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FOOD POLICY [illegible] CONCERNS IN SUB-SAHARA[illegible]

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FOOD POLICY ISSUES AND CONCERNS IN SUB-SAHARAN AFRICA

Papers prepared by researchers at the International Food Policy Research Institute and discussed with colleagues in Ibadan, Nigeria, February 9-11, 1981

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FOREWORD

The seven papers appearing in this volume are revised versions of papers prepared by IFPRI researchers and discussed with Nigerian colleagues in Ibadan, Nigeria, February 9-11, 1981. Although revised, these papers are still preliminary, reflecting IFPRI's initial effort to identify and discuss some relevant issues related to Africa's food problems. Some of the papers are a first step toward research specifically related to Africa. Others distill information from IFPRI research in other areas of potential value to Africa.

IFPRI recognizes the importance of the food situation in Africa and the difficulty surrounding research associated with it. We are extremely grateful to the United Nations Development Programme for providing the financial support necessary to facilitate the preparation of the papers and the discussions in Ibadan. It is expected that these papers will form a basis for a future formal workshop or conference on food policy problems in Sub-Saharan Africa.

John W. Mellor

Washington, D.C.
August 1981

THE FOOD SITUATION IN SUB-SAHARAN AFRICA: A PRELIMINARY ASSESSMENT

by Leonardo A. Paulino and Patrick Yeung

SUMMARY

In 1977 the 40 countries of Sub-Saharan Africa produced 36 million tons of cereals, 32 million tons of major noncereal food crops (in cereal equivalents), 3 million tons of meat, 6 million tons of milk, and less than half a million tons of eggs. Although the region was more than self-sufficient in the noncereal food crops, cereal imports, especially of wheat and rice, were needed to meet consumption requirements. Production and consumption of meat and of eggs were in approximate balance; consumption of the latter is generally constrained by local availability. However, the widespread deficit in milk had to be filled by imports of milk products.

Sub-Saharan production of major food crops in 1961-77 expanded at an average annual rate of only 1.6 percent--a full percent slower than the population growth in the region. About four fifths of the production growth of food crops may be attributed to increases in crop area and one fifth to improvements in output per hectare; output per hectare even declined in several countries. Extreme weather variations that occurred during the period resulted in severe crop production fluctuations. These magnified the food problems of the region, especially the Sahelian countries. The production of meat, milk, and eggs in Sub-Saharan Africa grew by 2.3 percent, 1.5 percent, and 3.4 percent a year, respectively. Although livestock and poultry production generally increased, the output of some specific commodities stagnated in certain countries.

Preliminary findings indicate that in 1973-77 about 80 percent of the total domestic utilization of major food crops in Sub-Saharan Africa was for food. The share of animal feed (excluding cereal bran and cakes) was less than 3 percent. Population increases from the early 1960s to the mid-1970s outpaced the growth of total domestic utilization of major food crops, which also led to the decline in the per capita use of these commodities for food. Meat and milk consumption lagged behind population growth but that of eggs grew faster.

Sub-Saharan Africa shifted its trade position in food crops from a minor net exporter in 1961-65 to a major net importer in 1973-77. Food exports dropped by more than half while imports rose more than twofold. However, the favorable trade in meat and meat products was maintained with net exports of these commodities growing by 35 percent during the period. But imports of milk and milk products

increased from 9 percent to 18 percent of domestic consumption during the same period.

If past trends remain unchanged, the projected food production shortfalls of the region appear to be manageable in 1985 but would become staggering by the year 2000. Projections show aggregate production-consumption gaps in 2000 amounting to 36-40 million tons of major food crops, 4-7 million tons of meat, 10-15 million tons of milk, and 0.5-1 million tons of eggs. A large portion of these projected deficits is accounted for by Nigeria where growth in food production has been slow in the face of rapid increases in population and income. If the indicated food gaps are to be closed by domestic production, the historical output growth rates of Sub-Saharan Africa would have to increase to at least 3.4 percent for the major food crops, 5.3 percent for both meat and milk, and 5.8 percent for eggs.

INTRODUCTION

IFPRI'S present study of future food gaps in the developing countries represents the Institute's third assessment of the future food situation in the Third World.1/ The study examines the trends of food production and consumption of more than 100 developing countries during the 1961-77 period and, based on these trends, projects food supply and demand for these countries to the year 2000. The commodities covered by the analysis include the major staple food crops, consisting of cereals, rootcrops, pulses, groundnuts, bananas and plantains, and the major livestock and poultry products, consisting of meat, milk, and eggs.

This paper presents the results for the 40 countries of Sub-Saharan Africa that are covered in the above-mentioned global study. Changes in the consumption and trade of the commodities studied are examined using data for the 1961-65 and 1973-77 periods. Intermediate-term projections of food production and consumption for 1985 are made in addition to long-term projections for 2000. Results of the study are presented for the 8 major producers of staple food crops and of livestock and poultry products in the region. Six of the countries (Ethiopia, Kenya, Madagascar, Nigeria, Tanzania, and Uganda) are leading Sub-Saharan producers of both food crops and livestock. However, Ghana and Zaire, included among the 8 major producers for crops, are replaced by Somalia and Zimbabwe on the livestock and poultry list. Aggregated results are shown for Sahelian countries, for the remaining 25 countries referred to as "others,"

1/ The two earlier studies were reported in International Food Policy Research Institute, Meeting Food Needs in the Developing World: The Location and Magnitude of the Task in the Next Decade, Research Report No. 1 (Washington, D.C.: IFPRI, 1976), and International Food Policy Research Institute, Food Needs of Developing Countries: Projections of Production and Consumption to 1990, Research Report No. 3 (Washington, D.C.: IFPRI, 1977).

and for Sub-Saharan Africa as a whole. In addition to the 14 tables in the text, supplementary tables are included in Appendix 2 (Tables 15 to 25).

The bulk of the data used in the analysis are from the Food and Agriculture Organization of the United Nations (FAO). Questions may be raised regarding data reliability and, consequently, the interpretation of the results for individual countries since data for many developing countries, especially those in Sub-Saharan Africa, come from inadequate statistical systems.2/ The attendant data problems are well recognized and, where possible, the analysis uses procedures that would reduce their effects. For example, in projecting food production and consumption in each country, the estimated annual growth rates for commodity groups are used rather than those of individual commodities, many of which are unrealistic because of their low data base. Even with such measures, doubts regarding the absolute levels of the projections would still remain. However, the comparative rates of change reflected by food production and consumption in the Sub-Saharan countries clearly suggest that the net results of these projections are in the right directions. Appendix 4 presents a complete list of data sources used in the report.

THE 1977 FOOD SITUATION

Global Perspective

World food output in 1977 was estimated at about 1,550 million tons of major staple food crops and 600 million tons of livestock and poultry products.3/ The food crops consisted of 1,332 million tons of cereals and 216 million tons of noncereal staple food crops; animal products consisted of 128 million tons of meat, 449 million tons of milk, and 25 million tons of eggs (Table 1). Although the developing countries had nearly three fourths of the world's population, they produced only 43 percent of its cereals in 1977. However, their output of noncereal staple food crops represented 73 percent of the world's production of these commodities during the same year. The Third World's shares of animal products were 35 percent, 22 percent, and 33 percent of meat, milk, and eggs, respectively. Sub-Saharan Africa, with 7 percent of the world's population, produced 3 percent of the cereals, 15 percent of the noncereal staple food crops, 2 percent each of meat and eggs, and 1 percent of milk.

Production and population data suggest that the average levels of world food output per capita in 1977 were about 320 kilograms of cereals, 50 kilograms of noncereal staple food crops, 30 kilograms of meat, 105 kilograms of milk, and 5 kilograms of eggs. By comparison, those in Sub-Saharan Africa were 115 kilograms of cereals, 100

2/ Notes on data reliability are presented in Appendix 3.

3/ For brevity, references to tons indicate metric tons.

Table 1--World population and food production, 1977

	World	Developed Countries[a]	Developing Countries: Total	Developing Countries: Sub-Saharan Africa	Developing Countries: Other Regions
Population (millions)	4,205 (100)	1,139 (27)	3,066 (73)	311 (7)	2,755 (66)
Food production (million tons)					
Major staple food crops	1,548 (100)	821 (53)	727 (47)	68 (4)	659 (43)
Cereals	1,332 (100)	762 (57)	570 (43)	36 (3)	534 (40)
Noncereals[b]	216 (100)	59 (27)	157 (73)	32 (15)	125 (58)
Livestock and poultry products					
Meat[c]	128 (100)	84 (65)	44 (35)	3 (2)	41 (33)
Milk[d]	449 (100)	351 (78)	99 (22)	6 (1)	93 (21)
Eggs	25 (100)	17 (67)	8 (33)	...[e] (2)	8 (31)

Note: Figures may not add up to totals because of rounding. Figures in parentheses represent percentages of the world total.

a/ Country grouping follows the FAO classification.

b/ This is the aggregate of rootcrops, pulses, groundnuts, bananas, and plantains, in cereal equivalents.

c/ This is the aggregate of meat of indigenous cattle, sheep, goats, pigs, and poultry, in carcass weight equivalent.

d/ This is the aggregate for cow, sheep, and goat milk, but camel milk is excluded.

e/ Less than a half a million tons.

kilograms of noncereal staple food crops, 10 kilograms of meat, 20 kilograms of milk, and less than 2 kilograms of eggs.

These data indicate the relative importance of the noncereal staple crops in the food production of Third World countries. This is especially so for countries in Sub-Saharan Africa where the per capita output of noncereal staples is twice that of the world's average.

Food Production and Consumption in Sub-Saharan Africa

Production of major staple food crops in Sub-Saharan Africa in 1977 consisted of 53 percent cereals, 31 percent rootcrops, 6 percent pulses, and 5 percent each of groundnuts and bananas and plantains (Table 2). Millet and sorghum held the largest share of cereal output; they jointly accounted for nearly one fourth of the total production of major staple food crops. Maize production closely followed with 20 percent. About 5 percent was contributed by rice and another 5 percent was contributed by wheat and other grains.

The matched data on production and consumption of these commodities indicate that the region had shortfalls in all of the cereal items. The largest deficits were for wheat (70 percent of total domestic needs) and rice (30 percent). Deficits in other cereals ranged from 5 percent to 7 percent of consumption, with the overall cereal production shortfall amounting to 6.1 million tons or about 14 percent of the domestic need for cereal in 1977. Although small deficits of rootcrops and pulses occurred, the region was more than self-sufficient in noncereal food crops in that year due to surpluses in groundnuts and bananas and plantains. Based on the total domestic utilization, the pattern of consumption of major staple food crops in the region in 1977 was about 58 percent cereals and 42 percent noncereals, with millet, sorghum, maize, and rootcrops together representing more than 70 percent of the requirements.

In 1977 Sub-Saharan Africa maintained a balance between production and consumption in meat and eggs, but had a milk deficit. It produced and consumed about 3 million tons of meat and 0.4 million tons of eggs. About 5.8 million tons of milk were produced, as compared to about 7.4 million tons consumed.

Ruminants produced not only the milk, but more than three fourths of Sub-Saharan meat output. Cattle produced the bulk of the meat (57 percent) and the milk (80 percent). Sheep and goats produced more than one fifth of the meat and one sixth of the milk. Poultry contributed the eggs and also 15 percent of Sub-Saharan meat production.

In many countries, such as Nigeria, Madagascar, Uganda, and Zimbabwe, cow milk is virtually the only form of milk output. In Somalia, however, goat milk accounts for 35-40 percent and camel milk about 30 percent of total milk output; cow milk accounts for only 20 percent. Goat milk represents more than one fourth of the milk output in the Sahel.

Table 2--Composition of food production and consumption in Sub-Saharan Africa, 1977

Commodity	Production		Consumption[a]	
	Volume	Proportion[b]	Volume	Proportion[b]
	(1,000 metric tons)	(percent)	(1,000 metric tons)	(percent)
Major staple food crops	67,717	100.0	72,859	100.0
Cereals	36,149	53.4	42,221	57.9
Millet and sorghum	15,524	22.9	16,486	22.6
Maize	13,521	20.0	14,223	19.5
Rice (milled)	3,555	5.2	5,020	6.9
Wheat	1,051	1.6	3,821	5.2
Others	2,498	3.7	2,671	3.7
Noncereals[c]	31,568	46.6	30,638	42.1
Rootcrops	(20,857)	(30.8)	(21,170)	(29.1)
Pulses	(3,816)	(5.6)	(4,135)	(5.7)
Groundnuts	(3,529)	(5.2)	(2,330)	(3.2)
Bananas and plantains	(3,366)	(5.0)	(3,003)	(4.1)
Meat[d]	3,050.3	100.0	2,973.7	100.0
Cattle	1,733.1	56.8	1,660.9	55.9
Sheep and goat	631.5	20.7	611.2	20.6
Pig	230.9	7.6	242.9	8.2
Poultry	455.5	14.9	458.7	15.4
Milk[e]	5,849.5	100.0	7,437.4	100.0
Cow	4,556.0	77.9	6,077.1	81.7
Sheep	222.9	3.8	275.4	3.7
Goat	757.2	12.9	771.6	10.4
Camel	313.3	5.4	313.4	4.2
Eggs	414.1	100.0	424.2	100.0
Hen	408.2	98.6	418.3	98.6
Other	5.8	1.4	5.8	1.4

Note: Figures may not add to totals because of rounding.

a/ Consumption refers to total domestic utilization in terms of primary commodity equivalent.

b/ These are the proportions of the major commodity group. For example, 19.5 percent of the cereal consumed is maize.

c/ Quantities are given in cereal equivalent.

d/ Quantities are given in carcass weight equivalents; beef, mutton, and pork production is from indigenous animals.

e/ Quantities are in whole milk equivalents.

FOOD PRODUCTION TRENDS

The production of major staple food crops in Sub-Saharan Africa expanded at an annual rate of only 1.5 percent in 1961-77, which was 1 percent slower than the population growth in the region (Table 3). Only two of the major food crop-producing countries achieved average growth rates that exceeded their population growth during the period. Kenya, whose population grew at a high 3.6 percent per year, registered a sharp increase in food output (5.0 percent) due to the rapid growth of its cereal production. Zaire's rate of increase in food crop output (2.7 percent) was achieved from both cereals and noncereals, whose production growth rates outpaced the country's yearly population increase of 2.3 percent.

Food production trends in the Sahelian countries indicate that their output of food crops remained practically unchanged during 1961-77. The group's extremely slow growth in total food production (0.1 percent) came solely from noncereal output whose slight increase offset the declining trend of cereal production. Nigeria also performed poorly in food production. Food crops increased at only half a percent a year, compared to a 3 percent growth in population per year. In Ethiopia growth of food crop production (1.2 percent) was only half the size of population growth. Despite fairly rapid growth rates in cereal output of more than 4 percent, the production of major staple food crops in Ghana and Uganda failed to keep abreast of population growth. The output of noncereal crops declined in Ghana, and it expanded only about half as fast as the population in Uganda. Population growth also outstripped food crop output in Madagascar, Tanzania, and in the 20 other non-Sahelian countries of the region.

About 80 percent of the growth in the production of staple food crops in Sub-Saharan Africa in 1961-77 can be attributed to increases in the land area planted to these crops. This predominance of area increases over improvements of output per hectare in contributing to the growth of food crop production in the region occurred for both cereals and noncereals. In most of the major producing countries, area expansion provided either the sole or the main source of output increases as a result of declining trends or minimal improvements in output per hectare. Because of area expansion, production increases were achieved in Ghana, Nigeria, Tanzania, Zaire, and a number of the Sahelian countries despite their negative growth rates of output per hectare. The regional pattern of production growth was reversed only in Ethiopia where the rise in output per hectare more than offset the declining trend in food crop area. In the remaining non-Sahelian countries, particularly Kenya, area expansion and increases in output per hectare contributed about equally to the growth of food crop output.

The extreme weather variations that occurred in the region during the period resulted in severe production fluctuations which magnified the food problems in Sub-Saharan Africa. This is reflected in the wide variability of the yearly level of output per hectare of food crops in the Sahel, Madagascar, Tanzania, and Zaire. Under rainfed conditions, crop yields are largely dependent on weather. It

Table 3--Average annual growth rates of population and of the production, area harvested, and output per hectare of major staple food crops, for selected countries and country groups, 1961-77.

Country/ Country Group	Population	All Major Staple Food Crops			Cereals			Noncereals		
	1961-77	Production	Area Harvested	Output per Hectare	Production	Area Harvested	Output per Hectare	Production	Area Harvested	Output per Hectare
	(percent)									
Sub-Saharan Africa	2.6	1.6	1.3	0.3	1.7	1.1	0.6	1.5	1.6	-0.1
Ethiopia	2.4	1.2	-0.2	1.4	1.2	-0.5	1.6	1.4	1.2	0.2
Ghana	2.6	1.2	3.1	-1.9	4.5	4.3	0.2	-0.1	2.1	-2.2
Kenya	3.6	5.0	2.4	2.5	6.5	3.7	2.7	0.3	-0.3	0.6
Madagascar	2.3	2.0	1.8	0.2	1.7	1.7	0.0	2.5	2.0	0.5
Nigeria	3.0	0.5	1.3	-0.7	0.2	1.2	-0.9	0.8	1.5	-0.7
Tanzania	2.8	2.2	2.7	-0.5	2.1	2.4	-0.3	2.3	4.1	-1.8
Uganda	3.4	2.8	2.4	0.4	4.1	2.1	2.0	1.8	2.7	-0.9
Zaire	2.3	2.7	2.9	-0.2	3.9	3.9	0.0	2.5	2.6	-0.0
Sahel group[a]	2.6	0.1	0.7	-0.6	-0.1	0.3	-0.4	0.4	1.3	-0.9
25 other countries	2.6	2.2	1.2	1.0	2.2	1.4	0.9	2.3	1.1	1.2

a/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

is also likely that the observed yearly fluctuations in the area planted in food crops, which possibly arise from land use practices add to the fluctuations in output per hectare, as reflected by wide production variations in countries such as Mali and Senegal.

Although livestock and poultry production increased in general in most of the major producing countries as well as in the rest of Sub-Saharan Africa (Table 4), output of some commodities stagnated in certain countries, notably ruminant meat in Ethiopia, cow milk in the Sahel, and sheep and goat milk in Kenya. Distributionally, countries like Ethiopia and the Sahel group decreased their relative shares of total Sub-Saharan animal production because of low output growth rates, while Kenya's share increased.

Meat and, especially, milk production also grew at a slower rate than Sub-Saharan population growth. Egg production, however, generally exceeded population growth. This indicates that poultry farming has shown greater gains in productivity than ruminant development.

FOOD CONSUMPTION TRENDS

Between 1961-65 and 1973-77, the total consumption of major staple food crops in Sub-Saharan Africa increased at an annual rate of 2.3 percent (Table 5).5/ This was 0.4 percent lower than the estimated rate of growth of population in the region and thus indicative of declining domestic use per capita of these commodities. The consumption of food crops expanded faster than population in Ghana, Madagascar, and Zaire and just about kept abreast of population increases in Tanzania and Uganda. However, it lagged behind population growth in Ethiopia, Kenya, Nigeria, and the Sahelian countries by at least 1 percent a year.

In countries where increases in the domestic use of food crops from 1961-65 to 1973-77 either outpaced or equaled population increases, the growth in consumption came from the increased use of cereals. The average yearly rates of growth in cereal consumption were particularly high in Zaire (5.3 percent), Ghana (4.9 percent), and Uganda (4.6 percent). Except in Kenya, the growth in consumption was sustained by noncereals in those countries where the domestic use of food crops lagged behind population. Although cereal utilization increased at a moderate rate in Kenya (2.6 percent) and largely accounted for the growth of its food crop consumption, it was still far short of the country's population growth rate during the period.

Between 1961-65 and 1973-77, the amounts of major staple food crops utilized for direct human consumption, for animal feed (excluding cereal bran and cakes) and for other uses (including seeds, allowance for waste, and nonfood purposes) in Sub-Saharan Africa increased at average annual rates of 2.6 percent, 2.9 percent,

5/ The term "consumption" is used interchangeably with total domestic utilization unless qualified.

Table 4--Average annual growth rates of population and of meat, milk, and egg production for selected countries and country groups, 1961-77

Country/Country Group	Population	Production		
		Meat[a]	Milk[b]	Eggs
		(percent)		
Sub-Saharan Africa	2.7	2.3	1.5(0.9)[c]	3.4
Ethiopia	2.4	-0.3	1.3(0.9)[c]	1.5
Kenya	3.6	2.8	2.3(1.8)[c]	6.0
Madagascar	2.3	1.3	-0.1	1.7
Nigeria	3.0	1.9	1.5	3.0
Somalia	2.4	4.6	2.1(1.1)[c]	4.6
Tanzania	2.8	2.6	2.0	4.6
Uganda	3.4	4.6	2.6	3.6
Zimbabwe	3.7	5.0	1.3	2.6
Sahel group[d]	2.6	0.5	0.2(-1.1)[c]	2.3
25 other countries	2.3	4.2	1.5	6.0

Note: See also Appendix 2, Table 15.

a/ Includes aggregate meat of indigenous cattle, sheep, goats, pigs, and poultry; in carcass weight equivalent.

b/ Includes the aggregates for cow, sheep, and goat milk; the figures in parentheses include camel milk as well.

c/ These figures are for the period 1966-67, for which camel milk production data are also available.

d/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 5--Average annual growth rates of population and of the consumption of major staple food crops for selected countries and country groups, 1961-65 to 1973-77.

Country/Country Group	Population[a]	Consumption of Major Staples[b]		
		Total	Cereals	Noncereals
	(percent)			
Sub-Saharan Africa	2.7	2.3	2.3	2.3
Ethiopia	2.5	1.5	1.5	1.8
Ghana	2.5	2.7	4.9	1.5
Kenya	3.6	2.3	2.6	1.5
Madagascar	2.3	3.1	3.3	2.6
Nigeria	3.0	1.7	1.3	2.2
Tanzania	2.8	2.9	3.1	2.6
Uganda	3.4	3.3	4.6	2.1
Zaire	2.3	3.1	5.3	2.6
Sahel Group[c]	2.6	1.5	1.3	2.2
25 other countries	2.6	2.8	3.1	2.4

Note: See also Appendix 2, Table 19.

a/ Based on population data for 1963 and 1975 from the United Nations, Department of International Economic and Social Affairs, World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment (New York: UN, 1979).

b/ Consumption here refers to total domestic utilization.

c/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

and 1.1 percent, respectively (Table 6). The estimated growth in the use of food crops directly for food barely equals that of population growth, suggesting that the average per capita use of these commodities for food for the region was barely maintained or declined slightly during the period. Increases in direct per capita food use are indicated for Ghana, Madagascar, Tanzania, Uganda, and Zaire. However, large declines in per capita utilization of major staple food crops for direct human consumption occurred in Ethiopia and the Sahelian countries where the slow growth (1.5 percent a year) was significantly exceeded by increases in population. Nigeria's annual increase of 2.7 percent in the use of food crops directly for food also fell short of population growth.

Growth in the utilization of major staple food crops, especially of cereals, for animal feed was rapid in Ghana (6.9 percent) and Uganda (4.2 percent), which is an indication of the pace of livestock and poultry development in those countries. But the growth in the use of food crops for feed was slow in Kenya and Nigeria, and even declined in Ethiopia and the Sahelian countries. The other countries in the region show a fairly rapid combined growth rate of 4.2 percent in the utilization of the major staple food crops for animal feed. As an average for the group, this growth rate suggests that even faster rates of increase in feed use were attained by a number of these countries during the period.

Sub-Saharan meat consumption increased between 1961-65 and 1973-77 at an average annual rate of 2.1 percent (Table 7). During the same period, milk and egg consumption increased at 2 percent and 3.5 percent per year, respectively. Meat and milk consumption lagged behind population growth (2.7 percent per year), while egg consumption grew more rapidly.

Among the meat groups, beef and veal consumption lagged behind population growth in general, except in Tanzania and Zimbabwe. Mutton and goat meat consumption in Sub-Saharan Africa grew at the slowest pace except in Madagascar and Zimbabwe. On the other hand, Sub-Saharan pork and poultry consumption generally outpaced population,6/ with poultry consumption gaining the fastest.

In Sub-Saharan milk consumption, goat, camel, and sheep milk failed to keep up with population growth, with goat milk even decreasing in Kenya, Tanzania, and Uganda between 1961-65 and 1973-77. Camel milk consumption, which is relatively important in such countries as Ethiopia and, especially, Somalia, generally stagnated during the same period. Cow milk consumption increased rapidly in Nigeria, reaching almost 13 percent of the Sub-Saharan total in 1973-77.7/

6/ Tanzania is a notable exception: pork consumption dropped about 50 percent between 1961-65 and 1973-77.

7/ Cow milk consumption in Nigeria was second only to that in Tanzania in 1973-77.

Table 6--Changes in the domestic utilization of major staple food crops, for selected countries and country groups, 1961-65 to 1973-77.

Country/ Country Group	Relative Distribution Among Uses						Average Annual Growth Rate of Domestic Utilization 1961-65 to 1973-77		
	1961-65 Average			1973-77 Average					
	Food	Feed[a]	Others[b]	Food	Feed[a]	Others[b]	Food	Feed[a]	Others[b]
	(percent)								
Sub-Saharan Africa	77.2	2.2	20.6	79.7	2.4	17.9	2.6	2.9	1.1
Ethiopia	89.3	0.3	10.4	90.2	0.2	9.6	1.6	-1.2	0.9
Ghana	76.7	1.7	21.6	76.8	2.7	20.5	2.7	6.9	2.3
Kenya	82.2	1.4	16.4	83.2	1.1	15.7	2.4	0.6	1.9
Madagascar	70.1	10.1	19.8	71.2	9.0	19.8	3.2	2.1	3.1
Nigeria	65.1	1.7	33.2	72.7	1.4	25.9	2.7	0.3	-0.4
Tanzania	85.3	1.5	13.2	85.7	1.5	12.8	2.9	2.6	2.6
Uganda	70.7	3.8	25.5	72.8	4.2	23.0	3.5	4.2	2.4
Zaire	90.7	0.6	8.7	90.8	0.6	8.6	3.1	2.6	3.1
Sahel group[c]	79.5	0.9	19.6	81.0	0.7	18.3	1.6	-0.6	0.9
25 other countries	80.9	3.5	15.6	80.5	4.1	15.4	2.8	4.2	2.7

Note: See also Appendix 2, Table 20.

a/ Excludes cereal bran and cake.

b/ Includes seed, waste, and nonfood uses.

c/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 7--Average annual growth rates of population and meat, milk, and egg consumption for selected countries and country groups, 1961-65 to 1973-77

Country/ Country Group	Population[a]	Consumption[b]		
		Meat[c]	Milk[d]	Eggs
	(percent)			
Sub-Saharan Africa	2.7	2.0	2.1	3.5
Ethiopia	2.5	-0.4	1.4	1.5
Kenya	3.6	1.4	-0.3	4.9
Madagascar	2.3	1.7	0.4	1.6
Nigeria	3.0	1.5	6.6	3.0
Somalia	2.4	0.9	1.8	4.7
Tanzania	2.8	3.2	2.1	4.7
Uganda	3.4	3.3	2.9	7.2
Zimbabwe	3.6	5.5	1.5	2.7
Sahel group[e]	2.6	1.0	1.2	2.3
25 other countries	2.5	3.7	3.3	6.0

Note: See also Appendix 2, Table 21.

a/ Based on population data for 1963 and 1975 from the United Nations, Department of International Economic and Social Affairs, World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment (New York: UN, 1979).

b/ Consumption here refers to total domestic utilization.

c/ Includes cattle, sheep, goat, pig, and poultry meat in carcass weight equivalents.

d/ Includes cow, sheep, goat, and camel milk and milk products in whole milk equivalents.

e/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

TRENDS IN FOOD TRADE

The five-year averages of imports and exports of the major staple food crops in Sub-Saharan Africa during 1961-65 and 1973-77 show that the region switched from being a minor exporter of food crops in the earlier period to a major importer of these commodities in the later period (Table 8). Exports of food crops (mostly groundnuts) decreased by 56 percent whereas imports (mostly cereals) increased by 122 percent. The average annual net imports in 1973-77, which amounted to 3.5 million metric tons, represented about 5 percent of the average yearly consumption in that period.

Of the eight major producers of food crops in Sub-Saharan Africa, Ethiopia, Kenya, Madagascar, and Nigeria were net exporters of these commodities in 1961-65. Only Ethiopia and Kenya retained their trade positions until 1973-77. Because of its rapid increase in food imports, Nigeria shifted from being the largest net exporter in the earlier period to the largest net importer in the later period. This appears to stem from the country's slow domestic food production and rapid growth in incomes.8/ As reflected by the self-sufficiency ratio, Nigeria's average annual net imports of food crops in 1973-77 were about 4 percent of domestic utilization.

Net imports of the four other major producing countries also increased during the period, especially those of Tanzania, which increased to eight times the 1961-65 level. The Sahelian countries as a group also shifted from net exporters to net importers of food crops between 1961-65 and 1973-77; their net imports of food crops during the latter period amounted to about 8 percent of domestic requirements. Aggregate average imports of major staple food crops by the 20 other countries in Sub-Saharan Africa increased from less than half a million tons in 1961-65 to nearly 1.5 million tons in 1973-77.

In general, Sub-Saharan sufficiency ratios calculated from net trade and domestic utilization during 1961-65 and 1973-77 indicate that there was an approximate balance between production and consumption of meat and eggs, but milk supplies were deficient (Table 9).9/

Sub-Saharan meat exports rose 14 percent between 1961-65 and 1973-77, whereas imports rose only half as much.10/ Meat exports exceeded imports by about 3 percent of production. Major Sub-Saharan net exporters of meat include Ethiopia, Kenya, Madagascar, Zimbabwe, and the Sahel group, the latter being the largest. Nigeria, on the other hand, is the largest Sub-Saharan net importer of meat.

Sub-Saharan milk exports during the same period rose about 60

8/ As shown in Appendix 2, Table 23, Nigeria exported an average of 0.8 million tons of food crops annually in 1961-65, almost all of it in noncereal staples, mostly groundnuts.

9/ Balance is shown by a sufficiency ratio of 1, surplus if it is above unity, and deficit if it is below unity.

10/ Trade in meat is adjusted for trade in live animals (in carcass weight equivalent).

Table 8--Exports, imports, net trade, and sufficiency ratios of major staple food crops, 1961-65 and 1973-77 averages

Country/ Country Group	Exports 1961-65	Exports 1973-77	Exports Relative Change	Imports 1961-65	Imports 1973-77	Imports Relative Change	Net Trade[a] 1961-65	Net Trade[a] 1973-77	Sufficiency Ratio[b] 1961-65	Sufficiency Ratio[b] 1973-77
	(1,000 metric tons)		(percent)	(1,000 metric tons)		(percent)	(1,000 metric tons)			
Sub-Saharan Africa	2,543	1,113	-56	2,090	4,640	+122	453	(3,527)	1.009	0.949
Ethiopia	89	119	+34	12	106	+818	77	13	1.017	1.002
Ghana	1	3	+222	107	184	+72	(106)	(181)	0.933	0.917
Kenya	112	166	+36	90	46	-49	22	120	1.107	1.041
Madagascar	78	31	-60	44	108	+147	34	(77)	1.022	0.966
Nigeria	824	70	-91	123	787	+541	701	(717)	1.049	0.960
Tanzania	78	24	-69	109	267	+144	(31)	(243)	0.987	0.929
Uganda	24	...[c]	-99	42	28	-34	(18)	(28)	0.992	0.992
Zaire	4	1	-88	158	414	+162	(154)	(413)	0.961	0.927
Sahel group[d]	672	282	-58	337	838	+149	335	(556)	1.060	0.916
25 other countries	661	417	-37	1,068	1,862	+74	(407)	(1,445)	0.971	0.926

Note: See also Appendix 2, Table 23.

a/ Exports minus imports; negative values are in parenthesis.

b/ Ratio of the sum of net trade and total domestic utilization to total domestic utilization.

c/ Less than 500 metric tons.

d/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 9--Exports, imports, net trade and sufficiency ratios of livestock and poultry products, for selected countries and country groups, 1961-65 and 1973-77

Country/ Country Group	Exports 1961-65	Exports 1973-77	Exports Relative Change	Imports 1961-65	Imports 1973-77	Imports Relative Change	Net Trade a/ 1961-65	Net Trade a/ 1973-77	Sufficiency Ratio b/ 1961-65	Sufficiency Ratio b/ 1973-77
	(1,000 metric tons)		(percent)	(1,000 metric tons)		(percent)	(1,000 metric tons)			
					Meat c/					
Sub-Saharan Africa	263.5	301.2	14.3	195.2	209.2	7.2	68.3	92.0	1.032	1.034
Ethiopia	5.4	12.3	128.1	0.1	0.2	261.1	5.3	12.1	1.013	1.031
Kenya	13.1	12.7	-2.4	7.4	2.0	-73.6	5.7	10.8	1.041	1.066
Madagascar	7.5	8.4	12.4	0.4	0.1	-64.6	7.1	8.3	1.053	1.051
Nigeria	1.4	0.1	-95.3	41.7	44.1	5.6	(40.3)	(44.0)	0.883	0.893
Somalia	14.8	29.3	98.4	..d/	..d/	14.3	14.8	29.3	1.161	1.286
Tanzania	10.5	2.9	-72.5	1.5	1.6	7.6	9.0	1.3	1.080	1.008
Uganda	0.8	..d/	-94.0	2.6	1.4	-48.0	(1.8)	(1.3)	0.974	0.983
Zimbabwe	18.7	16.8	-10.0	2.7	1.0	-63.6	16.0	15.8	1.185	1.096
Sahel Group e/	107.5	84.3	-21.6	20.4	7.9	-61.2	87.1	76.4	1.357	1.278
25 other countries	83.9	134.3	60.1	118.4	150.9	27.4	(34.5)	(16.6)	0.933	0.979
					Milk f/					
Sub-Saharan Africa	33.0	52.6	59.4	488.5	1,254.1	156.7	(455.5)	(1,201.4)	0.912	0.820
Ethiopia	0.1	0.7	469.0	7.7	15.6	103.1	(7.5)	(14.9)	0.989	0.981
Kenya	23.2	48.3	108.3	19.5	7.4	-62.7	3.7	40.9	1.051	1.058
Madagascar	..d/	..d/	500.0	20.1	17.8	-11.6	(20.1)	(17.8)	0.579	0.643
Nigeria	...	...	...	68.1	394.2	479.2	(68.1)	(394.2)	0.787	0.430
Somalia	...	...	...	1.0	11.9	1,118.9	(1.0)	(11.9)	0.998	0.983
Tanzania	0.2	..d/	-94.9	37.3	59.6	60.0	(37.0)	(59.6)	0.937	0.921
Uganda	0.1	...	-100.0	23.7	24.9	5.0	(23.6)	(24.9)	0.908	0.931
Zimbabwe	8.5	...	-100.0	14.3	14.1	-1.9	(5.9)	(14.1)	0.974	0.948
Sahel group e/	..d/	0.5	1,321.0	39.1	156.0	299.4	(39.0)	(155.5)	0.958	0.853
25 other countries	0.9	3.1	261.3	257.8	552.6	114.3	(257.0)	(549.5)	0.705	0.574
					Eggs					
Sub-Saharan Africa	1.1	0.6	-45.7	1.2	2.3	83.4	(0.1)	(1.6)	1.000	0.996
Ethiopia	0.7	0.4	-51.8	...	...	...	0.7	0.4	1.012	1.006
Kenya	0.2	0.1	-50.0	..c/	..c/	100.0	0.2	0.1	1.020	1.006
Madagascar	..d/	..d/	...	..c/	..c/	33.3	..d/	..d/	...	...
Nigeria	...	...	...	...	...	...	...	...	...	...
Somalia	...	...	...	...	...	...	...	...	...	...
Tanzania	..d/	..d/	250.0	..d/	..d/	-82.6	..d/	..d/	...	...
Uganda	..d/	...	-100.0	..d/	..d/	-64.3	..d/	..d/	...	...
Zimbabwe	0.1	...	-100.0	...	...	...	0.1	...	1.015	1.000
Sahel group e/	..d/	0.1	318.2	0.3	0.1	-66.0	(0.3)	..d/	0.985	...
25 other countries	..d/	..d/	58.6	0.9	2.1	139.0	(0.9)	(2.1)	0.980	0.977

Note: The ellipses signify that trade in this commodity is nil or negligible.

a/ Exports minus imports; negative values are in parentheses.

b/ Ratio of the sum of net trade and total domestic utilization to total domestic utilization.

c/ Includes cattle, sheep, goat, pig, and poultry meat, adjusted for trade in live animals in carcass weight equivalent.

d/ Less than 50 metric tons.

e/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

f/ Includes cow, sheep, goat, and camel milk and milk products in whole milk equivalents.

percent, whereas milk imports increased by more than 150 percent. Total Sub-Saharan imports of milk rose from about 9 percent of milk consumption in the early sixties to about 18 percent by the mid-seventies. Most Sub-Saharan countries are net importers of milk and milk products,11/ with Nigeria being the leader.12/ Milk imports dropped, however, in Kenya, Madagascar, and Zimbabwe between 1961-65 and 1973-77. Kenya was the only milk exporter of any significance.

In Africa eggs are not readily traded across wide distances, because that would involve refrigerated storage and transportation. Therefore, egg consumption is generally limited by local availability. Thus, most Sub-Saharan countries end up being "self-sufficient" in eggs.

PROJECTIONS OF FOOD PRODUCTION AND CONSUMPTION

Assuming that 1961-77 production trends continue, by 1985 Sub-Saharan Africa will have a probable deficit of major staple food crops of 11 million tons if per capita income grows slowly or 12 million tons if income expands rapidly.13/ If projections are extended to the year 2000, the probable production shortfalls would be about 36 million tons if income growth is slow (Table 10). The expected gaps between domestic food output and requirements in 1985 and 2000 represent about two and six times, respectively, the estimated shortfalls of these commodities in the region during 1977. Rapid growth of food production in some countries, especially Kenya, may generate aggregate national surpluses of 3 million tons in 1985 and 10 million tons in the year 2000. These potential surpluses would be offset by deficits in other countries resulting in net deficits of 8-9 million tons in 1985 and 26-30 million tons in 2000 for the region as a whole.

Kenya's surplus output of food crops of 0.8 million tons in 1977 could increase to about 2 million tons by 1985 and to more than 5 million tons by 2000, if production performance is maintained (Table 11). Unless the growth rate in food production is significantly increased in Nigeria, however, the expanding market demand for major

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11/ Milk products, such as skimmed milk powder, are in whole milk equivalents.

12/ Nigeria's sufficiency ratio in milk dropped from 0.79 in 1961-65 to only 0.43 in 1973-77, when it was importing 57 percent of its total domestic utilization of milk and milk products.

13/ It should be emphasized that these projections are not intended as forecasts. Projected food gaps are indications of potential future food problems if historical production trends remain unchanged and the assumed conditions for growth in consumption, (that is, rates of growth of population and per capita income) would occur. See Appendix 1 for further details.

Table 10--Trend-based projections of food production and consumption in Sub-Saharan Africa, 1985 and 2000

Assumptions Regarding Projected Consumption	1985 Production	1985 Consumption	1985 Surplus/(Deficit) Gross	1985 Surplus/(Deficit) Net	2000 Production	2000 Consumption	2000 Surplus/(Deficit) Gross	2000 Surplus/(Deficit) Net
	(million metric tons)							
Major staple food crops								
Low-income growth	81.0	89.0	3.3/(11.3)	(8.0)	112.7	138.6	10.2/(36.1)	(25.9)
High-income growth	81.0	90.3	3.0/(12.3)	(9.3)	112.7	143.2	9.8/(40.3)	(30.5)
Meat								
Low-income growth	3.9	4.2	0.4/(0.8)	(0.3)	6.3	9.1	1.1/(3.9)	(2.8)
High-income growth	3.9	4.7	0.3/(1.2)	(0.9)	6.3	12.2	0.6/(6.5)	(5.9)
Milk								
Low-income growth	6.5	9.7	0.2/(3.4)	(3.2)	8.3	18.8	0.0/(10.6)	(10.6)
High-income growth	6.5	10.4	0.1/(4.0)	(3.9)	8.3	23.5	0.0/(15.3)	(15.3)
Eggs								
Low-income growth	0.5	0.6	0.0/(0.1)	(0.0)	1.0	1.4	0.1/(0.5)	(0.4)
High-income growth	0.5	0.6	0.0/(0.1)	(0.1)	1.0	1.8	0.1/(0.9)	(0.8)

Notes: Figures may not add to totals because of rounding. See also Appendix 2, Tables 24 and 25.

Table 11--Production surplus/deficit of major staple food crops for selected countries and country groups, estimates for 1977 and projections to 1985 and 2000.

Country/Country Group	1977	1985 Low-Income Growth	1985 High-Income Growth	2000 Low-Income Growth	2000 High-Income Growth
	(1,000 metric tons of cereal equivalent)				
Sub-Saharan Africa	1,198/(6,342)	3,257/(11,330)	3,012/(12,315)	10,153/(36,057)	9,814/(40,312)
Ethiopia	(285)	(959)	(1,101)	(3,192)	(3,810)
Ghana	(178)	(423)	(461)	(1,672)	(1,848)
Kenya	806	2,050	1,967	5,540	5,270
Madagascar	(85)	(143)	(181)	(566)	(752)
Nigeria	(1,396)	(3,646)	(3,804)	(15,538)	(16,386)
Tanzania	(101)	(584)	(651)	(1,736)	(1,888)
Uganda	(301)	240	153	(10)	(398)
Zaire	(479)	(948)	(1,085)	(1,150)	(1,690)
Sahel group[a/]	302/(532)	114/(1,216)	91/(1,335)	75/(4,445)	70/(4,974)
25 other countries	90/(2,983)	853/(3,411)	801/(3,697)	4,538/(7,749)	4,474/(8,566)

Note: Low- and high-income growth assumptions are 75 percent and 125 percent, respectively, of the average annual growth rate of per capita gross national product during 1966-77. Data for country groups show both gross surplus and gross deficit; their algebraic sum gives the net surplus or deficit. Deficits are indicated by parentheses. See also Appendix 2, Table 24.

a/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

staple food crops due to rapid increases in population and incomes could widen the gap from 1.4 million tons in 1977, to 4 million tons in 1985 and to 16 million tons in 2000. Ethiopia and Zaire would probably have a deficit of about 1 million tons each by 1985, but because food production is growing slowly in Ethiopia, its expected shortfall would be 3.2-3.8 million tons in 2000 compared to only 1.2-1.7 million tons in Zaire. Production shortfalls in Ghana and Tanzania are expected to reach 1.7-1.9 million tons each because of their slow growth in food crop output and high population growth.

Widening food gaps are also expected in the Sahelian countries. Their 0.5 million ton gross deficit may more than double by 1985 and increase to nearly 5 million tons by the year 2000. Surpluses of some countries in this group, particularly Gambia and Senegal, which equaled 60 percent of the Sahel's gross deficit in 1977, would drastically decline to less than 2 percent of the expected shortfall in 2000. Gross deficits in major staple food crops of the 20 other countries in Sub-Saharan Africa, several of which are traditional food importers, are projected at 3.4-3.7 million tons in 1985 and 7.7-8.6 million tons in 2000. However, aggregate national surpluses of a number of countries in this group may increase from 0.8 million tons in 1985 to about 4.5 million tons in 2000, which can partially offset the projected deficits in other countries.

If attaining self-sufficiency in the major staple food crops in Sub-Saharan Africa by 2000 is a goal, the region as a whole would need a yearly increase in output from 1977 to 2000 of 3.4 percent at low-income growth rates and 3.5 percent at high-income growth rates (Table 12). These increases are about 1.4 percent higher than the trend-projected rate of growth of food crops during the period. Although it is unlikely that such drastic increases in the region's food crop production could occur in such a short span of time, to attain self-sufficiency by 1985 Sub-Saharan output would need to rise from the projected growth rate of 1.9 percent a year to 3.6-3.7 percent a year. Among the selected countries, the historical trends in Kenya and Uganda for 1977-85 and in Kenya alone for 1977-2000 exceed the self-sufficiency rates. Major increases in production would be required in Nigeria and the Sahelian countries where trend rates are exceedingly low. The trend-projected growth rates would have to double in Ethiopia and Ghana for these countries to achieve sufficiency in food crops in both 1985 and 2000. As a group, the other countries would require an average yearly output growth of at least 3.8 percent to balance the projected consumption of those commodities in the year 2000.

If the 1961-77 production trends for livestock and poultry products also continue, Sub-Saharan meat output is projected to increase from its 1977 level of 3 million tons to about 3.9 million tons in 1985 and to 6.3 million tons in 2000 (Table 10). The growth in meat production is projected to be much faster than the regional 3 percent annual growth in Somalia, Uganda, and Zimbabwe, much slower in the Sahel, and stagnating in Ethiopia. On the other hand, meat consumption is expected to increase from about 3 million tons in 1977 to between 4.2 and 4.7 million tons by 1985, and to 9-12 million tons by

Table 12--Projected growth rates of population and food crop production, and the average annual growth rates of production required to meet projected consumption for selected countries and country groups, 1977-85 and 1977-2000.

