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CONSUMPTION STABILITY AND THE CRUCIAL ROLE OF FOOD AID IN AFRICA

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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 and variations in food production are therefore directly transmitted to consumption levels. 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. However, limited financial capabilities have reduced their commercial import capacity. In recent years, as financial difficulties grew, these countries have become increasingly dependent on food aid to stabilize consumption.

This study reviews consumption patterns of African countries, identifies the main factors that shape the consumption trend, quantifies the impact of these factors on food availability, and estimates the expected need for food aid under different target consumption levels. Cereals are used as a proxy for food because of data availability, as well as the fact that they account for more than 60 percent of total food consumption in this region. In this study, cereals are defined as wheat, corn, rice, sorghum, millet, teff, and barley. The study includes 17 African countries: Ethiopia, Gambia, Kenya, Lesotho, Liberia, Madagascar, Mali, Morocco, Niger, Senegal, Sierra Leone, Somalia, Sudan, Tanzania, Tunisia, Zaire, and Zambia. The observed time period is 1966 to 1986.

Consumption Variability

Africa, consumption is shaped by characteristics of production, commercial imports, and food aid (stocks are limited). In almost all 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 remains high, 13 percent. Production variation averages about 17 percent, meaning that imports reduced variation by 4 percent (table 1). Most of the consumption stabilization can be attributed to commercial imports . Variation, with just production and commercial imports, was only slightly higher than consumption variation--13.3 percent, meaning that food aid has not worked to reduce variation during the study period. The reasons behind this are: delays in assessing food needs, delays in responding to the needs, and distribution problems in the recipient country (ports and roads). Both donors and recipients have been known to react slowly to a drought situation. Drought striken countries are reluctant to admit that they have a production shortfall or that starvation exists in their countries. Often, political considerations on the part of donors and, in many cases, inadequate information about the seriousness of the problem slows responses. The food aid issue has become an increasingly important factor 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 over time, resulting in a greater need for food aid to stabilize consumption.

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Table 1- Coefficients of variation and import dependency

Country	---Coefficients of variation--- Production	Production + commercial imports	Consumption	---Import--- --dependency 1/-- 1970-72	1984-86
	percent			percent	
Ethiopia	12.2	11.8	11.0	1.3	12.8
Gambia	24.1	16.4	16.0	19.3	45.8
Kenya	12.7	11.2	11.9	2.9	14.1
Lesotho	31.2	18.9	17.5	26.7	57.2
Liberia	4.4	8.3	6.2	32.7	38.6
Madagascar	3.9	4.9	5.1	6.2	8.7
Mali	15.0	13.2	14.7	7.9	16.8
Morocco	21.9	15.4	15.3	10.3	42.1
Niger	18.7	19.1	18.3	1.3	7.8
Senegal	27.0	18.1	17.7	40.2	39.1
Sierra Leone	7.4	8.0	8.1	15.9	23.7
Somalia	21.4	18.0	19.5	26.0	39.6
Sudan	25.5	22.8	25.5	10.5	22.1
Tanzania	10.4	9.5	9.3	7.8	8.1
Tunisia	26.3	8.2	6.6	28.5	38.0
Zaire	4.9	8.6	8.1	26.9	23.2
Zambia	15.6	13.7	13.6	19.4	17.0
Average	16.6	13.3	13.2	16.7	26.7

1/ Total imports as a percent of consumption

Consumption levels and behavior are not uniform among countries. Of the 17 countries, consumption variability in 10 fell between 10 and 20 percent. Sudan was the only study country with variation higher than 20 percent--25.5 percent (imports did not reduce production variation which is also 25.5 percent). Increasingly limited foreign exchange, because of a large debt service burden and reliance on food aid, which did not always arrive, are the likely reasons for this characteristic. In Gambia, Lesotho, Senegal, and Morocco, production variability, averaging 26 percent, caused the high consumption variability. In these countries, commercial imports reduced variability 9 percent (to 17 percent), while food aid reduced variation only marginally.

In Ethiopia, Kenya, Mali, Niger, Somalia, and Zambia, the production pattern was the main force shaping consumption trends as commercial imports had a marginal impact. With the exception of Zambia, these countries are among the poorest in Africa and, therefore, have not been able to import enough food commercially to reduce consumption fluctuations.

