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Consumption Stability and the Potential Role of Food Aid in Africa

Stacey Rosen

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Abstract

Africa's high consumption variation has resulted in severe food shortages and famine during drought years. This was caused by low and variable food production not supplemented by commercial and food aid imports. Results of a model estimated in this report suggest that weather is the primary determinant of production variation. The capacity to import, defined as the sum of net credit flow plus export earnings, is the variable that best determines levels of food imports. Using the model results, additional food aid needs were projected for 1990 and 1995 under three scenarios--trend, good weather, and bad weather. The range of these needs varied widely, depending on a country's degree of responsiveness to changes in weather. Under the bad weather scenario, all but one country studied are projected to have additional food aid needs in 1990, with food aid contributing almost 25 percent to target consumption.

Keywords: Africa, food aid, consumption, variation, commercial food imports, production, weather, import capacity

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Consumption Stability and the Potential Role of Food Aid in Africa

Stacey Rosen

Introduction

Food consumption in most areas of Africa has been characterized by declining trends and instability. Most African countries are dependent on a large subsistence agricultural sector to meet from two-thirds to all of their consumption requirements. Productivity changes and variations in food production are therefore directly transmitted to consumption levels. Sub-Saharan Africa is the only region in the world where total food production growth has not kept pace with population growth in the last two decades. In addition to slow long-term production growth, the lack of irrigated agriculture leaves the region vulnerable to drought, thus increasing production-consumption variability. For this region, which has always struggled with malnutrition and famine, food imports appeared to be the solution to the problem of variable consumption. Limited financial resources, however, have reduced their commercial import capacity. In recent years, as financial difficulties have grown, particularly in Sub-Saharan Africa, these countries have become increasingly dependent on food aid to stabilize consumption.

This report examines consumption patterns of African countries, identifies the main factors that shape the consumption trend, and estimates the expected need for food aid under different target consumption levels. Cereals are used as a proxy for food because data are readily available, and cereals account for more than 60 percent of total food consumption in this region. In this report, cereals are defined as wheat, corn, rice, sorghum, millet, teff, and barley. The 17 African countries studied are Ethiopia, Gambia, Kenya, Lesotho, Liberia, Madagascar, Mali, Morocco, Niger, Senegal, Sierra Leone, Somalia, Sudan, Tanzania, Tunisia, Zaire, and Zambia. These countries were chosen because of their reliance on imports to meet consumption requirements and availability of data. The time period studied is 1966-86.

Consumption Variability

African consumption is shaped by characteristics of production, commercial imports, and food aid imports (stocks are limited). In most of the countries, foreign exchange availability sets a limit on commercial imports. Governments are involved in regulating imports, in general, and food imports in particular. Although food imports are used to compensate for production shortfalls, average annual consumption variation (defined as variation from

consumption trend in percentage terms) remains high at 13 percent. Production variation, calculated from 1966-86, averages almost 17 percent, meaning that commercial and food aid imports reduced variation by 20 percent (table 1). The high production variation is illustrated in figures 1 and 2, using country specific examples. Most of the consumption stabilization can be attributed to commercial imports. Variation of production together with commercial imports, 13.3 percent, was only slightly higher than consumption variation, meaning that food aid did not reduce variation during 1966-86. A principal reason for this is the small contribution food aid made to consumption in the early part of the study period. Later in the period, food aid contributed more than 9 percent to consumption. Therefore, food aid is not expected to have a great effect on reducing variation. However, since food aid now plays a larger role in the composition of consumption, there is a potential for it to reduce variation. Other factors contributing to this are delays in assessing food needs, delays in responding to the needs, and distribution problems with ports and roads in the recipient country.

Both donors and recipients have been known to react slowly to a drought situation. Drought-stricken countries are reluctant to admit that they have a production shortfall or that starvation exists in their countries. Often,

Table 1--Coefficients of variation and import dependency

Country	Coefficients of variation: Production	Coefficients of variation: Production + commercial imports	Coefficients of variation: Consumption	Commercial import dependency 1/: 1970-72	Commercial import dependency 1/: 1984-86	Food aid import dependency 2/: 1970-72	Food aid import dependency 2/: 1984-86
			Percent				
Ethiopia	12.2	11.8	11.0	1.1	4.5	0.2	8.3
Gambia	24.1	16.4	16.0	17.3	29.7	2.0	16.1
Kenya	12.7	11.2	11.9	2.2	8.4	.1	6.1
Lesotho	31.2	18.9	17.5	19.0	40.5	7.7	16.7
Liberia	4.4	8.3	6.2	30.0	23.2	2.7	15.4
Madagascar	3.9	4.9	5.1	6.2	4.6	0	4.1
Mali	15.0	13.2	14.7	6.9	9.4	1.0	7.4
Morocco	21.9	15.4	15.3	3.7	36.2	6.6	5.9
Niger	18.7	19.1	18.3	.5	1.6	.8	6.2
Senegal	27.0	18.1	17.7	37.3	31.3	2.9	7.8
Sierra Leone	7.4	8.0	8.1	14.9	15.7	1.0	8.0
Somalia	21.4	18.0	19.5	22.8	18.5	3.2	21.5
Sudan	25.5	22.8	25.5	10.0	4.8	.5	17.3
Tanzania	10.4	9.5	9.3	7.4	4.3	.4	3.8
Tunisia	26.3	8.2	6.6	6.0	38.0	22.5	0
Zaire	4.9	8.6	8.1	24.6	17.1	2.3	6.1
Zambia	15.6	13.7	13.6	19.4	8.8	0	8.2
Average	16.6	13.3	13.2	13.5	17.4	3.2	9.3

1/ Commercial imports as a percentage of consumption.