Country/ Country Group	Projected Growth Rate				Production Growth Rate Required to Meet Projected Consumption[a]			
	Population		Production		1977-85		1977-2000	
	1977-85	1977-2000	1977-85	1977 2000	Low-Income Growth	High-Income Growth	Low-Income Growth	High-Income Growth
					(percent)			
Sub-Saharan Africa	3.1	3.0	1.9	2.1	3.6	3.7	3.4	3.5
Ethiopia	2.7	2.7	1.2	1.2	3.1	3.3	2.8	3.1
Ghana	3.2	3.1	1.2	1.2	3.4	3.5	3.3	3.5
Kenya	3.9	3.7	5.0	5.0	..[b]	..[b]	..[b]	..[b]
Madagascar	2.8	2.8	2.0	2.0	2.7	2.8	2.6	2.8
Nigeria	3.4	3.3	0.5	0.5	2.9	3.0	3.1	3.2
Tanzania	3.2	3.2	2.2	2.2	3.9	4.1	3.4	3.5
Uganda	3.2	3.2	2.8	2.8	..[b]	..[b]	2.8	3.1
Zaire	2.8	2.6	2.7	2.7	4.4	4.6	3.2	3.4
Sahel group[c]	2.8	2.8	0.5[d]	0.5[d]	2.5	2.7	2.5	2.7
25 other countries	2.9	2.8	2.6[d]	2.9[d]	4.4	4.5	3.8	3.8

Note: See also Appendix 2, Table 24.

a/ Based on the 1977 estimate of trend production.

b/ Less than the projected growth rate of production.

c/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

d/ A zero growth rate is assumed for countries with negative trends during 1961-77.

2000. The projected regional consumption growth rates exceed those of population. Demand is expected to grow fastest in Nigeria, given its high growth rates of per capita GNP and population. Aggregate national meat shortages for the region are projected to be 0.8-1.2 million tons in 1985, but by 2000 they may reach 3.9-6.5 million tons (Table 13). The largest deficit will be in Nigeria. Surplus countries, on the other hand, include Somalia and Uganda. Assuming that the potential shortages in one country could be offset by the surpluses in another, the region would face net deficits of 0.3-0.9 million tons of meat in 1985 and 2.8-5.9 million tons in 2000.

Sub-Saharan milk production is projected to increase at only half the rate of population growth, from 5.8 million tons in 1977 to 6.5 million tons in 1985 and 8.3 million tons in 2000. With milk demand rising from 7.4 million tons in 1977 to 9.7-10.4 million tons by 1985 and to 19-24 million tons by 2000, milk deficits will be severe and widespread if no changes in food policy are made.14/ Aggregate shortfalls may reach 10-15 million tons by 2000. Nigeria will lead in excess demand.

Egg production in Sub-Saharan Africa is projected to increase faster than population. From 0.4 million tons in 1977, it is projected to reach 0.5 million tons by 1985 and close to 1 million tons by 2000. But egg consumption in the region may increase to 0.6 million tons in 1985, and to 1.4-1.8 million tons in 2000. These projections show an approximate balance in 1985 and notional deficits of 0.5-0.9 million tons in 2000. Egg shortages would tend to be most severe in Ethiopia, Nigeria, and Zimbabwe.

The region's trend-projected production growth rates of meat, milk, and eggs are about 3.0 percent, 1.5 percent, and 4.0 percent per year, respectively (Table 14). If a goal of self-sufficiency is set, policies would have to be adopted to increase these growth rates to 5-7 percent a year to fill the expected deficits. The required growth rates for some of the countries appear staggering. For example, under varying assumptions, rates of 9 percent a year and higher are needed to cope with the rapid increase in demand for these commodities in Nigeria, in comparison with trend-projected production growth rates of 1.5-3.0 percent a year.

CONCLUSIONS

The foregoing projections show that if past food production performance in Sub-Saharan Africa continues, the region will face serious problems in meeting the food needs of its rapidly growing population, especially if incomes also rise swiftly in the coming decades. Aggregate production shortfalls of staple food crops are expected to increase from 9 percent of domestic requirements in 1977 to more than 25 percent in the year 2000. The projections for

14/ Even Kenya, a milk surplus country, is projected to fall into deficit by 2000.

Table 13--Projected production surplus/deficit of meat, milk, and eggs, 1985 and 2000

Country/ Country Group	Meat		Milk		Eggs	
	Low-Income Growth	High-Income Growth	Low-Income Growth	High-Income Growth	Low-Income Growth	High-Income Growth
			(1,000 metric tons)			
			1985			
Sub-Saharan Africa	424.8/ (757.5)	336.1/ (1,204.5)	181.0/ (3,384.7)	138.2/ (4,007.4)	32.8/ (65.1)	20.2/ (129.1)
Ethiopia	(87.3)	(118.6)	(249.1)	(286.6)	(9.0)	(14.5)
Kenya	3.2	(18.9)	181.0	138.6	3.9	1.6
Madagascar	(16.4)	(35.2)	(34.0)	(39.1)	(0.3)	(0.3)
Nigeria	(383.9)	(624.9)	(1,119.8)	(1,312.8)	(46.1)	(96.9)
Somalia	81.0	71.1	(145.4)	(167.0)	0.2	0.0
Tanzania	(42.9)	(68.7)	(235.0)	(321.2)	4.6	1.9
Uganda	31.4	17.4	(155.2)	(190.9)	(0.7)	(1.8)
Zimbabwe	10.7	(10.2)	(75.9)	(91.0)	(2.8)	(4.0)
Sahel Group[a]	41.0/ (9.0)	25.8/ (24.2)	(381.6)	(426.3)	4.4/ (0.8)	3.7/ (1.9)
25 other countries	257.5/ (218.0)	221.8/ (303.8)	(988.7)	(1,172.9)	19.7/ (5.4)	13.0/ (9.7)
			2000			
Sub-Saharan Africa	1,058.4/ (3,872.7)	625.4/ (6,524.9)	(10,557.9)	(15,259.7)	132.6/ (507.0)	77.9/ (905.2)
Ethiopia	(399.9)	(555.8)	(701.9)	(867.9)	(44.0)	(71.6)
Kenya	(155.9)	(302.6)	(286.9)	(516.5)	(11.5)	(5.1)
Madagascar	(110.8)	(206.2)	(72.8)	(98.6)	(1.0)	(1.0)
Nigeria	(2,345.6)	(3,710.5)	(4,484.7)	(6,760.7)	(423.6)	(720.1)
Somalia	209.3	161.3	464.8	537.0	1.1	0.0
Tanzania	(231.0)	(401.3)	(852.9)	(1,208.8)	3.0	(16.2)
Uganda	93.2	17.2	(340.7)	(528.0)	(1.5)	(7.0)
Zimbabwe	49.8	(77.5)	(275.0)	(360.0)	(11.7)	(19.4)
Sahel Group	21.3/ (150.1)	(287.4)	(981.1)	(1,181.1)	6.7/ (4.6)	4.1/ (11.1)
25 other countries	684.8/ (479.4)	446.9/ (983.6)	(2,097.1)	(3,201.1)	110.3/ (20.6)	73.8/ (53.7)

Note: See also Appendix 2, Table 25.

Deficits are indicated by parentheses.

a/ Low- and high-income growth assumptions are 75 percent and 125 percent, respectively, of the average annual growth rate of gross national product per capita during 1966-77.

b/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 14--Trend-projected growth rates of meat, milk, and egg production and the average annual growth rates of production required to meet projected consumption

Country/ Country Group	Production Growth Rate 1977-85	Production Growth Rate 1977-2000	Required Growth Rate for Consumption Target a/ 1977-85 Low-Income Growth	1977-85 High-Income Growth	1977-2000 Low-Income Growth	1977-2000 High-Income Growth
			(percent)			
			Meat			
Sub-Saharan Africa	2.9	3.1	5.2	6.4	5.3	6.4
Ethiopia	-0.3	-0.3	2.5	3.3	3.0	3.8
Kenya	2.8	2.8	..b/	3.7	4.3	5.4
Madagascar	1.3	1.3	2.3	3.3	2.9	4.0
Nigeria	1.9	1.9	10.0	..c/	9.2	..c/
Somalia	4.6	4.6	..b/	..b/	..b/	..b/
Tanzania	2.6	2.6	4.9	6.1	5.0	6.2
Uganda	4.6	4.6	..b/	..b/	..b/	..b/
Zimbabwe	5.0	5.0	..b/	5.4	..b/	5.5
Sahel group d/	1.0	1.2	1.3	1.7	2.4	3.3
25 other countries	4.4	4.5	6.5	7.3	5.3	6.1
			Milk			
Sub-Saharan Africa	1.5	1.6	7.0	7.8	5.3	6.3
Ethiopia	0.9	0.9	4.5	5.0	3.5	4.0
Kenya	1.8	1.8	..b/	..b/	2.5	3.1
Madagascar	-0.1	-0.1	10.0	..c/	5.5	6.6
Nigeria	1.5	1.5	..c/	..c/	..c/	..c/
Somalia	1.1	1.1	3.3	3.6	2.9	3.1
Tanzania	2.0	2.0	5.0	6.0	4.4	5.1
Uganda	2.6	2.6	7.5	8.4	4.9	5.8
Zimbabwe	1.3	1.3	4.3	4.8	3.9	4.5
Sahel group d/	0.6	0.7	4.9	5.4	3.6	4.0
25 other countries	2.4	2.6	..c/	..c/	6.8	8.1
			Eggs			
Sub-Saharan Africa	3.6	4.0	5.1	6.5	5.8	6.9
Ethiopia	1.5	1.5	2.8	3.6	3.1	3.9
Kenya	6.0	6.0	..b/	..b/	..b/	6.3
Madagascar	1.7	1.7	1.9	1.9	1.9	1.9
Nigeria	3.0	3.0	6.4	9.4	7.6	9.3
Somalia	4.6	4.6	..b/	4.6	..b/	4.6
Tanzania	4.6	4.6	..b/	..b/	..b/	5.6
Uganda	3.6	3.6	4.2	5.1	3.9	4.7
Zimbabwe	2.6	2.6	5.4	6.5	5.0	6.1
Sahel group d/	2.6	2.8	2.9	3.3	3.2	3.6
25 other countries	5.9	5.9	6.0	6.4	6.1	6.5

a/ Based on the 1977 estimate of trend production.

b/ Less than trend-projected growth rate of production.

c/ More than 10 percent.

d/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

livestock and poultry production also show large shortfalls. Relative to domestic needs, the projected aggregate food gaps by 2000 are about 40-50 percent for meat, 55-65 percent for milk, and 35-50 percent for eggs.

The national policies that the countries in the region would pursue in coping with these potential shortfalls will necessarily vary depending upon the physical endowments of the country and its fiscal resources. Three options (or combinations thereof) are open to these economies for closing the food gap: to increase domestic production, to utilize food transfers, and to reduce consumption.

Whereas the magnitudes of current food deficits, and possibly those of 1985, appear to be manageable, the huge sizes of the expected food gaps in the Sub-Saharan countries by the year 2000 suggest that they may be only partially filled by trade. Assuming that the food supplies available in the world market would be adequate, which is unlikely, the foreign exchange requirements would place a considerable burden on national finances. They would be extremely difficult for poor countries to bear. And even for a country like Nigeria, with ample opportunity to earn foreign exchange, in the year 2000 financing 40 percent of consumption of food crops, 60 percent of eggs, 80 percent of meat, and 90 percent of milk may not be a rational policy choice. Furthermore, major dependence on external sources for domestic food needs can be risky in the face of competition with high-income developing countries and with developed economies. Needless to say, the cost of food imports can be exceedingly high during periods of short supply; the consequent increase in domestic food prices can lead to reduced consumption which would have major adverse effects on the poorer segments of the population.

Domestic production increases in the food-deficit countries must account for the greater part of the task of minimizing future food gaps in the Sub-Saharan countries. But programs designed to achieve gap-filling increases in food output by the year 2000 will necessarily entail large investments. Output increases from new investments cannot produce results quickly enough to meet expected food deficits in 1985. Thus shorter-term strategies may have to be developed.

The share of noncereal staple food crops in Sub-Saharan consumption is greater than in other developing regions. Increased domestic output of these commodities, especially rootcrops, could potentially meet a significant part of future food requirements in many countries and reduce the pressure for larger cereal imports.

While raising food crop production levels, Sub-Saharan Africa will probably also have to cope with the continued occurrence of extreme weather fluctuations in the region. Most of the growth in food crop output in many countries has come from area expansion; growth in output per hectare has been small and sometimes declining. If the past instability of crop yields can be directly attributed to bad weather, investment in irrigation may be desirable. This would not only reduce vulnerability to weather, but also help ensure that the yield-increasing inputs being applied, such as fertilizer, can be

effective.15/

The social changes that Africa is undergoing are accompanied by changes in consumer preference that favor a greater demand for animal products. Thus increased domestic production of these commodities becomes important. Growing urbanization demands more intensive animal husbandry. In light of the projected deficit in milk availability, improvements in dairying, especially cattle development, would be necessary. The shift to increased consumption of chicken and eggs also calls for the use of improved technology in poultry farming.

As animal husbandry intensifies, the derived demand for feeds generates competition with the direct consumption of staples as food. Cheaper feed sources therefore need to be found.

Finally, the need for support from the international community in coping with the expected food problems in Sub-Saharan Africa will be more pronounced. Financial assistance would be needed especially to supplement domestic resources for the required investments aimed at increasing food output. Expanded food aid can supplement whatever commercial imports these poor countries can afford. This would help prevent further declines in the per capita food intake of populations in Ethiopia and the Sahel countries, for example, where population growth significantly exceeds growth in the use of food crops for direct human consumption.

15/ Detailed discussions on irrigation and other agricultural investments are presented elsewhere in this collection in Peter Oram's paper entitled "Production Potentials in Africa: Issues and Strategies."

APPENDIX 1: METHODOLOGY, ASSUMPTIONS AND DATA SOURCES

Methodology

The analysis of production trends in this paper fits a logarithmic trend equation to the 1961-77 output data of a commodity or group of commodities for each of the 40 countries in Sub-Saharan Africa.16/ Country trend estimates for the end years of the observation period are then aggregated to obtain trend indications for country groups and for the region as a whole. In examining the changes that have occurred in the consumption and trade of the commodities under study, the analysis makes use of the five-year averages of the data of each country or country group during the periods 1961-65 and 1973-77.

The production of a commodity or commodity group in each country is projected to 1985 and 2000 as an extrapolation of the fitted equation mentioned above. Exceptions are for countries that exhibit negative historical trends, for which a zero growth in production is used and the 1977 trend estimate of the fitted equation mentioned above is applied for both 1985 and 2000. This procedure is employed for each food group (major staple food crops, meat, milk, and eggs).

Consumption projections are generally based on trends during the period 1966-77. Using the 1977 per capita trend level of food use as a base, increases in the utilization of the commodities for direct human consumption are based further on assumptions regarding changes in population and per capita incomes.17/ For the major staple crops, the projected quantities for seed use are related to projections of harvested area. Allowances for waste are based on 10 percent of projected production while the quantities for feed and nonfeed uses are extrapolations of 1966-77 trends. For livestock and poultry products, the projections for feed use (milk) are based on trend levels, but constrained by the growth rate of milk production. "Seed" (eggs for breeding) and waste (milk and eggs) are assumed to be percentage allowances from projected production levels. Following the general historical pattern of Sub-Saharan data, little or no allowance is made for meat wastage or for industrial use (processed goods from manufacture) of meat, milk, and eggs. Therefore, these utilization categories were assumed to be zero.

16/ The exponential equation $Y_t = A \cdot B^t$ was used, where Y is the estimate of production and t is the period in years.

17/ For consumption projections, the equation used is of the form $c_t = c_0(1 + gz)^t$ where c_t represents the per capita consumption in 1985 or 2000; c_0 is the trend estimate of per capita consumption in 1977, g is the assumed annual growth rate in GNP per capita, z is the estimate of income elasticity, and t is the period in years. The projected per capita consumption is expanded to total consumption using the medium-variant population projections prepared by the United Nations.

Assumptions

As suggested by the methodology outlined above, output projections assume that the 1961-77 trends will continue into the future except for commodity groups with negative growth rates. For the projections of consumption, the assumed population growth rates follow those shown by medium-variant projections of the United Nations, whereas the rates of increase in income at "low-income growth" and "high-income growth" are 75 percent and 125 percent, respectively, of the average annual rate of growth of GNP per capita during the 1966-77 period. Minimum yearly growth rates of 0.5 percent and 1.5 percent are set for low- and high-income growth; a maximum rate of 6.0 percent for the latter is also assumed. Consumption projections further assume declining income elasticities of demand over time and unchanged price relationships.

Data Sources

The historical series on production, consumption, and trade, and the estimates of income elasticities of demand of the food commodities covered in the study are from the FAO. Specifically, the statistics on production are drawn from the 1978 FAO Production Tape while those on consumption and trade are FAO-generated data for their global study, Agriculture: Toward 2000. Time-series data on GNP are World Bank figures. The 1977 population estimates are from the United Nations Population Division, except those for Nigeria and Guinea-Bissau which are also World Bank figures.18/

18/ United Nations, World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment, ST/ESA/SER.R/33 (New York: UN, 1979); International Bank for Reconstruction and Development, 1979 World Bank Atlas (Washington, D.C.: IBRD, 1979); and International Bank for Reconstruction and Development "Gross National Product, 1960-78: Time-Series Data by Country, at Current and Constant Market Prices," Washington, D.C.: IBRD, 1979.

APPENDIX 2: SUPPLEMENTARY TABLES

Table 15--Production of cereal and noncereal staple food crops for selected countries and country groups, 1977

Country/ Country Group	Major Staple Food Crops Total	Cereals						Country/ Country Group	Cereals[a]				
		Total	Millet and Sorghum	Maize	Rice (milled)	Wheat	Others		Total	Rootcrops	Pulses	Groundnuts	Bananas and Plantains
						(1,000 metric tons)							
Sub-Saharan Africa	67,717	36,149	15,524	13,521	3,555	1,051	2,498	Sub-Saharan Africa	31,568	20,857	3,816	3,529	3,366
Ethiopia	5,200	4,340	883	998	...	592	1,867[b]	Ethiopia	860	242	576	29	13
Ghana	1,958	615	273	309	34	...	...	Ghana	1,342	1,028	14	79	221
Kenya	3,870	3,165	130	2,553	27	180	275	Kenya	705	318	315	8	64
Madagascar	2,308	1,501	...[c]	122	1,379	...	...	Madagascar	807	586	66	57	98
Nigeria	17,524	8,516	5,650	1,400	385	21	60	Nigeria	9,008	7,493	800	315	400
Tanzania	3,491	1,563	390	968	132	71	2	Tanzania	1,928	1,315	219	78	316
Uganda	3,142	1,431	895	515	9	12	...	Uganda	1,711	540	263	218	690
Zaire	5,460	737	26	515	154	3	39	Zaire	4,723	3,876	150	347	350
Sahel group[d]	6,916	4,737	4,220	193	237	10	77	Sahel group[c]	2,179	263	519	1,396	1
25 other countries	17,848	9,543	2,057	5,948	1,198	162	178	20 other countries	8,305	5,196	894	1,002	1,213

Sources of basic data: See Appendix 4.

a/ In terms of cereal equivalent.

b/ Includes 731,000 metric tons of barley, representing 91 percent of barley output in Sub-Saharan Africa.

c/ Less than 500 metric tons.

d/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 16--Production, area harvested, and output per hectare of major staple food crops for selected countries and country groups, 1977

Country/ Country Group	Production[a/]			Area Harvested			Output per Hectare[a/]		
	Cereals	Non-cereals	Total	Cereals	Non-cereals	Total	Cereals	Non-cereals	Total
	(1,000 metric tons)			(1,000 hectares)			(metric tons)		
Sub-Saharan Africa	36,149	31,568	67,717	47,028	26,091	73,119	0.77	1.22	0.93
Ethiopia	4,340	860	5,200	4,935	1,104	6,039	0.88	0.78	0.86
Ghana	616	1,342	1,958	782	807	1,589	0.79	1.66	1.23
Kenya	3,165	705	3,870	2,049	795	2,844	1.54	0.89	1.36
Madagascar	1,501	807	2,308	1,224	512	1,736	1.23	1.58	1.33
Nigeria	8,516	9,008	17,524	12,969	7,97[illegible]	20,947	0.66	1.13	0.84
Tanzania	1,563	1,928	3,491	2,082	1,532	3,614	0.75	1.26	0.97
Uganda	1,431	1,711	3,142	1,262	1,329	2,591	1.13	1.29	1.21
Zaire	737	4,723	5,460	1,080	2,560	3,640	0.68	1.84	1.50
Sahel group[b/]	4,737	2,179	6,916	9,362	3,549	12,911	0.51	0.61	0.54
25 other countries	9,543	8,305	17,848	11,283	5,925	17,208	0.85	1.40	1.04

Sources of basic data: See Appendix 4.

a/ Production and output per hectare of noncereals are in terms of cereal equivalent.

b/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 17--Distribution of meat, milk, and egg production among countries and country groups, 1977

Country/ Country Group	Meat[a/]		Milk[b/]		Eggs	
	(1,000 metric tons)	(percent)	(1,000 metric tons)	(percent)	(1,000 metric tons)	(percent)
Sub-Saharan Africa	3,050.3	100.0	5,849.5	100.0	414.1	100.0
Nigeria	406.4	13.3	316.3	5.4	136.8	33.0
Ethiopia	401.5	13.2	703.8	12.0	71.5	17.3
Kenya	225.3	7.4	1,006.7	17.2	18.7	4.5
Zimbabwe	197.1	6.5	260.0	4.4	10.2	2.5
Tanzania	180.7	5.9	750.0	12.8	23.6	5.7
Madagascar	171.9	5.6	28.0	0.5	13.7	3.3
Uganda	130.0	4.3	285.1	4.9	10.3	2.5
Somalia	129.2	4.2	730.5	12.5	2.1	0.5
Sahel group[c/]	375.8	12.3	986.9	16.9	29.6	7.1
25 other countries	832.4	27.3	782.2	13.4	97.6	23.6

Sources of basic data: See Appendix 4.

a/ Includes meat of indigenous cattle, sheep, goats, pigs, and poultry in carcass weight equivalents.

b/ Includes cow, sheep, goat, and camel milk.

c/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 18--Relative distribution of meat and milk production among sources, for selected countries and country groups, 1961-65 and 1973-77 averages

Country/ Country Group	1961-65 Average				1973-77 Average			
	(percent)							
	Meat							
	Cattle	Sheep/Goat	Pig	Poultry	Cattle	Sheep/Goat	Pig	Poultry
Sub-Saharan Africa	60.7	23.6	5.8	9.9	57.9	20.5	7.6	14.0
Ethiopia	54.4	34.7	0.1	10.8	53.4	32.3	0.2	14.1
Kenya	70.2	21.6	2.5	5.7	67.8	14.4	1.6	16.2
Madagascar	71.9	1.1	9.4	17.6	60.8	3.0	13.3	22.9
Nigeria	47.3	30.8	7.6	14.3	44.7	25.2	8.5	21.5
Somalia	44.2	54.0	0.1	1.7	38.0	59.8	0.2	2.0
Tanzania	68.6	24.2	0.2	7.0	69.8	17.3	0.1	12.8
Uganda	75.6	16.0	0.8	7.7	68.8	10.2	5.8	15.3
Zimbabwe	84.3	3.3	7.3	5.1	83.7	5.5	6.4	4.4
Sahel group a/	62.4	29.0	1.4	7.2	56.4	30.7	3.3	9.6
25 other countries	60.0	14.6	14.8	10.6	57.0	12.9	16.0	14.1
	Milk							
	Cow	Sheep	Goat	Camel	Cow	Sheep	Goat	Camel
Sub-Saharan Africa	76.1	3.8	14.1	6.0	77.6	3.8	12.9	5.6
Ethiopia	74.0	0.9	14.5	10.6	76.3	0.7	13.3	9.7
Kenya	89.7	2.2	6.9	1.2	92.8	1.5	4.1	1.6
Madagascar	100.0	...	...	...	100.0	...	...	...
Nigeria	100.0	...	...	...	100.0	...	...	...
Somalia	20.9	11.7	36.5	30.9	20.8	13.0	38.2	28.0
Tanzania	91.5	...	8.5	...	93.4	...	6.6	...
Uganda	100.0	...	...	...	100.0	...	...	...
Zimbabwe	100.0	...	...	...	100.0	...	...	...
Sahel group a/	59.7	10.0	26.7	3.6	58.3	10.8	27.1	3.8
25 other countries	95.1	0.5	4.4	...	94.7	0.6	4.6	...

Sources of basic data: See Appendix 4.

Note: Figures may not add to totals because of rounding.

a/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 19--Population and the consumption of major staple food crops for selected countries and country groups, 1961-65 and 1973-77 averages

Country/ Country Group	1961-65 Average				1973-77 Average			
	Population[a]	Consumption of Major Staples[b]			Population[a]	Consumption of Major Staples[b]		
		Total	Cereals	Noncereals		Total	Cereals	Noncereals
	(thousands)	(1,000 metric tons)			(thousands)	(1,000 metric tons)		
Sub-Saharan Africa	212,374	52,415	30,011	22,404	293,787	68,916	39,554	29,362
Ethiopia	21,517	4,447	3,749	698	28,770	5,345	4,480	865
Ghana	7,422	1,586	487	1,099	9,990	2,180	864	1,316
Kenya	8,855	2,203	1,551	652	13,531	2,882	2,100	782
Madagascar	5,825	1,559	1,066	493	7,675	2,244	1,569	675
Nigeria	51,946	14,419	7,605	6,814	74,150	17,704	8,857	8,847
Tanzania	11,001	2,449	1,163	1,286	15,393	3,431	1,681	1,750
Uganda	7,595	2,238	960	1,278	11,337	3,289	1,648	1,641
Zaire	18,791	3,919	651	3,268	24,655	5,649	1,216	4,433
Sahel group[c]	20,190	5,576	4,630	946	27,420	6,648	5,426	1,222
25 other countries	59,232	14,019	8,149	5,870	80,866	19,544	11,713	7,831

Sources of basic data: See Appendix 4.

a/ Estimates for 1963 and 1975; based on United Nations population data except for Nigeria and Guinea-Bissau (included in "Others") for which the 1977 World Bank estimates were used as benchmarks.

b/ Consumption here refers to total domestic utilization of major staple food crops; the non-cereal component is in terms of cereal equivalent.

c/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 20--Consumption of major staple food crops according to use for selected countries and country groups, 1961-65 and 1973-77 averages

Country/ Country Group	1961-65 Average				1973-77 Average			
	Total	Food	Feed[a]	Others[b]	Total	Food	Feed[a]	Others[b]
	(1,000 metric tons)							
Sub-Saharan Africa	52,415	40,489	1,147	10,779	68,916	54,947	1,619	12,350
Ethiopia	4,447	3,971	12	464	5,345	4,820	11	514
Ghana	1,586	1,217	27	342	2,180	1,673	60	447
Kenya	2,203	1,812	30	361	2,882	2,398	32	452
Madagascar	1,559	1,093	157	309	2,244	1,598	202	444
Nigeria	14,419	9,392	241	4,786	17,704	12,869	250	4,585
Tanzania	2,449	2,088	37	324	3,431	2,942	50	439
Uganda	2,238	1,582	85	571	3,289	2,395	139	755
Zaire	3,919	3,555	24	340	5,649	5,129	32	488
Sahel group[c]	5,576	4,434	49	1,093	6,648	5,384	46	1,218
25 other countries	14,019	11,345	485	2,189	19,544	15,739	797	3,008

Source of basic data: See Appendix 4.

Note: Consumption here refers to total domestic utilization; the noncereal component is in terms of cereal equivalent.

a/ Excludes cereal bran and cakes.

b/ Includes seeds, waste, and other uses.

c/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 21--Consumption of meat, milk, and eggs for selected countries and country groups, 1961-65 and 1973-77 averages

Country Country Group	Meat[a/]		Milk[b/]		Eggs	
	1961-65	1973-77	1961-65	1973-77	1961-65	1973-77
	(1,000 metric tons)					
Sub-Saharan Africa	2,143.4 (100.0)	2,733.6 (100.0)	5,183.0 (100.0)	6,661.8 (100.0)	252.6 (100.0)	382.5 (100.0)
Ethiopia	404.7 (18.9)	386.4 (14.1)	658.3 (12.7)	780.2 (11.2)	56.9 (22.5)	68.3 (17.9)
Kenya	139.2 (6.5)	164.1 (6.0)	723.1 (14.0)	701.0 (10.5)	10.0 (4.0)	17.7 (4.6)
Madagascar	134.1 (6.3)	163.9 (6.0)	47.7 (0.9)	49.8 (0.7)	10.6 (4.2)	12.9 (3.4)
Nigeria	344.2 (16.1)	412.8 (15.1)	320.0 (6.2)	691.6 (10.4)	82.4 (32.6)	117.2 (30.6)
Somalia	92.0 (4.3)	102.4 (3.7)	570.8 (11.0)	705.9 (10.6)	1.1 (0.4)	1.9 (0.5)
Tanzania	112.3 (5.3)	164.2 (6.0)	590.2 (11.4)	753.4 (11.3)	12.8 (5.1)	22.3 (5.8)
Uganda	68.2 (3.2)	100.4 (3.7)	256.7 (5.0)	362.8 (5.4)	6.1 (2.4)	14.0 (3.7)
Zimbabwe	86.6 (4.0)	164.3 (6.0)	223.8 (4.3)	268.1 (4.0)	6.6 (2.6)	9.1 (2.4)
Sahel group[c/]	243.7 (11.4)	275.1 (10.1)	921.1 (17.8)	1,058.1 (15.9)	20.6 (8.2)	27.1 (7.1)
25 other countries	518.4 (24.2)	800.1 (29.3)	871.4 (16.8)	1,291.0 (19.4)	45.5 (18.0)	92.0 (24.1)

Sources of basic data: See Appendix 4.

Note: Figures may not add to totals because of rounding; those in parentheses represent percentages of Sub-Saharan Africa total. Consumption refers to total domestic utilization.

a/ Includes cattle, sheep, goat, pig, and poultry meat in carcass weight equivalent.

b/ Includes cow, sheep, goat, and camel milk and milk products in whole milk equivalents.

c/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 22--Consumption of livestock and poultry products according to use for selected countries and country groups, 1961-65 and 1973-77 averages

Country/ Country Group	1961-65 Total	1961-65 Food	1961-65 Others a/	1973-77 Total	1973-77 Food	1973-77 Others a/	Average Annual Growth Rate 1961-65 to 1973-77 Total	Food	Others a/
	(1,000 metric tons)			(1,000 metric tons)			(percent)		
				Meat b/					
Sub-Saharan Africa	2,143.5	2,140.3	3.2	2,733.7	2,729.2	4.5	2.05	2.05	2.80
Ethiopia	404.7	404.7	...	386.4	386.4	...	-0.38	-0.38	...
Kenya	139.2	139.2	...	164.1	164.1	...	1.38	1.38	...
Madagascar	134.1	134.1	...	163.9	163.9	...	1.69	1.69	...
Nigeria	344.2	344.2	...	412.7	412.7	...	1.53	1.53	...
Somalia	92.0	92.0	...	102.5	102.5	...	0.90	0.90	...
Tanzania	112.3	112.3	...	164.2	164.2	...	3.22	3.22	...
Uganda	68.2	68.2	...	100.4	100.4	...	3.27	3.27	...
Zimbabwe	86.6	86.6	...	164.3	164.3	...	5.48	5.48	...
Sahel group c/	243.7	243.7	...	275.2	275.2	...	1.02	1.02	...
25 other countries	518.4	515.2	3.2	800.1	795.6	4.5	3.68	3.69	2.80
				Milk d/					
Sub-Saharan Africa	5,183.0	4,473.9	709.2	6,631.8	5,969.3	692.5	2.11	2.43	-0.20
Ethiopia	658.3	625.6	32.7	780.2	744.6	35.6	1.42	1.46	0.70
Kenya	723.1	561.2	161.9	701.0	596.8	104.2	-0.26	0.51	-3.61
Madagascar	47.7	46.3	1.4	49.8	48.2	1.6	0.36	0.33	1.25
Nigeria	320.0	196.7	123.3	691.6	545.3	146.2	6.63	8.87	1.43
Somalia	570.8	542.3	28.5	705.9	671.2	34.7	1.79	1.79	1.66
Tanzania	590.2	577.3	12.9	753.4	736.5	16.9	2.06	2.05	2.33
Uganda	256.7	244.4	12.3	362.8	345.0	17.8	2.92	2.91	3.11
Zimbabwe	223.8	161.1	62.8	268.1	194.9	73.2	1.51	1.60	1.28
Sahel group c/	921.1	769.3	151.7	1,058.1	874.9	183.2	1.16	1.08	1.58
25 other countries	871.4	749.7	121.6	1,291.0	1,211.9	79.1	3.33	4.00	-3.52
				Eggs					
Sub-Saharan Africa	252.6	184.6	68.0	382.5	280.8	101.7	3.52	3.56	3.41
Ethiopia	56.9	51.1	5.8	68.3	61.4	6.9	1.54	1.57	1.47
Kenya	10.0	6.5	3.5	17.7	11.7	6.1	4.89	4.97	4.73
Madagascar	10.6	2.1	8.5	12.9	2.6	10.3	1.66	1.66	1.66
Nigeria	82.4	57.7	24.7	117.2	82.1	35.2	2.98	2.98	2.98
Somalia	1.1	0.9	0.2	1.9	1.5	0.4	4.59	4.59	4.59
Tanzania	12.8	7.1	5.7	22.3	12.4	9.9	4.74	4.81	4.64
Uganda	6.1	3.7	2.4	14.0	8.4	5.6	7.13	7.14	7.12
Zimbabwe	6.6	6.0	0.7	9.1	8.1	0.9	2.62	2.63	2.55
Sahel group c/	20.6	14.1	6.6	27.1	19.1	8.0	2.30	2.58	1.67
25 other countries	45.5	35.5	9.9	92.0	73.5	18.5	6.05	6.24	5.32

Source of basic data: See Appendix 4.

Note: Consumption here refers to domestic utilization.

a/ Includes feed, seed, waste, and other uses.

b/ Includes cattle, sheep, goat, pig, and poultry meat in carcass weight equivalents.

c/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

d/ Includes cow, sheep, goat, and camel milk and milk products in whole milk equivalents.

Table 23--Exports, imports, and total domestic utilization of cereal and noncereal food crops, 1961-65 and 1973-77 averages

Country/ Country Group	Exports: Cereals	Exports: Non-cereals[a]	Exports: Total	Imports: Cereals	Imports: Non-cereals[a]	Imports: Total	Net Trade[b]	Total Domestic Utilization
	(1,000 metric tons)							
	1961-65 Average							
Sub-Saharan Africa	585	1,958	2,543	2,011	79	2,090	453	52,415
Ethiopia	3	86	89	12	..[c]	12	77	4,447
Ghana	..[c]	1	1	101	6	107	(106)	1,586
Kenya	93	19	112	79	11	90	22	2,203
Madagascar	30	48	78	44	..[c]	44	34	1,559
Nigeria	..[c]	824	824	122	1	123	701	14,419
Tanzania	26	52	78	101	8	109	(31)	2,449
Uganda	15	9	24	39	3	42	(18)	2,238
Zaire	0	4	4	153	5	158	(154)	3,919
Sahel group[d]	71	601	672	331	6	337	335	5,576
25 other countries	347	314	661	1,029	39	1,068	(407)	14,019
	1973-77 Average							
Sub-Saharan Africa	426	687	1,113	4,573	67	4,640	(3,527)	68,916
Ethiopia	6	113	119	106	..[c]	106	13	5,345
Ghana	3	..[c]	3	183	1	184	(181)	2,180
Kenya	148	18	166	41	5	46	120	2,882
Madagascar	5	26	31	108	..[c]	108	(77)	2,244
Nigeria	1	69	70	786	1	787	(717)	17,704
Tanzania	5	19	24	265	2	267	(243)	3,431
Uganda	..[c]	..[c]	..[c]	28	..[c]	28	(28)	3,289
Zaire	..[c]	..[c]	1	413	1	414	(413)	5,649
Sahel group[d]	70	212	282	829	9	838	(556)	6,648
25 other countries	188	229	417	1,814	48	1,862	(1,445)	19,544

Sources of data: See Appendix 4.

a/ Noncereal component is in terms of cereal equivalent.

b/ Exports minus total imports; negative values are in parentheses.

c/ Less than 500 metric tons.

d/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 24--Production and consumption of major staple food crops, estimates for 1977, and projections to 1985 and 2000

Country/ Country Group	1977 Production Actual	1977 Production Trend[a]	1977 Consumption Actual	1977 Consumption Trend[c]	1985 Production[a]	1985 Consumption[b] Low-Income Growth	1985 Consumption[b] High-Income Growth	2000 Production	2000 Consumption[b] Low-Income Growth	2000 Consumption[b] High-Income Growth
	(1,000 metric tons)									
Sub-Saharan Africa	67,717	69,537	72,859	72,380	80,960	89,033	90,263	112,735	138,639	143,233
Ethiopia	5,200	5,572	5,485	5,501	6,141	7,100	7,242	7,372	10,564	11,182
Ghana	1,958	2,080	2,136	2,252	2,285	2,708	2,746	2,726	4,398	4,574
Kenya	3,870	4,385	3,064	3,052	6,465	4,415	4,498	13,386	7,846	8,116
Madagascar	2,308	2,223	2,393	2,378	2,599	2,742	2,780	3,484	4,049	4,236
Nigeria	17,524	17,178	18,920	18,592	17,925	21,571	21,729	19,414	34,952	35,800
Tanzania	3,491	3,376	3,592	3,568	4,014	4,598	4,665	5,552	7,288	7,440
Uganda	3,142	3,511	3,443	3,528	4,377	4,137	4,224	6,616	6,626	7,014
Zaire	5,460	5,466	5,939	5,992	6,772	7,720	7,857	10,120	11,270	11,810
Sahel group[d]	6,916	6,873	7,146	6,831	7,147	8,249	8,391	7,741	12,111	12,645
25 other countries	17,848	18,873	20,741	20,686	23,235	25,793	26,131	36,324	39,535	40,416

Sources of basic data: See Appendix 4.

a/ Production trend values are based on 1961-77 data.

b/ Consumption trend values are based on 1966-77 data.

c/ For consumption projections the low- and high-income growth assumptions are 75 percent and 125 percent, respectively, of the trend growth rate of gross national product per capita during 1966-77. See Appendix 2 for other details.

d/ Includes Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta.

Table 25--Production and consumption of meat, milk, and eggs, projections to 1985 and 2000

Country/ Country Group	Meat			Milk			Eggs		
	Production	Consumption[a/] Low-Income Growth	Consumption[a/] High-Income Growth	Production	Consumption[a/] Low-Income Growth	Consumption[a/] High-Income Growth	Production	Consumption[a/] Low-Income Growth	Consumption[a/] High-Income Growth
	(1,000 metric tons)								
	1985								
Sub-Saharan Africa	3,870.0	4,202.7	4,738.4	6,499.1	9,702.8	10,368.3	539.7	572.0	648.6
Ethiopia	404.6	491.9	523.2	755.3	1,004.4	1,041.9	81.0	90.0	95.5
Kenya	263.2	260.0	282.1	1,173.5	992.5	1,034.9	29.2	25.3	27.6
Madagascar	203.2	219.6	238.4	29.7	63.7	68.8	15.2	15.5[b/]	15.5[b/]
Nigeria	452.1	836.0	1,077.0	361.4	1,481.2	1,674.2	158.9	205.0	255.8
Somalia	217.6	136.6	146.5	781.7	927.1	948.7	3.0	2.8	3.0
Tanzania	219.8	262.7	288.5	887.7	1,122.7	1,208.9	34.1	29.5	32.2
Uganda	179.0	147.6	161.6	345.8	501.0	536.7	15.0	15.7	16.8
Zimbabwe	291.9	281.2	302.1	287.4	363.3	378.4	11.4	14.2	15.4
Sahel Group[c/]	396.1	364.1	394.5	951.6	1,333.2	1,377.9	35.2	31.6	33.4
25 other countries	1,242.5	1,203.0	1,324.5	925.0	1,913.7	2,097.9	156.7	142.4	153.4
	2000								
Sub-Saharan Africa	6,257.5	9,071.8	12,157.0	8,263.5	18,821.4	23,523.2	988.6	1,363.0	1,815.9
Ethiopia	404.6	804.5	960.4	860.0	1,561.9	1,727.9	101.1	145.1	172.7
Kenya	399.6	555.5	702.2	1,527.1	1,814.0	2,043.6	69.7	58.2	74.8
Madagascar	246.4	357.2	452.6	29.7	102.5	128.3	19.5	20.5[b/]	20.5[b/]
Nigeria	596.6	2,942.2	4,307.1	451.5	4,936.2	7,212.2	249.0	672.6	969.1
Somalia	426.1	216.8	264.8	919.2	1,384.0	1,456.2	5.9	4.8	5.9
Tanzania	320.4	551.4	721.7	1,192.9	2,045.8	2,401.7	67.2	64.2	83.4
Uganda	348.8	255.6	331.6	507.2	847.9	1,035.2	25.5	27.0	32.5
Zimbabwe	602.4	552.6	679.9	347.9	622.9	707.9	16.6	28.3	36.0
Sahel Group[c/]	479.6	608.4	767.0	1,054.7	2,035.8	2,235.8	54.3	52.2	61.3
25 other countries	2,433.0	2,227.6	2,969.7	1,373.3	3,470.4	4,574.4	379.8	290.1	359.7

Source of basic data: See Appendix 4.

a/ For consumption projections, the low- and high-income growth assumptions are 75 percent and 125 percent, respectively, of the annual trend growth rate of gross national product per capita during 1966-77.

b/ Trend values are based on 1966-77 data.

c/ Includes Chad, Mali, Mauritania, Niger, Senegal, and Upper Volta.

APPENDIX 3: NOTES ON DATA RELIABILITY

In this paper, the statistics on production, consumption, and trade of the commodities included in the analysis are obtained from FAO.19/ As in other studies that use available statistics for Third World countries, the analysis implicitly assumes that the data for Sub-Saharan Africa are of acceptable reliability. However, most of these countries have problems of one form or another regarding data quality. A few of these problems are indicated here partly to gauge the assumption and partly to draw attention to the need for improving agricultural data systems in Sub-Saharan Africa and other developing countries. The latter is most important if research and policies based on information drawn from these systems are expected to assist Third World development. It should be pointed out, however, that improving the quality of agricultural statistics in a developing country is also a part of economic development; hence changes in the quality of estimates can be expected to occur over time.

Methods of Data Collection

In 1975 the FAO published descriptions of the methods of agricultural data collection among countries throughout the world.20/ These descriptions, which depicted the status of national data systems around 1970, indicated the following for the 21 reported countries in Sub-Saharan Africa:

1) The 1960s and early 1970s were periods of major changes in the agricultural data systems of many African countries. Significant strides were made toward the use of objective methods in the collection of current agricultural statistics in five countries: Nigeria (1963-64), Ghana (1965), Kenya (1966), Botswana (1970), and Uganda.21/ Limited use of objective means was also initiated in five others, namely Ethiopia (1963), Congo and Swaziland (1966), Chad (1967), and Malawi (1969 only). At the time of the report, plans were also laid to start objective data gathering in Guinea, Togo, and Zaire during 1971 and 1972.

2) Except perhaps for the first five countries mentioned above, the countries mainly employed subjective methods of collecting current agricultural data at the time. Country estimates were compiled from annual reports submitted by field offices of the agriculture ministry, whose duties included data collection as well as

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19/ Specific data sources are shown in Appendix 4.

20/ Food and Agriculture Organization of the United Nations, National Methods of Collecting Agricultural Statistics, Vol. 2 (Rome, FAO 1975).

21/ The year 1966 is given for Kenya because small farms were included in data collected at that time; objective methods have been used in the collection of annual data on large farms since 1954. The year the method was started in Uganda is not indicated in the FAO report.

extension work. Whereas some countries reportedly suffered from lack of agricultural data (due to the absence of field organizations, as in Liberia and Zambia), others had more than one series for the same commodity as data gathering was performed by several agencies (planning ministry, agriculture ministry, marketing boards, and private companies, as in Tanzania).

3) Seven of the reported countries had not carried out any agricultural census, although four of these had plans to undertake the activity in the 1970s. Another seven countries had conducted only one census of agriculture, five of them in the 1960s and two during the early 1970s. The rest of the countries already had two or more agricultural censuses; most of these activities were taken as part of the FAO-assisted decennial censuses while others, like Kenya and Nigeria, have also been conducting annual censuses.

Other than Kenya, which appears to have employed objective means of gathering data on large farms since the 1950s, much of the development of this methodology in Sub-Saharan Africa took place on a limited scale or test basis during the 1960s. Because it takes time before the objective method becomes operational on a national scale, partial changes in the country estimates must have occurred in those countries that implemented the technique. It can be expected that in this step of statistical improvement, the comparability of data over time is reduced and would remain so until the process is complete and an adjustment of the whole series is made. But concern for data reliability should be centered on those countries that employ subjective means of estimation. These methods generally lack standard procedures and are largely biased when carried out jointly with extension work. And for countries that have not carried out any agricultural census, benchmarks are not even available for the annual estimates of the output of agricultural commodities.