In Liberia, Madagascar, Sierra Leone, Tanzania, Tunisia, and Zaire, consumption variability was the lowest--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 these study countries and should be able to continue importing commercially.

Model

In order to determine the food aid required to stabilize consumption, a model was constructed to examine the factors affecting domestic production and commercial imports. The consumption level is a hypothetical level termed "target consumption," and could be based on meeting some nutritional target (for example, two-thirds of required nutrients) or 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:

$P = f(PX_{t-1}, P_{t-1}, DB, DG)$ (1)

$FE = CR + X$ (2)

$FI = f(P, FE, WPX, FA)$ (3)

$TC = PCC * POP$ (4)

$FA = TC - P - FI$ (5)

...where P is production, PX_{t-1} is a one year lag of producer prices, P_{t-1} is a one 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 net credit, X is export earnings, FI is commercial food imports, WPX is world prices, TC is target consumption, PCC is target per capita consumption, POP is population, and FA is food aid.

The decision to select variables is based on the knowledge of the African production structure and the availability of the data. In the food production equation (equation 1), the lag of 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 impact of policy change on production. The two dummy variables represent any abnormal changes in production behavior primarily induced by weather. Rainfall data were available for only four countries: 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. 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, government publications, and reports from agricultural officers were studied in order to distinguish the good and bad years from the normal years. A one was used in the good or bad dummy variable when reports indicated that conditions were better or worse than average; otherwise, a zero was used. While other factors, such as civil strife and institutional factors (policies, shortages of inputs), contributing to production variation, it is believed that weather is more short-term in nature and is the primary determinant of year-to-year fluctuations. The other factors are of a long-term nature and would influence the longer term trend rather than play a crucial role in annual variations. All variables, with the exception of the two dummy variables, are in log form.

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 flow and export earnings. Recent trends for both variables have been declining--meaning less available foreign exchange. As international liquidity increased in the mid-1970s, these countries received large inflows of credit from both industrialized and OPEC countries. However, as the world economy fell into a recession in the late 1970s, credit availability shrunk. Also, as interest

rates rose, 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, exports earnings in most countries declined or, at best, stagnated, resulting in an extremely limited capacity to import commercially.

The demand for commercial food imports (equation 3) is specified as a function of domestic food production, foreign exchange availability, the world food price (price of cereals in U.S. dollars deflated by the price index of nonfood items to show terms of trade between food and nonfood imports), and the quantity of food aid imports. As mentioned previously, production, commercial imports, and food aid are the primary factors behind consumption instability and any changes in the direction of their performance will directly affect food consumption levels.

Target consumption (equation 4) is derived by multiplying a base year per capita consumption level by projected population levels. Food aid needs are defined in equation 5 as target consumption not met by production and commercial imports.

Results

The estimated results of the food production equation indicate that the producer price had a positive and statistically significant impact 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 which were negative and not significant. This indicates that price impacts 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. Food is produced for home consumption, not for the market. The responsiveness of current production to lagged production varied widely. The response coefficients were positive and statistically significant in Ethiopia, Kenya, Liberia, Madagascar, Tanzania, and Zaire. In these countries, the production coefficients of variation ranged from less than 4 percent (Madagascar) to almost 13 percent (Kenya). Approximately 40 percent of Madagascar's arable land is irrigated, thus reducing vulnerability to drought. Liberia receives adequate levels of rainfall which lowers variation. Zaire's major food crop is cassava, a drought resistant crop. In Gambia, Lesotho, Mali, Niger, Sierra Leone, and Somalia, the relationship between current and lagged production was positive, but not significant. This result is to be expected in extreme drought vulnerable countries such as Mali, Niger, Somalia, and Sudan and areas of good weather conditions such as Sierra Leone where the weather variable would capture the variation in production. In Morocco, Senegal, Sudan, Tunisia, and Zambia the responses were negative and insignificant, reflecting extreme fluctuations in production. The coefficients of variation for production in these countries were among the highest of all of the study countries, ranging from 15.6 percent in Zambia to 27 percent in Senegal.

Production responsiveness with respect to the dummy variables for weather had the correct sign and were significant in most countries reflecting the fact that weather is the primary cause of production variation. Most of these African countries are extremely vulnerable to drought: Sahel countries: 1968-73, Sahel and the northeastern countries: 1977-78, Sahel: early 1980's, and East Africa: 1984-85. In the last 21 years, drought in these countries has occurred, on average, once in every three years.

