AN ANALYSIS OF FOOD SELF-SUFFICIENCY PROGRAMS IN SELECTED SUB-SAHARAN AFRICAN COUNTRIES: THE CASE OF LIVESTOCK PRODUCTS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Sub-Saharan Africa currently faces a crisis in food production and in overall development. The region is diverse, ecompassing a wide variety of ecological conditions, political and economic systems. Included are small countries with populations of less than 4.0 million, and Nigeria with a population of 95.2 million (World Bank, 1986). Some national economies are entirely dependent on the agricultural sector. During 1985 in West Africa, the percentage of each country's population engaged in agriculture ranged from a low of 43.5 percent in Cape Verde to 89.0 percent in Niger (Table I). In Central Africa, 61.1 percent of the people in Cameroon were employed in agriculture during 1985, while in East Africa, 92.3 percent of Burundi's population and 11.1 percent of South Africa's population was employed in agriculture.

The percentage of land suitable for permanent pasture ranges from 2.5 to 45.7 percent in West Africa. In Southern Africa, the range is from a low of 3.7 percent in Mauritius to 75.1 percent in Botswana.

With an annual growth rate of approximately 2.0

Table I. Land and Related Data for Sub-Saharan African Countries, 1970, 1984 and 1985.

Region and Country	Total Land Area (1000 HA) in 1984	Percentage of Total Land Area That is Suitable for			Percentage of land area that is irrigated	Percentage of Population in Agriculture		Population density km_2
		Arable and Permanent Cropland	Permanent Crops	Permanent Pasture		1970	1985	
West Africa								
Benin	11062	16.4	4.1	4.0	0.20	80.9	63.7	36
Bukina Faso	27380	9.6	0.04	36.5	0.02	88.3	85.8	26
Cape Verde	403	9.9	0.5	6.2	0.49	64.1	45.3	81*
Chad	125920	2.5	0.004	35.7	0.01	90.2	78.6	4
The Gambia	1000	16.0	NA	9.0	3.30	86.6	82.6	64*
Ghana	23002	12.0	7.2	14.9	0.03	58.4	54.5	52
Guinea	24586	6.4	0.31	12.2	0.28	85.2	78.1	24
Guinea Bissau	2800	9.2	0.01	45.7	NA	84.1	81.3	25*
Ivory Coast	31800	12.5	3.7	9.4	0.20	76.5	58.8	32
Liberia	9632	3.9	2.5	2.5	0.05	77.5	72.5	20
Mali	122000	1.9	0.003	24.6	0.28	89.2	83.3	6
Mauritania	103040	0.18	0.002	38.1	0.01	84.8	59.0	2
Niger	126670	2.8	NA	7.3	0.01	94.3	89.0	5
Nigeria	91077	33.4	2.8	23.0	1.32	71.0	66.7	105
Senegal	19200	27.2	0.02	29.7	0.91	82.7	79.5	31
Sierra Leone	7162	24.7	2.0	30.7	0.22	75.5	66.3	56
Togo	5439	26.2	1.3	3.7	0.03	76.7	71.0	55
Central Africa								
Cameroon	46944	14.8	2.2	17.7	0.02	83.4	61.1	21
Central African Republic	62298	3.1	0.13	4.8	NA	82.9	65.8	5
Congo	24150	1.9	0.06	29.2	0.01	65.0	61.1	6

Table I. (Continued)