2/ Food aid imports as a percentage of consumption.

Figure 1

Senegal: Production variation, actual vs. trend

1,000 metric tons

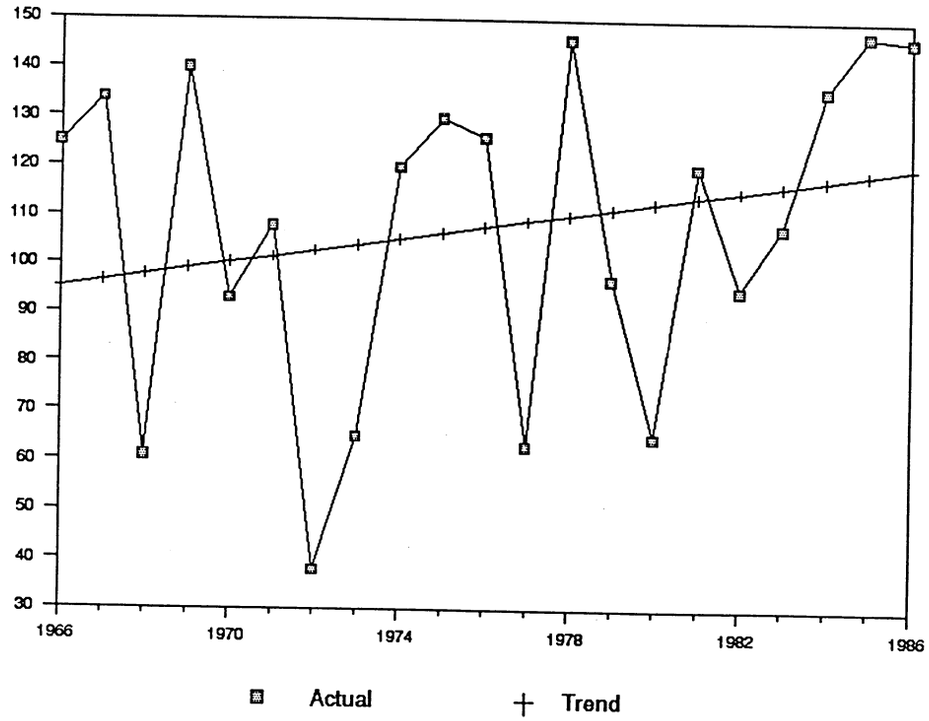
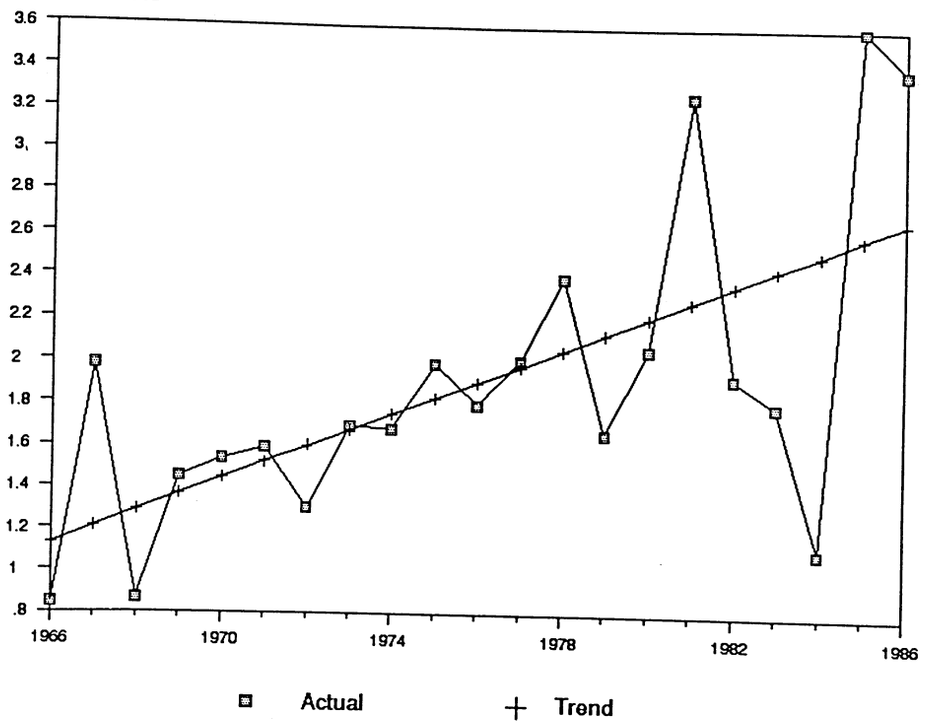