Comparisons With Other Data Series

The use of FAO data on production, consumption, and trade of all the commodities analyzed in this study provides the advantage of greater consistency in the assembled information than if each set were drawn from different sources. Another possible single source of statistics that could have been used for this analysis is the international data system operated by the U.S. Department of Agriculture (USDA). However, the coverage of the USDA data system is not as comprehensive as that of the FAO, as shown in a 1980 IFPRI study which compared data from the two organizations.22/ Although the study made no attempt to evaluate the quality of statistics assembled by FAO and USDA, it called attention to the differences that exist between production and trade data on the major staple food crops from the two systems.

22/ Leonardo Paulino and Shen Sheng Tseng, A Comparative Study of FAO and USDA Data on Production, Area, and Trade of Major Food Staples, Research Report 19 (Washington, D.C.: International Food Policy Research Institute, 1980).

The 1980 study indicated that a large part of the divergences between FAO and USDA figures, which are unexplained by differences of country numbers and reference periods between FAO and USDA figures, occurs for developing countries and can possibly be attributed to the modifications of official statistics by these organizations based on perceived weaknesses of national data systems. For Africa as a whole, differences between the FAO and USDA estimates on cereal production, for example, for the countries reported in common by the two systems reached 14 percent for wheat in 1975, 21 percent for maize in 1970, and as high as 45 percent for millet in 1965. The observed differences between trade data are even wider than those shown by production figures. Taking the divergences between FAO and USDA data as signals of uncertainty of the basic information on agriculture, the study suggests the need for developing countries to improve agricultural data collection systems for supporting their development planning and policymaking activities.

Observations Regarding the Sub-Saharan Data on Livestock Products

Some examples of the problems that were encountered in analyzing the data on the production and consumption of livestock and poultry products include:

1) Data on dairy products are not available for certain countries of Sub-Saharan Africa and the data coverage for some of the reporting countries are incomplete; these would result in underestimates, particularly as regards farm production.

2) Some countries have no statistics on egg production, and estimates were derived by the FAO from related data such as chicken or total poultry numbers and on the basis of assumed rates of egg laying.

3) The level of wastage in the utilization of eggs in a number of Sub-Saharan countries leads to doubts about the reported estimates.

4) The annual production and trade figures on livestock and poultry products for the period 1961-65 often show little resemblance to those of 1966 and later years.

5) Some of the reported estimates were likely obtained by regressing production against time. In the case of the Ethiopian sheep milk data, the coefficient of determination (R^2) of the fitted logarithmic trend equation to the production estimates for the 1970-77 period is unity.

APPENDIX 4: SPECIFIC SOURCES OF DATA USED

Food and Agriculture Organization of the United Nations. "Production Yearbook Tape, 1978." Rome: 1979.

_____. "Production Yearbook Tape, 1975." Rome, 1976.

_____. "Global Agriculture Programming System Supply Utilization Accounts Tape." Rome, 1980.

_____. Provisional Food Balance Sheets, 1972-74 Average. Rome: FAO, 1977.

International Bank for Reconstruction and Development. 1979 World Bank Atlas. Washington, D.C.: IBRD, 1979.

_____. "Gross National Product, 1960-78: Time-Series Data by Country, at Current and Constant Market Prices." Washington, D.C.: IBRD, 1979.

United Nations, Department of International Economic and Social Affairs. World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment. New York: UN, 1979.

PRODUCTION POTENTIALS IN AFRICA: ISSUES AND STRATEGIES

by Peter A. Oram

THE CAUSES OF THE DETERIORATING FOOD SITUATION

Africa has not traditionally been a major food importer. Sub-Saharan Africa had a food self-sufficiency ratio of 98 percent in the early 1960s, compared to about 88 percent today.1/

There appear to be three main contributory factors to the deteriorating food situation: population growth, unstable climate, and a generally poor production performance. Since the mid-1970s Africa has had the most rapid expansion of population and urbanization of any developing region, and the overall growth-rate of population through the 1980s is expected to surpass that of any region in the world. Such a population growth pattern both raises and changes the nature of demand for food, while mounting pressure of people on a fixed land resource makes it more difficult to meet demand by land-extensive methods.

An important issue is whether food production growth is lagging because of climatic deterioration. Most climatologists attributed the 1969-73 Sahelian emergency to a temporary cycle of unfavorable weather such as had occurred many times in the past, exacerbated by a northward expansion of cropping and grazing into drought-prone areas. This expansion was the consequence of population pressures and was made possible by years of good rainfall. The recent cycle of poor harvests has affected many more Sub-Saharan countries, but to impute this wholly to climatic change overlooks the diversity of climate in Africa (for example, from North to South in Nigeria and the great subregional variations due to altitude in East Africa), and implies a secular shift in world weather patterns, concerning which there is no expert consensus. Nor is there any consistent distribution of declining yields over time among predominantly wet or dry countries of Africa which might support such a hypothesis (Table 1).

Although poor yields cannot clearly be attributed to deteriorating weather, this does not mean that climate has no influence on production. Because 98 percent of cropped area in Africa south of the Sahara is rainfed (only 2.3 million hectares was irri-

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1/ According to the Regional Food Plan for Africa of the Food and Agriculture Organization of the United Nations, the self-sufficiency ratio of the region fell from 98 percent to 90 percent between 1962-64 and 1972-74, and could decrease further to 81 percent if urgent remedial measures are not applied.

Table 1--Growth rates of area, yield, and production of foodcrops by geographical region of Africa, 1961-77, and change in cereal yields, 1969/71-1977/79

Country	Area	Yield	Production	Cereal Yields: 1977/79 as Percentage of 1969/71
Sahel				
Chad	-1.20	-0.67	-1.86	77
Gambia	2.08	-0.24	1.33	81
Mali	-1.12	1.73	0.59	81
Mauritania	-4.33	-0.71	-5.02	104
Niger	2.45	-2.62	-0.24	100
Senegal	0.45	-0.37	0.08	112
Upper Volta	0.89	0.60	1.50	111
West Africa				
Benin	-1.39	2.27	0.85	136
Cameroon	2.70	-0.24	2.45	99
Ghana	3.15	-1.91	1.18	97
Guinea	2.40	-1.00	1.37	98
Guinea Bissau	-2.72	-1.01	-3.70	124
Ivory Coast	3.33	0.77	4.12	84
Liberia	2.57	0.89	3.48	108
Nigeria	1.26	-0.72	0.53	107
Sierra Leone	1.51	1.57	3.10	71
Togo	-2.93	2.58	-0.42	105
Central Africa				
Angola	1.05	-0.13	0.92	69
Central African Republic	3.01	-0.58	2.41	69
Congo	-0.07	1.38	1.31	105
Zaire	2.94	-0.22	2.71	97
Eastern Africa				
Burundi	1.46	0.54	2.01	101
Ethiopia	-0.17	1.40	1.22	107
Kenya	2.37	2.54	4.97	95
Rwanda	3.36	3.58	7.06	103
Somalia	1.16	-0.42	0.74	76
Tanzania	2.73	-0.53	2.19	101
Uganda	2.39	0.39	2.79	99

gated in 1978 out of a total arable area of 142 million hectares) and 51 percent of the continental area is classed as semiarid land, climatic risk is a powerful deterrent to innovation in an agriculture where the first concern is to ensure food security for the family, particularly if yield-increasing practices involve the adoption of purchased inputs such as fuel and fertilizers. Yield variability appears to be the major factor influencing year-to-year food supply and marketable surpluses in Africa, constraining producers' ability to respond to price or other incentives.

Whether variability is increasing deserves more detailed analysis, but it is not a new phenomenon. Throughout history climatic uncertainty exercised a pervasive influence on farming in tropical Africa, and African farmers and herdsmen became skilled at devising means of combating it. Shifting cultivation, bush fallow, mixed culture in crop production systems; nomadism and transhumance in livestock systems; and communal ownership of crop and pasture land are all aimed in large measure at mitigating unpredictable climatic hazards. In addition to providing risk insurance, such practices allow periodic regeneration of natural fertility, regrowth of natural vegetation, and (where the soil is not left bare) some measure of soil conservation. However, they are land-extensive, and once the length of the period of fallow falls below a critical level, the system breaks down and soil fertility becomes exhausted. Yields then decline in the absence of chemical fertilizer or animal manure, neither of which is widely applied in Africa today. The failure of traditional agricultural systems to maintain soil fertility in the face of rising population pressure; the low productivity of land and labor in a land-extensive, nonmechanized agriculture where the area cropped each year is limited by what a family can cultivate with handhoes; and the inadequacy of yield-increasing technologies, due to lack of research for some key foodcrops (millet, sorghum, cowpeas, yams, and cassava) and ruminant livestock, are probably the direct reasons for the increasingly serious failure of food production in Africa.

These are aggravated by poor technology delivery systems (extension, seed production, and fertilizer distribution services), by a lack of incentives, especially an inadequate rural infrastructure that frustrates both input distribution and price incentive policies, by a shortage of skills for development, including widespread farmer illiteracy, and by accelerating migration from the land by the younger and physically stronger males.[2/] The weight of these contributory factors varies between, and even within, countries but they are sufficiently widespread to be common denominators of

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2/ There is a high agricultural return to primary education according to World Bank studies. However, compulsory schooling siphons off potential field workers. The labor situation in Africa presents other paradoxes. Although there are persistent reports of labor scarcity and high migration rates, United Nations data shows the economically active population in agriculture rising by 1.5 million between 1970 and 1978. In only one Sub-Saharan country (Gabon) has there been a decline in absolute terms.

failure.3/ Indeed, in some countries in Africa and elsewhere, success in increasing food production despite difficult climates and high population growth seems to stem largely from sound policies directed to overcoming such structural problems.

A factor which needs to be taken into account in seeking prescriptions for improving production is the change in dietary habits brought about by the combined effects of urbanization, income growth, and the failure of production of traditional staple food crops to keep pace with demand. Most important is the rapid increase in wheat consumption in tropical Africa, which escalates imports, since wheat production is not technically feasible in the low-altitude tropics. Rice consumption is also expanding faster than production, with a preference for rice of a quality that is produced only in inadequate amounts in Africa. This is another cause of rising grain imports. There are also indications that demand for feedgrains is increasing, and since per capita food production already lags behind population growth, this must either lead to increasing imports or deteriorating nutrition for the poor.

These trends need to be considered when planning research, incentive, and storage policies to try to match or contain the continent-wide increases in wheat and rice consumption and to avoid unmarketable surpluses of other foods, as has happened in recent years in parts of Eastern Africa.

DEVELOPING FOOD PRODUCTION POTENTIAL

Although the present food situation is difficult and may deteriorate in the short term, there is no more cause for despair concerning Africa than there was in Asia 20 years ago. One estimate states that food production in Africa could be expanded tenfold,4/ and whereas this depends on some questionable assumptions, recent studies by IFPRI and the Food and Agriculture Organization of the United Nations (FAO) show reasonable grounds for hope that production can be accelerated.5/ How can this potential be realized?

3/ For example, there are differences in hybrid maize adoption due to rainfall, farm size, and level of education in different agroclimatic zones of Kenya. John Gerhart, The Diffusion of Hybrid Maize in Western Kenya (Mexico City: CIMMYT, 1975).

4/ This model, known as MOIRA, attempts to estimate the maximum potential food production in the world, assuming no pest or disease constraints. It is based on work by a team from the Netherlands Agricultural University at Wageningen.

5/ Peter Oram, Juan Zapata, George Alibaruho, and Shyamal Roy, Investment and Input Requirements for Accelerating Food Production in Low-Income Countries by 1990, Research Report 10 (Washington, D.C.: International Food Policy Research Institute, 1979); and Food and Agriculture Organization of the United Nations, Agriculture Towards 2000, C79/24 (Rome: FAO, 1979).

IFPRI's analysis of the sources of growth in Africa shows clearly how heavily most African countries have depended on area expansion in the past, and although research on food production problems relevant to Africa has been substantially strengthened in recent years at the international and national levels, it has not yet led to a significant shift of the production function toward higher yields. How long this will take is uncertain; nor is it certain how far the apparent failure of farmers to adopt existing improved technology successfully is due to its unsuitability to their perceived needs, or to weaknesses in extension and related services, or both.

Two issues arise here: first, can extending the cultivated area continue to provide most of Africa's food needs, or is it necessary to move quickly from a resource-based to a science-based agriculture with all that this may imply for inputs and services? Secondly, if such a shift is imperative, how much can area growth contribute to production while the necessary research and institutional foundations for a different base of growth are being laid?

EXPANDING CULTIVATED AREA IN AFRICA

The issue of how much cultivable land remains in reserve in Africa is clouded by statistical uncertainties. Estimates of the total potentially cultivable area vary from 304 million to 733 million hectares (Table 2). Whereas the total area now farmed (cropped and fallow) is about 250 million hectares, which is well below the lowest estimate of the potentially cultivable land, Africa appears favorably placed for bringing new land under crops. Yet between 1961 and 1976 the overall annual growth rate of arable area, in the face of an increasingly tight food situation in many African countries, was only 1.3 percent, and it has fallen to under 1.0 percent in the 1970s. Moreover, part of the contribution to the growth of foodcrop area in the drier regions came from the substitution of food crops for export crops, considering that the area under cotton, groundnuts, and sisal fell by 1.75 million hectares between 1969-71 and 1979. Both IFPRI and FAO postulate a future growth rate in food crop area of 2 percent as well as a faster growth of yields if increasing food deficits are to be avoided. Comparing these estimates with past performance suggests that Africa cannot avoid increasing dependence on science, and that African countries face difficult physical and socioeconomic obstacles in expanding area more rapidly. A special effort will be required to surmount these if more ambitious targets are to be realized.

Physical constraints in the drier areas are mainly due to highly variable and unreliable precipitation, with large year-to-year differences in total rainfall and its distribution and month-to-month differences within seasons. The rainfall is often of great intensity. Thus, there is more water at certain times than is needed or can be used effectively by plants, leading to high runoff and erosion losses, interspersed with periods of severe moisture stress.

Table 2--Estimates of potential for expanding cultivated area in the developing and industrialized countries, 1974

Developing and Industrialized Countries	Actual Arable Area	1974 Calculated Potential Arable Land					1974 Arable Area as a Proportion of Potential Arable Land				
		FAO (IWP)	Club of Rome	Alan Strout	U.S.A.	Wageningen	FAO (IWP)	Club of Rome	Alan Strout	U.S.A.	Wageningen
	(million hectares)						(percent)				
Latin America	127	570	429	586	680	692	22	30	22	19	18
Sub-Saharan Africa	186	304	423	470	733	658	61	44	40	25	28
North Africa/Middle East	80	80	86	80	n.a.	122	100	93	100	n.a.	66
Asia (Market Economy)	274	296	278	330	627	360	93	99	83	44	76
Asia (Centrally Planned)	132	n.a.	122	201	. . .	388	n.a.	92	66	. . .	34
Developing Countries	799	1,250	1,338	1,667	2,040	2,220	64	60	48	39	36
North America	235	. . .	392	347	466	533	. . .	60	68	50	44
Oceania	46	. . .	150	70	154	275	. . .	31	66	30	17
Europe (Market Economy)	116	. . .	163	137	174	164	. . .	71	85	67	71
Europe (Centrally Planned)	278	. . .	382	280	356	491	. . .	73	99	78	57
Industrialized Countries	673	n.a.	1,087	834	1,150	1,463	n.a.	62	81	59	46
World	1,472	n.a.	2,425	2,501	3,190	3,683	n.a.	61	59	46	40

Sources: 1974 Arable Area: Food and Agriculture Organization of the United Nations, *Production Yearbook, 1974* (Rome: FAO, 1973), Table 1. Permanent crops are included, and the data are mostly from 1970 or later.

FAO: Food and Agriculture Organization of the United Nations, *Provisional Indicative World Plan for Agricultural Development: A Synthesis and Analysis of Factors Relative to World, Regional, and National Agricultural Development* (Rome: FAO, 1970), Chapter 2, Tables 6-8. The data for Asia are expanded to include countries omitted from the Indicative World Plan.

Club of Rome: Calculations by Mesarovic and Pestel, *Mankind at the Turning Point: The Second Report to the Club of Rome* (New York: E. P. Dutton and Co./Reader's Digest Press, 1974), Table III, A-2.

Alan Strout: Calculations from Alan M. Strout, "World Agricultural Potential: Evidence from the Recent Past," 1975. (Mimeographed.)

U.S.A.: U.S. President's Science Advisory Committee, *The World Food Problem* (Washington, D.C.: U.S. Government Printing Office, 1967), v. 2, Tables 7-6 to 7-9.

Wageningen: P. Buring, H. D. J. van Heemst, and G. J. Staring, *Computation of the Absolute Maximum Food Production of the World* (Wageningen, The Netherlands: Agricultural University, Wageningen, Department of Tropical Soil Science, 1975).

Because these five sources have different base-years and their estimates of "actual" arable area in the base-year vary, they are all compared here to the same base-year taken from the Food and Agriculture Organization of the United Nations, *Production Yearbook, 1974*.

Desertification is a serious threat at the drier margins--Africa contains the highest proportion of land at risk of any continent, totalling over a billion hectares--a third of its entire area (Table 3). This implies greatly improved resource management to avoid further loss of land from productive use. Sub-Saharan countries with an unusually high proportion of arid and semiarid land (60 percent or more) include Botswana, Ethiopia, Kenya, Namibia, Somalia, Sudan, Zimbabwe, Chad, Gambia, Mali, Mauritania, Niger, Senegal, and Upper Volta. All North African countries are semiarid.

At the other end of the rainfall spectrum the tropical rain forest zone contains large areas of underpopulated land that might be reclaimed for crop production (only 1.4 percent of Zaire is cropped, for example), but the costs of mechanical clearing and destumping of forests are high. Soils are very difficult to manage when cleared, because of their inherent acidity and low-base status, and because of the hazards of high erosion and poor drainage. According to FAO, 45 percent of land resource potential in Africa is affected by difficult soils, and 7 percent by flooding (Table 4). Large-scale clearance of tropical forests may have unpredictable effects on the microclimate, especially on rainfall.[6/] Cloudiness (low solar radiation) and human, animal, and plant diseases are also serious constraints to arable farming in extremely wet areas. This is clear from the recent FAO agroclimatic map of Africa, which shows low suitability for nearly all food crops where the growing season exceeds 270 days. The optimum vocation of this zone is for trees--whether natural forests, managed forests, cash crops such as rubber, oil palm, or cocoa, or agroforestry.

The main development potential therefore lies in the subhumid to semiarid (120-270 day growing period) savannah areas of the northern Guinean, Sudanian, and Sudano-Sahelian zones. Clearing costs are lower in these regions and soils are mixed but include large areas of high-base status soils (alfisols and vertisols) where physical rather than chemical problems are the main constraints. As shown in Table 5, the largest areas classified by FAO as "very suitable" or "suitable" for the main food staples--millet, sorghum, peanuts, maize, cowpeas, and cassava--lie within this belt. It stretches roughly from 5 to 15 degrees north and south of the equator (beginning farther north in West Africa), but bridges the equator at high altitudes in East Africa, an area suited to temperate crops such as wheat and potatoes.

Although parts of this area are already developed and heavily settled, there are constraints in some otherwise favorable areas that have inhibited permanent settlement. Two important fly-vectored diseases occur: onchocerciasis (river blindness), which is endemic in some of the best-watered river valleys with good soils; and trypanosomiasis (sleeping sickness). The latter causes debilitating human disease and prohibits the keeping of most breeds of cattle and other

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6/ FAO states that 37 million hectares of forest in Africa were destroyed between 1975 and 1980. According to one estimate 50 percent of the total Amazonian rainfall is from evapo-transpiration from the rain forest.

Table 3--Area already affected and likely to be affected by desertification, by continent

Continent	Extreme Desert	Degree of Desertification Hazards[a/]			Total	Share of Total Land Area in Region
		Very High	High	Moderate		
	(thousand square kilometers)					(percent)
Africa	6,178 (37.3)	1,725 (10.5)	4,911 (29.7)	3,741 (22.5)	16,555	55
North and Central America	33 (0.8)	163 (3.7)	1,313 (30.1)	2,854 (65.4)	4,363	19
South America	200 (5.7)	414 (12.0)	1,261 (36.2)	1,602 (46.1)	3,478	20
Asia	1,581 (10.4)	790 (5.2)	7,253 (47.6)	5,608 (36.8)	15,232	34
Australia	... ...	308 (5.3)	1,722 (30.0)	3,712 (64.7)	5,742	75
Europe	... ...	49 (20.2)	... ...	190 (79.8)	238	2
Total	7,992 (17.5)	3,449 (7.6)	16,460 (36.1)	17,707 (38.8)	45,608	35

Source: FAO, UNESCO, WMO, "Explanatory Note and Desertification Map of the World," UN Conference on Desertification, (A/CONF 74/2), Nairobi, 1977.

Note: The percentage of each class in the total land affected by desertification in the region is shown in parentheses.

Table 4--Land resource potential for developing regions

Region	Total Potential Arable Land[a]	Potential in Specific Land and Water Classes[b]: Good Rainfall		Low Rainfall		Problem Areas		Naturally Flooded Areas		Desert[c]		Irrigated[d]
	(million hectares)	(million hectares)	(percent)	(million hectares)	(percent)	(million hectares)	(percent)	(million hectares)	(percent)	(million hectares)	(percent)	(million hectares)
Africa	638.1	243.9	38.2	61.3	9.6	288.4	45.2	43.5	6.8	1.0	0.2	114.9
Latin America	653.2	203.6	31.2	29.8	4.6	241.0	36.9	172.8	26.5	6.0	0.8	54.8
Middle East	130.1	50.8	39.0	45.5	35.0	15.5	11.9	10.3	7.9	8.0	6.2	42.6
Asia and Far East	353.6	81.7	23.1	81.8	23.1	101.3	28.6	73.8	20.9	15.0	4.3	181.1
Developing Countries	1,774.0	579.9	32.7	218.5	12.3	646.3	36.4	300.3	16.9	29.0	1.7	393.5
Needy Countries	688.7	207.8	30.2	143.4	20.8	246.7	35.8	74.8	10.9	16.0	2.3	265.3

Source: Food and Agriculture Organization of the United Nations, Agriculture: Towards 2000 c79/24 (Rome: FAO, 1979).

a/ The total excludes irrigated area except for desert land.

b/ The land and water classes are defined as follows:

Good rainfed land: Land with rainfall providing for 120-270 growing days, soil quality very suitable or suitable.

Low rainfed land: Rainfall providing for 75-120 growing days, soil quality very suitable, suitable, and marginally suitable.

Problem areas: Rainfall provides more than a 270-day growing season, soils of all usable qualities are in this zone, plus that part of the 120-270-day growing zone where soil rating is only marginally suitable.

Naturally flooded land: Consists of lowland nonirrigated paddy-fields and lands where water stands for part of the year.

Irrigated land: Consists of fully irrigated land equipped with irrigation and suitable drainage and not suffering from water shortages and Partially irrigated land--equipped for irrigation but lacking drainage or reliable water supplies, or where the quality of irrigation is low and reliability of distribution is poor.

c/ Desert lands under irrigation.

d/ Irrigated land includes both partially and fully equipped areas and is excluded from the total to avoid double counting.

Table 5--Food crop suitability by major agroclimatic division: Africa and West Asia

Zone	Total Area in Africa	Distribution	Area Considered Very Suitable, Suitable, or Marginally Suitable for Main Annual Foodcrops										Total Area in West Asia	Distribution
			Millet	Sorghum	Maize	Wheat	Rice	Soya	Phaseolus	Sweet Potato	Cassava	White Potato		
	(1,000 hectares)	(percent)	(1,000 hectares)											(percent)
Warm Tropical Lowlands	2,029,975	57.4	373,056	388,713	432,835	...	280,131	490,966	424,541	421,907	377,315	...	130,187	19.2
Cold Tropical Highlands	96,604	3.2	...	15,841	15,938	15,185	...	...	23,415	...	...	19,749	16,665	3.4
Cold Tropical Mountains	2,903	0.1	...	...	...	...	...	...	...	...	...	...	...	...
Warm Subtropical (s)	291,894	9.7	11,345	7,809	7,770	...	1,779	7,271	7,121	...	2,556	...	...	...
Cool Subtropical (s)	39.900	1.3	...	3,126	3,171	8,565	...	...	6,660	9,175	...	8,175	...	...
Cold Subtropical (s)	193	...	...	...	...	...	...	...	...	...	...	...	...	...
Cool Subtropical (w)	543,196	18.0	...	...	...	12,272	...	...	...	...	...	...	413,742	61.0
Cold Subtropics (w)	6,663	0.2	...	...	...	...	...	...	...	...	...	...	100,165	14.8
Cool Temperate	...	...	...	...	...	...	...	...	...	...	...	...	3,756	0.5
Warm Temperate	...	...	...	...	...	...	...	...	...	...	...	...	13,502	2.1
Totals(individualcrops nonadditive)	3,011,330	100.0	384,401 16,325	415,489 13,939	459,714 19,654	36,022 13,627	281,910 4,581	498,237 209	461,737 2,007	430,082 843	379,871 6,067	27,924 485	678,017 17,737	100.0 ...
Percent of total area crop classed as very suitable or suitable	...	...	63.5	66.3	63.2	75.3	47.3	54.0	61.6	70.4	62.7	49.4	...	...
Area suitable for crop as percent of total land area b/	...	...	12.7	13.8	15.3	1.3	9.4	16.5	15.3	14.3	12.6	0.9	...	...
Actual area sown with these crops 1976 c/	73,042	...	16,325	13,939	19,654	8,932	4,581	209	2,007	843	6,067	485	19,775	...

Source: Food and Agriculture Organization of the United Nations, Report on the Agro-Ecological Zones Project, World Soil Resources Report No. 48, 1 and 2 (Rome: FAO, 1978).

a/ Only wheat is listed for West Asia, as this represents over 75 percent of sown area of the crops listed.

b/ The area potentially suited to the production of the crops listed is calculated on the basis of climate and soil factors for that crop individually. These areas cannot be added and there is a good deal of overlapping, particularly in the suitable and most suitable classes.

c/ The areas shown as suitable represent potential rather than actual land use. (See area sown with those crops in Africa or West Asia, 1976).

ruminants. The area affected by the tsetse fly is estimated by FAO in its "Regional Food Plan for Africa" to cover no less than 10 million square kilometers.7/ Such areas often lack development infrastructure. But they are also less degraded by overgrazing and overcultivation. In Nigeria they include a large area of relatively good soils in the west and center, rated by FAO as having high potential under adequate soil management. It is probably for these reasons that the FAO Agriculture Towards 2000 study disagrees with the commonly held view that lands in reserve are necessarily less productive (given proper use of current knowledge) than lands already cultivated.

This does not necessarily mean that planned development of new land would be cheap. Bush clearance is essential for disease eradication and settled farming, and estimates of reclamation costs (excluding infrastructure and settlement) range from $300-$4,500 per hectare in 1975 dollars, with most of Africa lying in the $1,500-$4,500 category. Settlement costs in government projects range from $400-$5,000 per hectare, depending on infrastructure, with a mean for rainfed areas of around $650 per hectare.8/ In contrast, the cost of spontaneous settlement has been estimated at about $50 per hectare.9/ An important issue is therefore whether to provide the infrastructure and manage the settlement in a planned framework (including possibly land reform or restrictions on private land use); or to encourage, or even subsidize, spontaneous settlement, which has been the main contributor to area expansion in the past. Proponents of control argue that this helps prevent environmental degradation, prevents disease reinfestation of cleared land, promotes sound management and the use of improved technology, and reduces fragmentation of holdings and the dangers of conflict and competition for land.

7/ This is an even larger area than the estimate of 7 million square kilometers quoted in Item 9 of the 1974 United Nations World Conference report prepared by FAO, November 1974. The costs of eradicating tsetse and settling cleared land in the savannah area of 5 million square kilometers are estimated at between $2 and $3 billion. However, there are many uncertainties in the estimates of the areas affected by onchocerciasis and trypanosomiasis, in the costs and best methods of controlling the diseases or their vectors, and concerning the environmental effects of large-scale chemical treatment (Oram et al., Investment Requirements).

8/ For more detailed discussion of the variable costs of land development and settlements, see Buringh et al., Land and Water Development in the Third World, Publication No. 27 (Wageningen, The Netherlands: International Institute for Land Reclamation and Improvement, 1980); Oram et al., Investment Requirements; and the 1979 World Bank Sector Policy Paper on settlement.

9/ See United Nations World Conference, "The World Food Problem: Proposals for National and International Action" (E/CONF.65/4) World Food Conference, Rome, November 5-16, 1974.

In practice controlled settlement has not been very successful in achieving either higher productivity or social equity. It is also expensive in skills--probably an even scarcer resource than money in Africa. On the other hand, there is much evidence that weak infrastructure is a major contributory factor to low productivity in Africa, both by restricting access of output to markets and by hampering input distribution and advisory services in promoting technological change.

The improvement of communications appears particularly crucial to successful land expansion: 14 African countries have no direct access to the sea, and 10 have no line of rail (Table 6). There is an estimated total of 881,000 kilometers of roads in 36 countries of Sub-Saharan Africa for which information is available, but only 11.4 percent of these are paved. In its study of investment requirements for accelerating food production in low-income countries, IFPRI worked to a standard estimated 1975 cost of $15,000 per kilometer of all-weather, nontarmac road, and a norm of one kilometer of feeder road per 300 arable hectares. On this basis the cost of new road development related to land area expansion alone would be $2.25 billion in the countries studied by IFPRI. To this probably should be added costs of upgrading many existing roads to all-weather status.10/

Given the likely future costs of truck fuel, it may be prudent to seek alternatives to road transport over long distances. Extending rail networks, river transport, even STOL aircraft to main markets from rural nuclei such as the Agricultural Service Centers being established in Nigeria might be preferable to building lengthy new trunk roads. These other means of transport could be served by short feeder roads usable by four-wheel drive vehicles.

Based on an FAO assumption that 40 percent of future settlement will be planned, compared to 25 percent in the past, and on a cost of $650 per hectare for planned and $50 per hectare for spontaneous settlement, IFPRI has estimated that development costs of the 20 million hectares of new rainfed arable land required to help accelerate food production in the 23 low-income countries of Africa by 1990 would be $5.8 billion at 1975 prices. To this must be added a major share of the additional expenditures required for rural roads and electification in those countries, $1.6 billion for attempted eradication of onchocerciasis and trypanosomiasis in much of West Africa, and a proportion of the additional capital costs of mechanization, animal draft power, and research and extension systems. The development cost per additional cultivated hectare, including land clearance, settlement, and the infrastructural costs which must be

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10/ Cost figures vary greatly for road construction. IFPRI's figures were based on 1978 World Bank experience and have been considered modest (Oram et al., Investment Requirements). On the other hand, cost of labor-intensive, all-weather rural access road construction in Kenya averaged only about $4,100 in 1977/78, compared to around $17,000 by conventional machine-intensive methods. (Dharam Ghai, Martin Godfrey, and Franklin Lists, Planning for Basic Needs in Kenya: Performance, Policies, and Prospects (Geneva: ILO, 1979).

Table 6--Road and rail networks in Sub-Saharan Africa, 1977

Region	Number of Countries	Total Road Network	Paved Roads	Percent of Total Network Paved	Railroad Network	Countries with a/ No Railway	Countries with a/ No Port	Kilometers of Total Road per Capita	Hectares Cropped Per Kilometer of Road	Hectares Cropped Per Kilometer of Paved Road
		(kilometers)	(kilometers)		(kilometers)					
Sahelian Africa	8	87,416	8,497	9.7	3,498	4	4	0.003	180	1,956
Humid West Africa	10	249,936	44,096	17.9	8,697	1	0	0.002	182	1,006
Central Africa	1 (Zaire)	168,979	2,654	1.6	4,859	...	...	0.006	37	2,345
Eastern Africa	8	143,464	16,265	11.3	13,295	3	3	0.001	263	2,348
Southern Africa	9	231,675	29,102	12.5	13,806	1	6	0.006	79	632

Source: Data provided by the U.S. Agency for International Development. In all, 10 African countries have no railway and 14 have no direct access to the sea.

considered essential to providing the base for a sound, settled modern food production sector, could be at least $1,000. Assuming simply the provision of minimum services to spontaneous settlers, the short-term cost per hectare might be no more than a fifth of this, but the long-term costs in forgone production and land degradation might be very high.

The issue is perhaps not so much whether planned settlement should be extended, but what level and type of support is essential to make new land development work, and what approaches to providing the essentials are most cost effective. In land clearance and road building, what compromise is feasible between capital and labor-intensive methods; in settlements, what structures does government have to build, and what can settlers build themselves with appropriate technical assistance?

In this connection, one further point must be stressed. Effective land use planning has been, and remains, seriously constrained by inadequate data on climate, soils, topography, hydrology, and reclamation costs. Many of the assumptions on which plans are made and returns calculated are therefore conjectural, and results often fall below expectations. Many African countries are now attempting to develop national food production strategies--often with external assistance from bilateral or international agencies. One of the most valuable aids such agencies could give would be to help countries collect and evaluate this essential data and to provide them with the equipment, training, and knowledge to continue to collect and refine it. FAO has been pioneering work in this field.

RAISING THE PRODUCTIVITY OF LAND AND LABOR

Although many opportunities remain for expanding cultivated land in some African countries in a way that will not provoke degradation or lead to conflict between present and future utility, its nature, fertility, accessibility, ownership, present use, and optimum management merit more careful study. Table 7 shows that most of the new cropped land will have to come from land already used for pasture or forests, and it is vital not to overlook the social and environmental costs of its transfer. For most Africans freedom to move between and even within national boundaries is limited, so that large-scale migration of people to virgin lands offers no immediate solution to overcrowding. FAO estimates that 46 percent of Africa's population will be living in lands under severe pressure by the year 2000.

For many African countries, therefore, the main challenge facing agriculture is how to raise productivity on land already in use. Irrigation and fertilizer can both act as proxies for additional land by raising yields and cropping intensities, but the proportions of irrigated area and fertilizer use in Africa are well below other developing regions (Table 8). Increasing prices of fuel and fertilizer are likely to have a sharper disincentive effect in areas where almost no inputs are used at present than where farmers are

Table 7--Land use in Africa, 1975

Region	Arable Area[a/]	Harvested Area	Food Harvested Area	Other Harvested Area	Permanent Pasture	Forest	Harvested Area as Share of Arable Area
	(million hectares)						(percent)
Northern Africa	38.6	25.6	23.2	2.4	85.0	100.2	66.3
Sahel	46.2	14.1	13.7	0.3	137.1	56.7	30.5
Western Africa	67.5	39.0	34.4	4.6	55.1	80.1	57.7
Central Africa	20.3	7.7	6.7	1.0	73.1	238.6	37.9
Eastern and Southern Africa	50.9	31.0	29.0	2.0	361.0	160.7	60.9
Regional Total	223.5	117.4	107.0	10.3	711.3	636.3	52.5

a/ Includes land under temporary crops, meadows, or pasture; land under market or kitchen gardens; land temporarily fallow or lying idle; and land under permanent crops.

Table 8--Population density, agricultural inputs, and growth rates in area in selected Asian, African, and Latin American countries

Region[a]	1975 Economically Active Agricultural Population per Square Kilometer Arable Land	1976 Arable and Pasture Hectares per Animal Unit	1975 Irrigated Area as Percent of Arable Land	1975 Fertilizer Kilograms per Hectare of Arable Land	1975 Tractors per 1,000 Hectares of Arable Land	1975 Cropping Intensity
				(Units NPK)		(percent)
Asia	104	0.9	24.8	22.5	2.6	96
North Africa/ Middle East	47	3.1	17.7	28.7	6.3	61
West Africa	37	6.5	0.4	1.4	0.2	54
East Africa	97	3.6	2.0	3.6	0.6	66
South America	24	2.6	8.2	32.9	7.3	68
50 Country Average	69	2.2	15.8	22.3	3.5	77

Source: Peter Oram, Juan Zapata, George Alibaruho, and Shyamal Roy, Investment and Input Requirements for Accelerating Food Production in Low-Income Countries by 1990, Research Report 10 (Washington, D.C.: International Food Policy Research Institute, 1979).

a/ Represents the average of data for 10 selected countries in each region.

familiar with the benefits from their use, especially where the climatic risks are high. Farming systems and technologies need to be devised that both increase the cost-efficiency of chemical and mechanical inputs, and maximize biological and other low-cost techniques, including the more effective participation of human and animal resources in increasing output.

Success will depend on an understanding of the agroclimatic and human factors behind the rationale of traditional farming practices in Africa as a basis for determining where change might be most effective, what can best be retained, what technologies are appropriate to local conditions and the resources of local people, and how the necessary inputs and services can best be channeled to them. It demands an interdisciplinary, systems-oriented approach to agricultural research and planning for rural development, based on information, analysis, and prediction, and not just on empiricism.

The four strategies that would seem to be most rewarding as a means of accelerating food production are:

1. Building the base for expanded irrigated agriculture;

2. Increasing the efficiency of seed/fertilizer technology in dryland cropping systems;

3. Managing rainfed systems to conserve soil moisture and fertility; and

4. Integrating range livestock and arable farming more closely.

A fifth area that also merits high priority but is not dealt with specifically in this paper is the improvement of techniques for low-cost grain storage and processing at the farm and village levels.

Water Resources and the Potential for Irrigation in Africa

Irrigation is the traditional, and theoretically the most secure, escape route from the risks and uncertainties of rainfed farming, and is a means of extending cultivation to areas too dry for normal agriculture. High solar radiation makes high yields and cropping intensities possible in such areas once there is good water control. Yet despite the enormous area of semiarid and arid land in Africa and the recurring drought-induced crises there, only 4 percent of world irrigated land is in Africa, compared to about 8 percent in Latin America, and over 65 percent in Asia (Table 9).

The area available for more irrigation in Africa as a whole is considerable; an estimated 36 million hectares, compared to under 8 million irrigated in 1978. However, recent IFPRI analysis of national plans in 23 Sub-Saharan countries suggests a relatively modest growth of new area there from about 1.6 million hectares in 1975 to only 2.5 million hectares by 1990, an overall average annual growth rate of 3.0 percent. The largest proportionate rate of expansion would be in West Africa and the Sahel, with growth rates of 6.1 percent and 4.0

Table 9--Regional distribution and importance of irrigation, 1977

Asia		Africa		America		Europe		Oceania		
Region	Area	Region	Area	Region	Area	Region	Area	Region	Area	World
(million hectares)		(million hectares)		(million hectares)		(million hectares)		(million hectares)		
Southeast and East	14.6	West	0.4[a]	South	6.5[a]	South	7.6[a]	Australia	1.5[a]	...
Japan	3.3	East Central	2.5[a]	Central	6.3[a]	West	1.7	Others	0.2	...
Peoples Republic of China	48.7	South	1.0[a]	North	17.7[a]	East	3.7	...	...	...
India and Pakistan	49.0[a]	North	3.8[a]	...	...	U.S.S.R.	16.0[a]	...	...	...
West Asia	13.1[a]	...	...	...	...	...	...	...	...	...
Total	128.7		7.8		30.5		29.0		1.7	197.7
Share of world total	65.0		4.0		15.0		15.0		1.0	100.0
Share of Developing countries' total	97.0		87.0		42.0		0		0	73.0
Percent of arable area irrigated	28.0		3.0		8.0		8.0		4.0	13.0

Source: Food and Agriculture Organization of the United Nations, FAO Production Yearbook 1978 (Rome: FAO, 1978).

a/ Largely in dry areas. Estimated total approximately 115 million hectares.

percent respectively, and in Nigeria with 8.3 percent. In East Africa, where the terrain is more dissected and river basin development opportunities appear poorer, the growth rate would be only 2.2 percent (Table 10). Not all of the area to be developed would be used for food, and the food area would be mainly devoted to rice. Capital costs for irrigation for food production are estimated to be $1.7 billion, of which the bulk ($1.5 billion) would be for costly new surface water development since the opportunities for low-cost rehabilitation of old systems in Africa are relatively small because the total area irrigated is so small. The increment to food production by 1990 from these developments, plus increased output from existing irrigated land, is estimated to be just over 1.7 million metric tons--only about 4.5 percent of the overall increment expected from the proposed investments in accelerating food production, most of which would come from rainfed land.

There are a number of reasons for slow progress in expanding the irrigated area. These include the high costs of surface irrigation, the uncertainties of the groundwater resource, the lack of a deep-rooted tradition of irrigation in most African countries, the severe scarcity of trained local irrigation and maintenance staff, the vast distances and poor communications, and the low population densities in many irrigable areas, due to their remoteness and to disease. In some of the river basins, including the Nile, Niger, Senegal, Lake Chad, and the lake countries of East Africa, intercountry water agreements may be necessary for developing the resources.

The shortage of trained staff is reflected in the lack of good basic data on water resources and in weak research programs on water use in most countries of the region. The need for specialized training is particularly urgent, since aid donors frequently cite lack of good data and poor planning as a reason for not putting money into irrigation projects.

Although there are some discrepancies between estimates of the area that can be developed in the next two decades, it is clear from all the figures quoted that major irrigation projects will not provide a solution to food problems in most African countries by 1990 and will probably not contribute a major share before the year 2000. This is because of their heavy demands on technical skills for planning and execution, their high capital costs ($3,000-$5,000 per hectare or more),[11] the severe foreign exchange burden for poor countries, and the need to organize and train farmers if the land is to be used effectively once water becomes available. All this implies a lengthy gestation period, and few surface projects in Africa have achieved internal rates of return exceeding 10 percent.

11/ IFPRI's analysis suggested an average cost (in 1975 dollars) of $3,800 per hectare for the Sahelian countries and $3,000 elsewhere in Africa (Oram et al., Investment Requirements). A later estimate showed that where water storage is needed, surface water development costs have risen to $7,000-$10,000 per hectare or more (Gilbert Levine, Peter Oram, and Juan A. Zapata, Water [New York: Rockefeller Foundation, 1980]).

Table 10--Current and projected equipped and cultivated area, cropping intensity, and growth rates in 23 low-income African countries, 1975 and 1990

Country	Equipped Area 1975	Equipped Area 1970-90 Increase	Equipped Area 1975-90 Growth Rate	Percent of Arable Land Irrigated 1974	Cropping Intensity Gross Irrigated Area 1975	Cropping Intensity Gross Irrigated Area 1990	Cropping Intensity 1975	Cropping Intensity 1990	Gross Irrigated Area 1964/74-1975/90 Growth Rates	
	(1,000 hectares)		(percent)		(1,000 hectares)				(percent)	
Sahel Group										
Chad	10	14	6.01	0.01	120	150	12	36	...	7.6
Gambia	32	20	3.29	4.29	100	100	32	52	n.a.	3.3
Mali	150	85	3.03	0.60	75	100	112	235	4.97	5.1
Mauritania	20	15	3.80	0.30	80	100	16	35	...	5.4
Niger	25	16	3.35	0.04	152	146	38	60	1.84	3.1
Senegal	140	54	2.20	5.40	100	100	140	194	4.56	2.2
Upper Volta	5	15	9.68	0.03	100	100	5	20	...	9.7
Total Sahel	382	219	3.10	...	...	...	355	632	...	4.0
West Africa										
Benin	9	13	6.14	0.20	122	118	11	26	10.02	5.9
Cameroon	10	10	4.73	0.10	100	100	10	20	4.59	4.7
Guinea	50	30	3.18	1.10	80	100	40	80	7.37	4.7
Nigeria	30	70	8.36	n.a.	120	120	36	120	3.14	8.3
Sierra Leone	10	10	4.73	0.10	100	100	10	20	8.68	4.7
Togo	10	10	4.73	0.10	100	100	10	20	...	4.7
Total West Africa	119	143	5.40	...	...	...	117	286	...	6.2
East Africa										
Ethiopia	80	50	3.29	0.04	90	100	72	130	1.73	4.0
Kenya	17	15	4.31	1.30	100	109	17	35	3.49	4.9
Tanzania	52	38	3.72	0.40	81	90	42	81	3.64	4.5
Uganda	20	30	6.30	0.20	70	100	14	50	11.18	8.8
Zaire	4	6	6.30	n.a.	100	120	4	12	n.a.	7.6
Burundi	4	4	4.73	0.50	100	113	4	9	2.64	5.5
Madagascar	900	200	1.35	11.90	100	100	900	1,100	1.18	5.3
Malawi	10	20	7.60	0.20	100	100	10	30	11.19	7.6
Rwanda	10	6	3.18	0.20	120	150	10	30	...	7.6
Somalia	41	14	1.98	15.00	100	100	41	55	-0.25	2.0
Total East Africa	1,138	383	2.00	...	...	...	1,114	1,532	...	2.2
Total Africa	1,639	745	2.60	...	...	...	1,586	2,450	...	3.0

Sources: This table is based primarily on the unpublished data from the Food and Agriculture Organization of the United Nations for the United Nations (FAO) Water Conference, "Water for Agriculture" (E/Con.70/11), January 1977. Some figures were obtained directly from participants at the Water Conference.

In addition, the following sources were used: Ethiopia, Valleys Agricultural Development Authority, "Likely Irrigated Agriculture of 2000 A.D.--Role and Activities of ICID and Its National Committees to Meet the Challenge," International Commission on Irrigation and Drainage, Special Session, "Likely Irrigated Agriculture of 2000 A.D. in the Democratic Republic of Sudan," International Commission on Irrigation and Drainage, Special Session, "Likely Irrigated Agriculture of 2000 A.D.," Tehran, 1977; Irrigation Development in Africa, South of the Sahara (Rome: FAO, 1974). The data for the Sahel Group are from Food and Agriculture Organization of the United Nations, Perspective Study on Agricultural Development in the Sahelian Countries (Rome: FAO, 1976).

Note: Where n.a. is used, the data are not available.

