is the hypothesis that countries need not depend solely on domestic production for dietary maintenance. Thus, much of the ERS method's calculation involves estimating a recipient country's commercial import capacity. The ability of a country to purchase food or other goods on international markets is derived from its demonstrated willingness to do so in the past. Steps in the process include determining gross foreign exchange availability and the proportion to be allocated to commercial food imports, and applying price (import and export unit values) forecasts to determine total quantities which may be purchased.

The set of macroeconomic variables used to calculate commercial import capacity are used to derive commercial food imports. An admitted weakness of the ERS method is its inability to take into account short-term budgetary reallocations to adjust commercial imports, especially in years of large production shortfalls.

Both the FAO and ERS methods estimate annual food aid requirements (or what the ERS report calls additional food needs). Thus, these two methods do not recognize explicitly the trends of the parameters affecting food availability among low- and medium-income countries. Assessment of medium- and long-term food aid needs will help donor countries identify where and to what extent food aid is needed and for what purposes, and help establish a framework for delivering that assistance to greatest effect.

Medium-term FAO Method

FAO's medium-term assessments of food aid needs attempt to differentiate between project food aid (to supplement the nutritional need), nonproject food aid (to provide budgetary support), and emergency food aid (to provide additional supplies in event of a sudden food shortfall). The methodology estimates food imports as the difference between demand for and supply of food. The demand projections are based on population, income growth, and income elasticities estimated using consumption expenditure surveys. Demand projections for feed, seed, and waste are based on historical trends over 1970-81 and structural coefficients of the market. Food production projections are based on trend extrapolations of the yield and area (*17*).

Commercial import estimates are a function of export earnings and food import prices. The portion of food imports not satisfied by commercial imports is the nonproject food aid requirement. Project food aid is estimated as the quantity required to satisfy nutritional requirements plus the quantities needed to help build planned food security reserves in the low-income countries. The projection of emergency food aid is the average emergency of the recent past years applied to the future.

Long-term IFPRI Method

Huddleston estimated two different sets of food aid needs. She estimated the effective demand for cereals in 1990 by using UN population growth and assuming consumption will equal 1975 per capita amounts plus the amount of increase under different scenarios of income growth. The difference between her total projected consumption and long-term production trend (1961-87) is the import need (*30*).

She compared these total value figures for cereal imports with the projected value of export earnings for 1990, projected at the trend for 1961-78. From these, she obtained two estimates of food aid requirements, one assuming that cereal imports having a value in excess of 5 percent of export earnings would require concessional financing, and the other assuming that those in excess of 2 percent would require such financing. An important assumption made by Huddleston was that all low-income countries that need to import cereals in order to obtain adequate food supplies will require food aid for balance of payments support, since they have weak export sectors and need foreign exchange to import capital goods during the early stages of growth.

Projecting Food Aid Needs

Food aid requirements can be assessed in different ways, depending on the scope and intended use of the projections. A single number cannot indicate how much food aid is required in countries with different patterns of economic behavior. The uncertain influence of future behavior and growth rates of the key variables can significantly change the final outcome. Nevertheless, certain assumptions can be made to provide a range of the needs of a country in different economic circumstances.

In projecting food aid needs, we focused on the midterm outlook for 1990 under three different scenarios.[14] Our projections are based on the components of food availability defined earlier in the study.[15]

[14]The Food Security Act of 1985 reauthorized P.L. 480 to Sept. 30, 1990.
[15]See definitions, above, p. 6.

Structural Relationships

These components in a particular year may be written in equation form as follows:

Food production = f (Lagged total food production, Real producer price, Dummy variable) (1)

Available food production = Food production - Waste and seed[16] (2)

Commercial imports = f (Food production, Export earnings, World food price, Food aid)[17] (3)

Attainable food availability = Available food production + Commercial imports + Changes in stocks (4)

Food availability = Attainable food availability + Food aid (5)

Thus, our projections of food availability are based on the probable performance of the food production sector and commercial import responses. Our projections of food production are based on projections of real producer prices and weather patterns, using the previously estimated elasticities of production behavior in table 13. Our projections of commercial imports are based on production projections and foreign exchange performance, other factors being kept constant at base period (1981-83) levels, using the corresponding estimated elasticities in table 22.

In this model, the trend line of attainable food availability shows the degree to which a country's own resources (in the form of domestic production plus net commercial imports) are adequate to meeting its effective demand for food. Similarly, the difference between an appropriate target consumption level and the projection to 1990 of the attainable food availability trend line provides an estimate of aggregate food aid need. (See the following discussion, *The Chronic Food Gap and the Emergency Food Gap.*)

An important simplifying assumption in the present model is that all domestically produced food goes for domestic consumption. Therefore, we did not incorporate an allowance for exports into the projections. This is a heroic assumption. The 11 countries have agriculture-based economies, and their agricultural sectors are a major source of their foreign exchange earnings. Even when their exports consist of cereals, they show a tendency to give these exports priority when confronted with adverse circumstances. Zimbabwe, for instance, did not cut off exports of corn until mid-1983, by which time it was feeling severe effects of drought and had had to request food aid in the face of a massive drawdown of stocks (appendix table 11).

Conversely, this simple model does not provide for the likely expansion of effective demand for food generated by increasing exports and much better economic performance. Rising food

[16]And feed where applicable. Zimbabwe is the only country where feed use of cereals is a factor significantly affecting food availability, and this is reflected in an allowance of 25 percent of total production for this factor; in all other countries, the factor amounts to 15 percent of total production.

[17]We used both current and lagged values of the variables in the estimation. The criteria such as acceptancy of the signs and significance of the coefficients were used in the final selection of the equations.

demand as a result of rising incomes would have the effect of raising the target consumption level above the projection based exclusively on population growth because of the high income elasticity of demand for cereals among low-income people. The estimated food aid needs resulting from our optimistic scenario predicated on better-than-trend economic performance may therefore be considered conservative estimates.

Finally, the structural relationships are simulated to derive attainable food availability, assuming stocks to be constrained at the absolute 1981-83 levels. Projected population data are based on country projections prepared by Urban and Wade for the ERS world food study (*48*).

The target consumption level is the per capita food availability in the base period (1981-83) extrapolated by population growth. This forecast follows one of the objectives of food aid, which is to prevent deterioration of the nutritional status in poor countries.

In exercises of this sort, the potentially biasing effect of the consumption target level is often a source of criticism. The need for such a target point nevertheless forces a choice, and in this instance it is the average of the last 3 years of data. In 1981-83, most of the 11 study countries were coping with the effects of drought. Therefore, given the low level of per capita food availability the estimates arrived at may be regarded as a minimum for food aid need.

Scenarios

We discuss and compare the scenarios on the basis of differences in per capita attainable food availability from target consumption, per capita calorie availability by income group, and aggregated food aid needs (structural and emergency) by country in 1990. The total quantities of food aid requirements are presented based on meeting both 100 percent and 85 percent of target consumption levels.[18] In all cases, the key variables are production performance, foreign exchange earnings, and weather.

Base Case

This scenario assumes weather is normal and food production to 1990 grows following the trend established in 1966-83. The focus in this scenario is on what happens to these countries' chronic food gap and what the implications of these trends are for food aid needs.

With commercial imports being constrained by weak export performance and the shrinking of available means of financing from international banks, per capita attainable food availabilities in these countries in 1990 will have decreased considerably, with the exception only of Zimbabwe, Sudan, and, more marginally, Niger. The drop in terms of an index based on 1981-83 levels ranges from 5 percent in the case of Senegal to 47 percent in that of Mozambique (table 30, col. 8).[19] The population-weighted average for the 11 countries shows a drop of 8.8 percent.

[18]Meeting the 85 percent of target consumption levels reduces needs by 15 percent, approximating the average coefficient of variation of food availability from trend in all countries. This is the limit of possible internal adjustments by means of changes in village stocks and substitution of "famine foods."

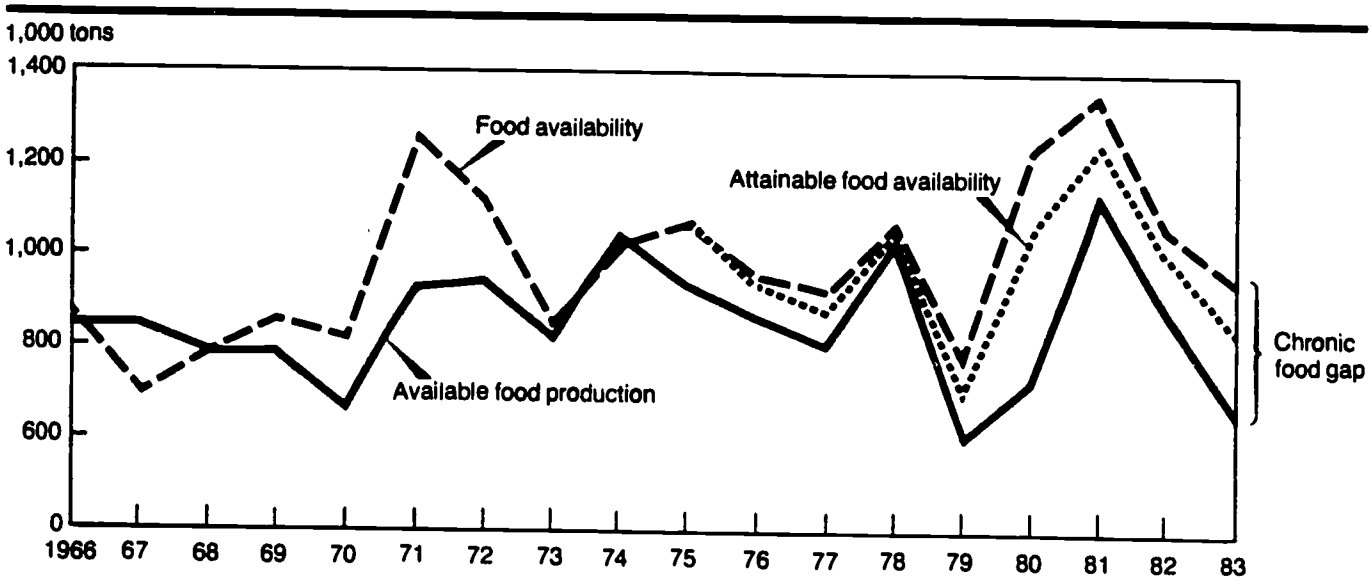
[19]The use of such an index allows comparisons among the study countries without distortion from the differing cereals content across national diets.

The Chronic Food Gap and the Emergency Food Gap

From the start of government-to-government food aid programs in the aftermath of World War I, food aid has been thought of as basically a response to an emergency situation, that is, a situation that was unforeseeable. Food aid went to feed people in danger of starving because their countries had been shattered by war (as in the case of those fed by the Hoover Commission after World War I and the Marshall Plan after World War II) or because they had no harvests (as in north India in the summers of 1965 and 1966 when the southwest monsoon failed).