Figure 2

Sudan: Production variation, actual vs. trend

Million tons



donors' political considerations such as their relationship with the recipient country and, in many cases, inadequate information about the seriousness of the problem delay responses. As the financial condition in these countries continues to deteriorate, commercial imports, which have contributed to reducing consumption variation during the last two decades, will most likely be reduced. As a result, food aid will play an increasingly important role in stabilizing consumption.

Consumption levels and behavior differ among countries. Consumption variability in 10 of the countries studied was between 10 and 20 percent. Sudan was the only country with variation higher than 20 percent, 25.5 percent (imports did not reduce consumption variation below that of production which is also 25.5 percent). Increasingly limited foreign exchange, because of large debt service burden, and reliance on food aid that did not always arrive, are the likely reasons for this characteristic. In Gambia, Lesotho, Morocco, and Senegal, production variability, averaging 26 percent, caused the high consumption variability. In these countries, commercial imports reduced variability by 35 percent (to 17 percent), while food aid reduced variation only marginally.

In Ethiopia, Kenya, Mali, and Zambia, the production pattern was the main force shaping consumption variation, as commercial imports had only a marginal effect. Production variation averaged 14 percent, while variation of production with commercial imports averaged 12.5 percent. Except for Zambia, these countries are among the poorest in Africa, and therefore, have been unable to import enough food commercially to reduce consumption fluctuations. In these countries, commercial imports generally accounted for less than 10 percent of consumption.

In Liberia, Madagascar, Sierra Leone, Tanzania, Tunisia, and Zaire, consumption variability was the lowest, at 5 to 10 percent. Only in Tunisia did commercial imports play a major part in stabilizing consumption to less than 7 percent (from production variation of more than 26 percent). As an oil exporter, Tunisia is an exception among the studied countries and should be able to continue importing commercially.

In Africa, high variations in consumption are alarming, primarily because most Africans' caloric intake is already inadequate. According to the Food and Agriculture Organization of the United Nations (FAO), the normal per capita daily intake is 2,450 calories (2).1/ In 1985, industrialized countries' average per capita intake was more than 3,400 calories and in low-income countries, it was 2,340 calories. In all countries studied (except for Gambia, which did not have data available), the daily per capita intake in 1985 averaged less than 2,200 calories (6). When Morocco and Tunisia (higher income countries than the studied countries) are excluded, the per capita intake falls to only 2,114 calories, approximately 85 percent of a normal supply. Therefore, any year of below-trend consumption, when consumption is already below normal, is cause for concern.

The Model

To determine the food aid required to stabilize consumption, we constructed a model to examine the factors affecting domestic production and commercial imports. The consumption level is hypothetical and termed "target

1/ Underscored numbers in parentheses are listed in the references.

consumption." It could be based on a nutritional target, such as two-thirds of required nutrients, or on the average per capita consumption during a normal historical period. The food aid requirement is defined as the gap between this target consumption and commercial imports plus domestic production. The equations estimated include:

$$P = f(PX_{t-1}, P_{t-1}, DB, DG) \quad (1)$$
$$FE = CR + X \quad (2)$$
$$FI = f(P, FE, WPX, FA) \quad (3)$$
$$TC = PCC * POP \quad (4)$$
$$FA = TC - P - FI. \quad (5)$$

where P is production, PX_{t-1} is producer price, deflated by the consumer price index and lagged 1 year, P_{t-1} is a 1-year lag of production, DB is a dummy variable for bad weather, DG is a dummy variable for good weather, FE is foreign exchange availability, CR is credit, X is export earnings, FI is commercial food imports, WPX is world cereal price, TC is target consumption, PCC is target per capita consumption, POP is population, and FA is food aid.

Food Production

We selected variables based on our knowledge of the African production structure and data availability. In the food production equation (equation 1), lagged production accounts for structural rigidity of the agricultural sector (which stems from land suitability constraints) and historical consumption patterns, especially for subsistence farming systems. The producer price reflects the effect of policy change on production because historically, the governments in these countries set prices. More recently, these prices have been liberalized and more closely reflect a free market price. The two dummy variables represent any abnormal changes in production primarily induced by weather. The purpose of using the dummy is to reduce the variation in production and measure the effect of policy variables, primarily the producer price effect. Rainfall data were available only for Gambia, Niger, Senegal, and Sudan. For these countries, variation in rainfall defined the dummy variable. When rainfall was more than one standard deviation below the trend rainfall level, a one was used in the bad weather dummy variable. Otherwise, the dummy variable was represented by a zero. Conversely, when rainfall was more than one standard deviation above trend, a one was used in the good weather dummy variable. Otherwise, a zero was used. For the remaining countries, a normative approach was used to define the dummy variables. Various periodicals and reports from government and agricultural officers were studied in order to distinguish good and bad years from normal years (1,3,4,5,). A one is used in the good weather dummy variable when reports indicated that conditions were better than average for production. Otherwise it is zero. The dummy variable for bad weather is represented by a one in years when conditions are considered below average. Otherwise, it is represented by a zero.