Region and Country	Total Land Area (1000 HA) in 1984	Percentage of Total Land Area That is Suitable for			Percentage of land area that is irrigated	Percentage of Population in Agriculture		Population density km_2
		Arable and Permanent Cropland	Permanent Crops	Permanent Pasture		1970	1985	
Equatorial Guinea	2805	8.2	3.6	3.7	NA	75.0	60.7	14*
Gabon	25767	1.8	0.62	18.2	NA	79.6	73.1	5*
Sao Tome Principipe	96	37.5	36.4	1.0	NA	NA	NA	101*
Zaire	226760	2.9	0.25	4.1	0.003	79.1	67.1	13
North East Africa								
Djibouti	2198	NA	NA	9.1	NA	NA	NA	17*
Ethiopia	110100	12.6	0.66	41.1	0.08	85.0	76.8	38
Somalia	62734	1.7	0.02	46.0	0.20	79.4	73.5	8
Sudan	237600	5.2	0.02	23.6	0.71	77.0	67.9	9
East Africa								
Burundi	2565	50.9	7.6	35.5	0.19	93.5	92.3	195
Kenya	56925	4.1	0.85	6.6	0.07	84.8	78.8	35
Rwanda	2495	40.4	11.4	17.6	0.60	93.7	92.3	241
Seychelles	27	25.9	22.2	NA	NA	NA	NA	282*
Tanzania	88604	5.9	1.1	39.5	0.15	90.4	82.6	24
Uganda	19971	32.5	8.5	25.0	0.08	89.3	83.8	75
Southern Africa								
Angola	124670	2.8	0.4	23.2	NA	77.7	71.6	7
Botswana	58537	2.3	NA	75.1	0.02	85.5	60.1	2

Table I. (Continued)

Region and Country	Total Land Area (1000 HA) in 1984	Percentage of Total Land Area That is Suitable for: Arable and Permanent Cropland	Permanent Crops	Permanent Pasture	Percentage of land area that is irrigated	Percentage of Population in Agriculture: 1970	1985	Population density km_2
Comoros	217	42.3	8.3	6.9	NA	86.7	80.8	205*
Lesotho	3035	9.8	NA	65.9	NA	89.9	84.0	33
Madagascar	58154	5.1	0.90	58.5	1.7	83.7	79.3	17
Malawi	9408	24.9	0.26	19.6	0.23	90.5	78.3	74
Maurituis	185	57.8	3.7	3.7	9.18	34.0	25.1	541
Mozambique	78409	3.9	0.29	56.1	0.09	86.4	83.4	17
Namibia	82329	0.80	0.002	64.26	0.01	51.0	39.8	2*
Reunion	250	22.0	1.6	4.0	2.0	38.1	11.5	212*
South Africa	122104	11.1	0.65	65.3	0.92	32.9	11.1	26
Swaziland	1720	8.3	0.23	66.8	3.48	80.6	70.3	38*
Zambia	74072	6.9	0.01	47.2	0.02	76.6	71.2	8
Zimbabwe	38667	6.9	0.21	12.6	0.43	77.3	70.4	21
AFRICA	2966450	6.2	0.62	26.2	0.35	74.4	65.5	17*

Source: Derived from FAO, Production Yearbook, various issues.

*Based on 1985 population figures predicted in FAO Production Yearbook, vol. 39. The rest of the figures in the column are derived from 1984 population estimates in World Development Report 1986, p. 228.

percent during the 1973-84 period, agriculture contributed 35.0 percent of the gross domestic product (GDP) in Sierra Leone during 1984 (Table II). Zimbabwe's annual growth rate of the agricultural sector was 1.1 percent during the 1973-84 period and agriculture contributed 14.0 percent of the GDP in 1984. In Senegal, the situation was entirely different during the 1973-84 period when the agricultural sector experienced negative annual growth rates of 0.2 percent and contributed 17.0 percent of the GDP in 1984. Sierra Leone's GDP growth rate declined from 3.7 percent during the 1965-73 period to 1.8 percent during 1973-84. The growth rate of GDP in Kenya declined from 7.9 percent in 1965-73 to 4.4 percent during the 1973-84 period.

Despite some of the differences mentioned above, illiteracy is a common denominator for most of the countries in Sub-Saharan Africa. As shown in Table III, illiteracy rates in West Africa during 1985 ranged from 63.1 percent in Cape Verde to 94.4 percent in Senegal and Chad. In East Africa, illiteracy rates ranged from a low of 42.3 percent in Seychelles to 95.8 percent in Ethiopia during the same period, and in Southern Africa, the range is from 21.0 percent in Mauritius to 97.0 percent in Angola. Other characteristics common to most nations in the region are land extensive agricultural economies and fragile political institutions. With the exception of Liberia and Ethiopia, virtually all countries in

Table II. Basic Economic Indicators in Sub-Saharan Africa, 1965-1985.