For those responsible for administering food aid programs, requests for food aid are usually emergency requests. In today's highly competitive world cereals markets, governments of surplus-producing countries are sensitive to accusations of dumping and therefore are not in the habit of giving away or selling at concessional prices food to other countries unless a real need for the food can be proved to exist. For their own reasons, governments of food-deficit countries are at pains to demonstrate need. (Feeding programs run by private voluntary organizations (PVO's), some of which have been going on for years, come under a slightly different category, since they are usually targeted to especially needy populations like children, refugees, or the urban poor.)

But are these always emergency situations? The 11 Sub-Saharan African countries covered by this report have not had the means to feed their people from their own resources in the period 1966-83, as the data in appendix tables 1-11 show. Unlike wealthier countries with chronic food gaps, like Nigeria, the study countries have difficulty in meeting their consumption needs by commercial imports alone. Hence, their structural food aid needs are large and foreseeable. The data for Zambia plotted below show how the need for food aid has persisted over the past decade:

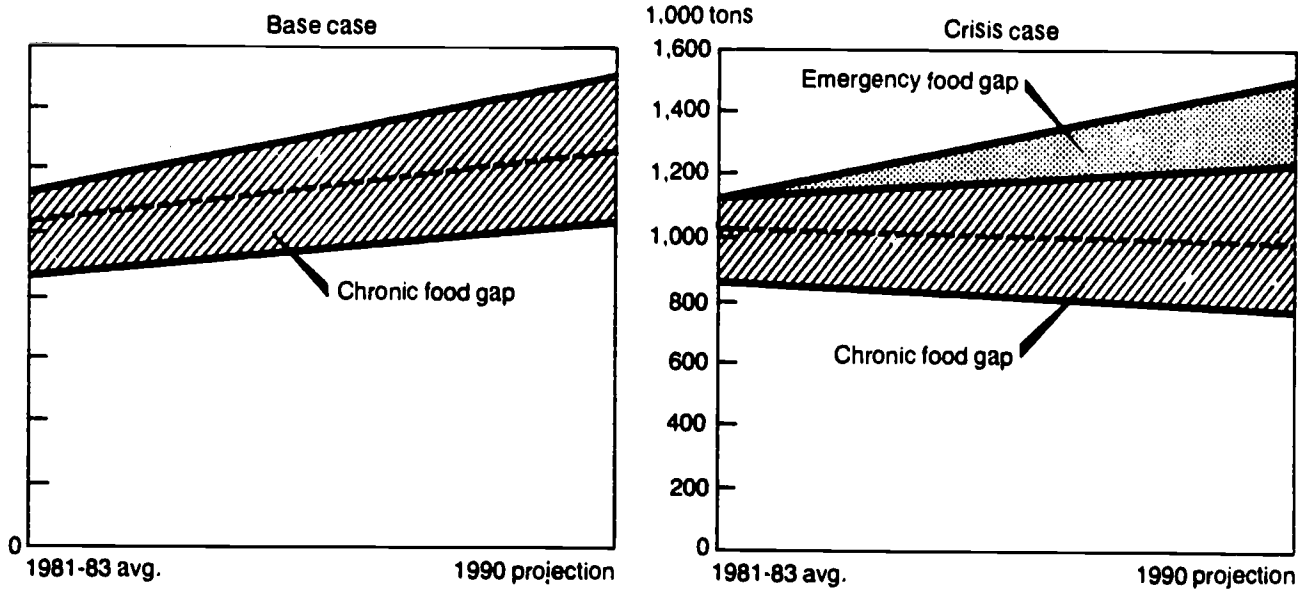


Note: Years in which food availability falls below available food production are years of heavy food exports.

When we try to look into the future, however, we confront the same uncertainty that faces farmers, consumers, food aid administrators, and finance ministers. Projecting food aid needs is more complicated than observing past patterns of food consumption. Future effective demand for food in our 11 countries will reflect not only their domestic food production and export performance, but also their ability to fill their chronic food gap (the gap between food availability and available food production) with commercial imports and structural food aid. And in the event of an emergency food gap, that, too, needs to be filled.

The most we can do in this situation is to calculate the probability with which a point representing attainable food availability will fall a certain amount above or below the extrapolation of a "trend" line plotted on the basis of how we have modeled our historical data.[1] We then are in a position to measure the food aid need. In the analysis consisting of three scenarios for 1990, we have done just this.

In the base scenario, the points are right on "trend." In the optimistic scenario, attainable food availability would rise above "trend" due to policy reforms and improved economic performance. In the crisis scenario, however, attainable food availability would fall below "trend" due to 2 consecutive years of drought. Because drought (unlike the chronic food gap) is unforeseeable, and therefore creates an emergency, we define the food aid need created by such a fall in attainable food availability as an emergency food gap and the type of food aid required as emergency food aid. Two such projections, again for the case of Zambia, are shown below in slightly stylized form:



In retrospect, emergency food aid needs defined in this manner become absorbed by the chronic food gap. Thus, in practice there is no way of separating out structural food aid from emergency food aid with respect to our data for 1966-83. Food aid shipments respond to estimates of needs that are constantly being revised. And, quite apart from intentions, the amounts actually received by the recipient country are poorly synchronized to fluctuations in production and imports because of transport and other lags, as this report makes clear.

Why, then, bother with this distinction at all? The answer is that it enables us to see how greatly real food aid needs, difficult to evaluate even in the best of circumstances, are influenced by the performance of these countries' own economies. In other words, these food-deficit countries, like others, will obviously be vulnerable to drought and unforeseeable events; but the vulnerability of these particular countries is accentuated by the fact that they are dependent, at least in part, on food aid to fill their chronic food gap even in the absence of emergency. This is why the food crisis in Sub-Saharan Africa is a continuing one.

[1]Our "trend" lines reflect parameter values in our historical model and are not trend lines fitted to data observations.

Ethiopia, Kenya, Mali, Senegal, and Zambia should all provide from 80 to 95 percent of their food consumption from their own resources in 1990. Lesotho, Mozambique, and Somalia, in which food aid in 1981-83 was contributing about 10, 17, and 26 percent of per capita food consumption, respectively, should perform very poorly, providing in 1990 barely 53 to 76 percent of their target (1981-83) consumption levels from their own resources. Both Mozambique and Somalia are facing external and internal conflict, combined with very weak food production and export market performance. In Lesotho, the problem stems mainly from poor domestic agricultural performance. Lesotho's historical production trend is negative (-2.3 percent per year), and even increases in commercial imports will not prevent availability from declining.

The relatively high levels of attainable food availability for Sudan and Zimbabwe in 1990 projected by these trends are partly accounted for by our assumption of no cereals exports; both these countries have traditionally been cereals exporters. Over the 1966-83 period, about 15 percent of Sudan's sorghum production, equivalent to about 10 percent of total cereal production, was exported. Zimbabwe exported significant amounts of corn annually during this period. With no cereals exports allowed in the present scenario, all cereals normally exported go for domestic consumption. Therefore, should these governments pursue policies of maintaining sorghum and corn exports at historical levels because of financial need, food availability might be considerably less than indicated in table 30. If these two countries are excluded from the 11-country grouping, average per capita attainable food availability in 1990 falls to 119.1 kg per year, and the index of the same variable in col. 8 falls from 91.2 to 85.5.

Both Sudan and Zimbabwe established a firm foundation of cereals production during the study period. These countries had the two highest food production growth rates over the study

Table 30--Base case: Attainable food availabilities, 1990

Country	Per capita food availability, 1981-83	Population 1990	Trend results, 1990: Production	Nonfood use[1]	Imports	Attainable food availability: (3)-(4)+(5)	Per capita attainable food availability: Quantity	Index
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Kilograms per year	Million	1,000 tons				Kilograms per year	1981-83=100
Ethiopia	[illegible]	[illegible]	6,772	1,016	107	5,863	133.2	80.4
Kenya	134.0	23	3,153	473	382	3,062	122.5	91.4
Lesotho	194.0	[illegible]	139	23	180	296	148.0	76.3
Mali	137.4	[illegible]	983	147	136	972	108.0	81.6
Mozambique	[illegible].0	[illegible]	530	80	123	573	33.7	53.2
Niger	186.8	7	1,436	215	103	1,324	189.1	101.2
Senegal	175.3	7	814	122	479	1,171	167.3	95.4
Somalia	108.[illegible]	6	276	41	233	468	78.0	72.1
Sudan	135.[illegible]	24	4,338	651	172	3,859	160.8	118.5
Zambia	187.6	8	1,226	184	218	1,261	157.6	84.0
Zimbabwe	166.6	11	2,895	724	52	2,223	202.1	121.3
11 countries	144.4[2]	160	22,598	3,689	2,147	21,072	131.7[3]	91.2

[1]15 percent of production except Zimbabwe, 25 percent.
[2]Average weighted by 1983 population.
[3]Average weighted by 1990 population.

Sources: Col. 1: appendix tables 1-11; col. 2: (48); cols. 3-8: ERS calculations.

period (table 3, column 1) and self-sufficiency ratios in 1981-83 (table 14). Coupled with a strong food production base, Zimbabwe has also had relatively effective administration of agricultural policies. However, these impressive records of performance in cereals production have been sustained by investments in the agricultural sector made possible by foreign exchange earnings derived in part from agricultural exports, especially cereal exports. If these countries were forced to reallocate cereal production from exports to domestic consumption, the effect on foreign exchange earnings would probably be considerable. The performance of their agricultural sectors would therefore be jeopardized.

Niger, which also ranks high on trend-based per capita attainable food availability, had the third highest production growth rate over the study period. Moreover, it had the highest growth rate of commercial imports of all the study countries (table 3, column 2), in part due to its strong foreign exchange earnings from uranium exports, which make up 84 percent of its total foreign exchange earnings (table 17, col. 2).

In the study countries, the level of food availability has historically been subjected to a high degree of variability, while consumption is hypothesized to have shown a smoother pattern, having been adjusted by continual changes in village stocks and substitution of noncereal subsistence crops for cereals. The average standard coefficient of variation of food availability from the trend line for all countries was about 13 percent from the mean (table 3). We assumed that in a given year consumption will be adjusted by up to a maximum of 15 percent around the level of food availability. Accordingly, when the forecasted level of per capita attainable food availability in 1990 is within the range of 15 percent of consumption target, the resulting food shortage in the country will probably not be alarming. Among the study countries, five will probably be in this position in 1990.

In the model, the function of structural food aid is to maintain food availability at target levels. Therefore, in those countries in which the attainable food availability trend rises at a rate lower than population growth, structural food aid must expand to take up the slack left by available production and commercial imports. This is the case of a number of countries studied, as may be seen from table 31 which takes country 1981-83 per capita food availabilities as the target level and shows what happens if performance patterns established in 1966-83 persist.