While other factors, such as civil strife, government policies, and shortages of inputs, contribute to production variation, variations in weather are assumed to be the primary determinant of yearly fluctuations. Other factors would influence the longer term trend rather than play a crucial role in annual variations. For example, in Somalia, Sudan, and Ethiopia, civil unrest and war have been ongoing for decades. In addition, most countries have consistently faced shortages of inputs such as fuel and fertilizers because of the lack of foreign exchange for imports. Until 1980, many policies could be

considered disincentives to production. Most notable was the maintenance of low nominal producer prices in order to depress retail prices and appease urban consumers. Since then, many countries have liberalized the pricing system, but very slowly.

The equations were estimated for the major, or one of the major, cereals in terms of domestic production in each country. All variables except the two dummy variables are in log form.

Foreign Exchange Availability

Foreign exchange availability (equation 2) in Africa has been limited, resulting in a reduced capacity to import and a need for food aid. Foreign exchange availability is defined as the sum of net credit flows and export earnings. Recent trends for both variables have been declining, meaning less foreign exchange is available. As international liquidity increased in the mid-1970's, these countries received large inflows of credit from both industrialized and OPEC (Organization of Petroleum Exporting Countries) countries. As the world ecoromy fell into a recession in the late 1970's, however, credit availability shrank. In addition, interest rates rose, and the recipient countries' ability to service their debt diminished. This was exacerbated as commodity prices for these countries' exports' declined because of competition among suppliers and lower demand. As a result, export earnings in most countries declined or, at best, stagnated, resulting in an extremely limited capacity to import commercially.

Commercial Food Imports

In the commercial food imports estimation (equation 3), cereals are used as a proxy for food because cereals contribute approximately 60 percent of the diet. The demand for commercial imports is specified as a function of domestic food production, foreign exchange availability (defined as export earnings plus net credit flow), the world food price (price of cereals in U.S. dollars, deflated by a nonfood price index to show terms of trade between food and nonfood imports), and quantities of food aid imports. The uncertainty surrounding the behavior of production, commercial imports, and food aid in any one year made it necessary to try different specifications of lagged and current values for the variables. The functional form of this equation is double log.

Target Consumption

Target consumption (equation 4) is derived by multiplying a base year (the 3-year average, 1984-86) per capita consumption level by projected population levels. The underlying assumption is to keep per capita consumption constant so as to prevent further deterioration of the nutritional level. Food aid needs are defined in equation 5 as target consumption not met by production and commercial food imports.

Results

Producer Price

Estimated results of the food production equation (equation 1) indicate that the lagged producer price had a positive and statistically significant effect

on food production in Niger, Senegal, Sierra Leone, Sudan, Tanzania, and Zambia (table 2). In the remaining countries, the elasticities were positive except for Gambia, Kenya, Morocco, Somalia, and Tunisia. This largely insignificant response indicates that price effects on production decisions were overshadowed by the influence of other explanatory variables: lagged production and weather. This result is most likely due to the subsistence nature of production in most countries where little surplus production enters commercial marketing channels. Production is highly valued for home use, resulting in low price responsiveness.

Lagged Production

The relation between current production and lagged production varied widely. The coefficients were positive and statistically significant in Ethiopia, Kenya, Liberia, Madagascar, Tanzania, and Zaire. These results were expected in that production variation in these countries was among the lowest in the countries studied. Production coefficients of variation ranged from less than 4 percent in Madagascar to almost 13 percent in Kenya. Approximately 40 percent of Madagascar's arable land is irrigated, thus reducing vulnerability to drought. Liberia usually receives adequate rainfall, which lowers variation. In Gambia, Lesotho, Mali, Niger, Sierra Leone, and Somalia, the relationship between current and lagged production was positive but not statistically significant. In Morocco, Senegal, Sudan, Tunisia, and Zambia, the responses were negative and insignificant (except in Sudan), reflecting extreme fluctuations in production. The production coefficients of variation in these countries were among the highest of the countries studied, ranging from 15.6 percent in Zambia to 27 percent in Senegal.

Weather

Production responsiveness with respect to the dummy variables for weather had the expected sign and was statistically significant in most countries, meaning that weather is a principal cause of production variation. Since 1966, drought has occurred in these countries, on average, once every 3 years. Major droughts during this time included those in the Sahel, 1968-73; Sahel and the northeastern countries, 1977-78; Sahel, early 1980's; and East Africa, 1984-85. In many regions of the world, irrigated cropland reduces vulnerability to drought, but in Africa, little arable land is irrigated. The exceptions are Madagascar and Sudan, which have formal irrigation schemes with full water control. These countries, however, do not have the foreign exchange to import inputs needed to maintain irrigated schemes, therefore, many of the schemes are in need of rehabilitation.