Given the need to provide greater stability to production and to minimize risk as an incentive to technological innovation, it is pertinent to seek less demanding or smaller scale methods of supplying additional water to crops, especially in the semiarid tropics. There are several possibilities, including tanks, low-lift pumping from rivers, ground water development, and improvement of existing traditional irrigation methods. Although none of these approaches is without snags, and the water control of some is inferior to soundly planned surface water projects, they all avoid the rigidities of large systems and are divisible investments suited to small farmers that lend themselves to step-by-step development. They permit rapid use of capital and the opportunity to revise and correct programs as experience and information are gained. A major obstacle, particularly with ground-water development, and with the improvement of traditional flood-based systems (which are extensive, for example, in Senegal, Madagascar, Zambia, Tanzania, and Nigeria), is lack of sound data on the nature and extent of the resource. Effective methods and tools are now available for determining where water resources are stored underground. Because of the great advantage of groundwater as a basis for irrigation and drinking water, African countries with substantial dry areas should give higher priority to the assessment of their potential and how to develop it.

A general conclusion from reviewing the situation in Africa is that even if irrigation can offer no complete solution to African food problems in the current century, the opportunities for its development in the longer term are not negligible and may well swing the balance from increasing malnutrition to increasing self-sufficiency in the drier regions. However, few countries are yet pursuing with vigor the measures necessary to build the base for this long-term development, which cannot be provided simply by irrigation consultants. As Idachaba has pointed out about Nigeria, research on water development, water use, and management is largely neglected, and expenditure on understanding the resource and managing it is rarely commensurate with the vast expenditures now planned for construction.[12/] Most African countries have little historical experience on which to base sound farmer organization--increasingly considered in the light of experience elsewhere to be the key to success. This is why it is so important to press ahead with small or divisible irrigation systems before launching major projects--even though the latter may offer economies of scale.

Many countries feel that they must give priority to developing rainfed agriculture in the short run. This choice is probably right, but the slow growth of area and yields of rainfed crops suggest that it would be wiser for planners to obtain a more comprehensive view of their water resources potential and to lay a sound foundation of skills for developing that potential as the basis of more intensive agriculture in the longer term.

12/ Francis S. Idachaba, Agricultural Research Policy in Nigeria, Research Report 17 (Washington, D.C.: International Food Policy Research Institute, 1980).

Increasing the Efficiency of Rainfed Seed/Fertilizer Technology

Biological improvement is fundamental to increasing crop production, especially where chemical inputs are expensive to transport or where response to fertilizer is limited by climate. Seed is a familiar input to all farmers, and for self-pollinated crops does not need annual renewal. For this reason the main focus of the International Agricultural Research Centers has been on plant breeding. They have marshalled a formidable array of genetic resources that has increased the availability to national systems of improved germ plasm for raising yield ceilings, increasing yield stability and stress tolerance, shortening maturity, improving pest and disease resistance, developing varieties for special conditions (deep flooding, acid soils, aluminum toxicity), and improving quality and nutritional status of the major food crops. In much of the middle rainfall belt of Africa, substitution of crops and varieties among food staples may also offer interesting possibilities for evading climatic hazards, increasing yields per unit of area or time, improving nutritional intakes, and reducing labor bottlenecks.

Among the issues which need to be considered in determining future biological research priorities for Africa are:

1. Should an attempt be made to meet changing consumer tastes through breeding? This implies a higher priority for irrigated rice and for the acclimatization of wheat for the drier tropics. Should some other form of crop substitution be encouraged (moving early-maturing maize further north); or should research priorities focus on improving traditional crops (such as sorghum and millet or upland rice) in their traditional growing regions?

2. Should sole cropping be substituted for haphazard mixed cropping, or could some more systematic interplanting techniques be developed, using appropriately designed varieties, that will provide the traditional risk insurance which mixed cropping offers, without the obstacles it presents to the introduction of some modern techniques, such as herbicide use? Setbacks have occurred both in Africa and in Latin America because the wrong varieties were chosen for areas where mixed cropping was important.

3. What breeding priority should be given to nitrogen-fixing legumes for grain or fodder? These do not play a major role in farming systems today, especially in the humid tropics, perhaps for lack of suitable adapted species, or perhaps because of low economic returns.

4. Should breeding policies be aimed at developing local specificity--which may be very necessary with variable soil types and where mixed cropping is widely practiced--or should wide adaptability be the objective? This seems to work well with some rainfed crops, such as wheat and barley, and with paddy rice, but not as well with other crops such as maize, upland rice, and grain legumes.

5. Which should be the primary objective--high yield potential or yield stability with better stress and pest tolerance--or can breeding accomplish both, as CIMMYT and IRRI have claimed?

6. What is the optimum plant model for different crops and ecological regions? Short-maturing determinate varieties may be appropriate where growing seasons are short, or with bimodal rainfall where two crops a year may be feasible. They may be less appropriate in areas where rains are of longer duration, but not long enough to assure two crops in a year. The value of straw and fodder should not be overlooked in emphasizing short stature. Storability may be more valuable than high yields with starchy crops. Special varietal characteristics may be needed where cereals and other crops (especially legumes) are grown in mixed systems.

7. What blend of disciplines is required in national and international research systems for developing improved biological technology? At present most institutions seem to be top-heavy on breeding and chemistry and weak on physiology and social sciences.

Breeding and testing of new crop varieties is time-consuming, but it appears that much could be done immediately to improve yields by simple practices, such as careful selection of varieties, the use of sound seed, timely planting, weed control (absolutely crucial in early crop growth stages) and rotational intercropping of legumes and cereals. These practices involve little cash expenditure, although shortage of human labor may be a bottleneck in the absence of mechanical or animal draft power. This may be one reason why farmers fail to adopt them. Changes in school hours and holidays might help overcome this.

Theoretically attractive approaches often founder on infrastructural or institutional inadequacies. For example, a widespread constraint to the faster adoption of improved genetic material is that most national seed services are still inadequate to provide farmers with good quality seed, especially of hybrid varieties. This may be one reason why Africa has such a small area under modern varieties. It is often argued that the stepwise approach suggested above will fail because simple advances do not show large enough benefits to attract farmers: however, this may simply be that researchers regard this type of experiment as beneath their dignity or that the extension services inadequately demonstrate the potential value of the advances.[13/] How to identify the bottlenecks and provide the incentives to the wider adoption of simple yield-improving practices is an important issue for increasing food production in the shorter term.

13/ Many reports stress the high returns to simple, well-timed cultural operations. This is amply confirmed by the author's field experience. National institutions should accord high priority to determining the reasons constraining their adoption by farmers.

Good infrastructure and organization, not just advice and exhortation, is particularly needed for efficient use of fertilizer and pesticides. These may be wasted if the right material is not available to farmers at the right time. Striking the right balance between the public sector and private enterprise is likely to be crucial to increasing land productivity, for although biological approaches can help to reduce excessive dependence on fertilizer and pesticides, there is nothing in current scientific knowledge which suggests that yield levels could be significantly improved, or even maintained, without their increased use. Moreover, fertilizer and pesticides, when properly combined with biological technology, can provide the quantum increase in productivity that gives the impetus to widespread adoption of improved practices. IFPRI's investment study envisages NPK fertilizer use on food crops increasing at an annual rate of 19 percent in Sub-Saharan Africa (and 22 percent in Nigeria) between 1975 and 1990. Total use would rise from 136,000 to 1.9 million tons in 1990 (at an estimated cost of approximately $1 billion) and per hectare levels from around 3 kilograms to nearly 23 kilograms (Table 11). Even the latter may seem a modest objective, but because high risk or high transportation costs may preclude the use of fertilizer in many areas, it probably implies the application of 80-100 kilograms of plant nutrients in the more favorable areas. To achieve these levels will require major national programs to demonstrate improved varieties and appropriate fertilizer formulations to farmers and to provide the related credit and input delivery systems. A "trickle-down" approach based on isolated projects is unlikely to provide the rapid growth needed in food supply.

An important issue in this respect is how to tailor the components of the input package to the local resource potential. Although the use of more concentrated fertilizer can reduce costs of transport, it may be wiser in some remote areas to emphasize seed improvement and low-volume inputs that are cheaper to transport, such as seed dressings, micronutrients, herbicides, or pesticides. These again, however, have to be selected to fit local needs and problems. This is an important reason for taking research down to the farm. A shotgun approach to input distribution does not ensure equity, but it can certainly lead to waste and unprofitability.

A difficult decision facing some African countries is whether to import chemical inputs or manufacture them locally. This applies especially to fertilizer since the total material costs foreseen by 1990 are about ten times higher than for pesticides, and the transportation costs are also much higher. Strategic as well as economic factors are involved. Without going into more detail, it does appear that there is a potential for developing domestic nitrogen industries in a few African countries with coal or natural gas resources (such as Nigeria), and for producing phosphate from rock deposits in several Sahelian countries. Intraregional trade in urea, superphosphate, and ammonium phosphate could thus be built up.

Managing Rainfed Systems to Conserve Soil Moisture and Fertility

If yields are to be increased in the drier areas, it will be necessary to find low-cost means of conserving soil moisture and

Table 11--Fertilizer use in low-income countries of Africa, 1975 and 1990

	Total Increment	Total 1990 Requirement	NPK Fertilizer Use on Foodcrops c/ 1975	NPK Fertilizer Use on Foodcrops c/ 1990	Growth Rates 1963-75	Growth Rates 1975-90	1975 Estimated NPK Fertilizer Use for Foodcrops a/	Additional NPK Fertilizer Requirement for Foodcrops 1990 b/: Irrigated Land New	Irrigated Land Improved	Irrigated Land Existing	Irrigated Land Total	Rainfed Land New	Rainfed Land Existing	Rainfed Land Total
			(kilograms per hectare)		(percent)						(1,000 metric tons)			
Africa														
Chad	23.20	24.2	1.3	14.9	39.0	23.7	1.0	1.82	0.50	0.48	2.80	7.20	13.20	20.40
Gambia	5.26	5.9	3.0	29.2	24.7	18.5	0.6	1.61	0.29	1.28	3.18	0.80	1.28	2.08
Mali	40.47	42.5	0.2	18.4	30.7	22.6	2.0	4.59	4.39	4.04	13.02	10.50	16.95	27.45
Mauritania	4.35	5.1	1.1	19.1	36.9	14.2	0.7	0.81	0.50	0.56	1.87	0.30	2.18	2.48
Niger	49.27	50.5	0.1	12.3	29.1	28.3	1.2	2.02	0.35	1.52	3.89	0.00	45.38	45.38
Senegal	36.36	62.4	18.2	27.1	12.2	6.0	26.0	2.94	0.95	5.04	8.93	8.60	18.83	27.43
Upper Volta	41.80	42.4	0.1	12.4	23.8	32.8	0.6	0.90	0.04	0.20	1.14	9.68	30.98	40.66
Sahel total	200.71	232.8	1.2	16.4	15.5	14.1	32.1	14.69	7.02	13.12	34.83	37.08	128.80	165.88
Benin	25.60	27.0	1.0	26.7	19.4	21.8	1.4	0.49	0.04	0.24	0.77	9.45	15.38	24.83
Cameroon	55.89	61.9	1.7	25.8	9.7	16.8	6.0	0.30	0.04	0.20	0.54	15.15	40.20	55.35
Guinea	30.42	32.0	0.5	17.6	-3.0	22.1	1.6	1.80	1.37	1.60	4.77	12.45	13.20	25.65
Nigeria	691.17	712.2	2.2	24.6	27.2	26.5	21.0	2.78	0.14	0.72	3.64	218.03	469.50	687.53
Sierra Leone	18.17	21.3	1.2	30.9	28.2	13.7	3.1	0.80	0.09	0.40	1.29	5.85	11.03	16.88
Togo	18.09	19.2	1.0	27.0	55.3	21.0	1.1	0.30	0.04	0.20	0.54	5.70	11.85	17.55
Guinean total	839.34	873.5	1.7	24.6	16.6	24.1	34.2	6.47	1.72	3.36	11.55	266.63	561.16	827.79
West Africa total	1,040.05	1,106.4	1.5	22.2	16.1	20.6	66.3	21.16	8.74	16.48	46.38	303.71	689.96	993.67
Burundi	23.83	24.2	0.8	26.8	20.6	31.5	0.4	0.24	0.06	0.08	0.38	6.65	16.80	23.45
Ethiopia	137.64	151.6	2.4	16.8	29.0	17.2	14.0	0.90	0.32	0.44	1.66	60.75	75.23	135.98
Kenya	75.74	102.9	10.6	29.2	10.5	6.9	27.2	0.79	0.18	0.24	1.21	16.65	57.88	74.53
Madagascar	83.20	87.7	2.1	44.3	8.0	21.9	4.5	16.08	8.24	36.00	60.32	10.95	11.93	22.88
Malawi	48.07	56.4	4.9	29.3	10.0	13.6	8.3	0.73	0.04	0.20	0.97	12.45	34.65	47.10
Rwanda	27.47	27.9	0.9	27.5	34.9	32.7	0.4	0.50	0.29	0.20	0.99	8.78	17.70	26.48
Somalia	10.70	13.7	3.5	23.4	13.1	10.7	3.0	2.10	0.56	1.64	4.30	1.75	4.65	6.40
Tanzania	81.24	90.6	4.9	16.0	19.4	16.3	9.4	1.13	0.46	0.92	2.51	31.48	47.25	78.73
Uganda	96.49	97.7	1.0	25.3	4.5	34.1	1.2	0.90	0.38	0.28	1.56	31.10	63.83	94.93
Zaire	137.66	139.0	0.7	27.8	17.6	36.5	1.3	0.24	0.06	0.08	0.38	65.35	71.93	137.28
East Africa total	693.04	762.7	3.2	23.2	13.2	17.3	69.7	23.61	10.59	40.08	74.28	245.91	372.85	618.76
Africa total	1,762.09	1,898.1	2.8	22.6	17.0	19.1	136.0	44.77	19.33	56.56	120.66	549.62	1,091.81	1,650.43

Source: Peter Oram, Juan Zapata, George Alibaruho, and Shyamal Roy, Investment and Input Requirements for Accelerating Food Production in Low-Income Countries by 1990, Research Report 10 (Washington, D.C.: International Food Policy Research Institute, 1979).

a/ This includes cereals, pulses, leguminous oilseeds, roots and tubers; and excludes sugar cane, fruits, and vegetables. Calculated from data in Food and Agriculture Organization of the United Nations, Annual Fertilizer Review 1976 (Rome: FAO, 1977).

b/ Calculated on the basis of area and production estimates for 1990.

c/ 1975 estimates based on proportion of arable and irrigated area recorded under annual food crops. 1990 estimates calculated from IFPRI's proposed 1990 production objectives and related fertilizer requirements.

maintaining soil fertility. The approaches traditionally followed mainly involve fallowing for periods from several years to a few months. But as population presses on resources, and the regenerative period shortens, the extent to which fallowing serves conservational purposes is doubtful (although bush fallow provides some grazing and fuelwood). Means are therefore being sought for increasing the intensity of land use in settled farming systems and maintaining soil fertility without fallow.

The FAO "Sahelian Zone Study" (1976) suggests that the fallow period in semiarid West Africa could be reduced from five years to no more than a year in the medium rainfall areas by the use of animal draft power or partial mechanization, fertilizers, and better crop husbandry practices. Ruthenberg, on the other hand, looking at the effects of the transition from shifting cultivation through semipermanent farming (with a declining area of fallow) to settled sedentary agriculture (without concomitant use of fertilizer) in semiarid East Africa, fears a "low-level equilibrium" of the type prevalent in some parts of India due to the depletion of soil fertility.14/ Certainly sedentarization without intensification should be avoided; but a policy of settled intensive crop production in more favorable soils, with marginal areas being sequestered for controlled grazing and forest uses, seems a more sensible planning objective than merely allowing the present creeping sedentarization to continue unchecked. Pereira states that because tribal traditions in Africa were founded on centuries of a scattered and rather stable population (compared to present growth rates), and because there was plenty of new land to use, there was no pressure to develop the elaborate terracing, soil conservation, and water control methods found on some other continents. Today there is still no general acceptance of the need to conserve the soil.15/

Though this may be true, his assertion that the fundamentals of good management are known is questionable for tropical Africa. There are several unsolved technical questions related to the optimum practices and equipment for soil and water conservation in semiarid areas. For example, "minimum tillage" (using herbicides) and mulching have shown great promise experimentally, compared to plowing, in reducing runoff and soil loss in the wetter tropics of Africa,16/ but have hardly been tested in the drier areas. These practices might greatly reduce the need for mechanical equipment. Some techniques

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14/ Recent studies of the effects of villagization in East Africa seem to support this view, which is also borne out by experience in some parts of the Sahel--for example, the Mossi Plateau in Upper Volta.

15/ H. C. Pereira, Land Use in Semiarid Southern Africa, trans. the Royal Society of London. (London: Royal Society, 1978), p. B.278.

16/ International Institute for Tropical Agriculture, Annual Report (Ibadan, Nigeria: IITA, various years). The minimum tillage technique also allows a larger area to be cropped each year.

such as bunding, ridging, and contour terracing have given highly variable results on different soil types. Suitable low-cost animal-drawn equipment and pumps have not been developed for some of the tillage and water-recycling practices being developed by International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in its small-scale watershed management work for India and the Sahel.

Based on ICRISAT's studies in India, Kampen concludes that although a variety of techniques have had a beneficial effect under some conditions, they have not yet provided the breakthrough in water conservation and management that is imperative for the development of agriculture in the low-income, semiarid tropics.17/ Moreover, there are problems in Africa that do not exist in India. Soils are more difficult, and the social and demographic situation is not comparable.

As a result of its higher population density, India has a tradition of intensive land and water use and a ready availability of agricultural labor; it also has a vast number of draft animals. Neither draft animals nor the plow are traditional in most of Sub-Saharan Africa, and late planting due to an inability to hoe dry soils by hand is a major cause of low yields in semiarid West Africa.18/

In some areas the use of draft animals is precluded by tsetse flies, but although their numbers are increasing in tsetse-free areas, government efforts to promote ox plowing have met with varying acceptance by farmers. Various reasons have been suggested for this, one probability being that whereas the benefits of improved soil and moisture conservation practices are not always easy to demonstrate, any additional cash expenditures on animals, equipment, or labor are soon obvious.19/ Mechanization must therefore be considered a necessary alternative in many regions, both for opening up new land and for raising land and labor productivity. Virtually all studies of African food problems are in agreement on this point.

This raises difficult policy issues related to the objectives,

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17/ J. Kampen and J. H. Krishnan, "Resource Conservation, Management and Use in the Semiarid Tropics," proceedings of the meeting of the American Society of Agricultural Engineers, Utah, June 1978.

18/ P. M. Ahn, Soil Factors Affecting Agriculture in Semiarid Regions with Particular Reference to the Sahel Zone of Africa, Technical Communication 8 (University of Nairobi, 1977).

19/ Christopher Delgado and John McIntire, "Economic Constraints on Farming with Plow Oxen in the Sahel," Washington, D.C.: International Food Policy Research Institute, 1980 (mimeographed); M. DeMoigne, "Animal Draft Cultivation in French-speaking Africa, paper prepared for a workshop on Socioeconomic Constraints to Development of Semiarid Tropical Agriculture, International Crops Research Institute for the Semiarid Tropics (ICRISAT), February 1979.

scale, type, mode of operation, ownership, costs (domestic and foreign exchange), and degree of subsidy for machinery purchase and use. Some governments restrict mechanization to state-run projects, others subsidize owner-operation (Sudan), a few provide mechanized services of various types for land clearance, land preparation, or harvesting. On the whole such schemes have had limited success relative to their cost, both because of administrative and maintenance difficulties, and because of inexperience with operating machinery and unsuitable equipment. It seems probable that mechanization will expand faster than use of draft animals in Sub-Saharan Africa in the next two decades, with capital and recurrent costs exceeding those of irrigation.[20/] A problem facing planners is how to achieve an orderly growth with adequate safeguards in both maintenance and operation. If this cannot be achieved, replacement costs are likely to be excessively high, and there could be environmental tragedies comparable with the U.S. Dust Bowl of the 1930s or the destruction of the marginal lands in North Africa and West Asia.

Closer Integration of Ruminant Livestock and Arable Farming

Economic returns from rainfed farming depend not just on the relative price of cereals, livestock, and by-products, such as stubbles and straw, but to an increasing extent on the costs of inputs, especially fuel and fertilizer, and of labor. In areas of relatively low and unreliable cereal yields, especially if mechanization is likely to be necessary for their successful cultivation, it might be good economic sense to move away from the present heavy dependence on dryland cereal-fallow cultivation towards a cereal/legume/livestock economy wherever moisture supply is adequate, especially in countries with rapidly rising demand for livestock products. This could help to spread risk (providing stocking was properly regulated and market infrastructure well organized), reduce cultivation costs, improve the availability of draft animals, and supply nitrogen and organic matter to the food crops.

An important obstacle to such a development in much of Africa today is that although there are approximately 200 million sheep and goats and 150 million cattle in Sub-Saharan Africa, the sheep and goats and most of the cattle are kept on free grazing systems, rather than as an integral component of settled arable systems. Some of the cattle are owned by nomads; most of the remainder are kept under systems of transhumance on grazing ranges that cover a quarter of Africa and represent a vast but deteriorating resource.

Yet the range, when properly managed, represents a large poten-

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20/ See Food and Agriculture Organization of the United Nations, Agriculture Towards 2000 and FAO, Regional Food Plan for Africa, 1980. Forty-eight percent of total gross investment in Africa by the year 2000 would be for tractors, draft animals, and hand tools. The cumulative expenditure on tractors, equipment, and draft animals foreseen in the Regional Food Plan between 1979 and 1990 is nearly $7 billion, with a foreign exchange component of 35 percent.

tial reservoir of ruminant animals. When placed on a better feeding regime (whether on improved grazings or in association with fodder production) these animals gain weight fast without having to improve the breed. No high technology is involved--only better feeding and management. How can this reservoir best be tapped?

A first measure would be to help restore the natural grazings by controlling range water points and restricting cultivation in erodable low rainfall areas. The latter is particularly important (apart from being a prime cause of erosion) because reestablishment of natural vegetation on land that has been plowed is a lengthy process.

Second, it is important to foster, and perhaps to subsidize, accepted systems of voluntary grazing control within traditional tribal boundaries or village common lands. In many countries these have been legally abolished in favor of state ownership of land, but because this can rarely be properly enforced, the result has been uncontrolled, free-for-all grazing. It is essential to work with the local people in efforts to protect, conserve, and manage communal resources.

Third, means must be found to provide more stable alternatives to the range for feeding immature animals that are not needed to maintain herds, so as to reduce their mass slaughter at low weight when the natural vegetation dries up and to permit destocking of the range at critical periods of pasture regeneration. Fattening cooperatives in irrigated areas, feed lots, the introduction of leguminous fodder groups into the dryland cereal system in place of fallow for grazing (possibly on a subsidized basis initially), improved marketing channels, and price incentives given for better finishing of animals are some of the measures necessary to provide this stability. Kenya has made considerable progress along these lines; so have some West African countries.

A fourth measure must be to expand research on ruminant livestock production in settled farming systems in better rainfall areas, where the scope for fodder crops or grassland management with fertilizer and improved species is greater. Some of the best of the potentially productive savannah areas in Africa are currently protected from mismanagement by the tsetse fly, but eventually will become available for crops and livestock. It is urgent that contingency plans are developed and tested for their management if a dangerous collision between herdsmen and cultivators is to be avoided.

Pressures on the ruminant livestock sector in Africa and especially on the range are being accelerated by population growth, human and veterinary health measures, new means of cross-country transport, mobile well-drilling outfits, and by escalating demand for meat and milk. Yet social structures, land holding and grazing rights, grazing management practices, technical and, particularly social research; and, in most cases, government recognition and willingness to take any action to effect improvements are lagging behind the pace of events. Efforts should be made to control and regulate land use, but since these may require sacrifices from both farmers and herdsmen, they should be accompanied by equally vigorous support to producers

in research, technical services, finance, marketing, and transportation.[21]

The aim of ruminant livestock policy should be to promote conjunctions of interest between settled farming, herding, and planting of trees for fuel and fodder, rather than the destructive competition that has so often been the rule in the past because the externalities rather than the complementarities have been dominant. Current trends in Africa urgently need monitoring since they contain the seeds both of hope and potential disaster.

National policies are required to reconcile these potential conflicts, and in most countries a drastic rethinking of support to the livestock sector commensurate with its social and economic potential is needed.

INVESTMENT IN THE DEVELOPMENT AND DIFFUSION OF IMPROVED TECHNOLOGY

A recurrent theme of this paper has been the need to strengthen and improve the institutions serving agriculture, and particularly to build up the stock of trained manpower. This is especially crucial for national research and extension systems, because the development and diffusion to farmers of a continuing flow of new and improved agricultural technology is central to the production of the additional food required to eliminate the food gaps projected for 1990. While IFPRI's analysis suggests that agricultural research was strengthened considerably in the Third World during the 1970s, both through the establishment of the Consultative Group on International Agricultural Research (CGIAR) and its 13 international agricultural research institutions and through reinforcement and reorganization of national programs, there is still a long way to go. In the mid-1970s only 10 out of 26 African countries surveyed had achieved the target expenditure of 0.5 percent of agricultural gross domestic product on research suggested by the 1974 World Food Conference. Expenditures per scientist and per research trainee were high in Africa, reflecting not so much strong support but weakness in domestic training by universities and institutions and a high proportion of expatriates still employed. Technical support services to research (field and laboratory technicians) and backup services such as seed production and extension are inadequate. Thus researchers often have to divert time from research to other tasks.

Idachaba's recent report on the Nigerian research systems is particularly important for policy because it shows that even though

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21/ It is widely accepted that the current critical and widespread degeneration of the natural grazings has been a relatively recent phenomenon. Experience in semiarid Australia and the United States, where similar pressures seriously damaged vast areas of range in under a century, shows that drastic government action accompanied by strong incentives to range owners to adopt conservational grazing management is essential to prevent irreversible loss of land.

Nigeria has one of the best research capabilities, it still exhibits many of the problems of organization and management common to less developed countries.22/ Although some of these are rooted in its colonial heritage, perhaps the most serious relate to fluctuating policies by successive governments in their overall commitment to supporting agriculture and agricultural research, and in their research priorities. These have led to uncertainty, instability, and low morale among research staff, which appear to be an even greater obstacle to successful research than deficiencies in numbers and quality of staff, although these latter deficiencies are often serious. The need for relating research to overall national priorities, and for a closer understanding between policymakers, ministries, and research planners emerges clearly.

Information on research allocations to commodities in Africa only permits tentative conclusions. Most countries are now giving higher priorities to food crops, but to cereals more than to starchy crops or pulses. Because the international centers of the CGIAR only deal with food commodities, tree crops and other nonfood crops may now be receiving less attention. Vegetables and fruit crops are often neglected. There are important gaps in many countries in interdisciplinary research related to factors of production (irrigation, soil and water management, plant nutrition, and mechanization). Social sciences are often more neglected than biological sciences. These gaps are particularly serious in view of the needs to improve resource management and to obtain a clearer view of the constraints facing farmers and herdsmen in the better use of resources.

A widespread weakness is at the junction between adaptive research and its users, which often falls between the two stools of research and extension. This gap must be bridged, not only to help the farmer but to get feedback that will increase the relevance of research and the awareness of policymakers.

Many approaches to transferring research results to farmers have been tried: contacts between extension agents and individual farmers, extension programs at group or village levels, and concentration of trained manpower resources on commodities or areas rather than diffusion over a whole country. Reviews of several of the better-known technology programs reveal weaknesses and strengths but no universally applicable system. Indeed, there is a lively controversy over the best approach.23/

22/ Idachaba, Agricultural Research.

23/ See Benor and Harrison, Agricultural Extension, the Training and Visit System (Washington, D.C.: International Bank for Reconstruction and Development, 1977). It strongly advocates an extension agent-to-farmer approach covering all farmers, whereas Wortman and Cummings seem to favor "forced-page campaigns," including commodity or area development approaches, which Benor considers divisive and inequitable (Sterling Wortman and Ralph W. Cummings, To Feed This World: The Challenge and the Strategy [Baltimore: Johns Hopkins Press, 1978]).

No matter what means are adopted of transferring the results of research to farmers, it is important to strike a satisfactory balance between resources devoted to research and to extension, and to provide the two with common goals. Otherwise both may be ineffective. In the past governments tended to neglect research and to overspend on extension in the hope of getting quick successes in technology transfer.[24/] In the last decade there has been a greater concentration of resources on research, but there is some danger of the pendulum swinging too far from extension. Policymakers should be aware of this risk in planning future resource allocations.

The future effectiveness of research and extension services will depend heavily on a great effort to expand the numbers of trained people. Virtually all national manpower studies show large gaps between supply and demand for scientists, extension specialists, engineers, technicians, and experienced administrators with conceptual skills for planning, priority-setting, organization, and the optimum allocation of resources. Strengthening the supply of the latter should receive high priority, since such people could greatly increase the efficient use of scarce resources.

IFPRI estimates that in the 23 low-income countries of East and West Africa the number of research staff should increase from about 3,800 in 1975, to nearly 9,000 by 1990, and the number of extensionists should increase from about 45,000 in 1975 to nearly 120,000 by 1990. This implies training about 5,000 extensionists and 340 researchers a year, plus some 600 research technicians. The direct cumulative training costs are assessed at $1.1 billion (Table 12), to which must be added improvements to university and other training facilities and the costs of in-service training to upgrade and refresh scientists and extension specialists. Training also needs to be expanded in other essential fields related to agricultural development, including engineering, survey, and institutional management.

Help will be needed in this challenging task of strengthening education and training from developed-country institutions in specialized fields, from the international agencies such as FAO and the international research centers, and from financing agencies. Most of all, however, success will depend on the will of the developing countries themselves to build up their most precious resource--the stock of human capital and experience on which their future will largely depend.

SUMMARY OF MAIN ISSUES

The deteriorating food situation is attributed basically to increasing pressures of population and urbanization, the vulnerabi-

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24/ See J. Boyce and R. Evensen, Agricultural Research and Extension Programs (New York: Agricultural Development Council, 1975) for comparative data by regions and countries; also Oram et al., Investment Requirements.

Table 12--Education and training costs and research and extension services by region, 1975-1990

Region	Average Annual Output of Students to Meet 1990 Needs[a/]				Average Training Costs[b/]				Cumulative Training Costs[c/]			
	Senior and Field Level Extension Workers	Research Scientists	Techni-cians	Total	Senior and Field Level Extension Workers	Research Scientists	Techni-cians	Total	Senior and Field Level Extension Workers	Research Scientists	Techni-cians	Total
					($1,000)				($ million)			
Asia	17,016	3,646	7,292	27,954	18,474	163,641	18,183	200,298	429.5	3,804.6	422.8	4,656.9
North Africa/ Middle East	1,562	168	336	2,066	6,063	7,575	842	14,480	141.0	176.1	19.6	336.7
West Africa	1,946	238	476	2,660	12,234	10,698	1,189	24,121	284.4	248.7	27.6	560.7
East Africa	3,076	97	194	3,367	19,490	4,356	485	24,331	453.1	101.3	11.3	565.7
Latin America	147	77	154	378	269	3,447	383	4,099	6.2	80.1	8.9	95.2
Total	23,747	4,226	8,452	36,425	56,530	189,717	21,082	267,329	1,314.2	4,410.8	490.2	6,215.2

Source: Peter Oram, Juan Zapata, George Alibaruho, and Shyamal Roy, Investment and Input Requirements for Accelerating Food Production in Low-Income Countries by 1990, Research Report 10 (Washington, D.C.: International Food Policy Research Institute, 1979), Table 36.

a/ Derived from 1990 research and extension requirements in Oram et al, Investment Requirements, Table 35. Assumes two technicians per scientist and five field level workers per senior extensionist.

b/ Assumes $45,000 per research scientist, $2,500 per technician, education costs for field and senior extension workers based on regional averages or data from the Food and Agricultural Organization of the United Nations, Provisional Indicative World Plan for Agricultural Development: A Synthesis and Analysis of Factors Relative to World, Regional, and National Agricultural Development (Rome: FAO, 1970).

c/ This total includes an allowance of 55 percent for staff turnover, etc., as well as training incremental numbers of new research and extension workers.

lity of a predominantly rainfed agriculture to climatic variability, and the current heavy dependence on a traditional resource-based agriculture. These problems are compounded by lack of infrastructure, inadequate research, high levels of poverty and illiteracy, and a critical shortage of trained manpower. Cause and effect are difficult to distinguish. The paper concludes that Africa has the potential to reverse the present decline in per capita food availability, but only if governments give high priority to accelerating food production by increasing investment in agricultural programs.

Area expansion, the main source of past growth, is not keeping pace with demand for food, although there is apparently considerable potential for bringing new land into cultivation in many countries. This suggests that considerable constraints hamper spontaneous movement of people into new areas, and that more positive government action, involving considerable expenditure on survey, land clearance, disease eradication, settlement, institutional improvement, infrastructure and transportation facilities, will be needed to increase the rate of area development. A key issue facing planners is how to manage this complex process in the most cost-effective way without rigid control, yet avoiding environmental degradation, safeguarding the interests of traditional users of the land, providing the incentives to productive new settled agriculture, and promoting self-help among new settlers.

Even a doubling of the present rate of new rainfed area development would not be enough to prevent widening food gaps in many countries: this can only be avoided by raising the productivity of land and labor. Irrigation offers a means of doing this, as well as of reducing vulnerability to climatic hazards. Irrigated area in most of Africa is insignificant today, and again there appears to be considerable potential underdeveloped for much the same reasons that hamper agricultural expansion overall. Although the rate of bringing new land under irrigation is expected to be faster than the expansion of rainfed area, high costs of surface water development, shortage of staff for project planning and implementation, lack of experience of irrigation among farmers, and a weak data base, especially concerning ground water resources, are constraints to growth and dictate a cautious step-by-step approach to irrigation if costly mistakes are to be avoided. Raising productivity on the vast expanse of existing rainfed land is likely to provide a more rapid and cost-effective approach to increasing food supply in the short run, especially in the less arid countries, but it would be unwise for countries with limited amounts of high-quality land and rapidly-growing populations to neglect their irrigation potential. The foundations of resource survey, research, planning, and organization for gradually accelerating national progress of irrigation development should be laid now, with emphasis on groundwater and on divisible surface water projects.

Raising the productivity of rainfed land is critical to both the short- and long-run solutions to Africa's food problems, since it is expected to produce about half of the additional food required by 1990. This will require a combination of biological, chemical, and

mechanical technology, which must be melded with traditional farming practices and livestock systems in a fashion appropriate to local ecological conditions and farmers' resource endowments. Present levels of fertilizer and pesticide use and draft power in Africa are well below those in other developing regions; so is the availability of seed of improved varieties. The issue is how to make the transition from an extensive resource-based to a more intensive technology-based agriculture as rapidly as possible, and against a background of rising fossil energy costs and changing food demand.

It is suggested that urgent priority is given to interdisciplinary research and extension to discover and demonstrate to farmers simple yield-increasing cultural practices, and to increase use of sound seed of varieties with good yield stability and stress resistance, along with graduated levels of fertilizer and pesticides. Strong emphasis is placed on infrastructural and institutional organization to provide materials and incentives to use more inputs and advice on their efficient use. Meanwhile, international and national research systems should be built up to tackle more basic issues of crop and livestock improvement and resource management, with particular emphasis on biological approaches.

While there is no technology in view which will allow production to be accelerated without wider use of improved seeds, fertilizer, and pesticides, a graduated and selective approach, rather than a shotgun approach, is considered necessary to designing appropriate packages of practices in the light of the resource potential, rainfall, traditional farming systems, and transportation costs. Governments and aid agencies have tended to adopt a narrow project approach in the past rather than a program-based one, leaving large areas out of the development process. In drier areas high priority is assigned to the introduction of improved soil and water management techniques, without which response to inputs may be poor and large areas may have to be held idle in fallow. Mechanization and increased use of draft animals may be essential to facilitate these techniques, as well as to allow cultivated area to be increased. "Minimum tillage" may offer a promising alternative to tractors, but has yet to be fully explored. Large investments and high foreign exchange costs are involved in tractorization, and the management, cost-effective operation, and maintenance of large tractor parks will present governments with difficult problems. Training at all levels appears basic to success.

The ruminant livestock sector is a neglected resource in many countries, and livestock numbers have been rising about as fast as human population without concomitant increases in productivity. This is leading to serious deterioration of the range resource and was a major cause of the Sahelian crisis. In view of the rising demand for meat and the need to prevent irreversible damage and desertification of natural grazings, it is suggested that governments review their priorities on support to ruminant animal production. Particular emphasis should be placed on promoting complementarities between traditional migratory systems of range-based livestock management and downstream settled agriculture, so as to improve nutrition and

liveweight gain without further increasing numbers of stock.

If productivity of land and labor is to be raised, agricultural research will need to receive greater financial support, more and better trained staff, and more consistent government commitment. This implies a mutual understanding between research directors and policy-makers which is lacking in many countries. Research services will also require stronger support from seed production, input distribution, and extension services, which often remain bottlenecks to the effective adoption of research results by farmers, as well as to researchers achieving correct feedback on the real problems facing farmers. The potential complementarities between the public and private sectors in developing these services have rarely been adequately explored.

In most countries lack of trained personnel is one of the main, if not the main, obstacle to faster growth of food production. Shortages exist in many disciplines and in conceptual and managerial, as well as professional and scientific skills. Crucial issues include how to determine priorities in providing the large numbers of people required, what level of education is adequate to fulfill a particular task, how overseas and domestic training resources can most effectively be utilized, and where to seek funds and technical assistance to train people overseas and, in parallel, to build up national educational systems.

NUTRITION CONCERNS IN FOOD POLICY FOR SUB-SAHARAN AFRICA

by Shubh K. Kumar

SUMMARY

This paper examines evidence on nutrition problems in Africa and the interrelationships between child malnutrition, family food availability, and agricultural production systems. Aggregate national studies of child nutritional status indicate an association between the prevalence of acute child malnutrition (low weight for height) and an aggregate food gap in nutrition. Analysis suggests that under present conditions of food distribution and availability, if the quantities of food available are increased to close the nutritional food gap, the majority of severe malnutrition cases in Africa would be eliminated, provided that income gains are not concentrated among a few people. Until such time, food distribution measures will be necessary to provide increased purchasing power to certain population groups. The study also looks at how production systems in the area are linked to nutrition problems via ecological, seasonal, and socioeconomic characteristics. Although there is a need for increased food production, the nature of the links between production systems and the adequacy of food consumption raise many questions about the overall success of various food supply-oriented strategies. The effects on food consumption of various policies aimed at increasing overall food supplies need to be examined, to assist in the effective distribution of increased supplies.

OBJECTIVES

The objectives of this study are to investigate the nature of the nutrition problem in Africa; to analyze the factors at both aggregate and household levels that are responsible; to examine food policy implications for maintaining and improving food consumption adequacy and nutrition; and to identify the areas where further study is required to clarify the effects of different food policy instruments. The emphasis in this report is heavily rural for two reasons. First, the rural situation has much more documentation, presumably because it is a great deal more complex. Second, the heart of the food problem in Africa resides in the countryside, not only because it is associated with production problems but also because continuing food deficiencies and low real incomes in rural areas contribute to the rapid growth of the urban population, further complicating the problem of investment in rural areas.

REASONS FOR NUTRITION-ORIENTED FOOD POLICIES

Adequate food availability is of primary concern to policymakers all over the world and is a central concern of food policy. This is so undeniable that even a statement to this effect seems redundant. However, the purposes served by adequate food availability are many, ranging from import substitution to domestic price stability to obtaining desirable consumption levels. These concerns are often contradictory, and it may not be unfair to state that raising consumption levels often is an objective of lesser importance in economic policy.

To obtain an adequate diet is a basic human need over which individuals expend enormous amounts of time and energy in most developing countries. The entire economic ramification of this use of human resources and its productivity has yet to be explored. Nonetheless, during the 1970s and especially following the World Food Conference of 1974, the specter of mass starvation has been raised time and again in an attempt to propel national priorities toward raising consumption levels. In retrospect it appears that the reasons that propelled this concern to the forefront were largely misguided. It was fear of starvation and associated deaths that were used more often than the positive benefits of improving diet adequacy--human resource utilization, dignity, and productivity--to raise concern. This gave rise to two major misconceptions: first, that inadequate diets or malnutrition are primary causes of high mortality and morbidity rates, rather than being associated with and in fact often a result of morbidity; and second, that because people are so close to starvation, income increments will be spent mainly on additional survival foods, namely low-cost calorie sources. But even in low-income countries, it is health services that reduce mortality more than food, and given larger incomes, people do not only consume more cheap calories but diversify their diets with higher priced, higher quality foods. The hasty conclusion that is often drawn from such observations is that inadequate food consumption is not a problem after all.

Food policies need to be concerned not only with human survival but with the quality of that survival. Indicators of nutritional status such as anthropometric measurements (height, weight) and the amount of food consumed are an attempt to measure the latter. Though questions can be raised about the level of food consumption in a given society that can be considered adequate, lack of clarity on this score need not stand in the way of devising effective means of improving food consumption when its inadequacy can be readily determined, for instance, by the low nutritional status of children. Thus although people consume food not only for nutrition; there is a need for improvement as long as clearly identifiable nutritional deprivation exists.

NUTRITION IN AFRICA

This section examines nutrition in Africa, its association with levels of food supply, and predictions for its future given present estimates of growth of food supply in the region.

Present Situation

National nutrition surveys that have been conducted recently present a more representative picture of the situation than the numerous area and village surveys. These national nutrition surveys measure the prevalence of malnutrition in young children, which can be used as a relatively sensitive indicator of the nutritional status of the sampled population as a whole, since shortfalls in the family food supply are usually reflected early in the nutrition of children in the family. Results from available surveys are given in Table 1.

The indicator of nutritional status shown is the child's weight-for-height ratio as a proportion of "standard" or healthy levels.[1/] The proportion of children in the population who fall below 80 percent of this standard ratio gives a measure of short-run acute undernutrition. There is substantial variation in rates of undernutrition in the countries shown. In comparing them some allowance must be made for the fact that countries where both rural and urban areas are covered all have somewhat higher rates of undernutrition in rural areas. In general the countries in the Sahel and Sudanian zones are the worst off. However, in making intercountry comparisons one must consider that the survey was taken in the aftermath of famine in the Sahel. Similarly the Zambia nutrition survey also coincided with a severe food shortage there.

In comparison with the few Asian countries for which national nutrition surveys are available, all countries outside the Sahel zone and Zambia in Africa have a better standard of child nutrition status. As stated, at the time of the survey both the Sahel countries and Zambia were facing severe food shortages.

1/ This ratio is a function of height and increases with height from 176 grams per centimeter for boys at 112 centimeters to 357 grams per centimeter for boys at 174 centimeters in height. The proportions of fat to lean mass in the composition of the body, as well as bone density affect this ratio. People who are more active and have proportionately more active lean muscle mass should have a higher weight for height than those who are less active since lean muscle tissue is heavier than fat tissue. However, if the high activity levels are not supported by higher energy intakes, the fat tissue is depleted without substantial buildup in muscle tissue, giving low weight for height ratios. Furthermore, since weights are pegged to standard height for age and the ratio gradually increases with age, tall-for-their-age children will tend to have a lower weight for height ratio and short-for-their-age children a higher weight for height. Therefore, on both activity and height considerations this is a relatively conservative measure of undernutrition in developing countries.

Table 1--Distribution of child nutrition, food consumption, and life expectancy for selected countries

Country	Children under 80 Percent of Standard Weight-for-Height	Survey Year	Age Group	Region[a]	Population[a] Below 1.2 BMR Level 1972-74	Food Supply, 1972-74	Aggregate Food Gap, 1975	Life Expectancy at Birth, 1970-75
	(percent)		(months)			(Cal/Cap/Day)	(Kg/Cap/Yr)	
Africa								
Egypt	0.6	1978	6-72	T	8	2,632	19.1	52.4
Cameroon	1.0	1977	3-60	T	16	2,383	29.7	43.5
Liberia	1.6	1976	0-60	T	37	1,976	41.0	45.9
Togo	2.0	1977	6-72	T	24	2,167	n.a.	43.5
Sierra Leone	3.0	1977	3-60	T	21	2,254	33.4	43.4
Gambia	5.0	1975	n.a.	R	n.a.	2,307	25.2	40.9
Niger	11.4	1974	6-72	R	47	1,857	98.1	40.9
Mali	6.8	1974-75	6-72	R	49	1,759	80.0	40.9
Mauritania	7.4	1974-75	6-72	R	48	1,867	n.a.	40.9
Chad	17.2	1974-75	6-72	R	54	1,765	57.3	41.3
Kenya	4.4	1977	12-48	R	30	2,137	48.1	53.2
Zambia	16.1-24.3	1970-72	0-48	R	34	2,016	8.0	45.9
Asia								
Philippines	10.9[c]	1978	0-72	T	n.a.	1,953	49.5	58.4
Sri Lanka	6.6	1976	6-72	R	n.a.	2,078	43.9	63.0
Nepal	6.6	1975	6-72	R	29	2,015	32.6	43.6

Table 1--Continued

Sources: Data on nutritional status of children under 80 percent of standard weight-for-height:

Cameroon, Egypt, Liberia, Nepal, Sierra Leone, Sri Lanka, Togo: U.S. Agency for International Development, Office of Nutrition, National Nutritional Surveys, various years.