Structural food aid would have to increase above 1981-83 per capita levels in eight of the countries just to maintain the target level of consumption in our base scenario (table 31, col. 5). Somalia, with its large refugee population, will depend even more on food aid in 1990 than it does now. Its already high per capita level of food aid will not be sufficient to maintain its food availability level. On average, per capita food availability in 1990 is projected to be at 98.4 percent of the target level in these countries. But if Sudan and Zimbabwe are again left out, for the reasons previously explained (we assumed no cereals exports), average per capita availability falls from 142.1 kg per year to 128.7 kg per year, and the index falls from 98.4 to 89.1. This 9.3-point drop in the index of per capita food availability represents a significant drop in consumption coverage and implies a large, necessary increase in structural food aid on the basis of existing trends alone.

If food aid flows continue at the same per capita levels of 1981-83, Ethiopia, Mali, Somalia, and Zambia in 1990 would be within the 15-percent range of food availability at current

levels. The share of food aid in Mozambique must increase from the current 17 percent of per capita food availability to 41 percent to be within the 15-percent range of food availability at consumption target levels. This increase would be even higher than the current per capita contribution of food aid in Somalia of 31 percent.

An estimation based on nutritional requirements yields dramatically different results. The obvious reason is the low, below-average calorie consumption in some countries historically, and, more important, the problem of uneven food distribution among different income and regional groups. Regional variations in cropping patterns in a country due to climatic factors, combined with variations in income, lead to significant differences in food distribution and, hence, in consumption. The recent famine situation in large areas of Africa started among low-income people in areas with highly variable rainfall, leading to out-migration in search of food. That magnifies the problem, because of associated physical weakness and vulnerability to disease.

Few existing attempts to estimate food aid needs in Africa take into account problems of distributing food. Of the reasons for uneven distribution of food, uneven income distribution is perhaps the most important. Therefore, we have attempted to manipulate our data to reflect this particular problem.

According to the summary data compiled by Reutlinger and Selowsky, the calorie consumption of 30 percent of the population in Africa was 15 percent lower than the average 2,154 calories per day (*42*). A second group, accounting for 32 percent of the population, consumed 3 percent lower than average. The highest income group, 4.5 percent of the population, consumed 2,978 calories per day, 28 percent higher than average.

Table 31--Base case: Per capita food availabilities, 1990, with constant per capita food aid

Country	Food availability, 1981-83	Attainable food availability, 1990	Food aid, 1981-83	Food availability, 1990	
				Quantity (2) + (3)	Index
	(1)	(2)	(3)	(4)	(5)
	Kilograms per year				1981-83=100
Ethiopia	165.6	133.2	4.0	137.2	82.8
Kenya	134.0	122.5	9.2	131.7	98.3
Lesotho	194.0	148.0	15.1	163.1	84.1
Mali	132.4	108.0	6.7	114.7	86.6
Mozambique	64.0	33.7	18.6	52.3	81.7
Niger	186.8	189.1	4.4	193.5	103.6
Senegal	175.3	167.3	14.4	181.7	103.6
Somalia	108.1	78.0	28.0	106.0	98.1
Sudan	135.7	160.8	15.8	176.6	130.1
Zambia	187.6	157.6	14.3	171.9	91.6
Zimbabwe	166.6	202.1	1.0	203.1	121.9
11 countries	144.4[1]	131.7[2]	10.4[1]	142.1[2]	98.4

[1]Average weighted by 1983 population.
[2]Average weighted by 1990 population.

Source: Col. 1: table 30, col. 1; col. 2: table 30, col. 7; col. 3: table 25; cols. 4-5: ERS calculations.

To examine the effects of income distribution on projected food availability by income class, we applied the above distributional pattern of calorie consumption to each country. We summarized the calorie distribution data and calculated the calorie consumption distribution for four different income groups. We assumed no change in consumption distribution through time. That is, class A, consisting of 30 percent of the population, consumes 15 percent less than the average; class B, 32 percent of the population, consumes 3 percent less than the average; class C, 22 percent of the population, consumes 8 percent more than the average; and finally class D, 16 percent of the population, consumes 25 percent higher than the average.

The average calorie availability and calorie availability by different income class of population and their corresponding ratios to the FAO/WHO-required calorie level of 2,340 calories are shown in table 32.

As the results indicate, nutritional levels will probably deteriorate through time. In the absence of food aid, with the exception of Sudan and Zimbabwe, the average nutritional level of all countries would fall not only lower than the required level but also lower than the levels existing in 1981-83 with food aid. The impact of the decline would be felt most severely in the two lowest income countries--Mali and Mozambique--which are currently consuming substantially less than the average regional level (table 2).

How low the average nutritional level could sink before a massive starvation situation arose is not known. Based on FAO data, there are many degrees of undernutrition, ranging from mild to fatal; a healthy person can tolerate the loss of about one-quarter of total body weight, but more may be life threatening. Among our study countries, Ethiopia, Mali, Mozambique, and Somalia definitely need help for their entire population. Even if we assume some percent of bias in calculation, the average diet in these three countries will probably fall to a level lower than 75 percent of the required level. Continued malnutrition on such a large scale will inevitably lead to mass starvation among these three nations' populations.

Table 33 displays projected aggregate quantities of food aid need in 1990 by country including total food aid needs based on consumption target and nutritional target and 15-percent variations lower than target levels.

A country's food aid requirement varies greatly according to the target level chosen, even on an "average" need basis. Sudan and Zimbabwe have no food aid needs based on the 1981-83 availability maintenance target. But, because of the low nutritional base, food availability in Sudan will probably not increase sufficiently to eliminate completely the need for food aid in 1990 under the nutritional target (table 33, col. 5). Food aid needs in all the other countries, meanwhile, would increase if the nutritional target is chosen. In Ethiopia, Kenya, Mali, Senegal, and Mozambique, food aid needs would at least double, reflecting the poor average nutritional status of their populations. Sudan and Zimbabwe, which showed zero need of food aid on an average nutritional basis, become eligible to receive food aid (table 33, col. 5). For the other countries, the amounts are marginally greater than under the undistributed nutritional target.

Optimistic Case

In this case, we assumed that policy reforms would lead to a 3-percent annual increase in real producer prices over historical trend and that improved performance of the domestic economies would lead to a significant increase in foreign exchange earnings--5 percent

Table 32--Base case: Calorie availabilities, 1990

Country	Per capita calorie availability: 1981-83		Trend results, 1990: Per capita attainable calories		Per capita attainable calories by income class without food aid: Class A		Class B		Class C		Class D	
	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent
Ethiopia	1,819	78	1,620	69	1,377	59	1,571	67	1,749	75	2,025	87
Kenya	2,022	86	1,791	77	1,522	65	1,737	74	1,934	83	2,238	96
Lesotho	2,281	98	1,601	68	1,360	58	1,553	66	1,729	74	2,001	86
Mali	1,568	68	1,233	53	1,048	45	1,196	51	1,332	57	1,541	66
Mozambique	1,592	68	822	35	699	30	797	34	888	38	1,027	44
Niger	2,106	99	2,220	95	1,887	81	2,154	92	2,398	102	2,776	119
Senegal	2,293	98	2,112	90	1,795	77	2,048	88	2,281	97	2,640	113
Somalia	2,176	89	1,491	64	1,267	54	1,446	62	1,610	69	1,864	80
Sudan	1,979	85	2,363	101	2,009	86	2,292	98	2,552	109	2,954	126
Zambia	2,230	95	1,798	77	1,528	65	1,744	75	1,942	83	2,248	96
Zimbabwe	2,215	95	2,583	110	2,196	94	2,506	107	2,790	119	3,229	138

Note: See fig. 2 for definition of income classes.

[1]Percent of FAO/WHO daily requirement.

Source: Cols. 1-2: table 2, cols. 3 and 5; cols. 3-12: calculated from ERS data base.

annually higher than historical trend. Other assumptions related to weather, stocks, and waste factors remain the same as in the base case scenario.

The assumptions regarding price movements and foreign exchange earnings may seem highly unrealistic, given the historical record of performance of food production and macroeconomic indicators. However, the purpose of this particular exercise is to show how dramatically the food situation in these countries could change if a few key economic variables performed better.

The outcomes for food production and commercial imports and aggregate and per capita attainable food availability are presented in table 34. Aggregate cereals production in 1990 is 8.4 percent higher than in the base case scenario, and commercial imports are 41 percent higher. As a result, attainable food availability is 11.7 percent higher.

Per capita attainable food availabilities in Kenya, Niger, Senegal, Sudan, and Zimbabwe will range 7-36 ercent higher in 1990 than consumption target (1981-83) levels (table 34, col. 8). Commercial imports in these countries will fill the chronic food gap, while Sudan and Zimbabwe will probably have exportable cereal surpluses. Ethiopia, Lesotho, Mali, Somalia, and Zambia should provide 85 percent or more of their consumption targets from their own resources in 1990.

If these countries continue to receive food aid, on the other hand, per capita availabilities in 1990 will be higher or will match the consumption target levels. In Mozambique, if the 1981-83 food aid allocation continues in 1990, per capita food availability will reach about 73 percent of the consumption target level. Total food aid needs for these last six countries will be about 876,000 tons of cereal, about 52 percent less than in the base case scenario (comparing table 36 with table 33).

Table 33--Base case: Food aid needs, 1990

Country	Food aid needs, 1990, based on--					
	Maintaining actual 1981-83 levels of food availability		Meeting average per capita calorie requirements		Meeting per capita calorie requirements with differentiation by income class	
	100 percent	85 percent	100 percent	85 percent	100 percent	85 percent
	(1)	(2)	(3)	(4)	(5)	(6)
	1,000 tons					
Ethiopia	1,452	1,234	2,621	2,228	2,624	2,231
Kenya	300	255	935	795	937	796
Lesotho	112	95	137	116	137	116
Mali	216	184	873	742	873	742
Mozambique	510	434	1,068	907	1,068	908
Niger	44	37	68	58	112	95
Senegal	56	48	126	107	151	128
Somalia	180	153	267	227	267	227
Sudan	0	0	0	0	187	159
Zambia	240	204	381	324	382	324
Zimbabwe	0	0	0	0	36	31
Total	3,110	2,644	6,475	5,504	6,774	5,757

Source: Calculated from tables 30, 31, and 32.

Based on the stated nutritional requirements, Senegal and a number of the other countries will have no food aid need at all (table 35). In contrast, Kenya, where food availability will increase by 9 percent, will still require food aid to meet nutritional targets. The picture for countries with severe nutritional problems will stay the same, however. Ethiopia will need the largest quantities of food aid, 1.9 million tons to meet 85 percent of target and almost 2.3 million tons to meet 100 percent of target (table 36). Mozambique, in second place, will need 864,000 tons and 1 million tons, respectively, followed by Mali with needs of 581,000 tons and 684,000 tons.