Coefficients of the dummy variable for bad weather were negative in all countries and statistically significant in all countries except Liberia, Madagascar, Sudan, and Zaire. The coefficients ranged from 0.16 to 0.71. Ethiopia, Lesotho, Mali, Morocco, Senegal, Somalia, and Tunisia have large coefficients and could be considered vulnerable to drought and, therefore, experience large import needs and possibly large food aid needs from time to time. Production coefficients of variation in these countries ranged from 12.2 percent in Ethiopia to 31.2 percent in Lesotho.

Coefficients of the dummy variable for good weather were positive in every country except Gambia and Zaire and statistically significant in all but five of those countries (Ethiopia, Liberia, Niger, Somalia, and Sudan). The coefficients ranged from 0.07 to 0.49. A large production response to good

Table 2--Results of the food production equation

Country	Commodity	Constant	Producer price (t-1)	Production (t-1)	Dummy: Bad weather	Dummy: Good weather	R2
Ethiopia	wheat	2.48	0.04	0.61*	-0.31*	0.06	0.92
			(.17)	(2.19)	(-5.78)	(1.10)	
Gambia	rice	5.51	-1.02*	.05	-.21*	-.08	.66
			(-3.38)	(.21)	(-1.87)	(.45)	
Kenya	corn	5.66	-.07	.26*	-.22*	.27*	.85
			(-.37)	(1.90)	(-3.82)	(5.41)	
Lesotho	corn	3.95	.10	.14	-.57*	.31*	.70
			(.37)	(.99)	(-5.09)	(3.16)	
Liberia	rice	1.51	.08	.76*	-.04	.03	.94
			(.68)	(5.85)	(-.47)	(.78)	
Madagascar	rice	4.11	.07	.40*	-.06	.07*	.80
			(1.24)	(2.28)	(-1.59)	(2.69)	
Mali	rice	4.03	.17	.01	-.36*	.37*	.81
			(1.20)	(.10)	(-3.68)	(4.27)	
Morocco	wheat	9.94	-.21	-.26	-.43*	.22*	.87
			(-.82)	(-1.20)	(-4.37)	(2.97)	
Niger	sorghum	2.13	.18*	.32	-.29*	.07	.60
			(2.48)	(1.61)	(-2.45)	(.59)	
Senegal	rice	-0.10	0.55*	-0.22	-0.39*	0.46*	0.63
			(3.45)	(-1.30)	(-2.74)	(2.35)	
Sierra Leone	rice	5.52	.11*	.10	-.16*	.11*	.92
			(3.62)	(.79)	(-4.67)	(4.02)	
Somalia	sorghum	4.38	-.10	.17	-.36*	.23	.89
			(-.60)	(.46)	(-3.96)	(1.28)	
Sudan	sorghum	6.81	.68*	-.63*	-.23	.13	.58
			(2.67)	(-1.91)	(-1.60)	(.81)	
Tanzania	corn	3.09	.47*	.41*	-.25*	.25*	.91
			(2.13)	(2.99)	(-2.70)	(2.92)	
Tunisia	wheat	6.76	-1.99	-.09	-.59*	.49*	.89
			(-1.46)	(-.32)	(-2.35)	(2.27)	
Zaire	corn	3.50	.09	.45*	-.03	-.02	.95
			(1.25)	(3.06)	(-.36)	(-0.23)	
Zambia	corn	7.01	.29*	-.01	-.22*	.19*	.82
			(1.91)	(-.08)	(-4.68)	(3.74)	

Numbers in parentheses are t-statistics.

* Significant at the 5-percent level of confidence.

weather would translate into a need for storage facilities in order to carry surplus stocks from year to year.

The evidence strongly supports the contention that weather is an important determinant of production variation. Kenya, Lesotho, Mali, Morocco, Senegal, Sierra Leone, Tanzania, Tunisia, and Zambia have statistically significant dummy variables and the expected sign and are the most vulnerable to weather changes. Therefore, they should have the largest production variability. Sierra Leone does not fit in this scenario because of its small variation in production (7.4 percent).

Commercial Food Imports

Results of the food import equation (equation 3) indicate that foreign exchange availability is the variable that best explains the levels of food imports (table 3). The coefficients for foreign exchange availability for 10 countries are statistically significant, suggesting that credit and export earnings, the components of import capacity, weigh heavily in the decision to import. The elasticities ranged from 0.38 to 1.74. Food imports were most responsive to changes in import capacity in Kenya, Liberia, Madagascar, Morocco, Tanzania, and Zambia.