Table 2- Results of the food production and import equations

		---Food production---							----Food imports----					
Country	Commodity	Constant	Producer price (t-1)	Production (t-1)	Dummy Bad weather	Dummy Good weather	R2		Country	Constant	Food production	Foreign exchange availability	Food price	Food aid	R2
Ethiopia	wheat	2.48	0.04	0.61*	-0.31*	0.06	0.92	:	Ethiopia 2/	7.90	-1.49	1.00	1.44	0.40	0.36
Gambia	rice	5.51	-1.02*	0.05	-0.21*	-0.08	0.66	:	Gambia	3.60	-0.38	0.38*	-0.24	0.02	0.76
Kenya	corn	5.66	-0.07	0.26*	-0.22*	0.27*	0.85	:	Kenya 2/	33.45	-4.82*	1.27*	-0.81	0.02	0.60
Lesotho	corn	3.95	0.10	0.14	-0.57*	0.31*	0.70	:	Lesotho 1/	-0.37	0.62*	0.42*	-0.6	0.03	0.89
Liberia	rice	1.51	0.08	0.76*	-0.04	0.03	0.94	:	Liberia 1/	14.76	-3.45*	1.22*	-0.34	0.07	0.74
Madagascar	rice	4.11	0.07	0.40*	-0.06	0.07*	0.80	:	Madagascar	44.29	-6.21	1.03*	-0.23	-0.09*	0.61
Mali	rice	4.03	0.17	0.01	-0.36*	0.37*	0.81	:	Mali 1/	23.13	-3.15*	0.52*	-0.43	0.17	0.59
Morocco	wheat	9.94	-0.21	-0.26	-0.43*	0.22*	0.87	:	Morocco 2/	4.82	-1.09	1.52*	0.83	-0.27	0.78
Niger	sorghum	2.13	0.18*	0.32	-0.29*	0.07	0.60	:	Niger 1/	57.42	-7.27*	1.26	-9.6	0.11	0.59
Senegal	rice	-0.10	0.55*	-0.22	-0.39*	0.46*	0.63	:	Senegal 2/	8.31	-0.47*	0.11	-0.27	0.06	0.40
Sierra Leone	rice	5.52	0.11*	0.10	-0.16*	0.11*	0.92	:	Sierra Leone	14.73	-2.05	0.43	-0.8	0.01	0.46
Somalia	sorghum	4.38	-0.10	0.17	-0.36*	0.23	0.89	:	Somalia 2/	4.56	-0.17	0.23	-0.56	0.12	0.35
Sudan	sorghum	6.81	0.68*	-0.63*	-0.23	0.13	0.58	:	Sudan	9.00	-0.32	-0.20	-0.41	0.09*	0.41
Tanzania	corn	3.09	0.47*	0.41*	-0.25*	0.25*	0.91	:	Tanzania 2/	6.94	-1.57	1.68*	-0.59	-0.24	0.49
Tunisia	wheat	6.76	-1.99	-0.09	-0.59*	0.49*	0.89	:	Tunisia	5.60	-1.84*	1.18	1.13	-0.06	0.55
Zaire	corn	3.50	0.09	0.45*	-0.03	-0.02	0.95	:	Zaire 1/	3.38	-0.48	0.85*	-0.10	-0.03	0.68
Zambia	corn	7.01	0.29*	-0.01	-0.22*	0.19*	0.82	:	Zambia 2/	-5.94	-0.09	1.74*	-0.30	-0.02	0.69

* significant at 5 percent
1/ all variables are lagged
2/ production is lagged

Coefficients of the dummy variable for bad weather were negative in all countries and significant in all but four countries (Liberia, Madagascar, Sudan, and Zaire). The coefficients ranged from 0.06 to 0.71. Countries with large coefficients could be considered vulnerable to drought and therefore experience large import needs, and possibly large food aid needs from time to time. These countries include Ethiopia, Lesotho, Mali, Morocco, Senegal, Somalia, and Tunisia. 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 significant in all but five of those countries (Ethiopia, Liberia, Niger, Somalia, and Sudan). A large production response to good weather would translate into a need for storage facilities in order to carry surplus stocks from one year to the next.