In sum, food availabilities in most of the countries would improve significantly under the optimistic scenario compared with the base case scenario and consumption targets. Given the financial problems facing these countries, food aid might help relax some of the budget constraints by reallocating available funds for imports. Structural food aid in particular, if it is managed as a resource for development, can play a role in increasing economic productivity. Other types of aid, such as providing inputs for countries like Sudan which are heavily dependent on imported inputs, could make the difference in shifting production levels. Most countries are short of foreign exchange and investment funds; even in conjunction with appropriate policy changes, aid could play a crucial role in the later eighties.

Crisis Case

In this scenario, food production grows following historical trends until 1989, when 2 successive years of drought drastically reduce cereals production. The point of this scenario is to show the costs, in economic terms and in risks to human life, of such a production shortfall. According to our data, these countries face drought once every 3 years on average.

Table 34--Optimistic case: Attainable food availabilities, 1990

Country	Per capita food availability, 1981-83	Population 1990	Trend results, 1990: Production	Nonfood use[1]	Imports	Attainable food availability: (3)-(4)+(5)	Per capita attainable food availability: Quantity	Index
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Kilograms per year	Million	1,000 tons				Kilograms per year	1981-83=100
Ethiopia	165.6	44	7,084	1063	171	6,192	140.7	85.0
Kenya	134.0	25	3,555	533	630	3,652	146.1	109.0
Lesotho	194.0	2	146	22	238	362	181.0	93.3
Mali	132.4	9	1,092	164	229	1,157	128.6	97.1
Mozambique	64.0	17	546	82	173	637	37.5	58.6
Niger	186.8	7	1,534	230	135	1,439	205.6	110.1
Senegal	175.3	7	896	134	552	1,314	187.7	107.1
Somalia	108.1	6	284	43	324	565	94.2	87.1
Sudan	135.7	24	4,746	712	266	4,300	179.2	132.1
Zambia	187.6	8	1,342	201	295	1,436	179.5	95.7
Zimbabwe	166.6	11	3,225	806	72	2,491	226.4	135.9
11 countries	144.4[2]	160	24,489	3,996	3,032	23,525	147.2[3]	101.9

[1]15 percent of production except Zimbabwe, 25 percent.
[2]Average weighted by 1983 population.
[3]Average weighted by 1990 population.

Source: Col. 1: appendix tables 1-11; col 2: (48); cols. 3-8: ERS calculations.

Table 35--Optimistic case: Calorie availabilities, 1990

Country	Per capita calorie availability: 1981-83		Trend results, 1990									
			Per capita attainable calories		Per capita attainable calories by income class without food aid							
					Class A		Class B		Class C		Class D	
	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent
Ethiopia	1,819	78	1,716	73	1,459	62	1,665	71	1,854	79	2,145	92
Kenya	2,022	86	2,143	92	1,821	78	2,079	89	2,314	99	2,679	114
Lesotho	2,527	108	1,957	84	1,664	71	1,899	81	2,114	90	2,447	105
Mali	1,568	68	1,473	63	1,252	53	1,428	61	1,590	68	1,841	79
Mozambique	1,592	68	894	38	760	32	868	37	966	41	1,118	48
Niger	2,106	99	2,527	108	2,148	92	2,451	105	2,729	117	3,159	135
Senegal	2,293	98	2,377	102	2,021	86	2,306	99	2,567	110	2,972	127
Somalia	2,176	89	1,797	77	1,527	65	1,743	74	1,940	83	2,246	96
Sudan	1,979	85	2,627	112	2,233	95	2,548	109	2,837	121	3,284	140
Zambia	2,363	101	2,276	97	1,935	83	2,208	94	2,458	105	2,845	122
Zimbabwe	2,215	95	2,948	126	2,506	107	2,860	122	3,184	136	3,686	158

Note: See fig. 2 for definition of income classes.

[1]Percent of daily requirement.

Source: Cols. 1-2: table 2, cols. 3 and 5; cols. 3-12: calculated from ERS data base.

The actual production shortfall in a drought year varies by country and by the severity of the situation, but it can reach 30-50 percent in a given year.[20] Historically, a 1-year drought is largely absorbed at the country level because of the adjustment mechanisms already described without giving rise to reports of famine. In fact, the effects of a 1-year drought on nutritional status (as against its effects on agricultural production) may be difficult to measure. However, most reports indicate that in a second successive year of severe drought, the effects will be felt at all levels.

In this scenario, therefore, we assumed that in 1990 food production drops 30 percent below trend. The drought of the earlier year should also reduce general economic growth, leading to lower-than-trend export earnings, with a 1-percent fall between 1989 and 1990. Remaining stocks in 1990 are assumed to be negligible. The waste, seed, and feed factor was reduced for Zimbabwe from 25 percent to 15 percent and for all other countries from 15 percent to 10 percent, reflecting the use of seed and feed for human consumption.

The outcomes in terms of aggregate food production and commercial imports and aggregate and per capita attainable food availabilities are presented in table 37. The results show that in 1990 per capita attainable food availabilities will decline from the consumption target level in all countries by amounts that range from 3 percent to 58 percent (table 37, col. 8), with an aggregate decline of 29.1 percent from the base case scenario. Increased commercial imports (in the aggregate, 4.2 percent over the base case scenario) help to mitigate the catastrophic 30-percent production drop. The cost of such imports is reduced general economic growth as priorities for foreign exchange get shifted.

[20]In Mali, in the two successive rainy seasons of 1983 and 1984 rainfall was measured at 26 percent below the 1960-82 average. As a result, aggregate production of millet, sorghum, and maize sustained drops in those seasons of 17 and 34 percent from the 1960-82 average.

Table 36--Optimistic case: Food aid needs, 1990

Country	Food aid needs, 1990, based on--					
	Maintaining actual 1981-83 levels of food availability		Meeting average per capita calorie requirements		Meeting per capita calorie requirements with differentiation by income class	
	100 percent	85 percent	100 percent	85 percent	100 percent	85 percent
	(1)	(2)	(3)	(4)	(5)	(6)
	1,000 tons					
Ethiopia	1,100	935	2,272	1,931	2,272	1,932
Kenya	0	0	336	285	418	355
Lesotho	46	39	71	60	74	63
Mali	27	23	684	581	684	582
Mozambique	459	390	1,017	864	1,017	864
Niger	0	0	0	0	33	28
Senegal	0	0	0	0	59	50
Somalia	84	71	170	145	171	145
Sudan	0	0	0	0	52	44
Zambia	64	54	40	34	104	88
Zimbabwe	0	0	0	0	0	0
Total	1,750	1,513	4,589	3,901	4,884	4,152

Source: Calculated from tables 32 and 33.

Zimbabwe, which showed an almost 20-percent gain in attainable food availability in 1990 in the base case, will show a 3-percent decline in the crisis case, meaning a repetition of its experience in 1982-84 when it had to request food aid. Mozambique's decline, the most serious, will be 58 percent, placing large segments of the country's population at risk of starvation. In the other countries, with the exception of Senegal and Sudan, per capita attainable food availabilities will drop below 80 percent. In these circumstances, per capita attainable calories decrease noticeably in almost every income class in every country (table 38).

Emergency food aid needs under this crisis scenario have been calculated for each country. These large projected emergency food aid needs for 1990, totaling 3.6 million tons in the first instance (table 39, col. 3), are in addition to structural food aid amounting to 3.1 million tons necessary to fill the chronic food gaps of these countries. This emergency food aid need is equivalent to 2.8 times the total annual food aid provided to these countries in 1981-83, and the total structural and emergency food aid is equivalent to five times such actual food aid annually in 1981-83.

If the target consumption level of 1981-83 is to be met in 1990, the largest needs for emergency food aid will be concentrated in Ethiopia, Kenya, and Sudan. But Zambia, Mali, and Niger are also extremely vulnerable to such a crisis scenario. The need for emergency food aid alone in Kenya, Niger, Senegal, and Zambia will be larger than their chronic food gaps. In Lesotho, Mozambique, and Somalia, all of which have large chronic food gaps, emergency food aid needs will represent only about one-fourth of total food aid needs. Zimbabwe, which has no chronic food gap, and Sudan, which is assumed to divert normal cereal exports to domestic consumption in this scenario, will require emergency food aid in varying amounts to overcome the crisis.

Table 37--Crisis case: Attainable food availabilities, 1990

Country	Per capita food availability, 1981-83	Population 1990	Trend results, 1990: Production	Nonfood use[1]	Imports	Attainable food availability: (3)-(4)+(5)	Per capita attainable food availability: Quantity	Index
	(1) Kilograms per year	(2) Million	(3)	(4)	(5)	(6)	(7) Kilograms per year	(8) 1981-83=100
			1,000 tons					
Ethiopia	165.6	44	4,741	474	111	4,378	99.5	60.1
Kenya	134.0	25	2,207	221	402	2,388	95.5	71.3
Lesotho	194.0	2	97	10	180	267	133.5	68.8
Mali	132.4	9	688	69	142	761	84.6	63.9
Mozambique	64.0	17	371	37	126	460	27.1	42.3
Niger	186.8	7	1,005	101	113	1,018	145.4	77.8
Senegal	175.3	7	570	57	483	996	142.3	81.2
Somalia	108.1	6	193	19	238	412	68.7	63.5
Sudan	135.7	24	3,037	304	198	2,931	122.1	90.0
Zambia	187.6	8	858	86	221	993	124.1	66.2
Zimbabwe	166.6	11	2,026	304	63	1,785	162.1	97.4
11 countries	144.4[2]	160	15,818	1,683	2,238	16,373	102.3[3]	70.9

[1]10 percent of production, except Zimbabwe, 15 percent.
[2]Average weighted by 1983 population.
[3]Average weighted by 1990 population.

Source: Col. 1: appendix tables 1-11; col. 2: (48); cols. 3-8: ERS calculations.

Table 38--Crisis case: Calorie availabilities, 1990

Country	Per capita calorie availability: 1981-83		Trend results, 1990									
			Per capita attainable calories		Per capita attainable calories by income class without food aid							
					Class A		Class B		Class C		Class D	
	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]	Daily	Share[1]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent	Calories	Percent
Ethiopia	1,819	78	1,209	52	1,027	44	1,172	50	1,305	56	1,511	65
Kenya	2,022	86	1,409	60	1,198	51	1,367	58	1,522	65	1,761	75
Lesotho	2,527	108	1,449	62	1,232	53	1,406	60	1,565	67	1,811	77
Mali	1,568	68	970	41	825	35	941	40	1,048	45	1,213	52
Mozambique	1,592	68	653	28	555	24	633	27	705	30	816	35
Niger	2,106	99	1,779	76	1,512	65	1,725	74	1,921	82	2,223	95
Senegal	2,293	98	1,796	77	1,526	65	1,742	74	1,939	83	2,244	96
Somalia	2,176	89	1,319	56	1,121	48	1,279	55	1,424	61	1,649	70
Sudan	1,979	85	1,791	77	1,522	65	1,737	74	1,934	83	2,238	96
Zambia	2,363	101	1,568	67	1,333	57	1,521	65	1,693	72	1,960	84
Zimbabwe	2,215	95	2,114	90	1,796	77	2,050	88	2,283	98	2,642	113

Note: See fig. 2 for definition of income classes.