	Annual Growth Rate (Percent)				GDP (Million Dollars)		Percent Distribution of GDP		External Public Debt Service as Percent of				Share of Livestock in Total Agricultural Production (Percent)
	GDP		Agriculture				Agriculture		GNP		Exports of Goods & Services		
	1965-73	1973-84	1965-73	1973-84	1965	1984	1965	1984	1970	1984	1970	1984	1985*
West Africa													
Benin	2.2	4.6	NA	2.7	210	900	53	43	0.7	3.9	2.3	NA	8.16
Bukina Faso	2.4	2.9	NA	1.3	250	820	52	43	0.6	2.3	6.2	NA	27.54
Chad	0.5	NA	NA	NA	240	NA	47	NA	1.0	NA	3.9	1.7	NA
Ghana	3.4	-0.9	4.5	0.2	1330	4485	41	52	1.1	1.7	5.0	13.2	2.23
Guinea	3.0	3.1	NA	2.4	520	2100	NA	41	2.2	5.3	NA	NA	11.98
Ivory Coast	7.1	3.7	3.7	3.3	960	6690	36	28	2.7	11.1	6.8	21.3	6.23
Liberia	5.5	0.2	6.5	2.0	270	980	27	36	5.5	4.3	8.1	8.6	7.67
Mali	3.1	4.1	0.9	5.0	NA	980	49	46	0.3	1.7	1.4	8.0	48.41
Mauritania	2.6	2.3	-2.1	2.3	160	660	32	30	1.7	6.2	3.1	10.0	NA
Niger	-0.8	5.2	-2.9	1.6	370	1340	66	33	0.6	6.1	3.8	NA	0.00
Nigeria	9.7	0.7	2.8	-0.5	4190	73450	53	27	0.6	4.2	4.2	25.4	14.38
Senegal	1.5	2.6	0.2	-0.2	810	2390	25	17	0.8	4.1	2.8	NA	26.48
Sierra Leone	3.7	1.8	1.5	2.0	320	900	34	35	2.9	1.6	9.9	7.2	2.89
Togo	5.3	2.3	2.6	1.1	190	720	45	22	0.9	10.1	2.9	26.3	4.87
Central Africa													
Cameroon	4.2	7.1	4.7	1.6	750	7800	32	22	0.8	3.0	3.1	8.9	12.91
Central African Republic	2.7	0.7	2.1	1.1	140	560	46	39	1.6	2.0	4.8	8.0	NA
Congo	6.8	8.1	4.1	0.4	200	2010	19	7	3.3	13.7	11.0	20.5	NA
Zaire	3.9	-1.0	NA	1.4	1640	4700	22	NA	2.1	11.4	4.4	7.7	3.91

Table II. (Continued)

	Annual Growth Rate (Percent)				GDP (Million Dollars)		Percent Distribution of GDP		External Public Debt Service as Percent of				Share of Livestock in Total Agricultural Production (Percent)
	GDP		Agriculture				Agriculture		GNP		Exports of Goods & Services		
	1965-73	1973-84	1965-73	1973-84	1965	1984	1965	1984	1970	1984	1970	1984	1985*
East Africa													
Ethiopia	4.1	2.3	2.1	1.2	1180	4270	58	48	1.2	1.8	11.4	13.8	29.39
Somalia	NA	NA	NA	NA	220	1364	71	NA	0.3	2.0	2.1	28.9	NA
Sudan	0.2	5.5	0.3	2.7	1330	6730	54	33	1.7	NA	10.6	13.6	31.14
Burundi	4.8	3.6	4.7	2.3	160	1020	NA	58	0.3	1.9	2.4	NA	5.05
Kenya	7.9	4.4	6.2	3.5	920	5140	35	31	1.8	6.1	5.4	21.5	27.58
Rwanda	6.3	5.4	NA	NA	150	1600	75	NA	0.1	0.4	1.2	3.3	4.69
Tanzania	5.0	2.6	3.1	NA	790	4410	46	NA	1.2	1.9	4.9	NA	14.36
Uganda	3.6	-1.3	3.6	-0.7	1180	4710	52	NA	0.4	1.7	2.7	NA	28.75
Southern Africa													
Botswana	14.8	10.7	6.4	-4.0	50	990	34	6	0.7	3.8	1.0	3.8	NA
Lesotho	3.9	5.0	NA	NA	50	360	65	NA	0.5	3.8	4.1	5.1	NA
Madagascar	3.5	NA	NA	0.3	730	2380	31	42	0.8	5.2	3.5	NA	16.91
Malawi	5.7	3.3	NA	2.5	220	1090	50	37	2.1	7.2	7.2	NA	14.48
Mauritius	2.3	3.6	NA	-3.1	190	860	16	14	1.3	7.5	3.0	14.8	NA
South Africa	5.1	2.7	NA	NA	10540	73390	10	5	NA	NA	NA	NA	58.60
Zambia	2.4	0.4	2.0	1.0	1060	2640	14	15	3.4	4.7	5.9	11.3	34.20
Zimbabwe	9.4	1.7	NA	1.1	960	4580	18	14	0.6	5.4	2.3	20.0	20.57