Chad, Mali, Mauritania, Niger: U.S. Department of Health, Education, and Welfare, Sahel Nutrition Surveys (Atlanta: Center for Disease Control: 1974, 1975).

Gambia: W. Keller et al, "Anthropometry in Nutritional Surveillance," Nutrition Abstracts and Reviews, No. 8, August 1976.

Kenya: Kenya, Ministry of Economic Planning, Child Nutrition in Kenya, 1979.

Philippines: Philippines Food and Nutrition Institute, First Nationwide Nutrition Survey, 1978.

Zambia: Food and Agriculture Organization of the United Nations, U.N. Development Program, Zambia Food and Nutrition Program, Nutrition Status Survey, 1974.

Data on nutritional status of population below 1.2 BMR level, 1972-74 and food supply, 1972-74: Food and Agriculture Organization of the United Nations, Fourth World Food Survey (Rome: FAO, 1977).

Data on aggregate food gap, 1975: International Food Policy Research Institute, Food Needs of Developing Countries: Projections of Production and Consumption to 1990, Research Report 3 (Washington, D.C.: IFPRI, 1977).

Data on life expectancy at birth: United Nations, World Population Trends and Prospects by Country, 1950-2000: Summary Report of the 1978 Assessment (New York: UN, 1978).

Notes: The aggregate food gap is the difference between trend consumption and dietary requirement (110 percent) at the aggregate level; n.a. means "not available."

a/ T indicates that both rural and urban population are covered; R indicates that only rural areas of the country were surveyed.

b/ See text for explanation.

c/ The figure for the Philippines is based on 75 percent of standard weight-for-age.

Nutrition and Food Supply

Increasing food supply is a major food policy objective in Africa. Between 1960 and 1975 domestic production of food staples grew at only 2.2 percent per year in Sub-Saharan Africa, lagging behind a population growth of 2.6 percent per year during the same period. Because capacity of countries in this region to import steadily increasing amounts of food has been eroded by escalating oil prices, domestic production performance has been gaining as a policy objective. It is clear that food production growth needs to improve, even to maintain existing levels of consumption. If that does not occur, then rising food prices could selectively reduce consumption levels of the poorest segments of the population. When expected increases in staple food demand from income growth is added to the above, then the pressure on food supplies becomes even greater.

It is not surprising, therefore, that achieving food self-sufficiency is the foremost policy concern in the region. What is the implication of this emphasis on the supply side, for nutrition? Scholars have a wide range of views on the subject. Conventional nutrition wisdom dictates that benefits from such measures are insignificant. It is often argued that intrahousehold maldistribution of available food, or misallocation of household resources for non-nutritional prestige foods, and similar behavioral factors are the main causes of the problem. It is also argued that even if consumption were increased the "leaky bucket syndrome," or biological losses due to disease frequency, would wipe out any gains. Development literature concerning hunger and malnutrition has usually focused on poverty and the basic needs approach. Here, an increase in food supply is seen as secondary to the more important need for income redistribution. If, however, increased food supply is accompanied by the new agricultural technologies, it has sometimes even been seen to contribute to the increased maldistribution of income and worsening poverty.

It is only in the economic literature that an increase in staple food production has been viewed as the core of efforts to raise consumption levels. This effect is expected via two means: through stable or lower relative staple food prices and through income growth--occurring directly for agricultural producers and workers and indirectly from the economic growth linkages generated by the process of increased production.

The issue of relating food availability to nutritional status has many complexities. At the individual level there is a biological association between food availability and nutrition. This can be expressed as:

$$N = f(I_a, I_u),$$

where

N = nutritional status;
I_a = adequacy of nutritional intake = I_c/I_r,
I_u = utilization of nutrients ingested, which is influenced by disease incidence
I_r = nutrient requirements, and
I_c = nutrient consumption.

Next, at the household level, the biological equation is modified by an intrahousehold distribution of food parameter, d_h. At the household level the nutrition equation also includes a socioeconomic dimension, involving purchasing power and tastes and this influences both I_a and I_u. For the sake of simplicity only its effect on I_a is considered here.

$$I_a = I_c/I_r = f(Y_h, P_f, t_h, d_h)$$

where

Y_h = household income;
P_f = price of food, both absolute and relative to price of non-food basic needs, such as fuel and housing;
t_h = tastes of household members;
d_h = intrahousehold distribution of food.

This implies that the role of economic factors in consumption is conditioned by their relation to meeting requirements for various nutrients.

Finally, when nutritional status is considered at a still higher level of aggregation--the community level--an additional parameter, Y_d, or the distribution of income among population households, has to be included. At the community level it is assumed that for a largely rural population in Africa imports are limited and fixed in the short run and prices are determined by food supply. Furthermore, if incomes are mainly generated in the agricultural sector and by related service activities, then Y_h is also a function of food production in the traditional sector.

Then

$$I_a = f(S_f, Y_d, t_h, d_h)$$

where

S_f = aggregate food available in the community.

Therefore, at the national level the observed nutrition level (determined by a short-run measure such as weight for height) will be a function of:

$$N_s = f(S_f, Y_d, t_h, d_h, I_u).$$

If it is further assumed that in the short run, tastes are constant and uniformly distributed and that intrahousehold distribution is closely related to household adequacy, then:

$$N_s = f(S_f, Y_d, I_u).$$

Estimating the above equation is difficult because neither income distribution nor morbidity figures are readily available. In view of these limitations, the proportion of the population below 1.2

BMR[2/] (determined jointly by S_f and Y_d), and life expectancy (as a proxy for morbidity) have been used (Table 1). Stepwise multiple regression analysis is performed for the above equation. The nutritional status measure is taken as the proportion of children who are wasted, that is, have low weight for their height. Food supply is taken as the per capita caloric availability of food. Since income distribution for these countries was not available, population below 1.2 BMR (P_m) estimated by FAO has been used in the second estimation in addition to S_f. As indicated earlier, $P_m = f(S_f \cdot Y_d)$. In the third equation the national life expectancy figures are introduced as a proxy for morbidity and the spread of health services. All the variables are given in Table 1. The regression results obtained for the 11 African countries are shown:[3/]

		$N_s=f(S_f)$ Equation 1		$N_s=f(S_f,P_m)$ Equation 2		$N_s=f(S_f,P_m,L)$ Equation 3	
	Mean Value	b	t ratio	b	t ratio	b	t ratio
Dependent variable							
Child malnutrition (proportion of children below 80 percent of standard weight/height) (N_s)	5.5		...		...		...
Independent variable							
Calorie supply (S_f)	2079	-0.014	3.1	0.030	1.7	0.034	1.7
Population <1 . 2 BMR (Basal Metabolic Rate) (P_m)	33.4			0.804	2.5	0.845	2.5
Life expectancy (L)	44.6					-0.18	0.6
R^2		0.55		0.76		0.78	

2/ Basal Metabolic Rate (BMR) is the energy requirement to sustain basic body physiology and functions. FAO (Fourth World Food Survey) has estimated that consumption below 1.2 times the average BMR has a high probability of caloric deficiency.

3/ Zambia was excluded because in 1970-71, the years of the survey, there was a severe food crisis in the country, which is not reflected in food availability in 1972-74, the years for which data are available.

The results indicate a negative association between aggregate food (calorie supply) and child malnutrition. Based on the value of the coefficient in equation 1, if food supply was increased to a level that covered average requirements plus 10 percent for maldistribution (about 2,530 calories per capita per day), then acute child malnutrition would be nearly eliminated. In equation 2 the significance of income distribution in conjunction with food supply is indicated.

The implications for nutrition of an increase in food supply are not unexpected. Based on food intake and income relationships, Reutlinger and Selowsky[4/] concluded that demand generated by growth in per capita income without income redistribution would make little contribution to reducing malnutrition. But "high rates of growth in per capita food consumption--based on high rates of food availability and lower food prices--could substantially reduce undernutrition," provided income distribution does not worsen. The issue of whether income distribution is likely to worsen in the process, however, is central in determining overall policy implications. One question that can be raised here is whether this result for Africa could be duplicated in Asia or Latin America where there is a high degree of landlessness.

Prospects for the Coming Decade

Expected income growth in the 1980s in Africa is anticipated to shift the major burden of providing adequate diets to the supply side.[5/] According to these estimates major staple production/supply would need to increase by 4.0-4.4 percent annually. Nevertheless, the nutritional food gap will not be closed, even if food supply grew rapidly to meet this increase in demand. In order to close the nutritional food gap and obtain 110 percent of average caloric requirements, food production would have to grow at 4.6 percent annually for 15 years. This is assuming that income distribution will not worsen and that increased supplies of cereals will be available for human consumption, and not used to raise livestock production to meet the rising demand for these products. If either of these occurs, there will be a greater need for selective food policies that augment demand for population groups with nutritional deficiencies. The principles in the effective use of these policies are addressed by Per Pinstrup-Andersen in his paper elsewhere in this collection.[6/] Even though it is usually assumed that demand-augmenting policies are required when supply increases are adequate to meet market demand, such a situation is only likely to occur in Africa if, with supply increase, income distribution worsens or if the country becomes a net exporter. At all other times the poor will need to effectively compete for their food in the market, which sells it to the highest bidder--either as staple calories, or refined, processed, or converted to livestock.

4/ S. Reutlinger and M. Selowsky, Malnutrition and Poverty: Magnitude and Policy Options, Johns Hopkins University Press, 1976.

5/ IFPRI, Food Needs in Developing Countries.

6/ Per Pinstrup-Andersen in Nigeria Papers.

The rest of this paper examines the ecological, seasonal, and socioeconomic factors that relate food consumption patterns and adequacy to production systems in the region.

INFLUENCE OF ECOLOGICAL CONDITIONS

A wide range of ecological, soil, and climatic conditions exist in Sub-Saharan equatorial Africa. Through their influence on production these conditions affect the composition of the diet and factors in diet adequacy. Broadly, Western Africa can be divided into the Sahelian, Sudanian, and Guinean ecological zones with rainfall level and modality increasing near the equator. In the east the same pattern can be traced from the Equatorial Savannah (encompassing Ethiopia, Somalia, and Kenya), to the Central Plateau (stretching from Angola to Mozambique), and to the high rainfall ridges of the Eastern Highlands. Traditional production systems are centered on livestock and cereals in the first ecological zone; on extensive cultivation of low-risk staples such as sorghum, millet, and cash crops such as cotton and groundnuts in the second zone; and on a variety of tropical roots, plantains, and irrigated crops in the third zone.

Diet composition in these zones shows the dominant effect of production systems. On the basis of household consumption surveys there is an indication that diets in the Sahelian zone have a high content of cereal and dairy products together with a fair amount of dietary diversity. Beans and pulses form an important part of the diet in the Sudanian zone, while roots and tubers become major staples in the Guinean zone (Table 2). A year-long study in different regions of Nigeria (Table 3) suggests that while qualitative differences do exist, per capita calorie intake in the various ecological zones is about the same.

However, the type of dietary problems can be expected to differ from one zone to the next. In the Guinean zone there is a high dependence on roots and other starchy staples. This would tend to compound child nutrition concerns. Policies are needed to improve dietary diversity here for vulnerable groups together with marketing or production-oriented strategies supply of other foods.

In the Sahel and Sudanian zones, where there is a relatively higher degree of seasonality in both food availability and energy expenditure required in production, the problems would be different. The effects on nutrition of seasonality will be discussed more fully in the next section. Even if consumption is comparatively adequate on an annual basis, several inefficiencies in the use of the available food would exist. These are discussed later. Since existing diet composition is cereal-based and has good diversity, policies to increase production, improve storage, and boost demand simultaneously are indicated.

A final point on ecological factors. As the fertile lands available for expansion of agriculture diminish, cropping patterns change to accommodate more intensive land use. Unless this is accompanied by improved production technology, the productivity of tradi-

Table 2--West Africa: mean consumption in Kg per person and per year (weight in "pods") and calorie value in percentage of total calories

Zone	Cereals		Roots and Tubers		Beans, Peas Peanuts, etc.	
	(quantity)	(percentage)	(quantity)	(percentage)	(quantity)	(percentage)
Sahelian Zone						
Senegal Vallee Fleuve	202.3	77.1	1.1	0.1	6.4	2.4
Mali Office de Niger	229.3	89.2	1.8	0.4	9.9	4.2
Mali Delta Vif	221.2	87.9	2.8	0.4	7.0	3.1
Sudanian Zone						
Togo Mobas	108.3	68.8	25.6	4.4	32.5	19.6
Togo Cabrais	98.3	54.5	110.9	20.1	23.5	12.2
Guinean Pre-Forest Zone						
Togo Cabrais emigres	70.2	30.9	349.8	51.4	7.5	3.2
Togo Quatchis	71.5	34.0	323.0	49.7	4.8	2.2
Ivory Coast Bouake	25.5	10.5	633.6	78.0	13.8	4.8
Guinean Forest Zone						
Togo Ewes	52.4	23.1	432.6	64.6	7.6	3.7
Ivory Coast Bongouanou	9.8	3.0	666.1	82.0	1.8	1.0

Source: Julien Perisse, L'Alimentation En Afrique Intertropicale Etude Critique A Partir Des Donnees Des Enquetes De Consommation 1950-1965, Faculte De Pharmacie De l'Universite de Paris, 1966.

Table 3--Nigeria: mean consumption in Kg per adult per year

Zone	Cereals	Roots and Tubers	Beans, Peas Peanuts, etc.
Sahelian Zone			
Jarawaji	242	2	7
Sudanian Zone			
Tangaza	186	8	8
Banga	203	71	5
Maidubu	210	12	61
Laugai	137	69	15
Guinean Pre-forest Zone			
Bero Okuta	38	460	2
Guinean Zone			
Mbanege	2	531	15

Source: Julien Perisse, L'Alimentation En Afrique Intertropicale Etude Critique a Partir Des Donnees Des Enquetes De Consummation 1950-1965, Faculte de Pharmacie de l'Universite de Paris, 1966.

tional high-security crops of sorghum and millet is lowered. Two types of changes seem to occur. When farmers do not have access to better inputs they shift to cassava. But when they use improved technology they plant hybrid maize, or other cash crops.[7] Given existing price structures, these shifts tend to increase all types of food insecurity in rural areas--chronic, seasonal, and year to year. From the nutritional as well as the production standpoint, these shifts and the effects of various policy alternatives on them need to be further investigated.

INFLUENCE OF SEASONAL FACTORS

In both the pastoral and sedentary production systems of the African savannah, there is a pronounced seasonality in food supplies and labor requirements. During the late dry season watering of cattle as well as land preparation and planting during the early rains, energy requirement is high, and this is also the period of seasonal food shortage. The effect on the nutrition of children is most pronounced because simultaneously there is not only less food left to go around and working members need to first meet requirements, but three additional factors are also contributing. First, the diet composition shifts to being more starchy with remaining cereals being combined with or substituted with cassava; second, where women are actively engaged in field work the loss of maternal care at this time results in additional feeding problems; and third, relatively higher prevalence of infections, especially diarrhea during the rainy season and malaria toward the end, further contributes to the problems at this time.

As for adults no clear picture is available on levels of consumption adequacy for most years. Even though many observations have been made on seasonal weight loss in adults, this loss may simply represent the timely use of body stores that will be replenished after the harvest. A high degree of seasonality in food availability often means that people go through a cycle of repleting and accumulating body stores during the peak season and using up body reserves in lean periods. This would be especially so for nutrients derived from hard-to-store foods. Then, because of the long storage period required between harvests, on-farm storage losses could be higher. Both these are sources of nutrient loss or inefficiency. What is more important is the degree to which food availability at the time of seasonal shortage determines the amount of work that can be performed. This is probably an important area where further work is required.

Although the seasonality of food consumption in Africa has been documented for some time (Figures 1 and 2), it is only recently that its association with the agricultural cycle of operations is being investigated more fully. Two relatively recent studies on the seaso-

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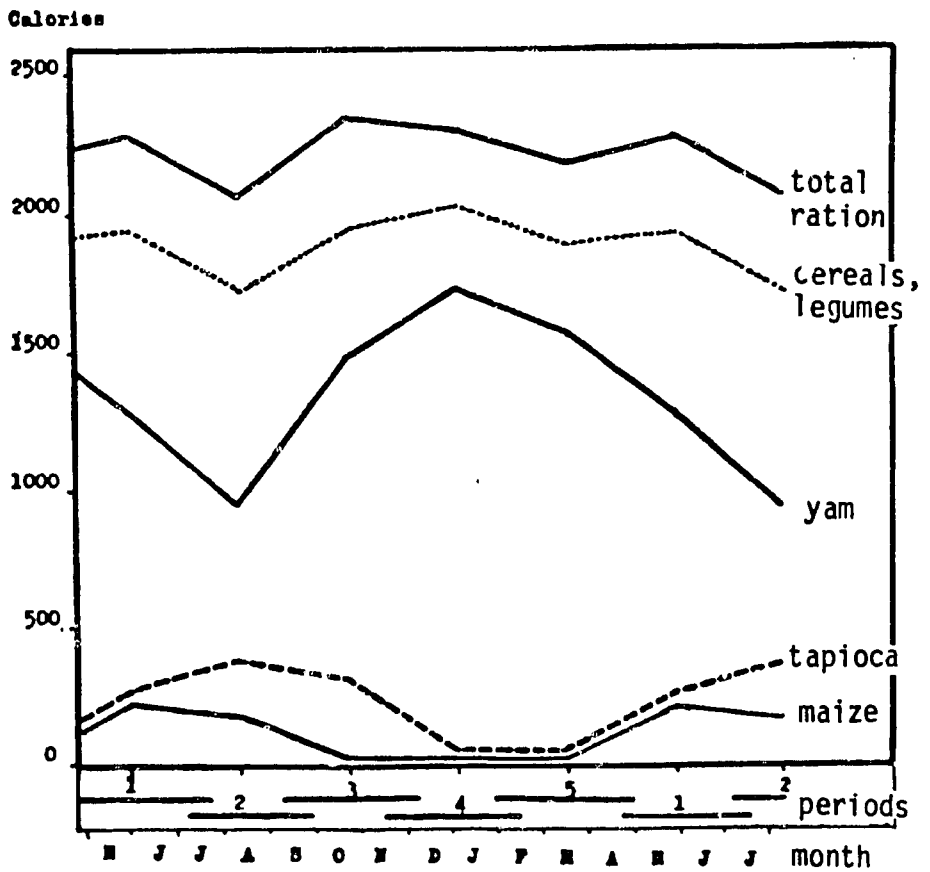
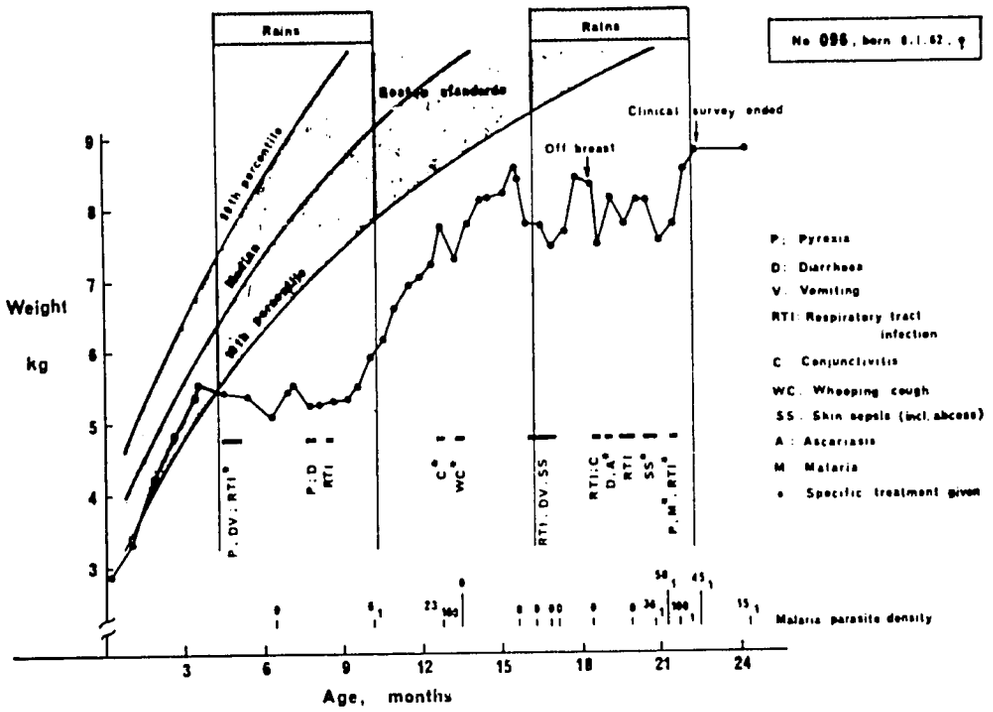
7/ Centro Internacional de Mejoramiento de Maiz y Trigo, Eastern African Economics Program, "Demonstrations of an Interdisciplinary Approach to Planning Adaptive Agriculture Research Programmes," Report No. 3, Rural Development Studies Bureau, University of Zambia, 1978.

Figure 1--Ivory Coast, Bouake - Seasonal variations of the consumption of staple foods in calories per person per day



Source: Julien Perisse, L'Alimentation En Afrique Intertropicale Etude Critique a Partir Des Donnees Des Enquetes De Consummation 1950-1965, Faculte de Pharmacie de l'Universite de Paris, 1966.

Figure 2--Weight curve of a child from birth to 2 years of age, illustrating the influence of infectious diseases and of season



Source: I. A. McGregor, et al, "The Health of Young Children in a West African (Gambian) Village," Transaction of the Royal Society of Tropical Medicine and Hygiene, Vol. 64, No. 1, 1970.

nality of food availability and timing of production operations have been conducted in Kenya, and north Mali. They show the times in the production cycle when food is likely to be short.[8] According to Simmons,[9] noncattle owners in northern Nigeria are more susceptible to consumption shortfalls than cattle owners. When adequate stores are present, however, people increase consumption to meet the seasonal increase in energy requirements. In Gambia several longitudinal studies on child nutrition and the seasonal dimensions of nutrition have been conducted.[10] Commenting on the comparatively higher seasonality observed in Gambia compared to some areas around Zaria in northern Nigeria, Tomkins suggests that cropping patterns and intensity of energy expenditure required may be a factor: "It may be that the energy cost of harvesting rice is great compared with that of growing guinea corn, a major staple of the Zaria region."[11]

This raises the question of whether the traditional, more extensive cropping patterns in the African savannah required less energy consumption than the new, intensive cultivation techniques that will be required if land productivity is to be maintained. Were labor requirements more spread out in the traditional methods? If intensive cultivation requires more concentrated energy expenditure, there are implications for nutrition and for the success of the techniques themselves.

Women's involvement in agricultural work also increases the child nutrition problems associated with seasonality. This occurs presumably because of higher energy requirements for the household together with less time being available for frequent food preparation and feeding of children.[12] Another aspect of women's work in agriculture that is

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8/ S. R. Onchere, "Seasonality of Food Production and Farm Resource Use in a Medium Potential Agricultural Area of Kenya," and J. Swift, "The Role of Seasonality in a West African Pastoral Economy," Papers presented at Institute of Development Studies, Sussex Conference on Seasonal Dimensions to Rural Poverty, July 1978.

9/ Emmy Simmons' paper presented at I.D.S. Conference on Seasonal Dimensions to Rural Poverty, University of Sussex, 1978.

10/ A. Tomkins, "Defining Health Problems of a Rural Savannah Area - Zaria". Paper presented at I.D.S. Conference on Seasonal Dimension of Rural Poverty, July 1978; I. A. McGregor, et al, "The Health of Young Children in a West African (Gambian) Village," Transaction of the Royal Society of Tropical Medicine and Hygiene, Vol. 64, No. I (1970): 48-77; and M. G. M. Rowland, et al, "Seasonal Aspects of Factors Relating to Infant Growth in a Rural Gambian Village," paper presented at I.D.S. Conference on Seasonal Dimensions to Rural Poverty, July 1978.

11/ Tomkins, "Defining Health Problems of a Rural Savanna Area -Zaria."

12/ McGregor et al, "The Health of Young Children," and Rowland et al, "Seasonal Aspects."

significant to food consumption patterns and adequacy of household diets relates to the often-reported predominance of women engaged in production of subsistence food crops in many parts of Africa. Men, on the other hand, predominately engage in cash crop production. If this is so, then production strategies leading to a shift into cash crop production could have repercussions for allocation of household resources to food production and consumption. This point is explored further in the next section and also appears to be an area where further study is required.

INFLUENCE OF SOCIOECONOMIC FACTORS

The discussion of socioeconomic factors affecting food consumption and nutrition can be divided into area level and household level factors.

Area Level Factors

The degree of local infrastructure development--that is, conditions of roads, markets, institutions providing inputs and relevant production support services and employment production--includes some of the important area level socioeconomic factors. Generally these conditions deteriorate as one moves away from urban areas, other major centers of commerce and communication/transport arteries such as the line of rail in Zambia. The hypothesis which is still hotly debated but appears to be substantiated by available evidence is that the prevalence of malnutrition is somewhat higher in rural and remote areas than in urban areas of Africa.[13/] The predominant etiology of the problem in urban and rural areas is, however, different. In rural areas malnutrition has a clearer association with socioeconomic factors and agricultural productivity, but with urbanization other factors such as shifts away from traditional staples and foods due to availability or change in tastes and food habits takes on additional significance.[14/]

There are two dimensions to area-level problems of importance to food policies. First, historically in Africa the base for economic growth has been outside of traditional agriculture, resulting in an orientation of institutions, services, and subsidies to the support of those sectors on which the economy rests. There is an impressive consistency of this pattern across countries, as is the high rate of migration away from traditional agriculture into urban areas. The

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13/ U.S. Agency for International Development, Office of Nutrition, National Nutrition Surveys conducted in Egypt, Cameroun, Liberia, Togo, and Sierra Leone, 1976-78.

14/ J. Newman and C. Gulliver. "Patterns of Protein-Energy Malnutrition and Food Deprivation Among Infants and Toddlers in Africa South of the Sahara." African Studies Review 22 (September 1979): 65-76.

second dimension of area level factors, largely a result of the first, is low agricultural productivity. Given the widely prevalent extensive cultivation practices, pressure on land is perceivable despite low man-land ratios. Widespread shifts in cropping patterns appear to be taking place to accommodate this pressure on land given present production methods and technologies. These new patterns are potentially detrimental ecologically and likely to lead to greater food insecurity (both in terms of variability and the average level of food available).

Remote areas and areas with poorly developed infrastructure generally have lower incomes and nutrition. They face disadvantages in employment opportunities, services, and availability of inputs for improving their productivity. In addition, their distance from urban markets raises transportation costs and further shrinks the margin on cash sales.[15/] As a consequence, when a primary policy concern is to supply urban centers with food or provide cash crops for export, these remote areas are at a comparative disadvantage in receiving assistance--at least with a short-run policy perspective. Remote areas also suffer a disadvantage because of their so-called "subsistence" orientation. To economists this is virtually synonymous with poverty. It signifies a high propensity to consume local produce, largely food, both at the average and the margin.[16/] This implies that income increments from development expenditure will be spent mainly on food and other local products, causing a net shift in resources to rural areas. While this is seen by many to be extremely desirable for improving local welfare, food consumption, and nutrition, the question is whether this net rural shift in resources can, will, or should be allowed to take place. The answer is beyond the scope of this paper. However, it is clear that there is a need for developing linkages between rural and urban income growth. In the meantime, given the absence of political clout in traditional agriculture, real income growth in rural areas will be limited except where substantial increases in productivity of land and labor occur.

Household Level Factors

During the 1970s there has been substantial progress in determining patterns of income distribution in Africa. As in Asia, the accumulation of empirical evidence has paved the way for moving away from earlier theories of undifferentiated or shared poverty which in Africa were bolstered by face value interpretations of tribal laws. It is true that elements of sharing do exist, particularly in times of

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15/ D. Honeybone and A. Marter, "An Evaluation Study of Zambia's Farm Institutes and Farmer Training Centers." Rural Development Studies Bureau, University of Zambia, December 1975.

16/ R. P. King and D. Byerlee, "Income Distribution, Consumption Patterns and Consumption Linkages in Rural Sierra Leone," African Rural Economy Paper No. 16, Michigan State University, Department of Agricultural Economics, 1977.

extreme distress.17/ The extent to which this kind of sharing helps to prevent extreme cases of malnutrition is not known, but nevertheless some tradeoff must be involved as exemplified by the African proverb "hunger is no disgrace but it can compromise a person's honor."18/ Be that as it may, if income differentials are readily apparent in urban areas they are also widespread in rural areas. There are three characteristics of income distribution in rural areas.19/ First, it is associated with size of landholding--cultivated land and livestock holdings in tsetse free areas. These asset holdings usually parallel the household size and its labor resource. Second, the pattern of asset distribution also parallels the household's productive resources, such as farming tools, equipment, and oxen. Third, because involuntary landlessness is practically nonexistent, crop and livestock sales occur at all income levels, increasing rapidly with the size of the landholding. Nonfarm income is also present across all income levels. It is, however, less productive than agriculture at the lowest income levels and more productive at the highest income levels. According to Honeybone and Marter, the first instance in Zambia is due to a lack of labor resources to engage more fully in crop production and the other instance is due to an increase in capital stock to invest elsewhere.20/ Landowners at the higher income levels can hire labor to farm their land and care for their livestock, freeing their time for more productive earnings outside of agriculture.21/

17/ The Kel Adrar Tuareg of North Mali as described by Swift are an example of this "...the Kel Adraf supplement their food supply at the moment of greatest shortage by the slaughter of animals in an informal rain making ceremony. If the onset of rains appears to be delayed, animals donated by richer herdsmen are killed and the meat is widely shared; this is accompanied by prayers for rain. The ceremony is repeated until the rains start. This appears to serve two purposes: first, that of providing meat (usually not a common part of the diet) for consumption at the moment of greatest nutritional stress, and also the redistribution of food from the rich to the poor." Swift, "The Role of Seasonality."

18/ M. Watts, "The Sociology and Political Economy of Seasonal Food Shortages: Some Thought on Hansaland." I.D.S. Conference on Seasonal Dimension of Rural Poverty, July, 1978.

19/ A. Marter, "The Resources, Activities, and Incomes of Rural Households in Poverty and Wealth in Rural Zambia," Rural Development Studies Bureau, University of Zambia, 1979; and A. Marter and D. Honeybone, "The Economic Resources of Rural Households and the Distribution of Agricultural Development," Rural Development Studies Bureau, University of Zambia, 1976.

20/ Honeybone and Marter, "An Evaluation Study."

21/ Swift, "The Role of Seasonality."

As did agricultural scientists, nutritionists too had an undifferentiated socioeconomic approach to problems until the 1960s. Few attempts were made to link child nutrition to household dietary adequacy or socioeconomic conditions, even when data on these were also available. The issues, when considered, were further clouded by use of classifications such as farmer and nonfarmer to indicate socioeconomic conditions. Because nonfarmers can be from the lowest and highest income classes, that such classifications failed to indicate differences is not surprising. They did, however, reinforce earlier views on the etiology of malnutrition, which had a strong behavioral orientation. The scattered evidence that exists does illustrate two facts. First, it indicates that a larger-than-average proportion of child malnutrition is present when mothers are widowed, divorced, separated, or receiving no financial support. In polygamous households, the comparable-age children of first wives are more likely to be undernourished than the children of last wives, indicating a link between child nutrition and the degree of financial support received.22/ Secondly, child nutrition has been found to be related to family dietary adequacy.23/

From the early to the mid-1970s progress was made in identifying the links between nutrition, socioeconomic factors, and agriculture. Much of this research centered on the seasonal patterns of nutrition and their link with the agricultural cycle and changes in the levels of food availability and energy expenditure required in agriculture and livestock care that were associated with this cycle. It was found that lower levels of food available at the end of the dry season and continuing into the early wet season were likely to be a larger factor in lower child nutrition than the incidence of disease in the rainy season.24/ A seasonal weight loss in adults also occurred at this time with unknown implications for labor supply and productivity.25/ In areas where women were also heavily engaged in the fields, the negative effects on children at this time were greater, due to less child care and time available for feeding.26/ Another more general finding was that child mortality was generally more prevalent in lower weight children.27/ Therefore, poor nutrition, resulting

22/ D. Morley, et al, "Factors Influencing the Growth and Nutritional Status of Infants and Young Children in a Nigerian Village," Transaction of the Royal Society of Tropical Medicine and Hygiene, Vol. 62, No. 2 (1968): 164-199.

23/ Ibid.

24/ M. G. M. Rowland, et al., "Seasonal Aspects of Factors."

25/ Ibid.

26/ Ibid. Also see A. Tomkins, "Defining Health Problems," and I. A. McGregor, "The Health of Young Children," pp. 48-77.

27/ I. A. McGregor, et al., "The Health of Young Children."

either from inadequate diet or from disease, led to a greater probability of child deaths from infections.

More recent evidence from work of the Food and Agriculture Organization points to a more direct association between child nutrition and income levels.[28] Analysis of comprehensive household surveys in two areas of Kenya--Machakos and Kericho, which are widely divergent in production conditions and practices--shows that household landholding size, foodgrain production (and retention), and crop incomes were all associated positively with child nutrition. Further differentiation was also attempted by separating producers of high security staples such as sorghum from producers of cash crop staples such as maize, and purely cash crop producers. These findings, discussed later, are relevant in relating income source to nutrition. The allocation of household income to food, its composition and distribution among household members, is known to be influenced by three major conditions. These are: first, the regularity of the income source; second, the nature of income received, that is, whether it is received in cash or in kind, namely food; and third, the utility function of the person deriving the income in relation to that of the household as a unit and that of other household members. In practice these conditions result from: the cropping pattern and quantities of various crops produced; how much produce is marketed compared to how much is retained for home use and prices and availability of retailed staple food; type of women's involvement in the production process; and other employment sources available.

One relatively predictable observation that has been made is that more food is consumed when food crops are grown than when cash crops are produced.[29] As far as the level of food consumption and its variability is concerned, it is expected that a combination of the characteristics of cash income received in conjunction with various food pricing policies, rather than face-value differences of food versus cash crop income, is responsible for the observed higher levels of food consumption and nutrition with higher levels of subsistence food production in Africa.

Food produced and stored can be seen as a continuous income source since it is available to the household on a daily basis. Cash crop income tends to be received only a few times in a year, and has three main identifiable allocation patterns: it is converted to security assets, such as livestock purchases;[30] it is spent on items

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28/ Unpublished provisional reports. Food Policy and Nutrition Division, FAO, 1981.

29/ Food and Agriculture Organization of the United Nations, Food Policy and Nutrition Division, "Food Policy and Nutrition," unpublished provisional paper, 1981; and T. Zalla, "The Relative Importance of Money and Subsistence Incomes in Explaining Dietary Intake in Kilimanjaro--Some Preliminary Results," Michigan State University, Department of Agricultural Economics, 1979.

30/ Swift, "The Role of Seasonality," and FAO, "Food Policy and Nutrition."

requiring relatively large sums at a time, such as clothing, education, or consumer items such as bicycles or radios;[31] and it is used to repay loans.[32] This allocation pattern can be easily understood in the context of conditions in rural areas with regard to holding relatively large amounts of cash.

A related issue is the availability of rural retail marketing of food. Marketing price regulations for food crops are in effect in many African countries. They tend to discourage private rural entrepreneurs from marketing food. In many countries state policies do not allow private traders to buy grain from producers and also discourage it indirectly by offering higher maize procurement prices than would be economical for traders. This makes retail food marketing in rural areas difficult, and may also be discouraging on-farm storage. Therefore, food pricing policies geared largely toward supplying urban consumers can be expected to reduce the value of cash incomes for food consumption in rural areas.

In many parts of Africa, women have an important role in producing or providing for the food needs of the family. This is seen by anthropologists as a continuation of an evolutionary division of labor between the sexes. In the Cameroon, Guyer estimated that up to 40 percent of real family income was provided by women's subsistence work in 1964. In addition food was also provided by women through their work in the cash economy, of which 74 percent was spent on "food and minor household" expenses.[33] Though the amounts are relatively small, they illustrate the significance of women's activity in family food consumption. Recognizing and, if possible, improving the productivity of these operations should play a role in African food policies designed to improve food security in rural areas--especially when policies to develop cash crop production could potentially eliminate these sources of income.

CONCLUSIONS AND AREAS FOR FURTHER STUDY

Analysis of aggregate data on nutrition and food availability in Africa indicate that closing the nutritional food gap can be expected to eliminate most existing malnutrition there. In comparison with other parts of the world, such as Asia or Latin America, where income maldistribution or extreme poverty is more common, this region is pro-

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31/ J. I. Guyer, "Household Budgets and Women's Incomes," African Studies Center, Boston University, 1979.

32/ F. Maimbo, "Incomes and Expenditures of More Prosperous Farmers in Pemba" in Poverty and Wealth in Rural Zambia, 1979.

33/ J. I. Guyer, "Household Budgets." p. 17. Guyer states, "It is explicitly recognized by women that they are searching for reliable ways of tapping men's incomes, and they will discuss the advantages and disadvantages of different strategies for making the most of the peak (cash income) season."

bably different in this respect. However, under the present production systems, productivity levels are declining. If the change to newer, more productive technologies is accompanied by a worsening of income distribution, or if food supply increases are not large enough to bridge the nutritional food gap, then strategies to augment demand for selected groups or to distribute food will continue to be required.

Farm and household studies indicate that the low productivity of land and labor in agriculture could be leading to shifts in production systems and labor out-migration, to the potential detriment of food security and nutrition in rural areas. The nutritional implications of the inherent seasonality of food availability, the production process in Africa, and women's roles in agriculture are also important. Efforts to introduce technological changes that require more intensive labor use could as a result face greater problems than expected. This is further compounded by limited retail marketing networks in rural areas and marketing and pricing policies that lower the subsistence value of cash incomes in rural areas, and also make the injection of food supplies difficult.

Given this situation it can be seen that the possibilities for various production strategies are closely linked with marketing, storage, and food price policies and with consumption policies in rural areas. These links need to be investigated further. In particular four areas for further study are the implications of:

(1) food crop versus cash crop production for nutrition and food security in rural areas.

(2) retail food marketing and pricing polcies for production decisions, farm food storage, and consumption levels;

(3) the seasonality of food availability and labor requirements for labor supply in different production systems; and

(4) new production technologies and changing farming systems for women's roles in food production, levels of food consumption, consumption patterns, and child nutrition, and food security.

PRICE POLICY, RETURNS TO LABOR, AND ACCELERATED FOODGRAIN PRODUCTION IN THE WEST AFRICAN SAVANNAH

by Christopher Delgado

This paper discusses some key issues in the design of price policy to increase production of rainfed millet, sorghum, and maize on small farms in the savannah, the main source of cereals in West Africa. Its purpose is to stress the complementary policies of agricultural research, extension, infrastructure development, and economic research that permit price policies to be effective.

The topic draws its relevance from a recent initiative undertaken by the Sahelian countries to rely primarily upon price increases to stimulate added food output.1/ The discussion may also be relevant to coastal states such as Nigeria, which also produce a significant proportion of their cereals in savannah areas, and which are currently involved in policy debates over the best means to stimulate growth in food output.2/ Basically, the decision has already been made to expand foodgrain production at whatever cost is necessary. This investigation is therefore limited to an assessment of the potential for price increases to provide adequate incentives for sustained increases in food output. Important questions concerning smallholder response to incentives and the distributive effects of price policy are left to other papers.

PRICE INCENTIVES

An agricultural price policy designed to stimulate sustained growth in foodgrain production must result in increased total resource use in agriculture if it is to be successful. Policies that

1/ This is essentially the policy position taken at the time of writing by the Comite Inter-Etats de Lutte contre la Secheresse au Sahel (CILSS), a multinational organization charged by the Sahelian states with developing a regional food policy, among other things. See CILSS/Club du Sahel, Cereals Policy in Sahel Countries, acts of the Nouakchott Colloquy, July 2-6, 1979.(Ouagadougou: CILSS, no date.)

2/ See Nigeria, Federal Ministry of Agriculture. The Green Revolution: A Food Production Plan for Nigeria, Volume 1: Main Report (Lagos: Federal Government Printer, May 1980).

simply shift resources around among activities without bringing more inputs to bear may increase efficiency of resource use or change the composition of output, but the gains in food production are likely to be of a one-shot or marginal nature. Thus increases in millet production obtained primarily by shifting acreage away from groundnut production do not represent a sustainable growth process; sooner or later there will be no cash crops from which to shift. Increases in total resource use by agriculture, on the other hand, can occur with or without net resource inflows to agriculture from nonagricultural sectors.

In traditional savannah agriculture, increments in aggregate agricultural output are typically brought about by putting underemployed farm labor and land to greater use. Price incentives, then, serve to coax out more family labor input, subject to diminishing marginal utility. This may or may not also be associated with increased use of land of lesser quality. As long as the prices of factor supplies are elastic, a higher return to inputs is likely to encourage higher usage and growth in aggregate output, other things being equal. It is possible that cash crops were successfully introduced to much of the savannah in the fifties and sixties in this manner, without diminishing the food supply.

The importance of net inflows from other sectors becomes more evident when farmers are faced with a range of innovations that require operating capital to implement. Use of fertilizer in otherwise traditional agriculture provides an example. Furthermore, if viable technological packages exist that boost the productivity of existing resources, then higher output prices encourage greater levels of purchased input usage and adoption of unfamiliar (and possibly risky) new practices.

Intersectoral resource transfers into agriculture can occur either indirectly or directly as a result of price policy. A change in the intersectoral terms of trade in favor of farmers fosters capital accumulation in rural areas, which can be invested in crop production.[3/] Furthermore, higher farm prices could lead to direct investment in agriculture by city people and might stem the outflow of rural labor.

This view of the potential for price policy to provide an incentive for greater total resource use in agriculture, and thus an increase in aggregate output, raises three sets of economic questions for policymakers in the West African savannah. These concern technical availability, institutional and infrastructural capacity, and financial profitability. The technical issues involve the potential

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3/ A fuller discussion of these issues may be found in John W. Mellor, "Prices and Price Policy," Chapter 11 in The Economics of Agricultural Development (Ithaca: Cornell University Press, 1966): 196-213; Uma Lele, "Considerations Related to Optimum Pricing and Marketing Strategies in Rural Development," in Decision-Making and Agriculture, ed. T. Dams and K. Hunt (Lincoln: University of Nebraska Press, 1977): 488-516; and C. Peter Timmer, "Food Prices and Food Policy Analysis in LDC's," Food Policy (August 1980): 188-199.

for expansion of land and labor inputs under the traditional system, use of technological packages of new practices and inputs to increase the productivity of the traditional inputs, and the use of one new input alone in otherwise traditional agriculture. The institutional and infrastructural questions concern the adequacy of facilities for making farmers aware of technological opportunities and encouraging them to take advantage of them. The profitability issues, then, hinge upon the potential for price policy to fundamentally alter the incentives to engage in a given set of enterprises, given the technologies, institutions, and infrastructure available to the farmer. Incentives, of course, only have meaning relative to other opportunities available to farm people, at home or abroad. The issues are obviously quite complex, somewhat location-specific, and of a multidisciplinary nature. The expected pay-off, therefore, is more a guide to future research than a set of definitive answers.

TECHNICAL ISSUES

Expanding Land and Labor Inputs Under Traditional Systems

The potential effectiveness of price policy to encourage extra output within a strictly traditional West African farming system depends essentially upon the price elasticities of supply of land and labor, the main factors of production. Historical experience is particularly enlightening in West Africa in this regard. The introduction of extensive cash cropping in savannah areas over the last 30 years was most likely facilitated by the slack in traditional farming systems--land and labor not used to its fullest potential. This permitted a response to price incentives for cash crops without diminishing food production.[4/] However, the slack in traditional systems is rapidly disappearing, partly because of this expansion and partly because of the flow of agricultural labor to the coastal areas. There is considerable evidence that many areas of the West African savannah are rapidly evolving from traditional shifting or bush fallow systems of cultivation to permanent upland farming systems under population pressure. Cropping intensity, the ratio of harvested land to land under crops plus fallow, has risen noticeably in recent years.[5/] Oram et al.'s estimate of an average for West Africa of 54 percent in 1975 is substantially less than their figures for East Africa (66 percent) or Asia (96 percent). However, the estimate for Nigeria at 94 percent

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4/ K. R. M. Anthony et al., Agricultural Change in Tropical Africa (Ithaca, N.Y., and London: Cornell University Press, 1979), Chapter 4.

5/ H. Ruthenberg, Farming Systems in the Tropics, 2nd ed. (Oxford: Oxford University Press, 1976).

is closer to the Asian average.6/

Unlike the semiarid regions of South Asia, hired labor is difficult to obtain on farms in the West Africa savannah and expensive when it can be found. Hired labor was generally not available in the rainy season in the central and eastern sections of Upper Volta in 1976 and 1977. Young men prepared to do wage work apparently preferred to take their chances on the plantations of the Ivory Coast. When hired labor has been observed in the West African savannah, wages are high. Converting local wage rates into kilograms of millet at harvest prices, daily agricultural wages of up to 9 to 14 kilograms a day are at least twice the comparable figures for semiarid India (see Table 1). Furthermore, labor scarcity in rural areas has increased significantly in the last two years. The figures in Table 1 show that agricultural wage rates in Northern Nigeria, for example, doubled between 1977 and 1980.

Adoption of Technological Innovations by Small Farmers

The main technical innovations made available to small farmers in recent years can be divided into mechanical and crop technology. Results have been discouraging on both counts.