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

Results of the food import equation (equation 3) indicate that foreign exchange availability is the variable which best determines levels of food imports. The coefficients for 10 of the 17 countries are significant which suggests that credit and export earnings weigh heavily in the decision to import. The countries in which food imports were most responsive to changes

in foreign exchange availability include Kenya, Liberia, Madagascar, Morocco, Tanzania, and Zambia. The import coefficients with respect to production were negative for all countries (except Lesotho), and significant in 6 of those countries, meaning that imports are used to fill the gap which results from production shortfalls. The import response to production variation was highest in Niger, -7.27, and lowest in Senegal, -0.47. The coefficients for the food price variable were negative in all but three countries (Ethiopia, Morocco, and Tunisia), but 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. Transportation costs can raise prices markedly, especially in landlocked countries (Mali, Niger, and Zambia). Also, suppliers have recently begun offering commodity credits and other price cutting schemes which cause prices to vary significantly from world prices. The import responsiveness to food aid was insignificant in all countries except for Madagascar and Sudan. The reason for this result is because decision makers in these countries do not know the quantity of food aid they will be receiving since volume and timing are determined by the donor countries. Therefore, the decision to import specific quantities of food is made independently of the knowledge of actual incoming levels of food aid.

Food Aid Projections

Using the model discussed above, food aid needs were estimated for 1990 and 1995 under three scenarios--trend, good weather, and bad weather. All three 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 study countries. The two weather scenarios demonstrate the short-term response to weather changes and the resulting wide swings in food aid needs. These projections assume all independent variables grow at their historical levels. Using elasticities calculated from the equations and historical growth rates, projections were estimated for production, foreign exchange availability, and commercial imports. Target consumption was estimated using a base year per capita consumption figure (average 1984-86) multiplied by projected population levels (recent annual growth rate multiplied by base year population). It must be emphasized that 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 (those which are above the estimated trend level). Table 3 shows the ranges of food needs by country for each scenario in both 1990 and 1995.

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

Table 3: Additional food needs under alternative scenarios

Country	Trend 1990	Trend 1995	Good Weather 1990	Good Weather 1995	Bad Weather 1990	Bad Weather 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

() denotes surplus, no food aid needs

response to good weather (Morocco, Tanzania, and Tunisia). By 1995, 11 countries are projected to need food aid under the good weather scenario.

Under the bad weather scenario, every country (with the exception of Tunisia) is projected to have additional food aid needs in 1990. Production follows historical trends until 1990 when there is one year of bad weather. Those with the highest needs are Ethiopia (3.2 million tons), Kenya (735,000 tons), Sudan (830,000 tons), and Tanzania (790,000 tons); those countries with the lowest need include Gambia, Lesotho, Liberia, and Sierra Leone. By 1995, Tunisia remains the only country where a surplus is projected.

The impact of weather is illustrated clearly when observing the ranges of aid needs under the various scenarios. Under the good weather scenario, there is a total surplus of 4.4 million tons in 1990 for all of the study countries. This high surplus is deceiving however, in that three countries (Morocco, Tanzania, and Tunisia) contribute to almost all of the surplus. Conversely, under the bad weather scenario, additional food aid needs soar to 8.2 million tons and contribute 24 percent of target consumption requirements. In the countries where production is highly responsive to good/bad weather, the changes from 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 one million tons results. However, if the weather is bad, food aid needs near 800,000 tons or 21 percent of target consumption. Other countries which experienced large responses to weather changes (both good and bad) include Ethiopia, Kenya, Mali, Morocco, Niger, and Senegal. Ethiopia demonstrates significantly more sensitivity to bad weather than good weather. The trend scenario projects food aid at almost 1.9 million

tons in 1990. If the weather is good, these needs fall to 1.6 million tons. However, if the weather is bad, food aid estimates rise 70 percent to more than 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 certainly explains many of the recurring problems in Ethiopia. While many of the study countries can recover after a 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--contributing more than half of the total requirements.

The variation in these aid projections illustrates the need for a coordinated system of assessing needs and timely distribution of food in the deficit countries in order to stabilize consumption. This is especially true when observing the contribution aid makes in stabilizing consumption by 1990 in the bad weather scenario--Ethiopia: where additional food aid contributes 51 percent of target consumption requirements, Senegal: 25 percent, and Somalia: 43 percent.