Source: World Bank, World Development Report, 1986.

*Derived from USDA/ERS, World Indices of Agricultural and Food Production, 1976-85, Statistical Bulletin #744, Washington, DC, July 1986.

Table III. Some Selected Indicators in Sub-Saharan Africa, 1972, 1973 and 1985.

Region and Country	Urban Population As a Percent of Total Population		Illiteracy Rate		Average Life Expectancy at Birth (years)	
	1973	1985	1972	1985	Male	Female
West Africa						
Benin	13.0	38.5	80.0	72.1	49.1	52.5
Bukina Faso	4.0	9.7	92.5	91.2	44.3	47.5
Cape Verde	NA	6.1	73.0	63.1	62.3	66.0
Chad	12.5	21.6	92.5	94.4	41.5	44.1
The Gambia	14.2	20.9	90.0	79.9	43.4	46.6
Ghana	33.0	39.6	75.0	69.8	51.5	55.0
Guinea	11.2	22.2	92.5	91.4	46.9	50.2
Guinea Bissau	18.1	27.1	NA	90.4	44.4	47.6
Ivory Coast	24.0	42.6	95.0	65.0	49.3	52.8
Liberia	27.6	36.7	90.0	79.0	56.8	58.6
Mali	13.0	22.9	95.0	90.6	44.3	47.5
Mauritania	8.0	47.6	97.0	82.6	44.3	47.5
Niger	8.2	15.1	95.0	90.2	44.3	47.5
Nigeria	22.0	23.0	75.0	66.0	50.8	54.3
Senegal	33.0	27.1	92.5	94.4	44.3	47.5
Sierra Leone	15.0	28.2	90.0	93.3	49.1	52.5
Togo	15.2	20.1	92.5	84.1	49.3	52.7
Central Africa						
Cameroon	23.0	41.6	92.5	59.5	49.4	52.6
Central African Republic	26.6	45.6	80.0	67.0	43.9	50.3
Congo	32.0	39.5	80.0	84.4	49.4	52.6
Equatorial Guinea	30.0	59.7	80.0	63.0	49.4	52.6
Gabon	21.0	40.9	88.0	87.6	46.9	50.2
Zaire	25.1	44.2	82.5	45.5	49.4	52.6
East Africa						
Ethiopia	11.0	17.6	95.0	95.8	41.4	44.6
Somalia	20.2	34.1	95.0	93.9	43.9	47.1
Sudan	11.0	29.4	92.5	85.3	50.4	52.5
Burundi	3.0	2.5	90.0	73.2	44.4	47.6
Kenya	11.0	16.7	77.5	52.9	56.0	60.6
Rwanda	3.4	5.1	90.0	50.3	49.1	52.5
Seychelles	26.1	NA	42.0	42.3	NA	NA
Tanzania	7.3	14.8	82.5	53.7	53.7	57.3
Uganda	9.0	14.4	80.0	47.7	55.6	59.3

Table III. (Continued)