Mechanical technology includes sources of tractive power for tools and auxiliary mechanization for equipment such as pumps, threshers, and mills. Even small-scale mechanization has suffered from the recent extremely rapid rise in fuel costs and the difficulty of maintaining a scale of operation that would permit reasonable proximity to service centers. In contrast to Asia, there has been remarkably little use of power-driven pumps for irrigation.7/ The intermediate form of farm power most often advocated for West Africa in the last 40 years is animal traction, particularly the use of bullocks.

Despite a heavy emphasis on this technology in agricultural projects in the Sahelian countries, adoption rates have been low and abandonment rates high in recent years.8/ Niger, for example, had

6/ Peter Oram et al., Investment and Input Requirements for Accelerating Food Production in Low-Income Countries by 1990, Research Report 10 (Washington, D.C.: International Food Policy Research Institute, 1979). Data deficiencies and possible incompatibilities in the definition of fallow prevent rigorous comparison of these figures. However, they do serve to illustrate major differences.

7/ Anthony et al., Agricultural Changes.

8/ The analysis in this section closely follows Christopher Delgado and John McIntire, "Labor on Oxen Cultivation in a Sahelian Context," (Washington, D.C.: International Food Policy Research Institute, April 1981) (mimeographed).

Table 1--Agricultural wage rates in the West African savannah compared to dryland India, 1977-80

Country	Place	Cropping Season	Wage per Man-Day	Grain Equivalent in Sorghum at Harvest Prices
				(kilograms)
Mali	Segou Area[a]	1977/78	FM450	6.0
Nigeria	Funtua[b]	1977/78	₦1.84	5.8
Nigeria	Gusau[b]	1977/78	₦1.44	6.0
Nigeria	Gombe[b]	1977/78	₦1.76	7.3
India	Dryland[c] Andhra Pradesh	1977/78	Rs. 4	4.4
Nigeria	Gombe[b]	1978/79	₦2.24	9.5
India	Dryland[c] Gujarat	1978/79	Rs. 5	4.6
India	Dryland[c] Andhra Pradesh	1978/79	Rs. 5	4.6
Nigeria	Zaria[d]	1980/81	₦3.50	14.0

a/ Personal communication, John McIntire. In Malian francs.

b/ Roger H. Slade, "The Monitoring and Evaluation of the Funtua, Gusau, and Gombe Agricultural Development Projects," Agricultural Projects Monitoring, Evaluation, and Planning Unit, 1980. (Mimeographed.) Price data used to calculate grain equivalents is tentative but adequate for purpose. (Cited with permission.) In Nigerian Naira (₦).

c/ India, Ministry of Agriculture and Irrigation, Agricultural Situation in India, various issues. In Rupees.

d/ Field trip, February 1981. In Nigerian Naira.

one plow per 900 hectares in 1977. A recent analysis of this problem contends that the profitability of ox-driven technology depends essentially on raising yields through simultaneous introduction of seed fertilizer innovations and other inputs. According to this view, the key element in technological change for West Africa lies in developing fertilizer-responsive varieties that can be used with other inputs to boost aggregate farm income. It is instructive to note that the successful introduction of ox-plowing and other innovations in Southern Mali was preceded by a major research effort to raise average yields of cotton from 200 to 1,000 kilograms per hectare on farmers' fields.

Some advances in crop technology have been made in developing varieties of rice and maize suitable for cultivation in the Middle Belt areas of West Africa. However, there has been little progress with millet, sorghum, or maize suitable for more northern areas.9/

Early results from the Funtua Agricultural Development Project in Nigeria suggest important technical possibilities for raising yields per hectare of maize and sorghum in the more humid parts of the savannah. Although only 7 percent of production of these grains came from improved cultivation in 1976, the proportion rose to 20 percent in 1978. However, it should be emphasized that at the present time traditional production significantly surpasses improved production even in the project area, which represents only a small part of the Nigerian savannah alone, not to mention West Africa as a whole.10/

Beyond the results for one project area, the aggregate evidence from Africa in the last 20 years indicates that where expansion in foodgrain production has occurred, the major cause has been the extension of cultivated area, rather than cropping intensification. For the continent as a whole, only maize among the major cereals has provided significant increases in average output per hectare since 1961, although there has been some success at raising rice yields in West Africa. Total cereal production actually declined by 1.5 percent per year from the early 1960s to the mid-1970s in West Africa, excluding the Sahelian states, due to both a decrease in acreage

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9/ Anthony et al., Agricultural Changes.

10/ Brian D'Silva and M. Rafique Raza, "Integrated Rural Development in Nigeria: The Funtua Project," Food Policy 5 (November 1980): 282-297. Various writers have explained relatively slow rates of adoption of new varieties by citing problems such as the length of the growing season for improved varieties of sorghum, palatability of new varieties of maize, or difficulty in obtaining key inputs on time. In any event, significant problems appear to remain in finding a widely extendable package for improved foodgrain production in Northern Nigeria, probably the area of the West African savannah where the most resources have been concentrated.

(-0.8 percent) and falling yields (-0.7 percent).11/

In sum, at the present time farmers in relatively dry savannah areas of West Africa do not appear to have access to a highly productive technological package for foodgrain production that they could adopt if "the price is right." However, price policy could still stimulate the use of improved inputs within otherwise traditional systems. In other words, given only modest success in seed technology, mechanization, and the extension of irrigation, can farmers greatly increase aggregate output by simply applying a single new input, say fertilizer, to the traditionally rainfed coarse grains?

Increasing Aggregate Output through Greater Use of Fertilizer in Otherwise Traditional Systems

Abiodun O. Falusi has assembled physical response rates of millet and sorghum to fertilizer from various studies in Northern Nigeria.12/ They show average physical response coefficients of the order of 5 to 6 for unimproved grains. Granted that these are average and not marginal rates, they are still quite low. Falusi's analysis shows that the net profitability to farmers of fertilizer use on millet and traditional sorghums at unsubsidized costs is marginal at best under these conditions. If this is true in Nigeria, it is even more likely to be the case farther inland in the Sahel, where transport costs are higher.

As in the use of mechanical technology alone, it seems likely that clearly profitable use of fertilizer on coarse grains in West Africa would depend upon also having access to a source of farm power and to improved seeds that make efficient use of the extra nutrients. Some form of weed control, either through improved implements or through chemical control, may also be necessary.13/

If fertilizer is highly subsidized, as in Nigeria, its use on unimproved grains is clearly profitable, even under traditional rainfed conditions. In fact, Falusi shows that approximately half of all fertilizer in Nigeria was used on millet, sorghum, and maize in 1979/80. The value/cost ratios are quite attractive, about 5 for traditional sorghum at the current high rate of subsidization. Because improved varieties of millet, sorghum, and maize accounted for only a very small percentage of these crops in 1979/80, it is reasonable to

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11/ Kenneth L. Bachman and Leonardo A. Paulino, Rapid Food Production Growth in Selected Developing Countries: A Comparative Analysis of Underlying Trends, 1961-76, Research Report 11 (Washington, D.C.: International Food Policy Research Institute, October 1979).

12/ Abiodun O. Falusi, "Critical Issues of Fertilizer Policy during Nigeria's Fourth National Development Plan," International Food Policy Research Institute, Washington, D.C., February 1981, Table 10. (Mimeographed.)

13/ Delgado and McIntire, "Oxen Cultivation."

suppose that a large share of the 43 thousand metric tons of nutrients put on these crops went to unimproved varieties. It would appear, therefore, that higher prices for coarse grains could only heighten farmers' willingness to use fertilizer on the major cereals provided that fertilizer is subsidized. Further encouragement to use fertilizer does not appear to be necessary.

The economic desirability of fertilizer subsidies to increase grain production goes beyond the scope of this paper. One issue of immediate relevance, however, is whether farmers can readily gain access to subsidized inputs. In what is perhaps an over-simplification, where fertilizer is unsubsidized this problem is often ignored because extra demand can presumably be met by imports. Whatever practical problems may arise here will only be compounded by the financial burden of subsidies on the state. This raises the more general problem for price policy design of a lack of institutions to translate technological possibilities into concrete options for farmers.

FACILITIES TO PERMIT THE USE OF NEW TECHNOLOGY

A technical potential for expansion of aggregate output is of little use if farmers cannot obtain the inputs that they require at the proper time or cannot dispose of increased output without having to sell in a severely depressed market. Difficulties of this nature have been cited as a major barrier to the widespread adoption of new maize technology in Northern Nigeria.[14/] The same could probably be said for other areas in the savannah.

For example, it is plausible that the main constraint on greater use of subsidized fertilizer in Nigeria is the overall supply that can be made available at the farm gate, not farmers' desire to use it.[15/] The increasing financial burden of subsidization is clearly an issue in policy debates and may at some point become the limiting factor in the growth of fertilizer application.[16/] A number of problems also remain to be solved in methods of fertilizer distribution.[17/]

To the extent that market failure prevents inputs from being used, the ability of output price policy to bring about increases in aggregate output through incentives to greater use of purchased inputs is limited. In that case price trends would probably shift a fixed amount of fertilizer resources among crops rather than increase

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14/ D'Silva and Raza, "Integrated Rural Development."

15/ Falusi, "Critical Issues."

16/ Nigeria, Federal Ministry of Agriculture, "The Green Revolution."

17/ Falusi, "Critical Issues."

total use. On the output marketing side, price policy obviously can only be effective if prices can in fact be realized. Nevertheless, perhaps because of the difficulties involved in data collection, the farm end of marketing chains is an area where little research has been done.

PROFITABILITY ISSUES AT THE FARM LEVEL

Given this somewhat pessimistic view of the current state of technological progress and institutional capacity for expanded foodgrain production in the African savannah, the potential for output price policy to provide an incentive for greater aggregate input use in agriculture can now be assessed. Returns to farm labor are a central concern.

Returns to Farm Labor

Seasonal labor bottlenecks tend to be the limiting factor in traditional savannah agriculture.18/ Therefore, any policy designed to increase agricultural output must immediately face the issue of the best means to stem the high rate of migration out of agriculture. The approach most likely to succeed is to make it more profitable to continue to farm than to migrate. Historically, the returns to farming have been low relative to urban wage rates.

Like most areas of the savannah, Upper Volta has a long tradition of supplying migrant workers to coastal areas, to the point that agricultural wage labor is something of a rarity at home. Young men in search of work often go south to the Ivory Coast. Agricultural wage work is occasionally observed in southwestern Upper Volta; however, the wage rates tend to be higher than the imputed average returns to labor in farming. This is shown for three major crops in Table 2.

The range of plausible shadow prices for farm labor in Upper Volta is anywhere from 40 to 70 percent below the going rate of cash agricultural wages for plantation work in Ivory Coast, although the lower margin is probably more accurate in recent years.19/ This

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18/ See, for example, John H. Cleave, African Farmers: Labor Use in the Development of Smallholder Agriculture, 1974; and D. W. Norman, D. H. Pryor, and C. J. N. Gibbs, Technical Change and the Small Farmer in Hausaland, Northern Nigeria, African Rural Economy Paper, No. 21, Department of Agricultural Economics (East Lansing: Michigan State University, 1979).

19/ The Ivorian figures do not include the imputed value of employer-provided meals and housing. Nonetheless, some observers have concluded that migration from Upper Volta to the Ivory Coast for agricultural work has become less attractive in recent years (B. den Tuinder, Ivory Coast: The Challenge of Success, 1978).

Table 2--Upper Volta: possible returns to unskilled labor at home and abroad, 1963-80

Period	Farming in Upper Volta[a]			Wage Labor at Home[b]		Migration to Coast[c]		Consumer Price Indexes, Low-Income Group, Ouagadougou[d]	
	Sorghum	Groundnuts	Cotton	Agri-cultural	Nonagri-cultural	Agri-cultural	Nonagri-cultural	General	Food
	(CFAF per man-day)								
1963-65	81 (±14)	129 (±26)	38	n.a.	232	156	325	100	100
1966-68	91 (±15)	130 (±16)	76	n.a.	232	161	347	97	98
1969-71	80 (±13)	107 (±22)	67	125	248	189	432	108	117
1972-74	144 (±37)	106 (±21)	94	167	299	219	595	115	150
1975-77	211 (±45)	179 (±36)	177	250	509	330	900	125	226
1978-80	317 (±56)	214 (±43)	322	383	672	550	1,275	210	307

Note: U.S. $1.00 equalled approximately 220 CFAF in 1980.

a/ The returns to labor in farming are calculated using the following labor times--including transformation and transport to market--for sorghum, peanuts, and cotton: 90, 100, and 120 man-days per hectare, respectively. The figures in the table are midpoints of a range. The upper and lower figures in each range are simple Food and Agriculture Organization of the United Nations estimates of average national yield per hectare times the official Voltaic producer price. Nonlabor cash costs applicable to cotton production with animal traction have been netted out. Producer sales of sorghum and groundnuts often occur at higher than official prices. The upper bound for sorghum is calculated using average yield times either the official consumer price (after 1972) or the observed harvest retail price in Ouagadougou (before 1972). The upper bound for groundnuts results from a 50 percent margin over official producer prices. Yield data is from Food and Agriculture Organization of the United Nations, Production Yearbook, various issues, and the price data is from World Bank working documents compiled from Voltaic official sources available to the public.

b/ The lower bounds on wage labor opportunities in Upper Volta consist of the average agricultural wage as determined by informal interviewing on visits to Upper Volta each year since 1975. The upper bound consists of the average legal minimum wage for nonagricultural employment (SMIG) over the period in question. The SMIG data was supplied by the Institut National de la Statistique et de la Démographie, Ouagadougou.

c/ The lower bounds on wage opportunities from migration consists of the cash part of the legal minimum wage for plantation workers (other than smallholder coffee and cocoa) in Ivory Coast, averaged over the period in question. The upper bound is the legal minimum wage in nonagricultural work in Ivory Coast (SMIG). Data sources are various official decrees of the Ivorian government, back issues of Marchés Tropicaux et Mediterranéens, and a forthcoming chapter by C. Humphreys and P. Rader in Pearson, S. et al., Rice in West Africa: Policy and Economics (Palo Alto: Stanford University Press, 1981).

d/ Index for the middle year of year period, 1964=100. Rounded to nearest percentage point. The 1979 figure is through September. The original figures are compiled by the Institut National de la Statistuque et de la Démographie, Ouagadougou.

suggests that the supply price of agricultural wage labor in Upper Volta has been raised by opportunities further south to the point that it is uneconomic for the average Voltaic farmer to employ wage workers on any appreciable scale.

Nonagricultural wages in West Africa have probably also put upward pressure on the supply price of rural wage labor. In any event, Table 2 shows that over the last two decades the returns per man-day to farming in Upper Volta are consistently about half the returns to the lowest form of nonagricultural wage work, as measured by the official minimum wage for unskilled labor. They are also typically less than one third of pay scales for unskilled nonagricultural work in the Ivory Coast.

Recent reports of wage rates in Nigeria suggest a similar situation there concerning labor markets in the north of the country. The going wage for unskilled labor in the south in early 1981 was ₦5.00 per man-day.20/ The peak-season agricultural wage in the north during the 1980/81 season was reported to be about ₦3.2 to ₦3.5 per man-day.21/ Although less than the going price in the south, this represents nearly an 80 percent increase over the peak-season wage rate of ₦1.8 per day for the Funtua Agricultural Development Project only two to three years previously.

The consequences of rapid wage inflation in Nigeria are illustrated in Table 3, which calculates farmers' labor as if it had been obtained in the marketplace. The results show that it was probably profitable to hire labor to cultivate land in the 1978/79 season (with the exception of labor for groundnuts). However, this was no longer the case in 1980/81 for the same expected yields.

The consistently negative returns at the bottom of Table 3 imply that farmers would be unlikely to want to continue to hire labor under these circumstances, and there is an incentive for younger men to migrate in search of wage employment. Naturally, these figures are purely illustrative, listing "average" yields, prices, and wage-rates. Farmers with top yields can probably still make money at the new wage rates by employing labor for only part of the season and taking a loss, in the sense of opportunity cost, on their own labor the rest of the time. Nevertheless, the exercise is valid to demonstrate the effect of the current wage inflation on farming in Nigeria. With free movement of labor under the ECOWAS accords, the effects will probably also be felt further to the north.

20/ This was the wage cited by a number of Nigerian agricultural economists interviewed in Ibadan in February 1981. At the time of this writing one naira (₦) was worth $1.85.

21/ These wages are for the Funtua Agricultural Development Project. The sources are the same as for Table 3 below. These estimates are low. Wage rates of up to ₦5.00 per man-day were observed for ridging work in the critical period in adjoining Giwa district during 1978 (personal communication from Brian D'Silva).

Table 3--Farmers' implicit labor costs and returns in northern Nigeria, 1978/79 and 1980/81

	Sorghum	Groundnuts in the Shell	Cotton
		(₦)	
Producer prices in Naira per kilogram			
1978/79 harvest	0.22	0.20	0.33
1980/81 harvest	0.21	0.29	0.40
Imputed cost of labor per hectare			
1978/79			
Peak season (₦1.8 per man-day)	142	154	184
Other in season (₦1.4 per man-day)			
1980/81			
Peak (₦3.2 per man-day)	268	294	352
Other in season (₦2.8 per man-day)			
Net profits to farming after conservatively costing labor at market rates (per hectare)			
1978/79	45	-11	66[a]
1980/81	-99	-130	-50[a]

Sources: The data underlying this table are drawn from the Funtua Agricultural Development Project. The yields for the three crops are assumed to be constant at the 1978/79 levels reported in F. S. Idachaba, Concepts and Strategies of Integrated Rural Development: Lessons from Nigeria, Food Policy Technical Research Paper No. 1 (Ibadan: Department of Agricultural Economics, University of Ibadan, 1980). This avoids consideration of variations in returns due solely to weather and presents a fair case, since the assumed levels of 844, 713, and 945 kilograms per hectare for sorghum, groundnuts, and cotton are about average for the ecological area. The assumed labor times are also consistent with Table 2. They are 40/50 for sorghum, 35/65 for peanuts, and 40/80 for cotton, where the first figure represents man-days in the peak period and the second is other labor time. The producer price data are the larger of either observed harvest producer prices in the Funtua Agricultural Development Project or the Guaranteed Minimum Producer Price. In practice, the former tend to be greater. They are taken from unpublished figures supplied by the Agricultural Projects Monitoring, Evaluation, and Planning Unit (APMEPU), Kaduna, Nigeria. The wage data were also extracted from APMEPU interview sheets, although it should be stressed that they tend to be lower than figures obtained through casual interviews with sources familiar with the area. The use of conservative figures strengthens the argument presented in the text.

a/ Twenty percent of the official producer price is deducted to cover nonlabor costs.

Implications for Agricultural Price Policy

The main implication of the previous analysis for agricultural price policy is that product prices would have to rise substantially before the returns to labor in family farming would be equal to the return to wage work, given current technological levels. Product prices that would equate the net value of production with the imputed value of labor at 1980 rates are ₦0.32, ₦0.41, and ₦0.47 for sorghum, groundnuts, and cotton, respectively. These prices compare with the observed 1980 values of ₦0.20, ₦0.23, and ₦0.40 in Funtua. That is, the hypothetical equilibrium prices are 1.6, 1.8, and 1.2 times the observed harvest values for sorghum, groundnuts, and cotton. If labor is valued at ₦5.00 per man-day, the legal minimum wage rate in Nigeria which has recently been extended to cover agricultural projects, foodgrain prices would have to rise by a factor of 2.7 under traditional production systems to cover just the opportunity cost of labor.

The crudeness of these calculations preclude drawing conclusions about optimal levels of product prices in northern Nigeria. But they do illustrate that agricultural price increases implemented through policy cannot by themselves radically change the profitability of rural-urban migration. Rather, technological change must occur in agriculture to boost both the marginal and average products of labor, and thus the returns to labor. Furthermore, farmers need to know about the options available to them and must have timely access to the necessary inputs. Finally, there must be a market outlet for increased output so that farmers can benefit from increased production.

The importance of these complements to price policy can perhaps best be seen in the incentive structure between food and export crops within the farming sector itself. In Upper Volta, the ratio of official producer prices per kilogram of seed cotton to sorghum has declined fairly steadily from a high of 3.1 in 1964 to 1.4 in 1978.[22/] On the other hand, Table 2, using the same producer prices, shows that the ratio of returns to labor has gone from 1.8 in favor of sorghum in 1963-65 to 1.2 in favor of cotton in 1978-80. This strong showing of cotton despite a decline in relative price is due to an impressive rate of technical progress over the period which has raised average national yields from 170 kilograms per hectare in 1964 to 960 kilograms per hectare in 1979.[23/]

Voltaic cotton farmers had the good fortune over this period to be able to capitalize upon 30 years of agricultural research on cot-

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22/ Official Voltaic price data from Food and Agriculture Organization of the United Nations (FAO), Producer Prices, 1961-70 (Rome: FAO, 1976); Republique de Haute-Volta, Annuaire des Statistique Agricoles 1977; and various cotton project evaluation reports written for SOFITEX, the Voltaic cotton company.

23/ Food and Agriculture Organization of the United Nations data. The 1979 figure is preliminary.

ton farming systems carried out in neighboring Mali. The Mali experience also gave valuable insights into viable institutions to support smallholder production.[24] Unfortunately, comparable successes for foodgrains are not yet evident in the region, and Voltaic cotton yields appear to have caught up with the state of the art in neighboring countries.

Vastly higher returns to labor in nonagricultural pursuits relative to farming are likely to primarily affect agriculture at the margin. The more labor intensive activities, primarily cash crops, will be abandoned first, as sons migrate and hired labor becomes more expensive. The shift of the terms of trade favoring foodgrains over commercial export crops has accentuated this tendency since the drought of the early 1970s.[25] The majority of rural people will probably continue to farm, perhaps because of lack of real opportunities to migrate to a higher paying nonagricultural job or the transaction cost of doing so. However, the relatively lower return to farming is likely to be associated with an inelastic supply of extra agricultural labor at the margin. Changes in the agricultural incentives structure would then be effective primarily at shifting a relatively fixed amount of total resources from crop to crop. It would presumably have a lesser impact on the expansion of total resources use and aggregate agricultural output. Recent experience in Nigeria is consistent with these hypotheses. Between 1965 and 1978 0.85 million hectares were added to cereal production; however, 0.94 million hectares were withdrawn from groundnut and cotton cultivation.[26]

TENTATIVE CONCLUSIONS AND RESEARCH ISSUES

On their own, price policy measures to increase foodgrain production in traditional West African savannah farming systems will primarily transfer resources into grains from commercial nonfood crops. The key allocation decisions probably concern labor at peak periods. Scope for growth in aggregate agricultural production of the type associated with the introduction of cash cropping may exist in areas where underemployed rural labor still exists. However, such zones are increasingly few in number. It is hard for even the most aggressive agricultural price policy to compete with the lure of the cities in the absence of agricultural technological change.

It is conceivable that simple applications of fertilizer will

24/ See J. C. DeWilde et al., Experience with Agricultural Development in Tropical Africa, vol. 2 (Baltimore: The Johns Hopkins University Press, 1967).

25/ The 50 percent shift in the Voltaic price terms of trade in favor of sorghum relative to cotton cited above is a case in point.

26/ Food and Agriculture Organization of the United Nations, "Production Yearbook Tape, 1978," Rome, 1978.

serve to raise labor productivity for bottleneck periods at some future output price/input cost ratio. This would permit price policy to increase total output. For the time being, however, net benefits at unsubsidized fertilizer prices appear to be marginal for unimproved seeds. Subsidization of input costs in conjunction with output price supports will most likely increase the demand for the input in question. However, the net economic benefits to such a policy need careful analysis. It is at least conceivable that some other use of resources would provide more rapid access to national food security. Furthermore, institutional limits on the aggregate amount of inputs such as fertilizer available to farmers may operate in such a way that the net effect of output price policy is to shift purchased inputs among crops, rather than to increase total input use.

Higher real foodgrain prices are undoubtedly a necessary aspect of policies to increase total input use and production in West Africa. But this should not obscure the fact that higher prices alone cannot solve the problem. Budget resources used to support production through input subsidies or artificially higher procurement prices have an opportunity cost in terms of basic interventions to develop the agricultural sector: improved crops, farming systems research, viable extension systems, reliable input delivery systems, and a means to market the extra output. It is plausible that on a world scale, the West African savannah is particularly deficient with respect to these basic agricultural support facilities.

Higher real foodgrain prices may help stimulate a degree of autonomous technological change in West African farming systems. As existing farm resources are concentrated in grain production, farmers are likely to be ingenious in adapting their problems of labor allocation to spread out operations as much as possible to alleviate the bottleneck period. Improved practices may be devised without outside input. The analysis above, however, illustrates that a breakthrough in higher grain yields per man-day is needed to provide competition with events outside the agricultural sector. Without a "green revolution," rural entrepreneurs are likely to conclude that the action is outside of agriculture.

FERTILIZER USE IN NIGERIAN AGRICULTURE: RECENT DEVELOPMENTS AND POLICY ISSUES

by Abiodun O. Falusi

INTRODUCTION

Significant productivity growth is necessary for agriculture during the Fourth National Development Plan (1981-85) and beyond if Nigeria is to reverse the trends of declining per capita food production, increasing food imports, and high and rising food prices that have become prominent in recent years (Table 1).

Accelerating the growth of food production has become a high priority for the federal and state governments in Nigeria. A food strategy team appointed by the Federal Ministry of Agriculture recently outlined a program of agricultural development that will be used in the National Plan. The program appropriately emphasizes the development of smallholder agriculture as the primary means of achieving a 3.5 percent growth rate in domestic food production. Emphasis is also being placed on modern farm inputs and practices as a means of raising crop yields.1/

Fertilizer is expected to play a major role in the food production program. It is expected to cause 60 percent of increases in food production. Plant nutrient consumption is expected to increase from the 85,000 metric tons during the 1979/80 cropping season to 430,000 metric tons by 1985.2/ The increased emphasis on fertilizer use is easy to understand in view of low soil fertility and plant nutrient use, the possibility of quick production response, the dependence of many technological changes on increased use of plant nutrients, and the possibility of enlarging supplies of fertilizer by increasing domestic production and imports.

A comparison of the trends in fertilizer use as shown in Table 2 with the targets suggested in the food plan clearly suggests the need to accelerate growth in fertilizer use. Annual increases in fertilizer use during the Fourth Plan will have to more than double the maximum annual increase (26,000 metric tons in 1979/80) obtained

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1/ Nigeria, Federal Ministry of Agriculture and Rural Development, The Green Revolution: A Food Production Plan for Nigeria, vol. 1: Main Report, Vol. 2: Annexes, (Lagos: Federal Government Printer, May 1980).

2/ Nigeria, Federal Ministry of Agriculture, The Green Revolution, vol. 1: pp. 21-25; vol. 2: pp. 84-142.

Table 1--Indexes of per capita food production, food prices, and value of food imports, 1970-79

Year	Index of Per Capita Production a/	Index of Food Prices b/	Value of Food Imports c/
			(₦ Million)
1970	102	100	57.7
1971	95	128	88.0
1972	94	132	95.1
1973	86	138	126.3
1974	91	159	155.7
1975	91	224	297.9
1976	91	283	439.0
1977	80	320	736.4
1978	90	327	1,114.6
1979	91	354	1,246.1

Sources: a/ Food and Agriculture Organization of the United Nations, 1979 Production Yearbook, vol. 33 (Rome: FAO, 1980). 1969-71 = 100.

b/ Nigeria, Federal Office of Statistics, The Consumer Price Index, various issues.

c/ Nigeria, Federal Office of Statistics, Nigeria Trade Summary, various issues.

Table 2--Fertilizer consumption, 1970/71 to 1979/80 and requirements, 1981-85

Year	Consumption	Increase in Consumption	
	(1,000 tons)		(percent)
Second Plan[a]			
1970/71	7	...	...
1971/72	9	2	29
1972/73	20	11	122
1973/74	16	-4	-20
1974/75	29	13	81
Third Plan[a]			
1975/76	54	25	86
1976/77	79	25	46
1977/78	74	-5	-6
1978/79	59	-15	-20
1979/80	85	26	44
Fourth Plan[b]			
1981	198.0	...	...
1982	256.0	58	30
1983	314.0	58	23
1984	372.0	58	18
1985	430.0	58	16

Notes: The figures refer to consumption of NPK fertilizers. Data for 1979/80 and before are based on statistics from the Food and Agriculture Organization of the United Nations. The data for 1979/80 are based primarily on consumption data from state ministries of agriculture and natural resources offices and data on shipments from the Federal Office of Fertilizer Procurement in Lagos.

a/ These figures are for the fertilizer year, July 1-June 30.

b/ These figures are from Nigeria, Federal Ministry of Agriculture and Rural Development, The Green Revolution: A Food Production Plan for Nigeria, Vol. 1: Main Report; Vol. 2: Annexes (Lagos: Federal Government Printer, 1980). They are for the calendar year, January 1-December 31.

during the past decade if the targets set are to be realized. The policy requirements for such rapid growth in fertilizer use will form the central theme of this paper.

The specific objectives of the paper are:

1. To identify the main elements of fertilizer policy in Nigeria;

2. To discuss and analyze recent developments in fertilizer use within the context of policy instruments adopted to promote use; and

3. To suggest changes in policy that will be necessary to ensure a broad-based accelerated growth in fertilizer use.

MAIN ELEMENTS OF FERTILIZER POLICY IN NIGERIA

Nigeria's fertilizer policy derives directly from general agricultural development policies. The goal of fertilizer policy is to encourage widespread adoption and use of fertilizers by smallholders as a means of increasing agricultural production and raising rural incomes.3/

Since the introduction of chemical fertilizer use to farmers in the early 1950s, the various governments have sought to promote use by: public procuring of imports; controlling the distribution of available supplies; establishing and regulating distribution outlets; subsidizing the price paid by farmers; and using the operations of the agricultural extension system to encourage adoption of fertilizer use.

In the 1960s and early 1970s the regional/state governments developed and implemented their fertilizer programs independently of one another. Planning, organizing, and operating the fertilizer program (procurement, distribution, price subsidy, sales promotion) were the responsibility of state (formerly regional) ministries of agriculture. There was no national policy or coordination for such matters as procurement, distribution, and prices. The federal government presence was felt only in the allocation of capital grants to states for agricultural development, part of which went toward their fertilizer supply and subsidy scheme.

During the Third Plan, the federal government was more active in the formulation and implementation of fertilizer policy. A national policy for fertilizer procurement, distribution, and pricing was established. The main elements of that policy included: expansion of

3/ Nigeria, Federal Ministry of Economic Development, Third National Development Plan 1975-80, revised edition (Lagos: Federal Government Printer, 1975), p. 171; and Federal Ministry of National Planning, Guidelines for the Fourth National Development Plan 1981-85 (Lagos: Federal Government Printer, 1980), p. 25.

supplies through centralization of procurement and creation of domestic production capacity; a nationally fixed uniform retail price for fertilizers; federal and state subsidies of fertilizer price; fertilizer distribution primarily through public channels (agro-service centers); and promotion of use through the operations of the agricultural extension machinery as well as project authorities in integrated agricultural development project areas.

Other ancillary agricultural development policies that influence fertilizer use include: crop price support; development of irrigation facilities; provision of agricultural credit; agricultural research (including soil fertility research and development of fertilizer-responsive varieties); development of rural infrastructures; and crop marketing improvements. However, as will be shown, fertilizer supply and price subsidy schemes received greater attention than other policy measures during the Third Development Plan.

RECENT DEVELOPMENTS IN FERTILIZER USE

National Trends

As a result of the policy measures discussed above, fertilizer consumption increased rapidly from 7,000 nutrient tons in 1970/71 to 85,000 nutrient tons in 1979/80 (Table 3). This represents an annual average growth rate of 32 percent. Despite this impressive growth, the latest Food and Agriculture Organization of the United Nations report indicates that fertilizer consumption per hectare of crop land (arable land and permanent crops) in Nigeria in 1978 was only 3.1 kilograms compared to a world average of 68 kilograms.[4/]

The most rapid growth in consumption has occurred in nitrogen which has increased at an annual rate of 35 percent since 1970. Phosphate consumption has increased at 26 percent. Very little potash is used in Nigeria; however, because of its very low base, usage has increased at about 33 percent annually since 1970. The NPK ratio has changed from 3:3:1 in 1970/71 to 4:2.2:1 in 1979/80.

Plant nutrient consumption increased considerably during the Third Plan. Average annual consumption was four and a half times greater than during the Second Plan. Some of the factors responsible for this higher use of fertilizer are: increased aggregate availability of fertilizer (Table 4); a more favorable price environment (Table 5); greater emphasis on the use of improved packages of technology in crop production programs such as the National Accelerated Food Production Project (NAFPP) and the Operation Feed the Nation (OFN) campaign; and expanded promotional work by extension personnel.

Although the growth rate averaged over the past decade seems high, annual growth rates (in absolute and percentage terms) were

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4/ Food and Agriculture Organization of the United Nations, FAO Fertilizer Yearbook 1978 (Rome: FAO, 1979), p. 12.

Table 3--Estimated plant nutrient use, 1970/71-1979/80

Year[a]	Estimated Use N	P	K	Total	Annual Change N	P	K	Total	Annual Change N	P	K	Total
	(1,000 tons)				(1,000 tons)				(1,000 tons)			
1970/71	3	3	1	7	...	...	...	...	...	...	...	...
1971/72	4	4	1	9	1	1	0	2	33	33	0	29
1972/73	9	7	4	20	5	3	3	11	125	75	300	122
1973/74	5	6	5	16	-4	-1	1	-4	-45	-14	25	-20
1974/75	13	11	5	29	8	5	0	13	160	83	0	81
1975/76	30	16	8	54	17	5	3	25	131	45	60	86
1976/77	35	30	14	79	5	14	6	25	17	88	75	46
1977/78	35	25	14	74	0	-5	0	-5	0	-17	0	6
1978/79	31	22	6	59	-4	-3	-8	-15	-13	-12	57	20
1979/80	46	28	11	85	11	6	5	22	35	27	83	37

Note: Data from before 1979/80 are based on FAO statistics. 1979/80 data are based primarily on consumption data from state ministries of agriculture and natural resources and data on shipments from the Fertilizer Procurement Unit, Federal Ministry of Agriculture and Rural Development, Lagos.

a/ These are fertilizer years, July 1-June 30.

Table 4--Trends in fertilizer supply to Nigerian agriculture, 1970-80

Year	Domestic Production	Imports	Total Supply	Annual Change	
	(1,000 tons)				(percent)
1970	...	28.1	28.1	...	...
1971	...	38.2	38.2	10.1	36.0
1972	...	75.7	75.7	37.5	98.2
1973	...	61.0	61.0	-14.7	-19.4
1974	...	84.0	84.0	23.0	37.7
Third Development Plan					
1975	...	154.0	151.0	67.0	79.8
1976	21.6	207.0	228.6	77.6	51.4
1977	20.5	299.5	320.0	91.4	40.0
1978	17.3	189.0	206.3	-113.7	-36.0
1979	35.0	394.3	429.3	223.0	108.1
1980	n.a.	500.0a/	500.0	70.7	16.5

Source: Nigeria, Federal Office of Statistics, Nigeria Trade Summary, various issues. The 1980 figures are from the Fertilizer Procurement Unit of the Federal Ministry of Agriculture and Rural Development in Lagos.

Note: n.a. means not available.

a/ These are planned imports.

Table 5--Index number of fixed fertilizer prices paid by farmers and producer prices of major agricultural commodities, 1970/71-1979/80

Year	Ammonium Sulphate	Single Super Phosphate	Sorghum	Rice	Maize	Groundnuts	Cocoa
1970/71	100	100	100	100	100	100	100
1971/72	100	100	146	128	142	117	103
1972/73	100	100	137	129	137	117	103
1973/74	100	100	134	140	133	138	188
1974/75	75	83	161	169	159	372	191
1975/76	75	83	180	241	226	372	229
1976/77	75	83	201	291	260	515	229
1977/78	75	83	211	352	295	585	358
1978/79	75	83	242	352	315	617	358
1979/80	90	100	343	470	395	893	417

Sources: 1970/71 to 1975/76 producer prices are derived from Food and Agriculture Organization of the United Nations, Agricultural Prices, various issues. 1976/77 to 1979/80 producer prices were announced by the government of Nigeria.

unsteady. As Table 3 shows, there were three cropping seasons (1973/74, 1977/78, and 1978/79) with negative growth rates during the ten-year period.

Aggregate use declined for two consecutive cropping seasons, 1977/78 and 1978/79. Not until the 1979/80 cropping season did the annual increment in use reach the 1975/76 and 1976/77 levels, despite the high subsidy on fertilizer prices. Supply management problems and inefficiencies in the distribution system continued to constrain fertilizer use on farms.5/

Trends by State

Because aggregate figures do not reveal spatial distribution of consumption, estimates of fertilizer consumption in different states between 1976/77 and 1979/80 are shown in Table 6 and Figure 1. The ten northern states (Kano, Kaduna, Bauchi, Plateau, Sokoto, Benue, Gongola, Niger, Borno, and Kwara) accounted for 80 percent of total fertilizer consumption annually. Six states (Kano, Kaduna, Bauchi, Plateau, Sokoto, and Benue) accounted for about 60 percent of total use, while three states (Kano, Kaduna, and Bauchi) accounted for 40 percent of total use.

Apart from the factors enumerated in the preceding section, two major reasons account for the greater use of fertilizers in the northern states as compared to the southern states. First, 70 percent of the crop acreage is located in the northern states.6/ Hence, there is a greater scope for expanded use of fertilizers. Second, as a result of the wider scope of promotional work of the extension machinery, there has been a greater diffusion of fertilizer use to previously unfertilized land areas.7/

5/ Previous studies have also highlighted supply and distribution problems as constraints on fertilizer use in Nigerian agriculture. See A. O. Falusi and O. A. Adubifa, Economics of Fertilizer Distribution in Nigeria NISER, March 1975; and J. A. Wells, A. O. Falusi, and A. T. Taylor, Fertilizers and Plant Projection Chemicals in Nigeria: A Review and Recommendations, report prepared for the National Accelerated Food Production Program, International Institute for Tropical Agriculture, Ibadan, 1976.

6/ S. A. Agboola, An Agricultural Atlas of Nigeria (Ibadan: Oxford University Press, 1979).

7/ In the 1960s and early 1970s, when the southern regional/state governments concentrated on land settlement and tree crop development in their agricultural development programs, the then northern regional government and succeeding state governments emphasized activities typical of extension work, such as widespread distribution of subsidized fertilizer backed by an extensive program of on-the-farm demonstrations of recommended cropping practices. For further discussion, see Jerome C. Wells, Agricultural Policy and Economic Growth in Nigeria (Ibadan, Nigeria: Oxford University Press, 1974), p. 268-285.

Table 6--Estimates of plant nutrient consumption in different states, 1976/77-1979/80

State	1976/77	1977/78	1978/79	1979/80	Average Annual Consumption
			(tons)		
Kano	11,530	11,550	9,027	11,300	10,852
Kaduna	13,600	10,064	8,668	10,600	10,798
Bauchi	10,060	8,620	6,100	9,600	8,595
Plateau	5,050	5,910	4,310	6,900	5,543
Sokoto	5,890	5,160	4,130	6,800	5,495
Benue	5,260	7,132	3,304	4,900	5,149
Gongola	4,950	4,070	3,363	5,800	4,546
Niger	4,820	4,484	3,422	4,400	4,283
Oyo a/	3,160	3,330	3,660	5,100	3,813
Borno	3,790	3,700	2,655	3,400	3,386
Imo	1,870	1,850	2,200	3,900	2,455
Kwara b/	2,210	2,110	2,293	3,200	2,453
Anambra	2,760	2,220	1,500	3,000	2,370
Ondo	1,850	2,070	2,140	3,000	2,265
Ogun	1,100	815	910	1,400	1,056
Bendel	600	380	413	800	548
Cross Rivers	400	290	295	300	321
Rivers	80	200	290	500	268
Lagos	20	40	120	40	55
Total	79,000	74,000	59,000	85,000	74,250

Source: These figures are derived from data on fertilizer sales from the ministries of agriculture of the states.

Note: These estimates are for NPK nutrients.

a/ Includes use by the Nigeria Tobacco Company.

b/ Includes use by the Nigerian Sugar Company.

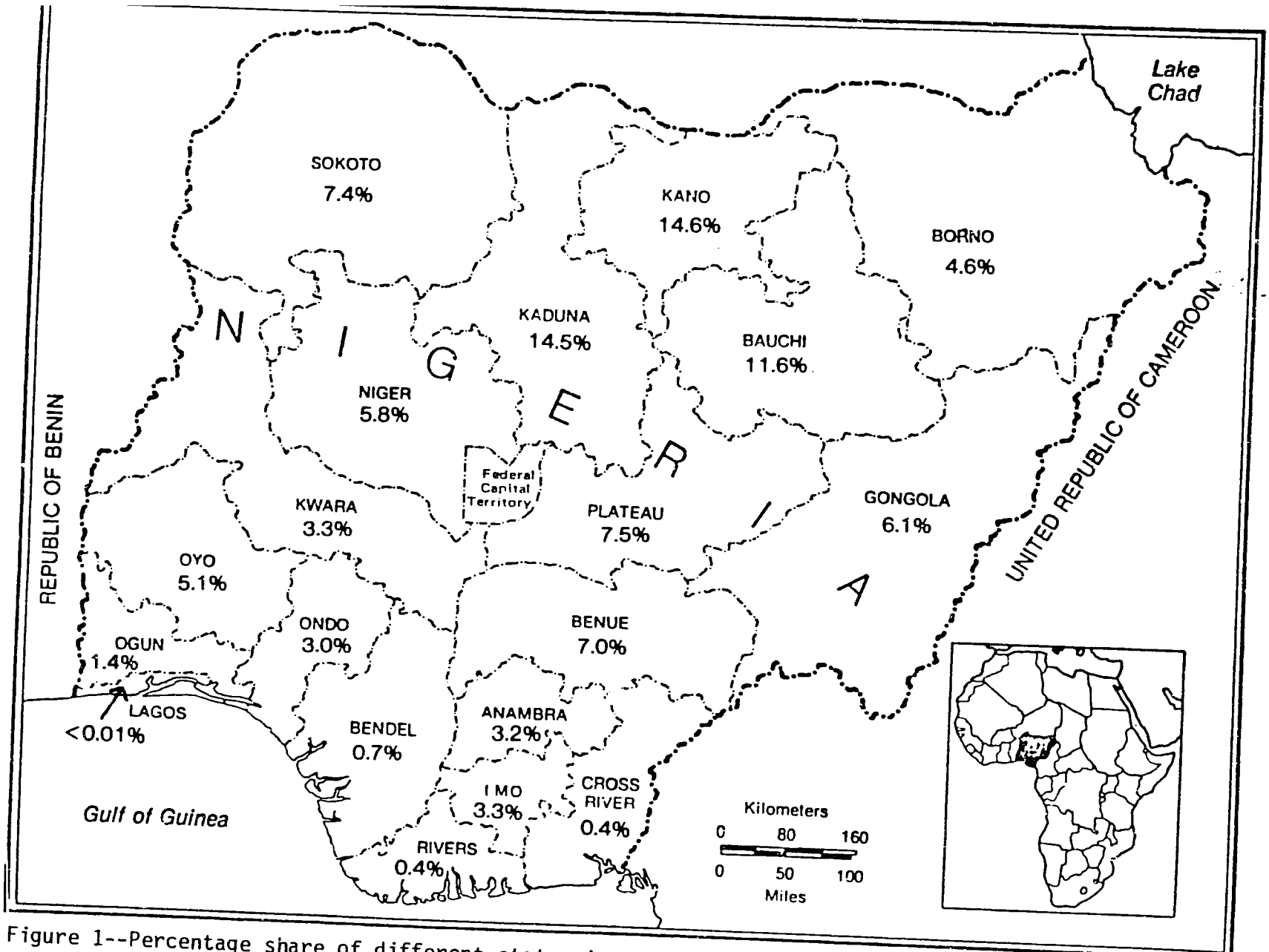


Figure 1--Percentage share of different states in total plant nutrient consumption, 1976/77-1979/80

A high proportion of total fertilizer use in Kaduna, Bauchi, Sokoto, Plateau, and Niger States has been in the agricultural development project (ADP) areas. For example, 35 percent of the fertilizer consumption in Kaduna, 40 percent in Sokoto, and 24 percent in Bauchi took place in the ADP areas of Funtua, Gombe, and Gussau. Fertilizer use in the three project areas accounted for 11 percent of total fertilizer use between 1976/77 and 1979/80, although they contained less than 2 percent of total arable land.

Table 7 shows some characteristic features of the trends in different states. The aggregate decline in fertilizer use during the 1977/78 and 1978/79 cropping seasons affected annual changes in fertilizer use in the states. Seven of the 19 states had two years of negative annual change, 9 had one year of negative annual change, whereas 3 of the states recorded an increase in use for each of the four years. The high instability in annual changes in fertilizer use is particularly noticeable in traditional high-use states such as Kano, Kaduna, and Bauchi.

It should also be noted that despite the high figures for aggregate fertilizer use in Kano, Kaduna, Sokoto, and Bauchi States, per hectare use was below the national average because of the large cultivated area in these states.