[1]Percent of daily requirement.

Source: Cols. 1-2: table 2, cols. 3 and 5; cols. 3-12: calculated from ERS data base.

Table 39--Crisis case: Food aid needs, 1990

Country	Attainable food availability, 1990	Food aid needs, based on-- Maintaining actual 1981-83 levels of availability: Structural food aid	Emergency food aid	Total food aid	Meeting average per capita calorie requirement: Structural food aid	Emergency food aid	Total food aid	Meeting per capita calorie requirement with differentiation by income class: Structural food aid	Emergency food aid	Total food aid
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1,000 tons									
Ethiopia	5,863	1,452	1,496	2,948	2,621	1,496	4,117	2,624	1,497	4,121
Kenya	3,062	300	650	950	935	651	1,586	937	649	1,586
Lesotho	296	112	28	139	137	28	165	137	28	165
Mali	972	216	207	423	873	207	1,080	873	207	1,080
Mozambique	573	510	119	629	1,068	119	1,187	1,068	119	1,187
Niger	1,324	44	250	294	68	252	320	112	209	321
Senegal	1,171	56	175	231	126	175	301	151	151	302
Somalia	468	180	54	234	267	54	321	267	54	321
Sudan	3,859	0	336	336	0	898	898	187	712	899
Zambia	1,261	240	272	512	381	107	488	382	107	489
Zimbabwe	2,223	0	55	55	0	191	191	36	192	228
Total	21,072	3,110	3,642	6,751	6,476	4,178	10,654	6,774	3,925	10,699

Source: Col. 1: table 30, col. 6; col. 2: table 33, col. 1; cols. 3-4: ERS calculations; col. 5: table 33, col. 3; cols. 6-7: ERS calculations; col. 8: table 33, col. 5; cols. 9-10: ERS calculations.

To meet nutritional requirements, even more food aid will be required, with total emergency food aid needs rising to about 4 million tons and structural food aid needs in excess of 6 million tons, making a total equivalent to eight times the total food aid actually received annually in 1981-83.

Again, the reality facing these countries is their growing chronic food gap, which leaves them in an extremely vulnerable position in the event of production shortfalls in drought years. In Ethiopia alone, the chronic food gap could increase from 1.5 million to 3 million tons by 1990, depending on target availability levels. It is unrealistic to assume that this size of gap can continue to be filled with food aid indefinitely. Therefore, unless governments take the indicated measures to solve their food problem, famine may well strike again as it did in 1984-85.

Conclusions

The analysis of food availabilities in the 11 study countries has revealed a picture of low and inadequate per capita nutrient intake in most of them even with large food aid inflows. This low level fluctuates rapidly for a number of reasons such as variability of food production and of marketed supplies arriving in urban markets, and is unevenly distributed because of uneven distribution of income and other factors. The low level, variability, and unevenness of effective demand place significant numbers of people at risk of undernourishment and famine. This situation is getting steadily worse as a result of high population growth. For these countries, statements like "World food supplies are growing on a per capita basis" are without meaning. They face a continuing food crisis whose only possible solution lies in technological change and investment to improve the productivity of their agriculture and in better economic performance to allow them to participate fully in world trade.

At low levels of per capita income, food imports increase the level of per capita food availability, but also absorb foreign currency badly needed for economic growth. Countries with a high export earning variability in unpredictable world market conditions, particularly, face variability in their overall food supplies. Our analysis shows that commercial imports alone, in present circumstances, do not normally cover the chronic food gap and are unlikely to be able to prevent further declines in food consumption. Moreover, as these countries' import dependence grows, their repayment capacity weakens.

Consequently, most of the study countries need large amounts of structural food aid to fill the gap left after commercial imports have been added to food supplies. In addition to structural food aid, emergency food aid will probably be necessary in all the study countries at some time to cope with unforeseen emergencies.

In the scenarios, we have attempted to measure the sensitivity of food availability to changes in other variables in the food system, such as weather, foreign exchange, and producer prices. Drought has an overwhelming influence because its effects are multiple: decreased food production and, therefore, decreased food availability; decreased cash crop production and, therefore, decreased foreign exchange earnings; increased commercial food import costs and, therefore, decreased foreign exchange reserves.

Increasing real producer prices by 3 percent above trend and improving the financial position of the countries should lead to an 8.4-percent aggregate food production increase over the

historical trend by 1990. This dramatic improvement would enable five of the countries to fill their chronic food gap from their own resources without food aid. In only Mozambique would per capita attainable availability be less than 85 percent of its consumption target of 1981-83 level. Aggregate food aid needs would drop 44 percent.

Such a change in economic policy management would allow these countries to absorb some of the effects of natural hazards. As our crisis scenario for 1990 shows, an aggregate 29.1-percent drop in per capita attainable food availability would mean that the study countries would need 3.6 million tons in emergency food aid and 3.1 million tons in structural food aid to maintain 1981-83 consumption. To meet required nutritional level, these need figures rise to 4.2 million tons and 6.5 million tons, respectively.

The magnitude of these needs for food aid may be tempered by the rather low probability of all the 11 countries being equally severely affected by drought. Although these are among the most hazard-prone countries on the African continent, they are widely dispersed. Nevertheless, recent experience argues against complacency on this score.

Realistically, dependence on food aid in these countries will probably grow in the years ahead as large numbers of people face inadequate diets and governments seek relief from the financial burden of commercial food imports. However, effective absorption of large quantities of food aid in the short term is very difficult because of their limited transportation, storage, and management capabilities. In the long term, also, a dependence on food aid can exert a disincentive effect on domestic production, increases import management problems, and tends to shift consumption away from locally produced food commodities.

The United States has attempted to tie food aid to self-help measures implemented by the recipient country to promote agricultural production and policy reforms (most recently, with the Food for Progress program). Measures such as these, although necessary, are difficult to administer. The governments of most African countries are desperately short of skilled personnel and can hardly coordinate the inflow of increasing food aid in emergency cases. Large increases in structural food aid to help developmental programs would put additional pressure on already fragile institutions, and projects could quickly lose their effectiveness.

But the broader question concerns the linkage between food aid and the search for a solution to the food crisis. The responsibilities of both recipient and donor countries are engaged here. The use of the enlarged resources constituted by food aid to support the implementation of food strategies and policy reform programs has already produced some initial benefits in certain African countries. But success depends on the maintenance of commitments to these countries by surplus-producing countries, where cereals stocks are at record high levels and aid for humanitarian purposes still enjoys an effective constituency. Looking at Africa as a whole in the years ahead, whether food aid is used as a resource for development or is merely a crutch governments rely on to put off needed changes in their agricultural sectors and policies is likely to be a key indicator of performance.

In most of Africa, the potential for increasing food production exists. Most crop yields are 20-70 percent lower than the international average because of a combination of deficient resources and a lack of proper technologies, incentives, and support systems. Food aid alone is not likely to reverse the declining trend in per capita food production, and must be combined with other types of aid capable of improving the institutional support necessary to expand total food supplies.

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Appendix A: Statistical Tables

Appendix table 1--Ethiopia: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	4,587	36.8	15.0	0	-10	532.8	4,116	23.1	178.18	198.57
1967	4,736	38.8	.6	0	130	549.4	4,096	23.7	172.83	199.83
1968	5,155	23.4	1.4	0	-120	544.8	4,755	24.2	196.49	213.02
1969	5,268	21.0	9.0	0	20	565.0	4,713	24.9	189.28	211.57
1970	5,089	75.7	12.8	3.7	20	578.8	4,575	25.4	180.12	200.35
1971	5,029	64.5	3.4	0	0	598.9	4,498	26.1	172.34	192.68
1972	4,482	5.2	10.0	4.3	70	580.9	3,842	26.7	143.90	167.87
1973	4,467	24.3	6.5	14.1	30	580.7	3,873	27.4	141.35	163.03
1974	4,240	60.4	104.6	12.4	50	542.6	3,800	28.1	135.23	150.89
1975	4,822	30.6	47.1	3.4	0	195.3	4,701	28.8	163.23	167.43
1976	4,434	70.5	30.6	.6	135	581.5	3,818	29.5	129.42	150.31
1977	4,094	146.7	54.7	.1	-190	522.3	3,963	30.2	131.23	135.56
1978	5,139	158.5	64.3	0	-150	521.8	4,990	31.0	160.97	165.77
1979	6,362	169.2	78.3	0	270	775.5	5,564	31.8	174.97	200.06
1980	5,553	303.5	93.9	2.2	-260	671.2	5,537	32.6	169.85	170.34
1981	5,334	123.5	115.9	1.5	-5	686.5	4,890	33.4	146.41	159.70
1982	6,504	113.8	201.4	0	-45	649.2	6,215	34.2	181.73	190.18
1983	6,225	2.5	319.2	0	-45	692.7	5,899	35.0	168.54	177.86
Average:										
1966-68	4,826	33.0	5.7	2.35	1.39	569.18	4,322	23.7	182.50	203.81
1981-83	6,021	79.9	212.2	.50	-31.67	676.27	5,668	34.2	165.56	175.91
					Percent per year					
Growth rate, 1966-83	1.5	5.9	24.1	NA	NA	NA	1.8	2.4	-.6	-1.0

NA = Not applicable.

[1] A negative quantity means a decrease in stocks and an increase in availability.

[2] The operational relationship is as follows:

Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste

Source: ERS data base.