The import coefficients with respect to production were negative for all countries except Lesotho, and statistically significant in six of those countries, meaning that imports are used to fill the gap that results from production shortfalls. The import response to production variation was greatest in Niger, -7.27, and least in Senegal, -0.47. In Lesotho, commercial food imports have a positive and statistically significant relationship with domestic food production. This could result from the growth in consumer preference for imported food, and therefore, despite an increase in domestic food production, commercial imports will also rise. Wheat and rice are the main imported food commodities and they are becoming an increasingly large part of the diet in many African countries.

The coefficients for the food price variable were negative in all but Ethiopia, Morocco, and Tunisia, but statistically significant only in Lesotho, Niger, and Sierra Leone. These results are suspect, however, since the accuracy of using world prices in these countries is questionable. Most likely, these prices do not reflect the actual price paid for the food imports. For example, transportation costs can markedly raise prices, especially in landlocked countries such as Mali, Niger, and Zambia. In addition, suppliers have been offering commodity credits and other price-cutting schemes, which cause prices to vary significantly from quoted prices.

The import responsiveness to food aid was insignificant in all countries except Madagascar and Sudan. One reason for this is that decisionmakers in the countries studied do not know the quantity of food aid they will be receiving since volume and timing are largely determined by the donor countries. Therefore, the decision to import specific quantities of food is often made without the knowledge of actual incoming levels of food aid. Another reason is government consumption policies. If their goal is to improve consumption, commercial imports could increase even if government decisionmakers were aware of incoming levels of food aid. The principal concern is the amount of commercial imports displaced by food aid. Estimated correlation coefficients between commercial food imports and food aid are

Table 3--Results of the food import equation

Country	Constant	Food production	Foreign exchange availability	Food price	Food aid	R2	Country	Constant	Food production	Foreign exchange availability	Food price	Food aid	R2
Ethiopia 1/	7.90	-1.49	1.00	1.44	0.40	0.36	Senegal 1/	8.31	-0.47*	0.11	-0.27	0.06	0.40
		(-.47)	(.97)	(.90)	(0.87)				(-2.12)	(.95)	(-1.10)	(.47)	
Gambia	3.60	-.38	.38*	-.24	.02	.76	Sierra Leone	14.73	-2.05	.43	-.83*	.01	.46
		(-1.07)	(2.48)	(-.80)	(1.02)				(-1.61)	(1.62)	(-2.10)	(.35)	
Kenya 1/	33.45	-4.82*	1.27*	-.81	.02	.60	Somalia 1/	4.56	-.17	.23	-.56	.12	.35
		(-2.40)	(3.53)	(-.93)	(.29)				(-.13)	(.38)	(-.64)	.25	
Lesotho 2/	-0.37	.62*	.42*	-.63*	.03	.89	Sudan	9.00	-.32	-.20	-.41	.09*	.41
		(2.41)	(3.41)	(-1.94)	(1.12)				(-.68)	(-.74)	(-1.05)	(2.20)	
Liberia 2/	14.76	-3.45*	1.22*	-.34	.07	.74	Tanzania 1/	6.94	-1.57	1.68*	-.59	-.24	.49
		(-2.53)	(3.31)	(-1.49)	(1.77)				(-.83)	(2.30)	(-.61)	(-.86)	
Madagascar	44.29	-6.21	1.03*	-.23	-.09*	.61	Tunisia	5.60	-1.84*	1.18	1.13	-.06	.55
		(-1.18)	(2.11)	(-.25)	(-1.82)				(-2.22)	(1.68)	(0.65)	(-.67)	
Mali 2/	23.13	-3.15*	.52*	-.43	.17	.59	Zaire 2/	3.38	-.48	.85*	-.10	-.03	.68
		(-2.55)	(1.97)	(-.66)	(1.51)				(-.89)	(2.98)	(-.36)	(-.95)	
Morocco 1/	4.82	-1.09	1.52*	.83	-.27	.78	Zambia 1/	-5.94	-.09	1.74*	-.30	-.02	.69
		(-1.65)	(4.67)	(.97)	(-.94)				(-.10)	(3.00)	(-.64)	(-.41)	
Niger 2/	57.42	-7.27*	1.26	-9.62*	.11	.59							
		(-1.82)	(1.42)	(-3.07)	(.43)								

Numbers in parentheses are t-statistics.

* Significant at the 5-percent level of confidence.

1/ Production is lagged.

2/ All variables are lagged.

shown in table 4. In only four countries was the relationship negative and, except for Tunisia, had a low coefficient. In the other countries, the correlation coefficient ranged from 0.02 (Morocco) to 0.80 (Lesotho). These results indicate that food aid and commercial imports usually move in the same direction. Both are used to supplement production shortfalls or improve consumption levels. Displacement of commercial imports by food aid may exist at different times or in different countries. This aspect, however, is not captured in this specification. Country policies for allocation of foreign exchange between food and nonfood imports, consumer policies, and the a priori knowledge of food aid levels are among the factors affecting the commercial import-food aid relationship.