Crop Trends

During the 1960s and the early 1970s, more than 60 percent of Nigeria's fertilizer was used on nonfood commercial export crops such as groundnuts and cotton in the northern region and cocoa, oil palm, rubber, and tobacco in the southern half of the country. The food crops (millet, sorghum, maize, rice, cowpeas, yams, and cassava) accounted for less than 35 percent of fertilizer used.8/ The proportions seem to have been reversed in recent years.

According to a recent study, 14 percent of the cultivated area received fertilizers during the 1979/80 cropping season. Estimates of use by crops are shown in Table 8.9/ Almost 80 percent of the fertilizer was used on food crops. The foodgrains, particularly sorghum, millet, maize, and rice, were the major users of fertilizer in Nigeria. Sorghum and millet received the largest amount of fertilizer in 1979/80, although less fertilizer was used per hectare than for many other crops.

The shift in fertilizer use in favor of the food crops during the latter half of the 1970s can be explained by the use of fertilizer on previously unfertilized food crop areas because of promo-

8/ K. L. Robinson and A. O. Falusi, "The Present and Potential Role of Fertilizer in Meeting Nigeria's Food Requirements," Nigerian Agricultural Journal 2 (No. 3, 1974): 100-07.

9/ International Fertilizer Development Center, Nigeria: Fertilizer Marketing Study (Muscle Shoals, Alabama: IFDC, 1980).

Table 7--Characteristic features of fertilizer consumption trends in different states, 1976/77-1979/80

State	Estimated Hectares Planted to Crops 1979/80	Estimated Plant Nutrient Consumption 1979/80	Nutrient Use Per Hectare 1979/80	Average Annual Change in in Consumption 1976/77-1979/80	Coefficient of Variation of Average Annual Change	Annual Change Maximum	Annual Change Minimum	Number of Years With Negative Annual Change
	(1,000 ha)	(tons)	(kilograms)	(tons)	(percent)	(tons)		
Kano	2,001.5	11,300	5.6	-76.7	-3,129.7	2,273	-2,523	1
Kaduna	2,577.6	10,660	4.1	-990.0	-272.5	1,792	-3,536	2
Bauchi	1,215.0	9,600	8.0	-153.3	-2,093.2	3,500	-2,520	2
Plateau	641.3	6,900	10.8	616.7	341.4	2,590	-1,600	1
Sokoto	2,500.4	6,800	2.7	303.3	677.5	2,760	-1,030	2
Gongola	599.5	5,800	9.7	283.3	659.0	2,437	-880	2
Oyo	448.7	5,100	11.4	647.0	107.0	1,440	170	0
Benue	698.7	4,900	7.0	-120.0	-2,678.5	1,872	-3,828	1
Niger	595.0	4,400	7.4	-140.0	739.9	978	-1,067	2
Imo	395.2	3,900	9.9	676.7	133.8	1,700	-20	1
Borno	1,355.0	3,400	2.5	-130.0	-689.0	745	-1,045	2
Kwara	540.0	3,200	5.9	330.0	157.4	907	-100	1
Anambra	255.0	3,000	11.8	80.0	1,541.3	1,500	-720	2
Ondo	287.3	3,000	10.5	383.3	109.5	860	70	0
Ogun	240.0	1,400	5.8	100.0	387.5	490	-285	1
Bendel	768.1	800	1.0	66.7	457.3	387	-220	1
Cross Rivers	235.0	300	1.3	-33.3	-199.2	5	-110	1
Rivers	85.3	500	5.9	140.0	44.6	210	90	0
Lagos	25.1	40	1.6	6.7	1,212.4	80	-80	1
Total	247.1	85,000	5.57	2,000.4	1,068.9	26,000	-15,000	2

Table 8--Nutrient consumption by crops, 1979/80

Crops[a]	N	P_2O_5	K_2O	Total	Percent of Total Fertilizer Use	Percentage of Total Land Area
			(metric tons)			
Foodgrains						
Sorghum	11,295	7,175	1,690	20,160	23.7	30.0
Millet	8,019	4,272	1,080	13,371	15.7	23.5
Maize	7,041	2,589	290	9,920	11.7	4.8
Rice	6,148	2,253	1,017	9,418	11.1	2.5
Groundnuts	...	1,960	...	1,960	2.3	5.8
Cowpeas	...	1,662	...	1,662	2.0	10.2
Wheat	275	84	...	359	0.4	...[b]
Soya bean	...	17	...	17	...[b]	...[b]
Total	32,778	20,012	4,077	56,867	66.9	76.8
Other food crops						
Yams	2,688	2,096	2,862	7,646	9.0	5.7
Cassava	446	233	496	1,175	1.4	5.0
Potatoes	621	243	210	1,074	1.3	0.6
Coco yams	84	38	2	88	0.1	1.2
Vegetables	991	389	609	1,989	2.3	1.2
Total	3,083	2,610	3,570	9,982	14.1	13.7
Nonfood commercial crops						
Cotton	4,281	1,917	...	6,198	7.3	2.3
Sugarcane	2,183	1,283	1,546	5,012	5.9	0.5
Cocoa	1,204	629	417	2,250	2.6	1.7
Tobacco	619	485	662	1,766	2.1	...[b]
Oil palm	290	134	388	812	0.9	3.4
Rubber	67	52	50	169	0.2	1.3
Citrus	3	1	...	4	...[b]	...
Total	9,638	4,890	3,672	18,200	19.0	9.2
Total for all crops	46,219	27,512	11,319	85,050	100.0	100.0

Source: Adapted from International Fertilizer Development Center, Nigeria Fertilizer Marketing Study (Muscle Shoals, Ala.: IFDC, 1980).

a/ Figures derived from Federal Office of Statistics and estimates provided by the ministry of agriculture and natural resources in each state.

b/ Less than 0.1 percent.

tional work by the extension agencies and the development and dissemination of improved crop production technology. This process was enhanced by the increased availability of fertilizer and by the favorable crop/fertilizer price ratio.

There are good economic returns from using fertilizer on food crops. The results of available research studies on various management practices for major crops have been summarized in Table 9. Data are used based on the nitrogen (N), phosphorus (P), and potassium (K) levels that are recommended by the agricultural extension personnel in Nigeria and tests conducted on farmers' fields. These data do not represent general use in Nigerian agriculture; they represent a higher level of technology than that currently used by the average farmer. The amount of fertilizer used, the yield response from this use, the cost of the fertilizer, and the value of additional production are also shown. At the subsidized price of fertilizer, the value/cost ratio for all the major food crops exceeds five. It is also clear from evaluation of the cost of the fertilizer and the value of output achieved that farmers can increase profits by using fertilizer even if fertilizer costs are not subsidized and crop prices are not increased above current levels.

The degree of profitability varies with the specific crop. Fertilizer use is less profitable on cereals (particularly sorghum and maize) and more profitable on root crops. When the fertilizer-related cost, risk, and technology factors are incorporated, using fertilizer on cereal crops may be only marginally profitable.

SOME POLICY SUGGESTIONS

From the discussions in the preceding section, it is quite obvious that changes in policy and institutions will be necessary if the required growth of fertilizer use is to be attained. The heavy emphasis on fertilizer price policy alone will not ensure a vast increase in fertilizer use during the Fourth Plan. The right mix of price and nonprice policy options will have to be adopted. Appropriate mixes of policy measures are needed to increase the aggregate availability of fertilizers, to improve the efficiency of the marketing system, and to generate continuous growth in farmers' effective demand for fertilizers. Some of the institutional and policy changes that will be required are discussed below.

Strengthening the Institutional Framework for Policy Coordination and Program Implementation

For a long time, activities for fertilizer use development have been initiated and regulated by the Ministry of Agriculture at both the federal and state levels. However, there are other public institutions and agencies whose activities will be particularly useful to an accelerated growth of fertilizer use in Nigeria. These include the

Table 9--Average economic response to fertilizer based on selected fertilizer response studies

Crop	Farm Practice	Area	Year	Treatment $N:P_2O_5:K_2O$	Additional Yield	Average Response Control	Subsidized Cost of Fertilizer a/	Unsubsidized Cost of Fertilizer b/	Value of Incremental Output c/	Value/Cost Ratio Subsidized	Value/Cost Ratio Unsubsidized	Source and Remarks
					(kilograms)	(kg per kg of nutrient)		(naira)				
Millet	Improved	Sokoto	1976	17-12-0	338	11.7	5.0	20.0	57.9	11.6	2.9	Joly, 1977; demonstrations
Sorghum	Farmer	Sokoto and Niger	1976	35-24-0	299	5.1	10.0	40.5	51.8	5.2	1.3	Joly, 1977; demonstrations
	Improved	Sokoto and Niger	1976	70-48-0	700	5.9	21.0	81.0	121.3	5.8	1.5	Joly, 1977; demonstrations
Maize	n.a.	Kwara	1970-72	73-40-0	1,288	11.4	22.0	74.2	219.6	10.0	2.9	Poulson, 1975; trials
	n.a.	Bendel	1976	75-34-34	836	5.8	20.2	80.9	142.5	7.0	1.8	NAFPP, 1976; demonstrations
Rice	Farmer	Niger	1976	84-36-0	591	4.9	21.0	76.1	106.1	5.0	1.4	Joly, 1977; demonstrations
	Improved	Niger	1976	126-36-0	1,234	7.6	28.0	96.5	221.6	7.9	2.3	Joly, 1977; demonstrations
	n.a.	Nigeria	1961-71	22-22-22	470	7.1	9.2	39.4	84.4	9.2	2.1	FAO, 1974; demonstrations
Wheat	Indus Variety	Kano	1973-75	80-40-0	1,442	12.0	21.2	78.0	403.8	19.0	5.2	Pandey, 1978; mini-kit
Yams	n.a.	Nigeria	1961-71	22.4-22.4-22.4	2,232	33.4	9.4	40.1	626.5	66.6	15.6	FAO, 1974; trials
Cassava	n.a.	Nigeria	1961-71	24-28-24	4,300	44.8	13.5	55.1	684.5	50.7	12.4	FAO, 1974; demonstrations
Groundnuts	Farmer	Niger and Sokoto	1976	0-18-0	269	14.9	3.5	17.6	78.0	22.3	4.4	Joly, 1977; demonstrations
	Improved	Niger and Sokoto	1976	0-36-0	602	16.7	7.0	35.2	174.0	25.0	5.0	Joly, 1977; demonstrations

Sources: C. Joly, Fertilizer Program--Annual Report of Activities in Sokoto State, 1976 Campaign (Rome: Food and Agriculture Organization of the United Nations, 1977); J. Poulson, Fertilizer Trials in Kwara State, 1970-72, Report 95 (Rome: Food and Agriculture Organization of the United Nations, 1975); National Accelerated Food Production Program, NAFPP: New Dimensions in Nigerian Agriculture (Ibadan, Nigeria: International Institute for Tropical Agriculture, 1976); Food and Agriculture Organization of the United Nations, FAO Fertilizer Program: Review of Fertilizer Trial and Demonstration Results, Nigeria 1961-1971 (Rome: FAO, 1974); and S. J. Pandey, NAFPP Review and Evaluation Report of National Center for Sorghum, Millet, and Wheat, 1974-1977 (Samaru, Nigeria: Agricultural Extension and Research Liaison Service, 1978).

Note: Where n.a. is used, the data were not available.

a/ The subsidized prices used are 0.167 naira per kilogram of N, 0.195 naira per kilogram of P_2O_5, and 0.328 naira per kilogram of K_2O.

b/ The unsubsidized prices used are 0.486 naira per kilogram of N, 0.367 naira per kilogram of P_2O_5, and 0.328 naira per kilogram of K_2O.

c/ These figures are based on the average farm prices in 1979.

Federal Ministry of Finance (in the provision of foreign exchange for imports), the Ministry of Industry (whose responsibility is to develop the domestic fertilizer industry), the Ministry of Science and Technology (responsible for coordinating the activities of the agricultural research institutes), the financial institutions (particularly the Nigeria Agricultural Credit and Cooperative Bank [NACCB] which provides agricultural credit facilities, making the use of fertilizers feasible for the majority of farmers who would otherwise have been unable to meet the capital expense involved). There is a need for a central authority to coordinate the activities of the various agencies/ministries.

It is recommended that a National Committee on Fertilizer Industry Development be formed to plan, organize, and implement programs for the development of the fertilizer sector during the Fourth Plan and beyond. The main functions of the committee would be: to formulate a strategy and master plan for development of the Nigerian fertilizer sector based on identified government policies and programs, delineating the nature and role of government and private enterprise involvement; to mobilize and coordinate the public and private sector organizations involved in fertilizer-related activities into a cohesive and dynamic national fertilizer program; and to prepare a program outline for increasing agricultural production through efficient use of fertilizers.

Improved Supply Management

The supply mechanism for fertilizer in Nigeria needs to be completely restructured if the desired gains from increased fertilizer use are to be forthcoming. The bulk of the fertilizer required during the Fourth Plan will have to come from imports. Thus to achieve the projected increase in fertilizer consumption, efficient planning and management of fertilizer imports will play a critical role.

The Nigerian government should also place a high priority on the completion of the planned Port Harcourt ammonia/urea complex and on operating it efficiently after it is completed. A plan for improving production and efficiency in the single superphosphate plant at Kaduna should be developed and closely monitored.

Improved Delivery System for Fertilizers and Other Farm Inputs

A clearly recognizable constraint to increasing food production in Nigeria has been the inability of both the federal and state systems to adequately cover the farming communities in the transfer of improved technology and in the provision of inputs and facilities for production, processing, storage, and marketing. The inability to supply enough fertilizers to farms at the right time is one of the major constraints to increased use in Nigeria. Persistent scarcities of fertilizer at the farm level are noticeable in traditional high-use areas (Kano, Kaduna, Sokoto, Bauchi, Plateau, and Benue States), where farmers have been exposed to and have recognized the benefits

of fertilizer use. Scarcities of fertilizer at the farm level also make it difficult for the extension machinery to spread use to previously unfertilized land.

The effectiveness of fertilizer price subsidy is also limited by fertilizer scarcities. Excess demand pushes up the effective price paid by farmers, suggesting that the available amount is below what would be demanded at the subsidized price because of inefficiency in procurement and distribution and/or because of the limited budgetary funds available for subsidy. Recent policies such as the establishing of agro-service centers and expanding of fertilizer warehouses have increased access to fertilizers; however, there is still the need for an expanded network of distribution outlets.

Table 10 shows the land area, the number of fertilizer stores, the storage capacity, and the walking radius to a fertilizer store in the different states in Nigeria in 1979. An important reason for the proportional higher use of fertilizer in the ADP areas is in the number of distribution outlets (see Table 11). A significant issue in the development of retail outlets for fertilizers is the role of the private sector in the marketing of fertilizers. During the 1960s and early 1970s, a number of state governments appointed sales agents to complement public sector distribution efforts. However, during the Third Plan their services were dispensed with.10/ The public sector unfortunately neither had the financial resources nor the manpower to fill the vacuum created by the exit of the private sector in retailing activities. Even when resources were adequate, the economic incentives to sell fertilizers to farmers through the public sector have been lacking. The rigid working hours of public agencies have not permitted retail outlets to develop freely, thus pockets of scarcity on farms are common even when stocks are building up in government stores.

Supply management problems and distribution inefficiencies at the retail level largely explain the fall in fertilizer consumption and the high inventory levels during the 1977/78 and 1978/79 cropping seasons (Table 12).

Letting the private sector market fertilizers would allow limited government financial and physical resources to be used in other agricultural programs and would allow agricultural officials to concentrate solely on extension work, particularly on the diffusion of improved crop production technology to farmers scattered over a wide area. It would undoubtedly widen the base for further growth in fertilizer use.

A method for developing a commercial fertilizer marketing organization has been suggested in a recent study.11/

10/ A common criticism against the sales agents was that they usually sold above government fixed-price levels, thereby cheating the farmer of the opportunity to enjoy fully the government subsidy.

11/ IFDC, Nigeria.

Table 10--The distribution of fertilizer stores and storage capacity by state, 1979

State	Land Area	Number of Fertilizer Stores	Total Storage Capacity	Walking Radius of a Fertilizer Store
	(square kilometers)		(1,000 metric tons)	(kilometers)
Borno	116,206	57	35.00	25.5
Sokoto	102,496	163	41.00	14.1
Gongola	91,493	30	41.25	31.2
Kaduna	70,218	204	57.00	10.5
Kwara	66,843	58	40.00	19.1
Niger	65,012	29	23.50	26.7
Bauchi	64,000	94	26.50	19.4
Plateau	58,008	35	30.00	23.0
Benue	45,187	36	25.80	20.0
Kano	43,268	114	56.31	11.0
Bendel	37,687	14	10.40	29.3
Oyo	37,671	26	26.00	21.5
Cross River	27,037	11	9.60	28.0
Ondo	20,951	46	13.50	12.0
Rivers	19,346	15	4.00	20.3
Anambra	17,776	22	11.80	16.0
Ogun	16,756	13	9.50	20.3
Imo	12,205	28	13.00	11.8
Lagos	3,344	8	4.00	11.5

Source: These figures are derived from data from the ministries of agriculture and natural resources of the states.

Note: In some states the fertilizer store is part of the agro/farm service center.

Table 11--Fertilizer use and the distribution of fertilizer stores between agricultural development project (ADP) and nonproject areas in five states of Nigeria, 1979

State ADP/Non-ADP Area	Land Area	Number of Fertilizer Stores[a]	Fertilizer Use (NPK)	Walking Radius of a Fertilizer Store
	(square kilometers)		(1,000 metric tons)	(kilometers)
Kaduna				
Funtua ADP	70,218	204	10.6	10.5
Non-ADP areas	7,500	71	3.4	5.8
	62,718	133	7.2	12.3
Sokoto				
Gusau ADP	102,496	163	6.8	14.1
Non-ADP areas	3,800	42	2.9	3.4
	98,696	121	3.9	16.1
Banchi				
Gombe ADP	64,000	94	9.6	19.4
Non-ADP areas	5,300	50	2.3	5.8
	58,700	44	7.3	20.6
Plateau				
Lafia ADP	58,008	35	6.9	23.0
Non-ADP areas	9,400	20	0.7	12.2
	48,608	15	6.2	32.1
Benue				
Ayangba ADP	45,187	36	4.9	20.0
Non-ADP areas	13,150	16	0.8	16.2
	32,037	20	4.1	22.6

Source: These figures are derived from data from the ministries of agricultural and national resources of the states and the Agricultural Projects Monitoring Evaluation and Planning Unit (APMEPU), Kaduna, Nigeria.

a/ In some states the fertilizer store is part of the agro/farm service center.

Table 12--Availability and consumption of plant nutrients, 1970/71-1979/80

Year	Opening Stock	Domestic Production	Import	Total Availability	Consumption	Closing Stock	Closing Stock as a Proportion of Consumption	Closing Stock as a Proportion of Availability
	(1,000 tons)						(percent)	
1970/71	...	...	7.6	7.6	7.0	0.6	8.5	8.0
1971/72	0.6	...	12.2	12.8	9.0	3.8	42.0	30.0
1972/73	3.8	...	21.5	25.3	20.0	5.3	26.5	21.0
1973/74	5.3	...	17.0	22.3	15.0	7.3	48.7	33.0
1974/75	7.3	...	34.1	41.4	29.0	12.4	42.7	30.0
1975/76	12.4	...	56.4	68.8	54.0	14.8	27.4	21.5
1976/77	14.8	4.0	84.6	103.4	79.0	24.4	30.9	23.6
1977/78	24.4	3.8	54.7	82.9	74.0	8.9	12.0	10.7
1978/79	8.9	3.2	123.0	135.1	58.0	77.1	133.0	57.0
1979/80	77.1	6.5	162.8	246.4	85.0	161.4	190.0	65.0

Source: Derived from Tables 4 and 5.

Fertilizer Price Policy Issues

Nigeria has chosen a high price subsidy to encourage adoption and continued use of fertilizer, to compensate farmers for market distortions, and implicitly to achieve an intersectoral distribution of income. Although this approach has obviously led to a general increase in use (particularly in the northern states), there have been some obvious disadvantages. These include: the lack of a cost-oriented approach in pricing government services that went into the distribution system; the disincentive efforts of uniform pricing (with fixed margins) to private sector participation in retailing activities; and the increased burden on government budget.

Thus, a revision of the fertilizer subsidy scheme is needed: to better reflect the economic value of fertilizer; to encourage an economic pattern of production; to increase the availability of fertilizers; and to ensure the growth of an economically viable commercial marketing system.12/

A Dynamic Crop Technology Policy

The profitability of fertilizer use can be increased by shifting the response function with agricultural technology policy and effective extension programs, by reducing fertilizer prices through fertilizer subsidies and a more efficient marketing system, and by increasing crop prices through price support programs and a more efficient crop marketing system. Consequently, in order to increase the profitability of fertilizer on farms, there is a need for the development and implementation of these policies, with clear priorities set according to their feasibility and cost.

Not enough attention has been paid to crop technology in Nigeria. Far too few resources have been committed to agricultural research for the development of new high-yielding varieties or genetic improvement of local cultivators. During the Third National Development Plan planned expenditures for agricultural research were less than 2 percent of the total public expenditure on agriculture compared to seven percent for the fertilizer supply and subsidy scheme.13/

To broaden the base and accelerate the growth of farmers' demand for fertilizers, Nigeria needs to devote many resources to indigenous research and educational work on crop fertility and fertilization practices, particularly in the southern states. The country also needs to develop and diffuse high-yielding varieties for varied agroclimatic conditions, and to accelerate work on the development of irrigation facilities.

12/ A major work in this regard is currently being undertaken by the author at the International Food Policy Research Institute, Washington, D.C.

13/ Nigeria, Federal Ministry of Economic Development, Third National Development Plan.

POLICY OPTIONS FOR SHORT-RUN EXPANSIONS OF FOOD CONSUMPTION AMONG FOOD-DEFICIT HOUSEHOLDS IN SUB-SAHARAN AFRICA

by Per Pinstrup-Andersen

Calorie-protein deficiencies are a major problem among poor households in many African countries. A self-sustaining solution to this problem must be sought through an integrated growth and equity development strategy. However, recent evidence suggests that the development strategy and public policies followed in a number of countries are unlikely to result in elimination of calorie-protein deficiencies for a long time to come.1/ Thus, in addition to an appropriate long-run development strategy, more directly focused public policy measures are needed to reduce or eliminate calorie-protein deficiencies in the short run.

This paper discusses possible measures to this effect. It addresses some of the policy options open to a government in the light of the underlying economic relationships and available evidence from countries where the various options have been employed. Although the options discussed in the paper may be applicable to any developing country, emphasis is placed on Sub-Saharan Africa in the discussion and in the choice of supporting empirical evidence.

THE NUTRITION AND FOOD CONSUMPTION SITUATION

In another selection in this collection of papers Shubh Kumar

1/ Reutlinger estimates that a continuation of recent historical growth trends through 1990 with unchanged income distribution will result in an increase in the number of calorie-deficient individuals in Africa, even if food supplies are expanded sufficiently to maintain constant real prices for food (Shlomo Reutlinger, The Prevalence of Calorie Deficient Diets in Developing Countries, World Bank Staff Working Paper No. 374, [Washington, D.C.: International Bank for Reconstruction and Development, 1980]). For related evidence from selected countries with high historical growth rates in Latin America, see Marcelo Selowsky, Balancing Trickle Down and Basic Needs Strategies: Income Distribution Issues in Large Middle-Income Countries with Special Reference to Latin America, World Bank Staff Working Paper No. 335 [Washington, D.C.: International Bank for Reconstruction and Development, 1979].

discusses the nutritional situation in Sub-Saharan Africa.[2/] Only a brief overview of food consumption patterns in selected countries and the factors influencing these patterns are presented here.

According to the Food and Agriculture Organization of the United Nations (FAO), 83 million people or 28 percent of the African population had food intakes below the critical minimum limit in 1972-74.[3/] Because there were severe food shortages in the period 1972-74, it is likely that the situation has improved somewhat since then. The nutritional problem is particularly pronounced among small children. Thus, FAO reports that 30-55 percent of all children under five years of age suffered from calorie-protein deficiencies in Burundi (30 percent), Cameroon (41 percent), Central African Republic (39 percent), and Rwanda (55 percent).[4/] Calorie-protein malnutrition also appears to be important among adults, particularly in rural areas. This adult malnutrition seems to be linked with cyclical variations in household income and food supply.

Food consumption is closely related to the level of household income. Although income distribution may be less skewed in Sub-Saharan Africa than in some other regions of the world, the distribution of food is far from equal. Table 1 presents the relative food expenditures for low-, medium-, and high-income strata for selected African countries and for urban and rural areas where such data were available. The relationship between the level of food expenditures and household incomes is clear. In some countries the difference in per capita food expenditures between low- and high-income households is quite large indeed. In rural Chad, for example, a high income household spends $17 for each $1 spent by a low-income household. In Malawi the ratio is 16 to 1. In other countries such as Ghana and Zambia, the difference is much smaller. There is no doubt, however, that food expenditures vary greatly with income, in most of the countries surveyed. Such a relationship is not surprising, but it does emphasize that merely meeting average national calorie-protein requirements will not assure that calorie-protein deficiencies at the household and individual levels are eliminated.

It should be pointed out that relative food expenditures are not an exact indicator of relative food intakes. As incomes increase, higher priced calories are substituted for lower priced ones. Thus, the distributional bias in food intakes is less than the bias in food expenditures. But food intakes are also distributed unevenly among income groups, as illustrated by data from Sierra Leone (Table 2).

2/ See Shubh Kumar, "Nutrition Concerns in Food Policy for Sub-Saharan Africa," elsewhere in this collection.

3/ Food and Agriculture Organization of the United Nations, The Fourth World Food Survey (Rome: FAO, 1977).

4/ Ibid.

Table 1--Percent of average food expenditures by income group for selected countries

Country	Coverage	Income Group			Ratio of High/Low Income
		Low	Medium	High	
		(percent)			
Botswana	Nationwide	62	102	399	6.4
Chad	Rural	29	135	503	17.3
Chad	Urban	29	54	194	6.7
Ghana	Urban(Eastern Region)	75	98	120	1.6
Ghana	Rural(Eastern Region)	74	96	107	1.4
Kenya	Urban	67	91	141	2.1
Lesotho	Rural	92	158	236	2.6
Lesotho	Urban	49	92	172	3.5
Malawi	Nationwide	26	71	422	16.2
Tanzania	Nationwide	48	237	478	10.0
Tanzania	Urban	20	115	262	13.1
Tanzania	Rural	51	252	329	6.5
Zaire	Kinshasa(Urban)	54	89	187	3.5
Zambia	Urban	89	101	129	1.4

Source: Estimated on the basis of data from the Food and Agriculture Organization of the United Nations (FAO), Review of Food Consumption Surveys, 1977, Vol. 2 (Rome: FAO, 1979).

Table 2--Mean annual consumption of principal commodities per consumer equivalent, all households by income group, rural Sierra Leone

Commodity Group	Lowest 3 Deciles (Under 63 Leones)	Deciles 4 Through 7 (63-142 Leones)	Deciles 8 and 9 (143-242 Leones)	Highest Decile (243-515 Leones)
		(kilograms)		
Clean Rice, A	87	161	318	343
Clean Rice, B	77	117	192	230
Cassava	51	61	128	10
Palm Kernel	7	59	104	162
Vegetables	0	23	20	66

Source: Victor E. Smith, et al, Household Food Consumption in Rural Sierra Leone, Working Paper No. 7 (East Lansing, Michigan: Michigan State University, 1979).

FACTORS AFFECTING FOOD CONSUMPTION AND NUTRITION

The factors influencing food consumption and nutrition are briefly outlined in Figure 1. Although the relative importance of each of these factors may vary from one country and intracountry population group to another, lack of adequate food entitlement is likely to be a primary cause of calorie-protein deficiencies where such deficiencies exist. The term "food entitlement", as defined by Amartya Sen, refers to the ability to obtain or "establish entitlement" over a certain amount of food.5/ The food entitlement possessed by a household is arrived at by combining household income with food availability and prices. Changes in household income, whether in money or in kind, as well as changes in commodity prices will influence food entitlement. Changes in food prices and food availability are of particular significance. However, it should be stressed that changes in food supplies affect existing calorie-protein deficiencies only to the extent that the food entitlement of the deficient households is affected. Simple estimates of total per capita food availability for a given country or region are of little or no use as indicators of the magnitudes of calorie-protein deficiencies. Although exceptions may be found, calorie-protein deficiencies usually exist alongside a more or less plentiful food supply. But whether a plentiful food supply exists is irrelevant to households that do not hold adequate food entitlement. A particularly forceful illustration of this point was made by Sen in his analysis of the principal causes of four famines in Bangladesh and Ethiopia.6/ Sen concludes that "what has to be guaranteed to prevent starvation is not food availability but food entitlement." He argues further that "a focus on ratio of food supply to population hides more than it reveals." It has poor predictive power and may suggest the wrong policy measures to deal with starvation.

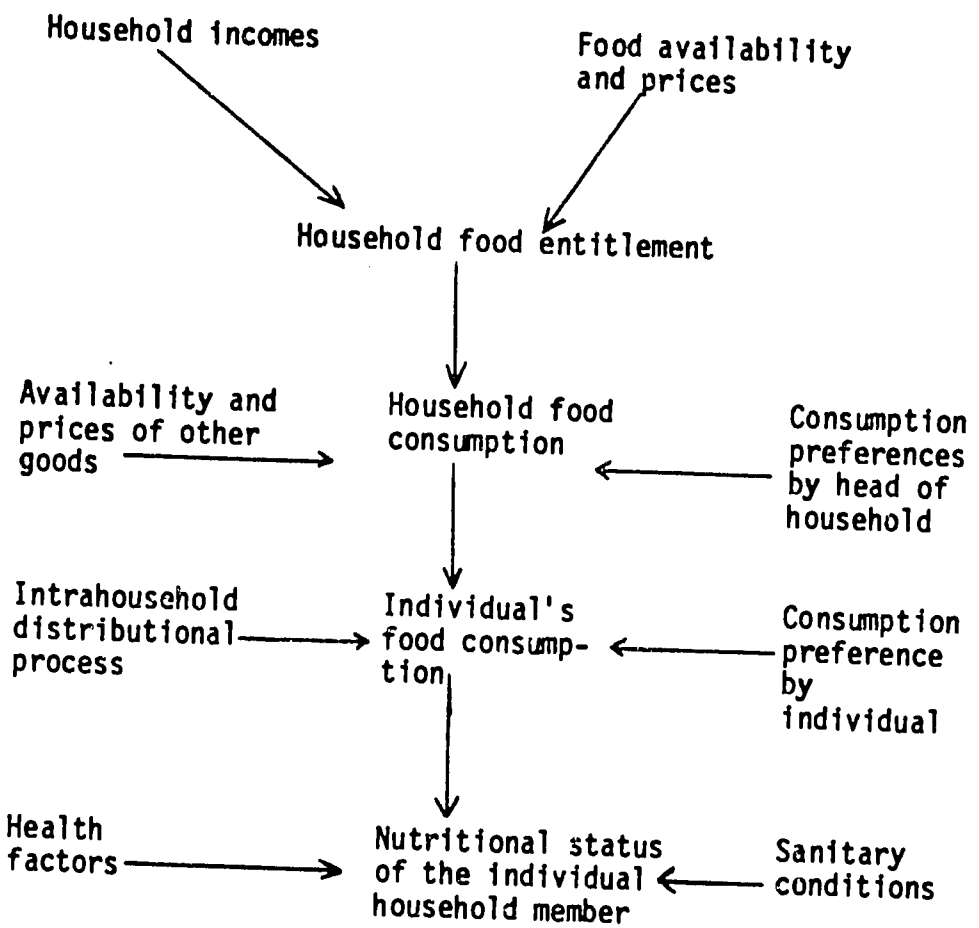
In addition to entitlement, two other factors should be considered in determining household food consumption: consumption preferences of the head of the household, and availability and prices of nonfood commodities and services.

Improving food entitlement among households with members who are calorie-protein deficient need not result in significant reductions in such deficiencies. The improved entitlement may be utilized on food for well-nourished members of the household, it may be spent on foods with low nutritional value, or it may be spent on nonfoods. Furthermore, increasing household incomes may cause commodity substitution--that is, the purchase of more expensive nutrients. Recent evidence from India suggests that such substitution may be significant even in households

5/ Amartya Sen, "Famines," World Development 8 (September 1980): 613-621; and Amartya Sen, "Starvation and Exchange Entitlements: A General Approach and its Application to the Great Bengal Famine," Cambridge Journal of Economics 1 (1977): 33-59.

6/ Ibid.

Figure 1--Factors influencing food consumption and nutrition



where calorie-protein deficiencies are significant.7/ The effects on nutrition of a growth in real income whether in money, in kind, or through price decreases may depend on who in the household decides what the appropriate adjustments in household consumption patterns should be.8/

The impact of changes in household food consumption on the consumption of the individual household members depends on the intrahousehold food distributional process and consumption preferences of the individual household members. Households with extremely limited food entitlement may be faced with a hard choice between maintaining a source of income by allocating sufficient food to income-earning members of the household at the cost of malnutrition among those who are economically inactive or placing high priority on the nutritional status of nonworking members (children) at the risk of losing the income-earning capacity of the household. If, as is usually the case, the person who earns the income controls expenditure patterns and intrahousehold food distribution, nutritional needs of small children may receive low priority. Attempts to improve the nutritional status of small children by means of direct feeding programs or other interventions that can be translated into expanded real incomes of households will cause adjustments in spending patterns and intrahousehold food distribution that may partially or totally offset the desired effect on child nutrition.

The nutritional status of individual household members is also influenced by how the body utilizes the food consumed. A number of factors, including health, diet composition, nutritional balance of the diet, energy density, food processing and preparation as well as general child care and extent of breastfeeding affect utilization. Agricultural policies influence how women allocate their time, which in turn affects nutrition through changes in breastfeeding, child care, food preparation, and eating habits in general. This may be an important consideration in designing food policy.

The factors influencing food consumption and nutrition are interrelated. Changes in one may be ineffective unless others are changed simultaneously. For example, efforts to expand food availability have no nutritional effect if food entitlement is not improved. Similarly, efforts to improve food entitlement may be of little use if food availability is strictly limited or if households with malnourished members do not take advantage of it but instead use additional real income to purchase nonfood commodities.

Many attempts to improve human nutrition focus on one of the

7/ C. H. Shah, "Food Preferences and Nutrition: A Perspective on Poverty in Less Developed Countries," Indian Journal of Agricultural Economics 35 (1980): 1-39.

8/ Jane I. Guyer, Household Budgets and Women's Incomes, Working Paper No. 28 (Boston: African Studies Center, Boston University, 1980); and Shubh Kumar, Role of the Household Economy in Child Nutrition at Low Incomes: A Case Study in Kerala, Occasional Paper No. 95 (Ithaca, N.Y.: Cornell University Press, 1978).

factors while ignoring the rest. Agricultural projects and policies aimed at the promotion of food production often ignore the possibility that the additional food may be unaccessible to malnourished people. Direct nutrition intervention schemes, such as direct feeding or other food transfer programs, frequently ignore the fact that households may not desire to eat the foods provided in the quantities provided and thus may make corresponding adjustments in food purchases. Nutrition education programs may neglect the fact that better nutritional knowledge per se need not improve the access to food.

POLICY OPTIONS

Consumption by food-deficit households may be influenced by many different policy measures. Only those affecting food entitlements in the short run will be treated in this paper. Some policy measures that have a significant short-run impact on food entitlement may include subsidy or income transfer elements, others may not. The effect on food entitlement need not be closely correlated with the degree to which improved food entitlement is a goal of the particular policy measure. Policy measures introduced without regard to food entitlement issues may have significant positive or negative effects on these issues, whereas some policies designed to improve food entitlement may have little impact. A treatment of all policy measures relevant to the food entitlement situation of food-deficit households would involve a comprehensive discussion of economic policy as a whole. In fact, as argued in the introduction, a self-sustaining elimination of calorie-protein deficiencies must be sought as an integral part of total development strategy and not through isolated nutrition intervention programs and policies. However, the latter are essential for alleviating inadequate food entitlements in the short run.

The policy options to be discussed here may be divided into five groups:

1. Policies aimed at improving food production;

2. Food price policies with or without public food distribution, subsidies, and/or differential pricing among population groups;

3. Direct feeding programs;

4. Policies that focus on transferring direct income to food-deficit households; and

5. Food-for-work programs.

POLICIES ORIENTED TO FOOD PRODUCTION

Food availability may be affected by a series of programs, projects, and policies including price, technological change, foreign trade, resource ownership, and distribution, storage, and processing policies. Some policy measures, such as those to expand irrigation facilities for food crops, may increase the quantity of food available, while others, such as policies to make more profitable the production of nonfood agricultural commodities, may reduce the quantity of food available. The nutritional composition or quality of available food may also be changed, either through crop substitution or through changes in the nutritional composition of the individual commodity, for example, higher protein content of a certain commodity.

Food availability should be considered from the points of view of place and time, that is, where and when the food is available. Seasonal variations in local food availability appear to be of great nutritional significance in many parts of Africa.[9/] Food shortages and corresponding high food prices during parts of the year appear to have severe implications for the food entitlement situation of many low-income rural households. Thus, policies aimed at reducing supply and price fluctuations may strongly influence food entitlements and the nutritional status of poor rural households.

The effect of food supply-oriented policies on calorie-protein malnutrition depends heavily on the design and character of the particular policy measures. If the reduction or elimination of existing calorie-protein deficiencies is a major goal of supply-oriented policies, it is important that they be focused on improving the food entitlement situation rather than merely expanding food supplies.

Changes in the amount and kind of food available in the market need not result in corresponding changes in the degree of calorie-protein deficiencies. The amount of nutrients made available by a given project or policy is usually a poor indicator of the nutritional effects, and choosing among alternative policies on the basis of their relative contributions to the quantity of available nutrients is not likely to be effective from a nutritional point of view.

However, expansions of food supply resulting in improved food availability and reduced food prices for food-deficit households could have a significant effect on the level of calorie-protein deficiencies through improvements in the food entitlement situation. Food supply expansions are <u>necessary</u> but not <u>sufficient</u> for eliminating these deficiencies. But improved food entitlement may be both necessary and sufficient.

9/ Sue Schofield, <u>Development and the Problem of Village Nutrition</u> (London: Croom Helm, in association with the Institute of Development Studies, University of Sussex, 1979); and Richard Longhurst and Philip Payne, <u>Seasonal Aspects of Nutrition: Review of Evidence and Policy Implications</u>, Discussion Paper 145, (Brighton: Institute of Development Studies, University of Sussex, 1979).

If the food entitlement approach is applied, considerable attention would have to be paid to the effect of supply policies on endowments and incomes among low-income households as well as the prices of the foods consumed by these households. Thus the choice of commodities for which supply expansions are attempted is of considerable importance. This point is illustrated by a study of the nutritional impact of shifts in the supply curves of individual food commodities in Colombia. It found that the percentage of the supply increase that would be consumed by calorie-deficient households varied from 8 to 30 percent depending on which commodity was considered.[10/] Furthermore, the nutritional effects of export crop policies and policies influencing semisubsistence food production can be more effectively assessed if the assessment focuses on food entitlement rather than on total food supply.

GENERAL FOOD PRICE POLICIES

Government intervention in food pricing is widespread. Many African countries try to keep food prices low so that the economic surplus thus extracted from agriculture can be used to promote industrial development and to improve living standards in urban areas. Such attempts are closely linked to low urban wages and although the direct effects on food entitlement of food-deficit urban consumers are positive, the net effect depends on the relationship between wages and food prices and is not easily determined. Furthermore, direct effects tend to be positively correlated to household food expenditures. The total direct effect increases with increasing household incomes whereas the direct effect as a proportion of household incomes decreases. The direct effect on the food entitlement of food-producing households is negative, whereas the effect on food-deficit households producing nonfood crops is positive. The short-run impact on the food entitlement of food-deficit rural labor may be positive or negative depending on the extent to which rural labor is employed in food or nonfood production, the agricultural labor market, and the proportion of total wage earning spent on food.

Policies for low food prices have adverse effects on employment and earnings in the food-producing sector. If a large proportion of the households that possess inadequate food entitlement depends on food production for their income--a situation not uncommon in Africa --low food prices may be responsible for a major portion of existing calorie-protein deficiencies. Furthermore, maintaining low food prices is likely to worsen the food entitlement situation in the long

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10/ Per Pinstrup-Andersen, Norha Ruiz de Londono, and Edward Hoover, "The Impact of Increasing Food Supply on Human Nutrition: Implications for Commodity Priorities in Agricultural Research and Policy," American Journal of Agricultural Economics 58 (1976): 131-142.

run due to lack of investment and economic progress in the agricultural sector, low earnings by households in the food-producing sector, reduced domestic food supply, and rapid population expansion. The distribution of agricultural land between food and nonfood commodities is influenced by relative output prices. Thus, if food prices are kept low, nonfood commodities would occupy a larger share of the land than would otherwise be the case. Christopher Delgado points out that labor use per unit of land under African cropping conditions tends to be larger in nonfood production than in food production.[11] Thus, it appears that low food prices relative to nonfood prices might contribute to increased rural employment. The effect on food entitlement would then depend on relative wages and the structure of the local food supply. If the local food supply is inelastic, the effect of increased wage earnings from nonfood production on food entitlement may be partially offset by increasing local food prices. On the other hand, if food is plentiful at the existing price, substitution of nonfood for food crops in local agriculture may result in improved food entitlement for the rural poor.

Food prices can be kept below a free market equilibrium for an extended period of time only if certain food rationing schemes are enforced or if additional food is imported to close the demand/supply gap. As shown in Table 3, attempts to maintain low food prices are common in Africa, but overall food rationing is not. However, in a number of cases these policies are ineffective.[12]

In some countries, low food prices are attempted or maintained through food imports and foreign food aid. Dependence on food imports and foreign aid to feed the urban population while extracting the economic surplus from agriculture through low domestic food prices and taxes on agricultural export commodities introduces a dual food consumption structure. In many African countries existing sharp distinctions between urban and rural consumption patterns are largely a result of the above strategy, although inherent consumption preferences and ease of food preparation also play a role. Typically, urban consumers rely heavily on imported wheat and rice, whereas domestically produced millet, sorghum, maize, roots and tubers provide a large proportion of total calorie intake among rural consumers (Table 4).

Policies to maintain low food prices tend to be more effectively enforced for urban staples such as imported wheat and rice than for domestically produced millet, sorghum, roots and tubers. This differential enforcement contributes to a stronger demand for imported wheat and rice than would otherwise be the case.

Urban consumption patterns that depend heavily on imported wheat and rice are vulnerable to changes in the availability of foreign

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11/ See the paper in this collection by Christopher L. Delgado, "Price Policy Research for Accelerated Foodgrain Production in the West African Savannah."

12/ U.S. Department of Agriculture, Food Problems and Prospects in Sub-Saharan Africa (Washington, D.C.: USDA, 1980).

Table 3--Commodities with retail price controls for 38 African countries

Country	Rice		Wheat		Millet and Sorghum	Maize	Roots and Tubers
	Imported Only	Imported and Domestically Produced	Imported Only	Imported and Domestically Produced			
Sahel							
Chad		X		X	X		
Gambia		X					
Mali		X	X		X	X	
Mauritania		X			X	X	
Niger		X			X	X	
Senegal		X	X				
Upper Volta		X			X	X	
West Africa							
Benin		X			X	X	X
Cameroon		X			X	X	X
Ghana		X			X	X	X
Guinea				X	X		
Guinea-Bissau							
Ivory Coast							
Liberia		X					
Sierra Leone		X					
Togo							
Central Africa							
Angola		X	X			X	X
Central African Rep.					X	X	X
Congo			X			X	X
Gabon		X	X				X
Zaire		X	X		X	X	X
East Africa							
Burundi							
Ethiopia							
Kenya		X		X		X	
Rwanda							
Somalia					X	X	
Sudan				X	X	X	
Tanzania		X		X		X	
Uganda					X	X	
Southern Africa							
Botswana					X	X	
Lesotho				X		X	
Madagascar		X					
Malawi							
Mozambique		X					X
Namibia							
Swaziland							
Zambia					X		
Zimbabwe							

Source: U.S. Department of Agriculture, Food Problems and Prospects in Sub-Saharan Africa (Washington, D.C.: USDA, 1980).