Appendix table 2--Kenya: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	1,782	33	197.6	53	52.0	510.6	1,397	9.8	142.55	181.84
1967	2,009	37	1.2	165	-30.0	566.2	1,346	10.1	133.27	198.91
1968	2,218	10	2.7	319	-127.0	629.7	1,409	10.5	134.19	211.24
1969	2,190	6	0	265	8.5	625.5	1,297	10.9	118.99	200.92
1970	2,001	25	2.3	84	44.8	619.5	1,280	11.3	113.27	177.08
1971	2,088	54	2.9	61	-126.0	605.9	1,604	11.7	137.09	178.46
1972	1,859	72	1.7	32	13.0	626.7	1,261	12.1	104.21	153.64
1973	2,251	33	1.4	286	-71.0	694.4	1,376	12.6	109.21	178.65
1974	2,129	63	0	76	-76.0	658.0	1,534	13.0	118.00	163.77
1975	2,137	69	5.0	126	167.0	678.0	1,240	13.5	91.85	158.30
1976	2,467	50	8.7	118	81.0	718.7	1,608	14.1	114.04	174.96
1977	2,766	0	13.0	15	54.0	723.0	1,987	14.6	136.10	189.45
1978	2,741	65	6.1	29	-209.0	673.1	2,319	15.2	152.57	180.33
1979	2,449	126	16.9	148	-298.0	391.9	2,350	15.8	148.73	155.00
1980	1,987	350	121.6	50	-169.0	346.6	2,231	16.4	136.04	121.16
1981	2,326	288	203.0	0	101.0	407.0	2,309	17.1	135.03	136.02
1982	2,739	306	149.4	0	393.0	478.4	2,323	17.8	130.51	153.88
1983	2,901	42	179.6	0	52.0	532.6	2,538	18.6	136.45	155.97
Average:										
1966-68	2,003	27	67.2	101.5	-7.76	582.54	1,384	10.1	136.67	197.33
1981-83	2,655	212	177.3	0	182.00	472.67	2,390	17.8	133.99	148.62
	Percent per year									
Growth rate, 1966-83	1.9	13.8	6.5	NA	NA	-1.23	3.6	3.8	-.1	-1.9

NA = Not applicable.

[1] A negative quantity means a decrease in stocks and an increase in availability.

[2] The operational relationship is as follows:

Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste

Source: ERS data base.

Appendix table 3--Lesotho: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	213	40	0	1	29	23.00	200	1.0	200.00	213.00
1967	222	20	0	2	4	53.00	183	1.0	183.00	222.00
1968	209	28	0	10	-3	57.00	173	1.0	173.00	209.00
1969	204	43	2.0	14	13	58.00	184	1.0	184.00	204.00
1970	182	39	0	2	-10	59.00	170	1.1	154.55	165.45
1971	233	42	0	2	28	26.00	219	1.1	199.09	211.82
1972	143	53	14.5	3	-35	71.50	171	1.1	155.45	130.00
1973	166	57	19.6	2	-6	57.60	189	1.1	171.82	150.91
1974	264	47	5.7	0	0	60.70	256	1.2	213.33	220.00
1975	152	50	7.5	0	-41	83.50	167	1.2	139.17	126.67
1976	119	78	11.2	0	-49	92.20	165	1.2	137.50	99.17
1977	237	74	9.3	0	44	32.70	309	1.2	257.50	197.50
1978	279	115	12.4	0	72	20.40	314	1.3	241.54	214.62
1979	252	133	15.7	0	13	67.70	320	1.3	246.15	193.85
1980	199	168	46.0	0	-48	156.00	305	1.3	234.62	153.08
1981	206	177	26.7	0	-20	119.70	310	1.4	221.43	147.14
1982	126	218	15.3	0	0	117.30	242	1.4	172.86	90.00
1983	120	140	45.0	0	0	42.00	263	1.4	187.86	85.71
Average:										
1966-68	215	29	0	2	2.78	62.13	185	1.0	185.33	214.67
1981-83	151	178	29	0	-6.67	93.00	272	1.4	194.05	107.62
	Percent per year									
Growth rate, 1966-83	-2.4	12.0	8.7[3]	NA	NA	4.94	2.5	2.2	.3	-4.6

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste
[3]1972-83.

Source: ERS data base.

Appendix table 4--Mali: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	1,132	20	0	0	0	284.00	868	4.6	188.70	246.09
1967	1,074	12	0	0	21	265.00	800	4.7	170.21	228.51
1968	1,090	10	0	0	99	272.00	729	4.8	151.88	227.08
1969	962	10	3.0	0	-95	255.00	815	4.9	166.33	196.33
1970	1,107	17	30.0	0	61	272.00	821	5.0	164.20	221.40
1971	1,010	36	19.5	0	-167	293.50	939	5.1	184.12	198.04
1972	951	58	42.8	0	-24	262.80	813	5.2	156.35	182.88
1973	786	49	88.9	0	-155	267.90	811	5.3	153.02	148.30
1974	855	178	171.0	0	17	341.00	846	5.4	156.67	158.33
1975	1,152	254	47.8	0	193	365.80	895	5.5	162.73	209.45
1976	1,090	170	8.4	0	110	297.40	861	5.8	148.45	187.93
1977	1,219	50	.2	31	-86	318.20	1,006	6.0	167.67	203.17
1978	1,051	23	44.2	3	-118	306.20	927	6.1	151.97	172.30
1979	1,308	48	18.7	0	88	332.70	954	6.3	151.43	207.62
1980	1,174	34	9.7	0	-117	303.70	1,031	6.5	158.62	180.62
1981	894	94	36.8	0	-155	268.80	911	6.6	138.03	135.45
1982	1,075	111	46.6	0	122	274.60	836	6.8	122.94	158.09
1983	1,094	80	80.0	0	20	281.00	953	7.0	136.14	156.29
Average:										
1966-68	1,099	14	0	1.89	-10.33	292.31	799	4.7	170.26	233.89
1981-83	1,021	95	54.5	0	-4.33	274.80	900	6.8	132.37	149.94
	Percent per year									
Growth rate, 1966-83	-.5	12.8	9.5[3]	NA	NA	.03	.8	2.5	-1.7	-3.0

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste
[3]1969-83.

Source: ERS data base.

Appendix table 5--Mozambique: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	816	63	0	4	20	96.00	759	7.6	99.87	107.37
1967	894	71	0	30	40	102.00	793	7.8	101.67	114.62
1968	741	64	0	126	-90	78.00	691	7.9	87.47	93.80
1969	771	95	0	25	20	71.00	750	8.1	92.59	95.19
1970	699	112	0	13	33	77.00	688	8.3	82.89	84.22
1971	896	111	0	1	0	78.00	928	8.5	109.18	105.41
1972	898	111	0	153	-53	94.00	815	8.7	93.68	103.22
1973	876	125	0	20	150	99.00	732	9.0	81.33	97.33
1974	759	61	0	0	5	84.00	731	9.2	79.46	82.50
1975	602	186	2.0	0	-130	82.00	838	9.4	89.15	64.04
1976	513	116	59.5	0	5	77.50	606	9.7	62.47	52.89
1977	692	104	126.7	0	0	58.70	864	11.1	77.84	62.34
1978	705	187	85.8	0	5	58.80	914	11.4	80.18	61.84
1979	648	215	119.9	0	-30	97.90	915	11.7	78.21	55.38
1980	562	249	160.2	0	0	68.20	903	12.0	75.25	46.83
1981	625	185	110.0	0	0	62.00	858	12.4	69.19	50.40
1982	589	108	146.0	0	0	64.00	779	12.7	61.34	46.38
1983	384	297	171.0	0	0	52.00	800	13.0	61.54	29.54
Average:										
1966-68	817	66	0	20.67	-8.61	85.01	748	7.8	96.33	105.26
1981-83	533	197	142.3	0	0	59.33	812	12.7	64.02	42.11
	Percent per year									
Growth rate, 1966-83	-2.8	7.3	9.0[3]	NA	NA	-2.92	.5	3.3	-2.7	-6.1

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste
[3]1976-83.

Source: ERS data base.

Appendix table 6--Niger: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	702	7	0	40	-200	286.00	583	3.5	166.57	200.57
1967	745	9	0	40	6	95.00	613	3.6	170.28	206.94
1968	912	9	0	50	0	115.00	756	3.7	204.32	246.49
1969	660	8	18.7	50	-170	253.70	553	3.8	145.53	173.68
1970	938	9	15.0	55	-19	132.00	794	3.9	203.59	240.51
1971	719	13	0	58	-111	191.00	594	4.0	148.50	179.75
1972	777	7	7.3	58	-54	136.30	651	4.1	158.78	189.51
1973	741	20	49.9	4	-66	207.90	665	4.2	158.33	176.43
1974	502	53	186.4	23	-260	351.40	627	4.3	145.81	116.74
1975	743	130	39.1	56	-66	133.10	789	4.5	175.33	165.11
1976	493	16	84.2	7	-231	337.20	480	4.6	104.35	107.17
1977	893	58	3.6	42	-9	140.60	781	4.7	166.17	190.00
1978	1,057	28	35.7	6	116	71.70	927	4.8	193.13	220.21
1979	1,004	68	18.8	18	100	72.80	900	5.0	180.00	200.80
1980	1,117	33	5.0	20	111	73.00	951	5.1	186.47	219.02
1981	1,153	58	13.8	30	27	163.80	1,004	5.3	189.43	217.55
1982	1,100	95	55.0	30	-100	280.00	1,040	5.4	192.59	203.70
1983	1,104	85	22.0	0	0	212.00	999	5.6	178.39	197.14
Average:										
1966-68	786	8	0	32.61	-45.06	174.31	651	3.6	180.39	218.00
1981-83	1,119	79	30.3	20.00	24.33	218.60	1,014	5.4	186.81	206.13
	Percent per year									
Growth rate, 1966-83	2.3	15.0	8.3[3]	NA	NA	3.62	3.0	2.7	.2	-.4

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste
[3]1969-83.

Source: ERS data base.

Appendix table 7--Senegal: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	720	257	18.1	28	0	285.10	682	3.8	179.47	189.47
1967	590	215	52.7	25	-4	253.70	583	3.9	149.49	151.28
1968	850	232	23.9	13	104	380.90	608	4.0	152.00	212.50
1969	533	261	30.6	23	-70	239.60	632	4.1	154.15	130.00
1970	839	300	17.3	24	157	376.30	599	4.2	142.62	199.76
1971	531	237	15.7	29	-158	266.70	646	4.3	150.23	123.49
1972	729	290	20.7	7	100	306.70	626	4.4	142.27	165.68
1973	380	285	54.0	0	-179	215.00	683	4.6	148.48	82.61
1974	609	429	90.1	12	95	295.10	726	4.7	154.47	129.57
1975	955	337	29.4	15	181	373.40	752	4.8	156.67	198.96
1976	786	218	24.4	8	-83	359.40	744	5.0	148.80	157.20
1977	723	420	73.5	0	70	315.50	831	5.1	162.94	141.76
1978	541	424	125.1	9	-140	270.10	951	5.2	182.88	104.04
1979	1,003	449	44.2	29	230	347.20	890	5.4	164.81	185.74
1980	662	504	87.6	0	-106	327.60	1,032	5.5	187.64	120.36
1981	653	412	102.8	0	-197	309.80	1,055	5.7	185.09	114.56
1982	918	450	63.8	0	81	348.80	1,002	5.8	172.76	158.28
1983	770	420	113.0	0	-30	325.00	1,008	6.0	168.00	128.33
Average:										
1966-68	720	235	31.6	12.33	2.83	310.88	624	3.9	160.32	184.42
1981-83	780	427	93.2	0	-48.67	327.87	1,022	5.8	175.28	133.72
					Percent per year					
Growth rate, 1966-83	.5	4	7.2	NA	NA	.45	3.3	2.7	.6	-2.1

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste

Source: ERS data base.