Food Aid Projections

Using the model discussed here, we estimated food aid needs for 1990 and 1995 under three scenarios--trend, good weather, and bad weather. All three scenarios were estimated to illustrate the range of food needs if the objective is to stabilize consumption in these countries. The objective of the trend scenario is to illustrate that food aid has become institutionalized as part of the consumption pattern in some of the countries studied. The two weather scenarios demonstrate the short-term response to weather changes and the resulting wide swings in food aid needs. These projections assume that all independent variables grow at their historical levels. Using elasticities calculated from the equations and historical growth rates, we estimated projections for production, import capacity, and commercial imports. Target consumption was estimated from a base year per capita consumption figure (1984-86 average) multiplied by projected population levels (recent annual growth rate multiplied by base year population). Target consumption is arbitrary and, therefore, does not reflect a uniform level of food availability among countries. The target consumption not met by projected production and commercial imports is regarded as additional food aid needs, that is, above the estimated trend level. Table 5 shows the ranges of food needs by country for each scenario in both 1990 and 1995.

Table 4--Commercial food import and food aid correlation coefficients

Country	Correlation coefficients	Country	Correlation coefficients
Ethiopia	0.46	Senegal	0.39
Gambia	.41	Sierra Leone	.20
Kenya	.65	Somalia	.50
Lesotho	.80	Sudan	.11
Liberia	.07	Tanzania	-.12
Madagascar	.08	Tunisia	-.56
Mali	.69	Zaire	-.12
Morocco	.02	Zambia	-.18
Niger	.04		

Table 5--Additional food needs under alternative scenarios

Country	Trend		Good weather		Bad weather	
	1990	1995	1990	1995	1990	1995
	1,000 tons					
Ethiopia	1,849	2,421	1,588	2,147	3,198	3,838
Gambia	(10)	18	(3)	25	8	35
Kenya	110	781	(657)	8	735	1,411
Lesotho	11	56	(34)	11	94	140
Liberia	52	95	46	88	61	104
Madagascar	300	580	189	466	395	677
Mali	(97)	56	(464)	(316)	261	419
Morocco	(1,109)	(1,378)	(1,900)	(2,148)	439	128
Niger	(162)	42	(277)	(77)	313	535
Senegal	(18)	206	(450)	(245)	348	589
Sierra Leone	46	102	10	65	99	156
Somalia	154	289	23	156	359	498
Sudan	126	829	(272)	448	829	1,502
Tanzania	(137)	203	(1,064)	(819)	791	1,225
Tunisia	(994)	(2,872)	(1,390)	(3,193)	(517)	(2,487)
Zaire	188	323	209	345	219	356
Zambia	288	516	81	303	528	763
Total	597	2,267	(4,365)	(2,736)	8,160	9,889

Numbers in parentheses denote surpluses and, therefore, no food aid needs.

In order to meet the target consumption levels in 1990, the trend scenario projects that 10 of the 17 countries studied will have additional food aid needs (Ethiopia, Kenya, Lesotho, Liberia, Madagascar, Sierra Leone, Somalia, Sudan, Zaire, and Zambia). The volume of aid ranges from 11,000 tons in Lesotho to approximately 1.85 million tons in Ethiopia. Seven countries will have surpluses ranging from 10,000 tons in Gambia to 1.1 million tons in Morocco. By 1995, all but Morocco and Tunisia will need food aid. Gambia, Lesotho, Liberia, Mali, and Niger have low additional aid needs. Ethiopia, Kenya, Madagascar, Sudan, and Zambia have higher aid needs.

In the good weather scenario, food production grows according to a base year trend until 1990 when there is 1 year of good weather. This works the same way for 1995 when there is 1 year of good weather after several years of trend growth. There are no intervening years of better-than-average weather. In this scenario, the number of countries with food aid needs fell, needs were reduced, and surpluses increased relative to the trend scenario. By 1990, only 7 countries will have additional food aid needs, while 10 countries will have surpluses. Ethiopia's needs remain high, 1.6 million tons, which reflects the insignificant response to good weather estimated in the production equation. The needs in the remaining deficit countries are quite low, averaging less than 100,000 tons. The surpluses in Morocco, Tanzania, and Tunisia are quite high, reflecting the large production response to good weather. By 1995, 11 countries are projected to need food aid under the good weather scenario.

Under the bad weather scenario, every country except Tunisia is projected to have additional food aid needs in 1990. Production follows historic trends until 1990, when there is 1 year of bad weather. Countries with the highest

needs are Ethiopia (3.2 million tons), Kenya (735,000 tons), Sudan (830,000 tons), and Tanzania (790,000 tons). Countries with the lowest needs are Gambia, Lesotho, Liberia, and Sierra Leone. By 1995, Tunisia remains the only country with a projected surplus.