Table 4--Principal food staples in rural and urban areas for 40 African countries

Country	Staple Foods	
	Rural	Urban
Sahel		
Cape Verde	Maize	Maize
Chad	Millet, sorghum	Rice, wheat
Gambia	Rice	Rice
Mali	Millet, rice, sorghum	Rice, wheat
Mauritania	Millet, sorghum	Rice, wheat
Niger	Millet, sorghum	Rice, wheat
Senegal	Millet, rice	Rice, wheat
Upper Volta	Millet, sorghum	Rice, wheat
West Africa		
Benin	Maize, millet	Rice, wheat
Cameroon	Maize, millet	Maize, millet
Ghana	Maize, cassava	Maize, cassava, wheat
Guinea	Rice, cassava	Rice
Guinea-Bissau	Rice, cassava	Rice, cassava
Ivory Coast	Cassava, millet	Cassava, rice, wheat
Liberia	Rice	Rice, cassava
Nigeria	Rice, maize, sorghum	Rice, cassava, wheat
Sierra Leone	Rice	Rice, wheat
Togo	Rice, maize, millet, cassava	Rice, wheat, cassava
Central Africa		
Angola	Cassava, maize	Cassava, wheat
Central African Republic	Sorghum, maize, cassava	Wheat, rice
Congo	Cassava, rice, maize	Wheat, rice
Gabon	Cassava, plantains	Wheat, rice
Zaire	Cassava, maize, wheat	Cassava, maize, wheat
East Africa		
Burundi	Maize, sweet potatoes, cassava, plantains, pulses	Cassava, sweet potatoes, pulses, plantains
Ethiopia	Teff, maize, barley, sorghum, wheat	Teff, maize, barley sorghum, wheat
Kenya	Maize	Wheat, maize
Rwanda	Plantains, pulses, maize, sweet potatoes	Plantains, pulses, sweet potatoes
Somalia	Maize, sorghum	Maize
Sudan	Sorghum, wheat	Sorghum, wheat
Tanzania	Maize, rice, cassava	Wheat, maize, rice
Uganda	Plantains, pulses, millet, maize, sweet potatoes, cassava	Plantains, pulses, millet, maize, sweet potatoes
Southern Africa		
Botswana	Maize, sorghum	Maize
Lesotho	Maize, wheat	Maize, wheat
Madagascar	Rice	Rice
Malawi	Maize	Maize
Mozambique	Cassava, maize, wheat, rice	Cassava, wheat, rice
Namibia	Mahangu	Maize
Swaziland	Maize	Maize
Zambia	Maize	Maize
Zimbabwe	Maize	Maize

Source: U.S. Department of Agriculture, Food Problems and Prospects in Sub-Saharan Africa (Washington, D.C.: USDA, 1980).

food aid and grain prices in the world market. Furthermore, low domestic prices for imported grains and the development of consumption patterns favoring such grains reduce urban demand for domestically produced food. This is likely to hamper efforts to promote agricultural development and improve food entitlement of the rural poor through expanded domestic food production. The rapid expansion of demand for livestock products currently seen in parts of Africa may provide an alternative market for domestically produced staples.

In some countries efforts are being made to reduce import demand for grains and to promote substitution of domestically produced food for imports. A composite flour using millet, sorghum, and cassava is being promoted in a number of countries including Senegal, Nigeria, Sudan, and Tanzania. The success of these attempts has been limited so far. Direct import restrictions and associated price increases for wheat and rice have also been attempted in some countries. But they have generally met with strong resistance from urban consumers.

Recent oil price increases and the consequent worsening of the foreign exchange situation of many oil-importing developing countries are placing increasing pressure on governments to reduce food imports. Unless the quantity of foreign food aid is expanded, a number of African countries may have little choice but to make a significant effort to shift current urban consumption patterns toward domestically produced foods. Such efforts would only be successful if accompanied by a rapid expansion of domestic food supplies.

Use of price policy to reduce long-run price and supply fluctuations offers tremendous opportunities for improving food entitlement among food-deficit households. Such policies might focus on seasonal variations as well as fluctuations from year to year. To be effective these policies must be accompanied by facilities for assuring that the necessary food supplies arrive at the place and time required. Improved storage and transport facilities and foreign trade are important elements.[13/]

TARGETED FOOD PRICE POLICIES

Although general food price policies may have significant positive or negative effects on the food entitlements of food-deficit households, their focus and scope extend far beyond these effects. If price policy is used solely or primarily to improve food entitlement, its effectiveness will be greater if it is targeted to the population groups with the greatest need.

Nontargeted policies to maintain low food prices benefit food consumers according to how much they consume, not according to the size of their food deficit. In addition, low food prices have adverse effects on the food entitlements of households for which food production provides the principal source of income, unless the lower food

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13/ See Alberto Valdés, "Issues on Food Security in Developing Countries," elsewhere in this book.

prices are maintained by means of government subsidies. If inadequate food entitlement is more severe in the food-producing sector than among urban consumers, it is unlikely that low food prices will improve the overall food entitlement situation unless subsidized. And this does not take into account the adverse effects on food supply and agricultural development in the longer run.

On the other hand, if low food prices can be directed to households with inadequate food entitlement without adversely affecting producer prices, the food entitlement situation might be greatly improved. Such targeted food price subsidy schemes are common in many developing countries, for example, India, Bangladesh, Pakistan, and Egypt.

Although government food subsidies are found in a number of African countries, these subsidies are usually applied to the commodity in general. Directing subsidies to specific population groups is much less common.

TARGETING

The cost-effectiveness, that is, the government cost of improving food entitlement among food-deficit households by a certain amount, is positively correlated with the degree of targeting, at least up to a certain level. This is because targeting excludes some or all nondeficit households from sharing in the benefits from the subsidies. However, the administrative costs of operating a food price subsidy program increase in proportion to the degree of targeting. Thus, there is undoubtedly a point beyond which increases in administrative costs exceed the reduction in costs due to benefit leakages to nondeficit households.

Targeting implies restriction of eligibility or participation. It may also imply rationing of the quantity of food that can be obtained under the subsidy program. Targeting may be based on a number of criteria, the most obvious of which would be household income. While this is in fact used as a criterion in certain programs it is usually quite difficult to obtain a reasonably accurate estimate of individual household incomes. A second criterion that is frequently used relates to the location of the outlets for subsidized foods. The approach is to select neighborhoods with a high proportion of households apparently suffering from inadequate food entitlement and to place outlets for subsidized foods in those neighborhoods. A main source of potential leakages in this case would be purchases by consumers from outside the neighborhood. A third criterion may be that of selecting malnourished individuals at existing health clinics. This approach is used in a number of integrated health and nutrition programs, for example, the rural health clinics in Costa Rica. A certain degree of targeting may also be provided in cases where the customers desiring to purchase subsidized foods must wait in line for a long period of time. Whether the long wait is intentional or merely a result of inefficient operation of the program, a

higher alternative cost of time may discourage participation by higher-income groups. Of course, if the subsidy is sufficiently large, higher income groups may hire persons to wait in line for them. Targeting can also be accomplished by offering lower quality foods or those commodities that are generally undesirable to higher income groups. There are many cases where this approach has been used.

CHOICE OF COMMODITY

In addition, making an effective choice of commodities to subsidize depends on a number of criteria. First and foremost, the commodity chosen should reflect the nutritional needs of the target population. Second, it should be readily available. Frequently, certain commodities are available on concessional terms under foreign food aid programs. Use of these commodities would greatly reduce government costs of a subsidy program. Furthermore, it might reduce the need for domestic procurement of food at a price below market prices at the expense of the producing sector. However, great care should be taken to avoid the extensive use of food aid commodities that are not readily produced in the country, because consumer preferences may be generated that may be difficult to meet out of domestic production at a later time. Third, it is important that the commodity chosen has a high price elasticity among target households and commands a large share of their food budget. Finally a chosen commodity should provide relatively inexpensive nutrients; that is, the price per unit of the nutrient that the program is attempting to provide should be low.

IMPLEMENTATION

Targeted food price subsidy programs may be implemented in various ways. In some cases such as in Kerala, India, public ration shops distribute the food. The food may also be distributed through private shops or a combination of private and public shops, as is done in Egypt. If attempts are made to identify target households, these households may be issued ration cards or food stamps that may be exchanged for subsidized foods. Such measures both identify the target household and ration the amount of food that can be obtained under subsidy. Although food price subsidy policies have been implemented with reasonable success in many urban areas, their success has been limited indeed in rural areas. In fact, relatively few attempts have been made to even try to reach the rural poor with these programs.

There are a number of intriguing questions involved in the design of a subsidy program. For instance, should food entitlements be tradable? Should free market price formation be permitted for the commodities under subsidy in parallel markets?

Obtaining food for the subsidy programs also presents difficult questions. These include the most appropriate way of procuring food domestically and the proper combination of foreign food aid, commercial imports, and domestic procurement. Procurement schemes that include producer prices below free market prices may be hard to enforce and may introduce not only large administrative costs but also large economic costs for the agricultural sector.

The implementation of targeted food price subsidy programs also may be difficult. Correctly identifying target groups and assuring that subsidized food is in fact obtained by these groups may be a much greater and more costly task than what is envisaged prior to initiating the program. As a result, a large proportion of the subsidized food may actually go to nontargeted households while administrative costs run high.

Another drawback of targeting relates to intrahousehold food distribution. Calorie-protein deficiencies are usually most pronounced among children. But improvements in household food entitlements are unlikely to be passed on totally to food-deficit children. Thus, leakages should be expected not only to nontarget households but also to nondeficit members of target households. Finally, a portion of the increase in real income of target households which is generated by food price subsidies will probably be allocated to commodities other than food and/or to higher-priced calories.

GOVERNMENT COST OF SUBSIDY

The budgetary costs of food subsidy programs depend on the price wedge that must be introduced between the government purchase price and selling prices. The size of the wedge, in turn, depends on the source and price of the food available to governments and the desired consumer price level. Sometimes the wedge may be quite large whereas at other times the government may actually sell low-cost food aid commodities at a profit.

In Egypt, the domestic selling price of subsidized wheat is reported to have been only 28 percent of the import costs in 1974.[14] An even larger price wedge was introduced for vegetable oil in Egypt, which was reportedly sold at 12 percent of the import cost in 1975.[15]

Budgetary costs may be quite large. In Sri Lanka food price subsidies accounted for 18 percent of total government current expenditures in 1975.[16] In Bangladesh, the costs of food subsidy programs

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14/ Jeffrey M. Davis, "The Fiscal Role of Food Subsidy Programs," IMF Staff Papers 24 (March 1977): 100-127.

15/ Ibid.

16/ James D. Gavan and Indrani Sri Chandrasekera, The Impact of Public Foodgrain Distribution on Food Consumption and Welfare in Sri Lanka, Research Report 13 (Washington, D.C.: IFPRI, 1979).

are estimated at 14.7 percent of total government current expenditures in 1979.[17] In Egypt an even larger share of government expenditures was spent on food subsidies. Egypt reportedly spent about $1.4 billion or about 23 percent of government current expenditures in 1979.[18] These high government costs together with the implications for foreign exchange spending have forced governments in some countries to reduce the size of existing food subsidy programs. Such reductions have occurred recently in the Sudan, Sri Lanka, Jamaica, and other developing countries.

THE EFFECTIVENESS OF SUBSIDY PROGRAMS

Studies of food subsidy programs in Kerala, India; Sri Lanka, Bangladesh; and Pakistan conclude that such programs may provide an effective means of reducing calorie-protein deficiencies among low income households.[19] However, both costs and benefits of subsidized food price policies appear to be high in many cases. But even if the benefit/cost ratio is favorable, scarcity of public revenue may prohibit the introduction and/or maintenance of large-scale food subsidy programs unless new sources of government revenue are identified. One possibility would be to place a tax on luxury goods, including certain foods, and to use the tax revenues to subsidize foods primarily consumed by households with inadequate food entitlements. Another possibility would be to use the revenues obtained from free market sales of foreign food aid commodities. In the case of some African countries where sluggish demand for domestically produced food is a major constraint to production expansion, the possibility of intro-

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17/ Raisuddin Ahmed, Foodgrain Supply, Distribution and Consumption Policies Within a Dual Pricing Mechanism: A Case Study of Bangladesh, Research Report 8 (Washington, D.C.: IFPRI, 1979).

18/ Karima Korayem, "The Impact of the Elimination of Food Subsidy on the Cost of Living of the Urban Population in Egypt," paper presented to the International Labour Organization, 1980, and IMF statistics.

19/ Shubh K. Kumar, Impact of Subsidized Rice and Food Consumption and Nutrition in Kerala. Research Report 5 (Washington, D.C.: IFPRI, 1979); Beatrice L. Rogers and F. James Levinson, Subsidized Food Consumption Systems in Low-Income Countries: The Pakistan Experience, Discussion Paper 6 (Cambridge, Mass: MIT International Nutrition Planning Program, 1976); Beatrice L. Rogers, "Consumer Food Price Subsidies and Subsidized Food Distribution Systems in Pakistan" (Ph.D. dissertation, Brandeis University, 1978); P. S. George, Public Distribution of Foodgrains in Kerala--Income Distribution Implications and Effectiveness, Research Report 7 (Washington, D.C.: IFPRI, 1979); Gavan and Chandrasekera, The Impact of Public Foodgrain; and Ahmed, Foodgrain Supply.

ducing a tax on imported wheat and rice for the purpose of subsidizing domestically produced commodities might be explored. However, such a solution may not be politically feasible because of its adverse effect on the real incomes of middle- and high-income urban consumers.

DIRECT FEEDING PROGRAMS

To reduce these leakages and thus increase cost effectiveness, some countries have opted for direct feeding of individuals deficient in calories and protein, usually children and pregnant women. School lunch programs and feeding of preschool children in health and nutrition clinics are examples of such direct feeding. Assuming that the individuals are correctly identified, the leakages to nontargeted households may be eliminated. However, intrahousehold leakages will still occur through reductions in the allocation of food to these individuals at home. In a study that reviewed over 200 reports of past food distribution programs for young children, it was found that the net increase in food intake by the target recipients was 45-70 percent of the food distributed.[20/] Thus, the leakage varied between one half and one third of the food provided. But even though it did not completely reach the target population, such leakage may have benefited the households of which the target children were members through added real household income and improved nutrition of other household members. The leakage is merely a reflection of household preferences regarding expenditure and consumption patterns as discussed earlier. Nevertheless, if the purpose of the direct feeding programs is to improve nutrition of certain target groups and not to transfer real income, then these programs have generally not been too successful although they may present the most cost-effective alternative.

DIRECT INCOME TRANSFERS

If administrative costs of targeted subsidy policies and direct feeding programs are high, implementation is difficult, and leakages are large, why not rely on direct income transfers to households with calorie-protein deficits? In some cases such direct income transfers may be preferable. However, in low-income countries administrative costs of such programs would also be high and implementation difficult. From a political point of view, direct income transfers tend to be less acceptable than food subsidy schemes or direct feeding programs. Political resistance to programs directly aimed at a reduc-

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20/ G. H. Beaton and H. Ghassemi, "Supplementary Feeding Programmes for Young Children in Developing Countries," report prepared for UNICEF and the ACC Subcommittee on Nutrition, 1979.

tion in starvation and malnutrition is likely to be much less severe than political resistance to direct income transfers, even though the former results in transfer of real income that is at least partially fungible.

Another argument against direct income transfers is that food price subsidy and direct feeding schemes reduce food prices relative to other commodity prices and thus contribute to a substitution of food for nonfoods that would not occur as a result of a direct income transfer. Finally, there is some evidence that for food the marginal propensity to consume (MPC) is higher for real incomes originating from food subsidy programs or direct feeding schemes. The reason for differences in MPC is probably to be found in the differences in preferences of different household members and the relationship between source of income and intrahousehold distribution of budget control (as discussed earlier).

FOOD-FOR-WORK PROGRAMS

If food is available, for example, from foreign aid, food-for-work projects may be effective in promoting development in rural areas with excess labor supply through the creation of rural infrastructure and expanded employment and incomes among low-income households. Such projects may be effective in improving food entitlement of food-deficit rural households through the additional food and incomes provided to workers.

CRITERIA FOR CHOOSING PROGRAMS

The most widely used criterion for selecting and designing the desired policies and program is cost-effectiveness. This is defined as the budgetary cost of obtaining a certain improvement in food entitlement among food-deficit households or alternatively of obtaining an increase in calorie or protein consumption among deficient households or individuals. Although cost-effectiveness may provide useful guidelines for the choice and design of policies and programs, it "is clearly incomplete from the point of view of a full welfare economic analysis."[21/] First, the cost reflects government budgetary outlays regardless of whether outlays are resource costs or simply transfers. Second, the measure implies that each additional unit of consumption has the same value to society. Clearly, the value of an additional unit of consumption would depend on the degree of deficiency. Third, leakage of benefits from subsidy programs to non-targeted groups are considered to have no value to society.

21/ Marcelo Selowsky, "Target Group Oriented Food Programs: Cost-Effectiveness Comparisons," American Journal of Agricultural Economics 61 (December 1979): 988-994.

If costs and benefits could be properly estimated, a social benefit/cost analysis would clearly be more appropriate than a cost-effectiveness analysis. A cost/benefit analysis based on a social demand function has been suggested by Arnold Harberger and further developed and applied in empirical analysis by Pasquale Scandizzo and Odin Knudsen.[22/]

The likelihood of successful implementation and control of subsidy programs should also be part of deliberations on the choice and design of specific policies and programs. As mentioned above, some subsidies are extremely difficult to implement and control. Thus, this issue should be considered in the estimation of cost-effectiveness or the cost/benefit ratio.

The impact on the agricultural sector is another criterion that should be considered. The real resource cost to the sector and the economy as a whole is not included in the cost-effectiveness analysis and should be considered separately. Similarly, the foreign exchange requirements tend to differ among the various programs and policies. Because foreign exchange limitations are a serious issue in many developing countries, deliberations regarding the choice and design of food subsidy schemes must necessarily include an estimate of the impact on them. An additional point to be considered is that food subsidy schemes may result in large transfers of real income to low-income households even though only a portion is spent on food. As an illustration of this point, Stevens reports that food subsidy schemes in Botswana provided approximately one-third of the total real income of low-income households.[23/] Thus, both the nutritional impact and the impact of real incomes should be considered. Although the policies and programs must be chosen thoughtfully and implemented carefully, subsidies are an important tool for alleviating protein-calorie deficiencies in the short run.

22/ Arnold Harberger, "On the Use of Distributional Weights in Social Cost-Benefit Analysis," a supplement of the Journal of Political Economy (April 1978); Arnold Harberger, "Basic Needs Versus Distributional Weights in Social Cost-Benefit Analysis," background notes for a seminar of the International Bank for Reconstruction and Development, 1979; and Pasquale L. Scandizzo and Odin K. Knudsen, "One Evaluation of the Benefits of Basic Need Policies," American Journal of Agricultural Economics (February 1980): 46-57.

23/ Christopher Stevens, "Food Aid and Nutrition: The Case of Botswana," Food Policy 3 (February 1978): 18.

ISSUES ON FOOD SECURITY IN DEVELOPING COUNTRIES*

by Alberto Valdés

INTRODUCTION

Several developing countries have established explicit consumption policies for their urban populations. Some are also expanding these policies to their rural sectors. A prime objective of such policies is to achieve and maintain food security: that is to provide an adequate and stable diet for all people, and in particular to raise the nutritional status of the poorest segments of their populations.

Policies to achieve food security often depend on foreign supplies, and thus have direct implications for food import policy. The latter must balance the need to stabilize food supplies (and hence prices) with the pressure to economize on imports.

Every country can take important steps to reduce food insecurity. The remedies will usually include large investments in food distribution systems, transportation and communications, early warning systems, and a mix of stock and trade policies. An effect of policies which attempt to stabilize food consumption is that the government budget and the foreign trade balance have to absorb the instability. This also applies to food subsidies that are financed through government accounts. This is one of the fundamental constraints at the national level.

Several national and international strategies are currently being considered that would enhance food security. These include policy changes at the national level in developed and developing countries, greater reliance on an international grain reserve system, food aid, and compensatory financial schemes to alleviate the foreign exchange constraint. International initiatives to reduce world price instability and provide external financial assistance would reduce the cost of national solutions for less-developed countries (LDCs), but they would not substitute for them. In fact, realizing benefits

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*Research on which this paper is based is part of a study undertaken by IFPRI on various aspects of food security. Parts of this paper draw upon the following articles: Alberto Valdés and Ammar Siamwalla, "Food Security for Developing Countries," in Food Policy, November 1980; Alberto Valdés and Panos Konandreas, "Assessing Food Insecurity Based on National Aggregates in LDCs" in Food Security for Developing Countries, ed. Alberto Valdés (Boulder, Colorado, Westview Press, 1981).

from international approaches largely depends on the efforts of LDCs to improve their information and internal food distribution systems. Without greater investment in crop forecasts, transportation, and food distribution, the actual benefits to LDCs of international initiatives are likely to be limited.

The aim of this paper is to improve understanding of food security problems in LDCs, with some emphasis on Sub-Saharan Africa, and to assess the relative merits of national and international intervention schemes currently being considered.

THE NATURE OF FOOD INSECURITY

Food security may be defined as the ability of food-deficit countries, or regions, or households, to meet "target levels" of consumption on a year-to-year basis. The answers to two questions are central to a country's food policy: what constitutes a target consumption level, and which groups comprise the target population?

A target for consumption can be based on a minimum recommended level according to nutritional criteria, on an average level calculated over a number of years, or on the trend level of consumption. In this article food security is viewed as a problem of short-term variability around trend or the average level of consumption. Chronic malnutrition associated with persistent poverty is a long-term problem, the solutions to which lie well beyond the single issue of food insecurity.

The problem of target population can be analyzed as the ability of a household, region, or nation to attain food security. Although food supplies may be stable for a nation as a whole, there may still be large segments of the population whose food supplies are insecure if the nation does not have sufficient means to deliver food to the households exposed to food insecurity risks.

The causes of food insecurity can be divided into two categories: production fluctuations in food or nonfood sectors, and price fluctuations in the affected food and/or nonfood commodity. For a country, variability in food supplies may have many causes. A basic underlying cause is the effect of weather on the size of the harvest. Sudden acute shortages may also be the consequence of natural disasters such as floods or political disasters such as the current Ethiopian-Somalian conflict. Food insecurity resulting from natural disasters or war is distinct from chronic forms of food insecurity in that it involves disruption of the normal channels of delivery of food to the afflicted area in addition to production shortfalls. In such cases political and engineering solutions are needed rather than economic ones because the quantities of food required are relatively small and the humanitarian grounds for providing them are so evident. These problems are not considered in this paper.

Changes in the price of food and nonfood imports and unstable export revenues may also affect food security considerably. In fact,

the demand for foreign exchange to meet food import requirements in normal production years can coincide with reduced export earnings and/or increased costs of nonfood imports. The balance-of-payment position of a country can be such that the country is unable to increase imports sufficiently to stabilize domestic food supplies.

The essence of the problem of instability in food consumption is the underlying fluctuations in real income within a country. These fluctuations in income will ultimately alter the food consumption of the farmer, of the laborer, and of the urban consumer. It follows that if fluctuations in a country's disposable income could be controlled, stable food consumption could be attained, at least at the country level and probably for a large portion of the population. The standard, and usually costly solution, is to hold assets in the form of food stocks themselves, or in the form of monetary assets that are highly liquid so that they can be readily converted to food. Both at household and country levels, determining which assets to hold is a portfolio management problem, which may be solved by using conventional economic criteria. Furthermore, to avoid the perceived risk of dependence on foreign supplies for food, a country can attempt to build food security by increasing its self-sufficiency in food. But, regardless of the form, investments to increase security usually have lower returns than alternative investments in plants and machinery, land, or education. Therefore, attaining food security is costly. The solution at the national level lies in the proper choice of instruments for cancelling out the pluses and the minuses in the real-income fluctuations caused by price and production fluctuations.

VARIABILITY IN CONSUMPTION AND PRODUCTION AND CONSTRAINTS TO FOOD IMPORTS

Food security has often been identified solely with cereals even though the share of cereals in total food consumption varies considerably from country to country. Although grains are the major food imported by most countries, in Sub-Saharan Africa noncereal consumption is extremely important. Nevertheless wheat is the principal traded food used to meet shortfalls in domestic production of food staples worldwide.

In this brief quantitative assessment,1/ food consumption is defined to include cereal and other major staples (pulses, groundnuts, root crops, and plantains). Instability was measured around the long-term trend (1961-76), using the coefficient of variation as an indicator of variability (see Table 1). The observed consumption variability ranged from a low of 3-4 percent in the Philippines and Peru to a high of 20-25 percent in Morocco and Algeria. In Sub-Saharan Africa it was relatively low, especially in Nigeria,

1/ The availability and quality of data is a serious limitation for this analysis. The best that can be hoped for is to at least obtain an approximate order of magnitude of trends and variability.

Table 1--Variability in staple food consumption for selected LDCs, 1961-76

Country	Staple Food Consumption Instability: Standard Deviation[a]	Staple Food Consumption Instability: Coefficient of Variation	Probability of Actual Consumption Falling Below 95 Percent of Trend
	(1,000 metric tons)	(percent)	(percent)
Asia			
Bangladesh	1,013	7.6	26
India	5,570	5.3	17
Indonesia	1,204	6.1	21
Korea, Republic of	531	6.5	22
Philippines	192	3.3	6
Sri Lanka	163	8.3	27
North Africa/Middle East			
Algeria	667	24.6	42
Egypt	1,164	12.6	34
Jordan	88	21.2	40
Libya	115	16.2	38
Morocco	933	19.3	40
Syria	360	18.7	39
Sub-Saharan Africa			
Ghana	134	6.1	21
Nigeria	965	5.6	19
Senegal	319	15.7	37
Tanzania	517	14.6	37
Upper Volta	126	9.5	30
Zaire	172	4.1	11
Latin America			
Brazil	1,955	5.8	20
Chile	386	14.4	36
Colombia	147	4.7	14
Guatemala	69	6.9	24
Mexico	757	5.3	17
Peru	110	3.9	10

Sources: Data for cereals and other major staples from Food and Agriculture Organization of the United Nations (FAO) Production Yearbook (Rome: FAO, various years); net cereal imports from FAO Trade Yearbook (Rome: FAO, various years); and cereal stocks from U.S. Department of Agriculture data. Sensitivity of results differs according to different sources and to the exclusion of stocks.

a/ Defined as the standard deviation of the variable $C_t - C_t$.

Zaire, and Ghana. It was high in Senegal and Tanzania where a consumption shortfall below 95 percent of trend occurred once every 2.7 years.

It is generally assumed that shortfalls in domestic production are the basic cause of consumption deficits. This need not be the case, for the urban population at least, if the country has the capacity to vary its food import volume to compensate for the fluctuations in production. An alternative to relying on imports is to release stocks. But historically for most LDCs carry-over stocks of grains (beyond working stocks) are of no practical significance. Very few countries have any stocks at all.

As shown in Table 2, food production in Nigeria, Zaire, and Ghana has been relatively stable compared to other regions whereas in Senegal and Tanzania it has been unstable. A comparison of Tables 1 and 2 suggests that neither imports nor stocks have been effectively used to reduce consumption instability in the latter two countries. For some low-income LDCs, the large rise in cereal imports has placed severe pressure on their balance of payments and their internal food distribution systems. The situation varies from country to country and so does the ability to finance food imports.

As a rough indicator of the pressure of food imports on the balance of payments from 1965 to 1977, Table 3 presents the average ratio of the food import bill to total export revenues from goods and services for 24 LDCs. These results indicate that during normal years the mean ratio is relatively low for the countries in the Sub-Saharan Africa sample. Senegal and Tanzania are the most dependent on imports. With the exception of Tanzania, the ratio is relatively stable for this group of countries.

But in years of production shortfalls and/or higher import prices, the pressure of the food import bill on the country's overall import capacity has been considerable, as shown in column 4 of Table 3. The ratio is remarkably low even at its maximum value in Nigeria, Zaire, and Ghana.

POLICY CHANGES AT THE NATIONAL LEVEL IN DEVELOPING COUNTRIES

As discussed earlier, food insecurity is ultimately a problem that arises from fluctuations in real income. A logical solution is to provide credit facilities or grants (including food subsidies), which would enable countries and individuals within these countries to survive the bad years.

For those in urban areas, stabilizing consumption is synonymous with stabilizing prices, which is attainable if a nation is able to adjust its imports and/or the level of its stocks to compensate for fluctuations in domestic production. The problem is even more intractable in rural areas. Unfortunately, with few exceptions, the governments in LDCs seem impotent to deal with real income fluctuation and the concomitant food insecurity in rural areas. Not only are there logistical difficulties, the problem of providing rural households

Table 2--Variability in staple food production for selected LDCs, 1961-76

Country	Staple Food Production Instability: Standard Deviation[a]	Staple Food Production Instability: Coefficient of Variation[b]	Probability of Actual Production Falling Below 95% of Trend	Correlation Coefficient Between Total Staple Food Production and Consumption	Correlation Coefficient Between Cereal Production and Total Staple Food Production
	(1,000 metric tons)	(percent)	(percent)		
Asia					
Bangladesh	765	6.4	22	0.90	0.99
India	6,653	6.4	22	0.89	0.99
Indonesia	1,040	5.4	18	0.92	0.94
Korea, Republic of	445	7.1	24	0.20	0.96
Philippines	346	5.7	19	0.03	0.99
Sri Lanka	107	9.3	29	0.56	0.91
North Africa/Middle East					
Algeria	531	28.9	43	0.78	1.00
Egypt	282	4.5	13	0.29	0.96
Jordan	119	65.6	47	0.63	1.00
Libya	56	28.0	43	0.62	1.00
Morocco	1,156	27.2	43	0.98	0.96
Syria	702	38.8	45	0.92	1.00
Sub-Saharan Africa					
Ghana	121	5.8	20	0.98	0.93
Nigeria	958	5.7	19	0.99	0.92
Senegal	325	18.6	39	0.99	0.81
Tanzania	430	12.7	35	0.98	0.09
Upper Volta	128	9.8	30	0.95	0.99
Zaire	190	4.9	15	0.96	-0.21
Latin America					
Brazil	1,631	5.2	17	0.92	0.60
Chile	215	11.1	33	0.54	0.99
Colombia	126	4.4	13	0.51	0.85
Guatemala	56	6.5	22	0.51	0.99
Mexico	1,060	7.7	26	0.53	1.00
Peru	197	9.8	30	0.37	0.97

a/ Defined as the standard deviation of the variable $Q_t - Q_t$.

b/ Defined as the standard deviation of the variable $Q_t - Q_t/Q_t \cdot 100$.

Table 3--Ratio of food imports to total export revenues, 1965-77

Country	1965-67	1970-72	1975-77	1965-77 Mean	1965-77 Maximum
		(percent)			
Asia					
Bangladesh	...	...	67	77a/	123 (1975)
India	40	10	24	23b/	45 (1966)
Indonesia	7	13	6	11	21 (1968)
Korea, Rep. of	13	16	7	13	22 (1969)
Philippines	7	5	4	5	9 (1965)
Sri Lanka	25	25	36	30	50 (1975)
North Africa/ Middle East					
Algeria	8	6	9	7c/	10 (1973)
Egypt	23	12	20	17	32 (1974)
Jordan	13	17	7	12c/	18 (1972)
Libya	2	1	2	2c/	3 (1975)
Morocco	9	6	2	8	14 (1975)
Syria	8	14	7	9	19 (1971)
Sub-Saharan Africa					
Ghana	5	3	4	4c/	6 (1977)
Nigeria	3	2	2	2c/	3 (1977)
Senegal	...	10	10	10d/	20 (1973)
Tanzania	3	3	10	6c/	22 (1974)
Upper Volta	...	8	9	9e/	19 (1974)
Zaire	3	3	6	3f/	6 (1975)
Latin America					
Brazil	10	4	4	6	11 (1967)
Chile	4	4	6	6	14 (1974)
Colombia	3	3	4	3	5 (1974)
Guatemala	3	2	3	3	4 (1975)
Mexico	...	2	5	3c/	10 (1975)
Peru	6	5	11	7c/	16 (1975)

Note: Export revenues include goods and services (except for Brazil for 1966-67). They were taken from International Monetary Fund, International Financial Statistics. Data for food import bill from FAO tape, includes cereal and other staples. All food imports at commercial prices, including food aid.

a/ 1973-77

b/ 1965-76

c/ 1967-77

d/ 1968-76

e/ 1968-75

f/ 1965-75

with additional income at times of crop failure also exists.

The rapid growth of food imports has placed severe pressure on food distribution systems in LDCs. Both port facilities and domestic infrastructures for the timely internal movement of grain are woefully inadequate in many countries. Also, before considering the use of buffer stocks, many LDCs need to expand their working stock operations. These stocks serve to fill short-term gaps in domestic supplies, often for periods of only a few weeks. The gaps arise from the variable time lags between the order and delivery of imported grains and from incomplete (and sometimes unreliable) information about domestic harvests, stock levels, and import prices. Policymakers in the LDCs express a great deal of concern about the difficulties in managing the day-to-day operations of the agencies involved in food supplies.

Every country can take important initiatives to reduce food insecurity. The remedies include large investments in food distribution systems, in transportation and communications, in early warning systems, and in a mix of stock and trade policies. There is considerable scope in many LDCs for larger investments in working stocks. However, it is clear on the basis of past research that heavy reliance on domestic grain reserves to cover the year-to-year fluctuations can be a costly solution.[2/] This is especially true when trade is a real possibility. Investments in domestic carry-over stocks may be more beneficial for only a few importing countries, such as India, which are not price takers in world food markets.[3/]

If policies that attempt to stabilize food consumption were undertaken, the government budget and the foreign trade balance would have to absorb the instability. This is one of the fundamental constraints at the national level. In addition, it would be necessary to compensate for the loss of purchasing power of farmers and rural laborers due to crop failures or declines in world prices. Otherwise, stabilizing national food supplies would not be enough to offset declines in effective demand in rural areas. This can be resolved only at extremely high fiscal cost.

It is important to stress that international initiatives to reduce world price instability would reduce the cost of national solutions for LDCs, although they would not substitute for them. Less price instability in world markets would reduce optimal carry-over stock levels in most LDCs. Similarly, access to food aid and external financial insurance such as that provided by a food financial facility could reduce the need for grain reserves in most LDCs, with the consequent savings in interest and storage costs. On the other hand, the possibility of export controls by major exporters (predominantly the developed countries) provides an additional incentive for

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2/ David Bigman and Shlomo Reutlinger, "National and International Policies Toward Food Security and Price Stabilization," American Economic Review (May 1979).

3/ Carry-over stocks defined as ending stocks in excess of minimum working stocks.

stockholding by all importers, including LDCs.

The potential benefits to LDCs of international approaches to food insecurity are largely conditioned by the efforts of LDCs in improving information and their internal food distribution systems. Without greater investments in crop forecasts, transportation, and food distribution systems, coupled with their active participation in early warning systems of possible food production shortfalls, the actual benefit to LDCs of international initiatives is likely to be limited.

INTERNATIONAL POLICIES

There are two related international approaches to food security for LDCs currently being considered. One addresses the question of mechanisms to enhance world price stabilization. These include an international grain reserve system and policy modifications at the national level in developed and centrally planned countries (including the U.S.S.R.). The other addresses the question of mechanisms to alleviate the foreign exchange constraint in food-deficit LDCs. The overall objectives are to improve the performance of the food trade system by making world market prices more stable and to enable LDCs to import more food when their own production is deficient. Greater stability would allow LDCs to depend more on trade, with its consequent potential gains in economic efficiency, and would enhance their ability to pursue food consumption policies.

There is substantial evidence from published research that much of the international price instability and the concomitant need for large grain reserves is induced by government policies, rather than the vagaries of nature. Production, consumption, and stocks policies of the developed countries and the U.S.S.R. have particular significance for market instability. The root of the problem of world price instability lies in the lack of response of domestic prices, which results from national policies that insulate the domestic market from variations in world market conditions.[4/] The OECD countries and the U.S.S.R. constitute the major exporters and importers, and their long-term price support, consumption, and stockholding policies strongly influence market stability. But neither consumption adjustments nor policy-induced production variability have been the subject

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4/ In the 1970s, following modifications of farm policies in numerous countries, the pattern of stockholding shifted. Major exporters avoided large stockholding and instead relied more on protection controls and direct payments to support producers' income. This change coincided with a change in policy in the Soviet Union, where a stronger commitment to maintain stable consumer prices was made. See Daniel T. Morrow, The Economics of the International Stockholding of Wheat, Research Report 18 (Washington, D.C.: International Food Policy Research Institute, 1980).

of serious international negotiations because they run counter to motives for encouraging domestic stability in the developed countries and the U.S.S.R. As an alternative, all the price stabilization measures focus on grain reserves, which have to be greater than those required under a policy of more price flexibility.

Undoubtedly, larger grain reserves could be managed so that they reduced world price instability. However, the collapse of the Wheat Trade Convention (WTC) negotiations in 1979 confirms the suspicion that an agreement on price issues that would simultaneously consider market realities and accommodate LDC requirements is most unlikely. Unless some countries are willing to pay substantial subsidies on grain reserves, as did the United States and Canada in the 1960s when they accumulated large stocks for purely domestic reasons, only a modest degree of price stability can be achieved by relying mainly on grain reserves.[5/] Unanticipated changes in policy and incorrect information lie at the heart of the problem of shortages of stocks.

Although its direct tangible effects on stocks and price variability is likely to be modest, a new agreement would allow an active periodic review of market conditions and consultations on national cereal policies. Recent and confusing developments in world markets make it imperative that governments proceed soon to reopen discussions on world food security. Most importantly, a new agreement should require exchange of information on production and stocks of all major exporters and importers, including the Soviet Union. Furthermore, its contribution to food security would be greatly enhanced if its signatories were to agree to limit the use of production and export controls. The concerns of cereal importers who fear embargoes and other measures to withhold supplies would not have been appeased by the price stabilization schemes discussed in previous negotiations. There is no guarantee that an agreement such as that negotiated in 1977-78 would prevent the use of export controls.

Even if a new WTC were to succeed in reducing world price instability, this in itself does not preclude the need for a country to cope with a highly unstable food import bill as a result of fluctuations in its own production. Thus there is a need to understand how various complementary policy instruments affect food security in LDCs.

Increasing attention is being given to initiatives that address the foreign exchange problem in LDCs, derived from variability of food import costs. In essence these schemes would alleviate the short-term pressure on balance of payments resulting from internal food consumption stabilization policies in LDCs. Two types of policies are being discussed: the compensatory financial facility for

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5/ Timothy Josling, Developed-Country Agricultural Policies and Developing-Country Supplies: The Case of Wheat, Research Report 14 (Washington, D.C.: International Food Policy Research Institute, 1980).

food imports, often referred to as a food financial facility, and variable food aid programs.

A food financial facility could take the form of an additional line of credit, enlarging the scope of existing compensatory financial schemes[6] to include fluctuations in the cost of food imports. A basic underlying premise is that the country must act rapidly in acquiring the additional imports, and thus cannot wait for the results of an overall evaluation as required for general balance-of-payment support. Also, for many poor LDCs, borrowing on such short notice in the international capital market is not a feasible possibility. Hence a multilateral financial scheme that offers rapid processing based on clear predetermined rules and is free of political criteria, such as those prevailing in the allocation of food aid, represents an effective approach for dealing with instability in food trade. The creation of such a mechanism seems highly desirable.[7]

The more traditional approach has been to rely on food aid. But for several reasons there is no guarantee that sufficient food aid will be forthcoming in years when it is most needed. First, aid is dependent on surpluses in developed countries. Second, allocations can be influenced by political considerations. And finally, budget allocations for food aid are made in fixed values. When world prices rise because supplies are short, less food can be purchased for the same amount. If food aid was reoriented by incorporating a variable component in aid flows, it would greatly enhance food security in LDCs.[8]

WORLD PRICES OF FOOD SUPPLIES AND THE GRAIN OUTLOOK FOR 1980/81

During the 1970s world prices of cereals in real terms fluctuated widely, far more than in the 1960s. However, the long-term trend in real prices in world markets did not indicate that supply was growing more slowly than effective import demand (Figure 1), in

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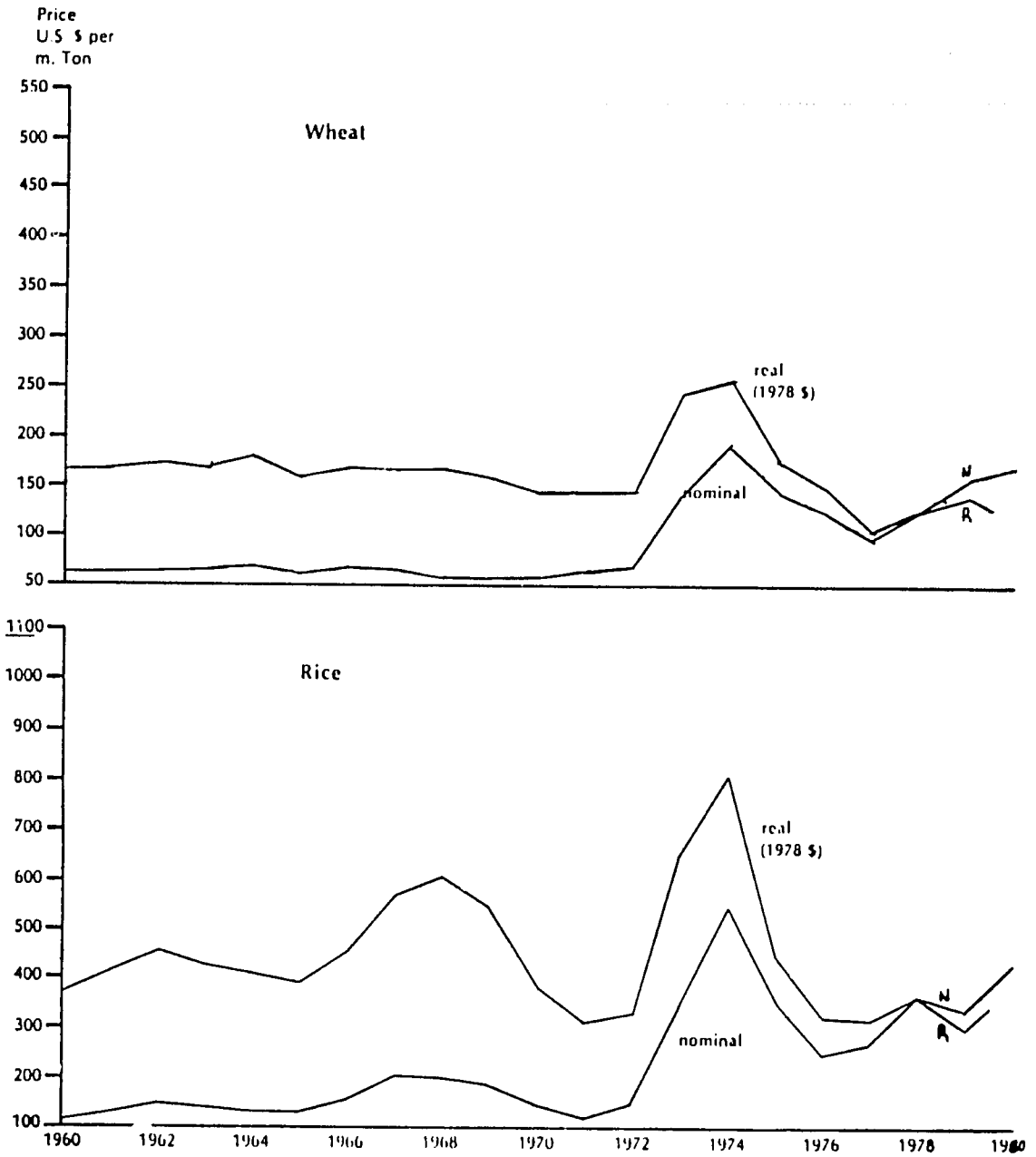
6/ Existing schemes are the International Monetary Fund (IMF) facility, the STABEX scheme (administered by the European Community for some 50 African, Caribbean, and Pacific countries) and the Arab Monetary Fund.

7/ The Executive Board of the IMF is currently considering the creation of a fund to deal with excesses in the cost of cereal imports.

8/ D. Gale Johnson, "Grain Insurance , Reserves, and Trade: Contributions to Food Security for LDCs" in Food Security for Developing Countries, ed. Alberto Valdes (Boulder, Colorado: Westview Press, 1981); and Barbara Huddleston, "Responsiveness of Food Aid to Variable Import Requirements" in Food Security for Developing Countries, ed. Alberto Valdés (Boulder, Colorado: Westview Press, 1981).

Figure 1—World Price of Wheat and Rice



Sources: Wheat (U.S. No. 1 Soft Red Winter, f.o.b. Atlantic Ports) from International Bank for Reconstruction and Development, Commodity Trade and Price Trends (Washington, D.C.: IBRD, 1980), p. 48. Rice (5 percent broken f.o.b. Bangkok), from International Bank for Reconstruction and Development, Commodity Trade and Price Trends,(Washington, D.C.: IBRD, 1979), p. 42; 1979 and 1980 data are from U.S. Department of Agriculture. Up to 1979, the deflator used to produce real prices for both wheat and rice was the index of U.S. dollar unit value of manufactured exports from developed to developing countries (c.i.f. index), from International Bank for Reconstruction and Development, Commodity Trade and Price Trends. The deflator for wheat and rice for the first half of 1980 is the "Export Unit Value for Industrial Countries" taken from International Monetary Fund, International Financial Statistics, (Washington, D.C.: IMF, December 1980). The index is rebased to 1978 and adjusted by the average ratio of the IMF index to the corresponding IBRD index used for the earlier years. The time series for the real prices ends with the second quarter of 1980.

spite of the rapid growth in world trade in cereals, which doubled in volume during the 1970s. Export prices of wheat have not increased in real terms.

In late 1980 the market situation was quite different than it was in 1978 and 1979. The world's supply of cereals was the tightest it has been since 1974, which resulted in a slight increase in real prices compared to 1976. World carryover stocks in 1980/81 as a percentage of consumption (around 17 percent in 1980/81), were lower than in the previous two years. Thus the outlook for world supplies of cereals in 1981/82 will depend entirely on the 1980/81 harvest, which will not provide an adequate buffer against the possibility of an additional year or more below trend. As a result of prospects for a good harvest of winter wheat in the United States, wheat prices (Kansas City, Hard Winter Wheat No. 2) have fallen from $182 per ton in November 1980 to approximately $160 per ton in March 1981. These events confirm the view that the world cereal balance continues to be governed by relatively small unexpected shifts in supply and demand and that the underlying causes of a food crisis, like the one that occurred in 1972-74, have not disappeared.