Appendix table 8--Somalia: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	200	42	2.2	0	0	6.20	238	2.9	82.07	68.97
1967	253	32	0.8	0	-5	37.80	253	3.0	84.33	84.33
1968	291	31	0	0	-2.5	39.50	285	3.1	91.94	93.87
1969	260	45	.7	0	-3.7	33.40	276	3.2	86.25	81.25
1970	270	46	10.6	0	10	34.60	282	3.3	85.45	81.82
1971	231	118	16.3	0	-10	32.30	343	3.4	100.88	67.94
1972	224	58	15.0	0	16.3	36.70	244	3.5	69.71	64.00
1973	319	47	15.0	0	17	41.00	323	3.5	92.29	91.14
1974	318	54	12.0	0	5	44.00	335	3.6	93.06	88.33
1975	291	143	51.5	0	-33.3	37.80	481	3.7	130.00	78.65
1976	246	92	58.4	0	25	47.40	324	3.8	85.26	64.74
1977	227	93	53.9	0	-20	41.90	352	3.9	90.26	58.21
1978	263	15	62.1	0	20	40.10	280	4.2	66.67	62.62
1979	256	130	85.8	0	-20	39.80	452	4.5	100.44	56.89
1980	261	92	222.2	0	0	40.20	535	4.8	111.46	54.38
1981	254	195	215.9	0	30	31.90	603	5.1	118.24	49.80
1982	278	261	145.4	0	50	45.40	589	5.0	117.80	55.60
1983	281	73	145.0	0	-80	129.00	450	5.1	88.24	55.10
Average:										
1966-68	248	35	1.0	0	-.07	42.17	259	3.0	86.11	82.39
1981-83	271	176	168.8	0	0	68.77	547	5.1	108.09	53.50
	Percent per year									
Growth rate, 1966-83	.6	10.8	34.2	NA	NA	6.03	5	3.5	1.5	-2.9

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste

Source: ERS data base.

Appendix table 9--Sudan: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	1,251	95	39.6	35	0	209.60	1,141	12.5	91.28	100.08
1967	1,217	161	16.8	94	-307	200.80	1,407	12.8	109.92	95.08
1968	2,457	227	0	9	-273	317.00	2,631	13.1	200.84	187.56
1969	1,277	157	24.8	62	-654	267.80	1,783	13.4	133.06	95.30
1970	2,037	103	10.0	23	45	297.00	1,785	13.7	130.29	148.69
1971	2,194	231	9.0	31	150	333.00	1,920	14.1	136.17	155.60
1972	2,070	182	12.0	64	97	342.00	1,761	14.4	122.29	143.75
1973	1,837	196	37.0	83	-271	334.00	1,924	14.8	130.00	124.12
1974	2,304	170	34.6	125	-45	349.60	2,079	15.2	136.78	151.58
1975	2,460	97	28.9	117	30	409.90	2,029	15.6	130.06	157.69
1976	2,780	110	14.4	59	300	460.40	2,085	16.0	130.31	173.75
1977	2,754	119	68.2	90	-275	482.20	2,644	16.4	161.22	167.93
1978	2,870	63	101.8	135	30	503.80	2,366	17.0	139.18	168.82
1979	3,187	137	160.3	64	10	565.30	2,845	17.5	162.57	182.11
1980	2,262	132	184.1	198	-180	425.10	2,135	18.1	117.96	124.97
1981	2,815	158	241.0	338	30	499.00	2,347	18.7	125.51	150.53
1982	3,966	106	275.1	259	284	695.10	3,109	19.3	161.09	205.49
1983	2,480	115	401.4	388	-264	479.40	2,393	19.9	120.25	124.62
Average:										
1966-68	1,642	161	18.8	120.78	-71.83	398.39	1,726	12.8	134.00	127.57
1981-83	3,087	126	305.8	328.33	16.67	557.83	2,616	19.3	135.69	160.22
	Percent per year									
Growth rate, 1966-83	4.2	-1.6	18.6	NA	NA	5.55	2.8	2.7	.1	1.5

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste

Source: ERS data base.

Appendix table 10--Zambia: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste	Availability[2]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	982	64	0.6	40	-5	140.60	871	3.7	235.41	265.41
1967	973	54	0	198	-102	234.00	697	3.8	183.42	256.05
1968	903	71	0	64	-35	158.00	787	3.9	201.79	231.54
1969	910	78	0	8	-20	143.00	857	4.0	214.25	227.50
1970	767	147	1.0	0	-75	178.00	812	4.2	193.33	182.62
1971	1,066	351	.2	9	-92	237.20	1,263	4.3	293.72	247.91
1972	1,091	182	.5	2	-73	222.50	1,122	4.4	255.00	247.95
1973	931	82	5.3	50	-160	281.30	847	4.5	188.22	206.89
1974	1,207	93	0	111	-37	203.00	1,023	4.7	217.66	256.81
1975	1,092	160	5.8	17	0	168.80	1,072	4.8	223.33	227.50
1976	1,220	84	20.3	9	-15	373.30	957	5.0	191.40	244.00
1977	1,124	98	41.8	26	-90	407.80	920	5.1	180.39	220.39
1978	912	83	12.0	61	-279	162.00	1,063	5.3	200.57	172.08
1979	788	132	83.7	30	-15	201.70	787	5.5	143.09	143.27
1980	841	348	163.0	0	34	87.00	1,231	5.6	219.82	150.18
1981	1,301	125	103.4	1	14	160.40	1,354	5.8	233.45	224.31
1982	1,025	222	60.1	1	-19	263.10	1,062	6.0	177.00	170.83
1983	1,043	171	108.4	1	17	359.40	945	6.2	152.42	168.23
Average:										
1966-68	953	63	.2	34.89	-27	195.28	785	3.8	206.87	251.00
1981-83	1,123	173	90.6	1.00	4	260.97	1,120	6.0	187.62	187.79
	Percent per year									
Growth rate, 1966-83	1.1	6.7	40.8	NA	NA	3.88	2.4	3	-.6	-1.9

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste

Source: ERS data base.

Appendix table 11--Zimbabwe: Country data, 1966-83

Year	Production	Imports	Food aid	Exports	Change in stocks[1]	Seed and waste[2]	Availability[3]	Population	Per capita availability	Per capita production
	1,000 tons							Million	Kilograms per year	
1966	1,285	101	0	312	51	199.00	824	4.6	179.13	279.35
1967	1,887	67	0	715	-10	305.00	944	4.8	196.67	393.13
1968	1,143	87	0	182	-73	192.00	929	5.0	185.80	228.60
1969	2,000	58	0	673	59	318.00	1,008	5.1	197.65	392.16
1970	1,436	84	0	243	-9	264.00	1,022	5.3	192.83	270.94
1971	2,210	64	0	717	104	421.00	1,032	5.5	187.64	401.82
1972	2,724	20	0	891	275	580.00	998	5.7	175.09	477.89
1973	1,415	65	0	364	-236	263.00	1,089	5.9	184.58	239.83
1974	2,508	214	0	881	238	475.00	1,128	6.0	188.00	418.00
1975	2,163	26	0	758	-151	442.00	1,140	6.2	183.87	348.87
1976	2,156	11	0	297	304	434.00	1,132	6.5	174.15	331.69
1977	2,095	1	0	422	53	432.00	1,189	6.7	177.46	312.69
1978	2,101	1	0	555	-166	475.00	1,238	6.9	179.42	304.49
1979	1,509	149	0	266	-262	442.00	1,212	7.1	170.70	212.54
1980	2,052	98	9.6	101	45	609.60	1,404	7.4	189.73	277.30
1981	3,254	13	8.0	305	1,047	720.00	1,203	7.6	158.29	428.16
1982	2,256	27	5.2	495	-171	687.20	1,277	7.9	161.65	285.57
1983	1,298	70	10.1	265	-958	596.10	1,475	8.2	179.88	158.29
Average:										
1966-68	1,438	85	0	469	7.78	436.38	899	4.8	187.20	300.36
1981-83	2,269	37	7.8	355	-27.33	667.77	1,318	7.9	166.60	290.67
	Percent per year									
Growth rate, 1966-83	3	-5.6	NA	NA	NA	7.05	2.5	3.3	-.8	-.2

NA = Not applicable.
[1]A negative quantity means a decrease in stocks and an increase in availability.
[2]Includes feed use.
[3]The operational relationship is as follows:
Availability = Production + Imports + Food aid - Exports - Change in stocks - Seed and waste

Source: ERS data base.

Appendix table 12--Indicators of relative variability in data series and correlation coefficients, 1966-83

Country/commodity	Coefficient of variation				Correlation coefficient between--					
	Production	Imports	Food aid	Availability	1 & 2	1 & 3	1 & 4	2 & 3	2 & 4	3 & 4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Percent									
Ethiopia:										
Wheat	22.0	90.1	77.7	23.9	-0.35	0.24	0.80	0.19	0.15	0.67
Corn	17.4	217.8	191.2	16.9	.29	.18	.95	-.16	.28	.26
Sorghum	24.1	135.8	169.0	26.5	-.44	-.08	.93	.13	-.37	-.06
All cereals	12.0	82.4	81.0	12.8	.29	.64	.96	.14	.40	.70
Kenya:										
Rice	14.0	176.4	138.7	29.8	.16	.39	.70	.39	.68	.77
Corn	13.6	189.3	284.0	18.3	.06	-.31	.74	.23	.52	.05
Wheat	18.3	125.6	112.4	21.1	-.61	.41	.32	-.36	.05	.79
All cereals	10.5	95.5	144.7	13.7	.07	.15	.72	.57	.58	.55
Lesotho:										
Corn	28.7	79.1	74.5	29.4	.15	-.02	.65	.47	.80	.45
Sorghum	32.8	80.2	..	22.6	-.59	..	.82	..	-.08	..
Wheat	28.8	16.2	99.8	23.4	-.70	-.63	.33	.74	.31	.11
All cereals	25.4	33.0	71.7	19.1	-.20	-.33	.49	.72	.67	.53
Mali:										
Rice	24.0	109.7	151.0	25 5	.37	-.12	.61	.10	.54	.11
Wheat	..	48.2	109.7	46.8	..	..	..	.09	.76	.71
Corn	18.7	125.9	154.2	26.6	-.05	-.57	.15	.43	.79	.44
Millet/sorghum	13.1	159.2	163.6	11.8	-.35	-.57	.60	.68	-.45	-.29
All cereals	12.5	94.7	119.1	7.2	-.08	-.57	.46	.48	.07	-.07
Mozambique:										
Wheat	..	43.5	68.6	17.3	..	..	..	-.64	-.08	.80
Rice	21.8	74.6	171.9	21.5	-.75	-.54	-.22	.39	.63	.67
Corn	18.5	99.3	211.6	18.7	-.39	-.60	.21	.05	.48	.07
All cereals	13.8	33.6	58.4	10.8	-.59	-.75	.04	.71	.50	.41

See note at end of table.