The effect of weather is illustrated clearly when observing the ranges of aid needs under various scenarios (fig. 3). The good weather scenario projects a total surplus of 4.4 million tons in 1990 for all the countries studied. Morocco, Tanzania, and Tunisia account for a large part of this surplus. Conversely, the bad weather scenario sends additional food aid needs soaring to 8.2 million tons, contributing 24 percent of target consumption requirements (table 6). In the countries where production is highly responsive to good or bad weather, changes from the trend are quite significant. Perhaps the best example is Tanzania, where the trend scenario projects a small surplus in 1990. If the weather is good, a surplus of more than 1 million tons results. If the weather is bad, however, additional food aid needs are projected to be near 800,000 tons or 21 percent of target consumption. Kenya is a similar case, where small additional food aid needs in the trend scenario become a 660,000-ton surplus in the good weather scenario and a 735,000-ton deficit in the bad weather scenario. Ethiopia, Mali, Morocco, Niger, and Senegal also experienced large responses to weather changes, both good and bad. Ethiopia demonstrates significantly more sensitivity to bad weather than to good weather. The trend scenario projects food aid needs at almost 1.9 million tons in 1990. If the weather is good, these needs fall to 1.6 million tons. If the weather is bad, however, food aid estimates rise 70 percent to 3.2 million tons. This response can be easily explained by the estimated results of the production equation. The production coefficient with respect to bad weather was significant, while that with respect to good weather was not. This explains many of the recurring problems in Ethiopia. While many of the countries studied can recover after a

Figure 3
Projected food aid needs

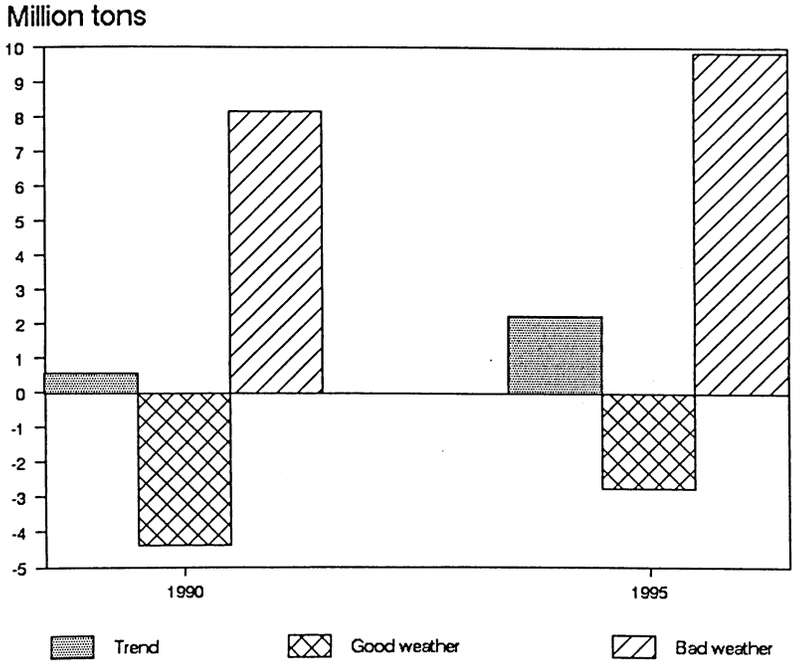


Table 6--Additional food needs as a percentage of target consumption in the bad weather scenario

Country	1990	1995	Country	1990	1995
	Percent			Percent	
Ethiopia	50.7	60.9	Senegal	24.9	42.1
Gambia	5.8	25.4	Sierra Leone	24.0	37.8
Kenya	23.3	44.7	Somalia	42.6	59.1
Lesotho	28.8	42.9	Sudan	24.0	43.5
Liberia	19.6	33.4	Tanzania	21.1	32.7
Madagascar	20.2	34.6	Tunisia	NA	NA
Mali	22.8	36.6	Zaire	15.5	25.1
Morocco	9.0	2.6	Zambia	36.2	52.3
Niger	21.0	36.0	Average	24.3	38.1

NA= Not applicable.

drought year if the weather is favorable, Ethiopia has a more difficult time because production is not particularly responsive to good weather. Even more important than the amount of food aid needs is the role food aid plays in stabilizing consumption in Ethiopia in the bad weather scenario, contributing more than half of the total requirements.

Conclusions and Implications

Our results indicate that weather is an important determinant of production variation in the countries studied. When there is a production shortfall, imports increase to meet consumption requirements. Foreign exchange availability was found to explain the level of food imports best. Recently, however, foreign exchange availability has been limited in these countries and, thus, their capacity to import has been reduced. As a result, the role of food aid in filling the gap between production and consumption has become increasingly important, and may become even more so in the future.

The potential for the increased role for food aid has two implications. First, it illustrates the need for a coordinated system of needs assessment and timely distribution of food in the deficit countries in order to stabilize consumption. This is especially true when observing the contribution that aid makes to consumption by 1990 in the bad weather scenario in the countries most prone to drought. These include Ethiopia, where additional food aid is projected to contribute 51 percent of target consumption requirements, Senegal, 25 percent, and Somalia, 43 percent. Second, decisionmakers in donor countries will have to prepare for greater provision of aid or provide these countries with other means to meet their future food needs.

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