Continued--

Appendix table 12--Indicators of relative variability in data series and correlation coefficients, 1966-83--Continued

Country/commodity	Coefficient of variation				Correlation coefficient between--					
	Production	Imports	Food aid	Availability	1 & 2	1 & 3	1 & 4	2 & 3	2 & 4	3 & 4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Percent									
Niger:										
Wheat	--	54.4	109.0	45.3	--	--	--	-0.29	0.47	0.70
Rice	25.0	129.1	--	49.6	.26	--	.48	--	.95	--
Sorghum	24.1	186.0	193.8	18.6	-.33	-.54	.24	.20	.56	.47
All cereals	19.7	70.8	148.9	15.0	.34	-.46	.94	.23	.60	-.17
Senegal:										
Millet	23.4	95.7	87.7	8.9	.21	-.47	.32	.40	.23	.30
Wheat	--	19.2	61.5	17.5	--	--	--	.38	.64	.86
Rice	32.7	23.6	113.6	20.7	-.23	-.14	-.24	.77	.94	.77
Corn	26.1	66.0	55.1	12.7	[illegible]5	-.21	.86	.09	.23	-.30
All cereals	23.2	16.6	48.6	8.3	[illegible]22	-.24	.18	.74	.85	.77
Somalia:										
Corn	24.8	149.6	172.6	23.6	.19	-.08	.58	.03	.54	.56
Wheat	--	87.3	58.2	59.4	--	--	--	.63	.90	.90
Rice	--	49.6	77.1	51.4	--	--	--	.45	.87	.79
All cereals	12.0	59.5	64.9	19.6	0	.03	.23	.62	.85	.88
Sudan:										
Wheat	36.0	31.6	69.7	12.2	-.39	.11	.50	-.30	-.12	.84
Corn	34.5	--	216.4	29.3	--	-.13	.62	--	--	.56
All cereals	19.2	31.4	72.7	16.5	-.26	.52	.90	-.31	-.08	.54
Zambia:										
Corn	15.6	136.0	214.7	18.4	-.15	-.26	.40	.67	.66	.45
Wheat	--	46.7	96.0	49.3	--	--	--	.34	.71	.29
All cereals	14.7	60.5	95.7	16.7	-.08	-.03	.50	.48	.65	.40
Zimbabwe:										
Corn	32.3	229.3	--	10.3	.05	--	.07	--	.25	--
Wheat	28.1	62.3	--	15.6	-.85	--	.77	--	-.47	--
All cereals	27.3	86.5	147.5	5.2	-.31	.17	.17	-.06	-.09	.75

-- = Not calculated.

Source: Calculated from ERS data base.

Appendix table 13--Producer price responses

Country/dependent and independent variables	Wheat	Corn	Millet	Sorghum	Teff	Barley	Rice
Ethiopia:							
Production--							
Production (t-1)	0.35*	0.28	-0.30	NA	-0.14	0.41*	NA
Deflated price (t-1)	.53	.47	.28	NA	.28*	.19	NA
Dummy variable	0	0	-.46*	NA	-.23*	-.28	NA
Area--							
Area (t-1)	.67*	-.08	.46	NA	.70*	.08	NA
Deflated price (t-1)	.76*	.38*	.28	NA	.11	-.03	NA
Dummy variable	-.01	-.02	-.19	NA	-.08	-.11	NA
Kenya:							
Production--							
Production (t-1)	.59*	.63*	.38*	.10	NA	NA	0.68*
Deflated price (t-1)	.46*	.40*	.39*	.07	NA	NA	-.15
Dummy variable	-.15	-.01	-.21	-.03	NA	NA	-.10
Area--							
Area (t-1)	.73*	.99*	.49*	.64*	NA	NA	.77*
Deflated price (t-1)	.29*	.17*	.34	-.02	NA	NA	.03
Dummy variable	-.10*	-.11*	-.15*	-.01	NA	NA	-.02
Marketed surplus--							
Marketed surplus (t-1)	NA	.27	NA	NA	NA	NA	NA
Deflated current price	NA	1.13*	NA	NA	NA	NA	NA
Dummy variable	NA	-.41*	NA	NA	NA	NA	NA
Lesotho:							
Production--							
Production (t-1)	.04	.21	NA	.29*	NA	NA	NA
Deflated price (t-1)	-.76	-.25	NA	.13	NA	NA	NA
Dummy variable	-.34*	-.42*	NA	-.34*	NA	NA	NA
Area--							
Area (t-1)	1.10*	.49*	NA	.72*	NA	NA	NA
Deflated price (t-1)	.30	.28	NA	.14	NA	NA	NA
Dummy variable	-.07	-.30*	NA	-.02	NA	NA	NA
Mali:							
Production--							
Production (t-1)	NA	.11	-.12[1]	NA	NA	NA	.08
Deflated price (t-1)	NA	-.12	.35*[1]	NA	NA	NA	.34*
Dummy variable	NA	.35*	-.21*[1]	NA	NA	NA	-.38*
Area--							
Area (t-1)	NA	.44*	-.03[1]	NA	NA	NA	-.15
Deflated price (t-1)	NA	.07	.20*[1]	NA	NA	NA	.23*
Dummy variable	NA	-.14*	.09*[1]	NA	NA	NA	-.20

See notes at end of table.

Continued--

Appendix table 13 Producer price responses--Continued

Country/dependent and independent variables	Wheat	Corn	Millet	Sorghum	Teff	Barley	Rice
Niger:							
Production--							
Production (t-1)	NA	NA	0.37*	0.37*	NA	NA	0.36*
Deflated price (t-1)	NA	NA	.14	.11	NA	NA	-.60*
Dummy variable	NA	NA	-.37*	-.31*	NA	NA	0
Area--							
Area (t-1)	NA	NA	.35*	.78*	NA	NA	.79
Deflated price (t-1)	NA	NA	.10	.29*	NA	NA	-.09
Dummy variable	NA	NA	-.29*	-.11	NA	NA	-.07
Senegal:							
Production--							
Production (t-1)	NA	.30*	.21	NA	NA	NA	-.02
Deflated price (t-1)	NA	.01	.11	NA	NA	NA	.32
Dummy variable	NA	-.83*	-.42	NA	NA	NA	-.37*
Area--							
Area (t-1)	NA	.63	.03	NA	NA	NA	-.03
Deflated price (t-1)	NA	-.16	.40*	NA	NA	NA	.46
Dummy variable	NA	-.60*	-.11*	NA	NA	NA	-.23
Somalia:							
Production--							
Production (t-1)	NA	.21*	NA	.23	NA	NA	NA
Deflated price (t-1)	NA	.10	NA	.03	NA	NA	NA
Dummy variable	NA	-.25*	NA	-.17*	NA	NA	NA
Area--							
Area (t-1)	NA	.49*	NA	-.30	NA	NA	NA
Deflated price (t-1)	NA	.09	NA	.14*	NA	NA	NA
Dummy variable	NA	-.27*	NA	-.36*	NA	NA	NA
Sudan:							
Production--							
Production (t-1)	.72*	.68*	.23*	.32*	NA	NA	NA
Deflated price (t-1)	.34*	.31*	.14*	.22*	NA	NA	NA
Dummy variable	-.34*	-.22*	-.27*	-.34*	NA	NA	NA
Area--							
Area (t-1)	.86*	.10	.88*	.02	NA	NA	NA
Deflated price (t-1)	.28*	.27	-.09	.33*	NA	NA	NA
Dummy variable	-.86	-.31	-.04	-.09	NA	NA	NA

See notes at end of table.

Continued--

Appendix table 13--Producer price responses--Continued

Country/dependent and independent variables	Wheat	Corn	Millet	Sorghum	Teff	Barley	Rice
Zambia:							
Production--							
Production (t-1)	NA	0.16	0.41*[1]	NA	NA	NA	NA
Deflated price (t-1)	NA	.61*	.21*[1]	NA	NA	NA	NA
Dummy variable	NA	-.18*	-.08*[1]	NA	NA	NA	NA
Area--							
Area (t-1)	NA	.46*	.72*[1]	NA	NA	NA	NA
Nominal price (t-1)	NA	.31*	.06[1]	NA	NA	NA	NA
Dummy variable	NA	.01	.02*[1]	NA	NA	NA	NA
Marketed surplus--							
Marketed surplus (t-1)	NA	.60*	NA	NA	NA	NA	NA
Deflated current price	NA	1.69*	NA	NA	NA	NA	NA
Dummy variable	NA	-.27	NA	NA	NA	NA	NA
Zimbabwe:							
Production--							
Production (t-1)	.64*	.04	.03*	.23	NA	NA	NA
Deflated price (t-1)	.33	.36*	.02	.43	NA	NA	NA
Dummy variable	-.38*	-.31*	-.40*	-.61*	NA	NA	NA
Area--							
Area (t-1)	.71*	.14	.79*	.42*	NA	NA	NA
Deflated price (t-1)	.40*	.92*	.23*	.21	NA	NA	NA
Dummy variable	-.48*	-.06	-.20*	-.29	NA	NA	NA
Marketed surplus--							
Marketed surplus (t-1)	NA	.10	NA	NA	NA	NA	NA
Deflated current price	NA	1.42*	NA	NA	NA	NA	NA
Dummy variable	NA	-.53*	NA	NA	NA	NA	NA

(t-1) = Lagged by 1 year.
NA = Not applicable.
* = Significant at 90-percent confidence level.
[1]Millet and sorghum combined.

Source: ERS estimates.

Appendix table 14--Growth rate of volume of imports of major food commodities, 1966-83[1]

Country	Wheat	Rice	Corn
	Percent per year		
Ethiopia	13.69	NC	14.95
Kenya	11.61	16.37	8.31
Lesotho[2]	10.26	NC	49.17
Mali[3]	8.00	5.07	7.61
Mozambique[4]	5.57	18.39	NC
Niger	12.92	NC	NC
Senegal	4.13	4.95	-1.04
Somalia	14.80	9.32	NC
Sudan	5.72	4.32	NC
Zambia	6.40	5.03	NC
Zimbabwe	-4.58	NC	5.08

NC = Not calculated: imports minor and data too inconsistent to reflect meaningful growth rate.
[1]Including food aid.
[2]Corn series is 1975-83.
[3]Rice series is 1971-83; corn series is 1972-83.
[4]Rice series is 1975-83.

Source: ERS data base.

Appendix B: Recommended Additional Reading

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INDEX

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