Region and Country	Urban Population As a Percent of Total Population		Illiteracy Rate		Average Life Expectancy at Birth (years)	
	1973	1985	1972	1985	Male	Female
Southern Africa						
Angola	14.3	24.5	87.5	97.0	44.5	47.6
Botswana	13.2	42.3	80.0	59.0	51.5	55.0
Comoros	NA	14.0	42.0	41.6	48.3	51.7
Lesotho	2.0	5.8	41.0	41.4	54.2	56.4
Madagascar	15.0	21.1	61.0	66.5	49.3	52.8
Malawi	6.0	47.6	78.0	77.9	49.3	52.7
Maurituis	44.0	56.8	39.0	21.0	65.1	70.2
Mozambique	5.7	10.6	93.0	73.5	49.3	52.8
Namibia	31.8	50.8	NA	61.6	55.0	57.5
Reunion	27.3	59.8	37.0	37.1	66.0	69.6
South Africa	47.9	51.5	17.0	43.0	62.8	66.0
Swaziland	7.9	10.0	64.0	44.8	49.3	52.5
Zambia	34.3	42.2	82.5	52.7	51.5	55.0
Zimbabwe	18.0	26.5	72.5	31.2	56.2	59.9

Source: UNCTAD, Handbook of International Trade and Development Statistics, 1976, pp. 416-423; and Supplement, 1985,pp. 500-508.

Sub-Saharan Africa achieved political independence within the last three decade (World Bank, 1983).

As Mellor and Adams noted (November 1983), we live in a paradoxical world. The developed countries of Europe, North America and Australia have recorded food surpluses and farmers are paid not to produce certain foods. But in Sub-Saharan Africa, some countries in Asia and Latin America, food deficits are a recurrent theme. The famine in Ethiopia, Sudan and other parts of Africa is a constant reminder of the food situation in Africa. The majority of people in the region lack employment opportunities and purchasing power to buy food.

Increasingly frequent shortages of food supplies such as meat, milk, eggs, other livestock products and cereals in Africa has attracted the attention of governments, donor agencies, and economists to investigate the causes of the problem and design appropriate policies. The past decade has witnessed the development of persistent unviable balance of payments deficits in Sub-Saharan Africa. There is a growing belief that these problems are not amenable to narrow demand management policies, thus interest has shifted from the application of short term stabilization policies to more gradual structural adjustment programs (Yagi, Kamin and Rosenbaum, May 1985).

Objectives and Justification of the Study

This study examines the causes for frequent shortages of meat, milk, eggs and other livestock products in Sub-Saharan Africa.

More specifically the study has the following objectives:

1. To estimate demand elasticities for imported livestock products with respect to income and prices in Sub-Saharan Africa, and
2. Recommend appropriate policy alternatives.

It is known that the effectiveness of pricing and international trade policy is highly dependent upon the direction and magnitude of the underlying elasticities (Murray and Ginman, 1975). However, this importance has not been fully realized in Sub-Saharan Africa's livestock sector. To date, there has been little estimation of import demand elasticities for livestock products in the region.

Geographic Location of Sub-Saharan Africa

In this dissertation, Sub-Saharan Africa refers to all countries in Africa except the countries bordering the Mediterranean in the north and Western Sahara. Madagascar and other island nations are also included as

shown in figure 1.

Most of Sub-Saharan Africa falls within the tropics and does not experience wide fluctuations in temperature typical of Europe and other temperate regions. The presence of continuously warm temperatures with high humidity are conditions suitable for bacteria infestation and disease bearing insects that inflict a heavy toll on livestock and human productivity. The agro-climatic conditions range from extreme aridity in deserts and desert like areas to high humid environments in the dense rain forests. These conditions reflect the distribution of rainfall in the region. Rainfall patterns are closely associated with the movement of air masses that converge from north and south to form the Intertropical Convergence Zone (ITCZ). The ITCZ oscillates between the tropic of cancer and tropic of capricon following the movement of the sun. The distribution of rainfall is uneven in most of Sub-Saharan Africa. The movement of the ITCZ causes some areas to receive most of their rainfall within a 4-6 month period, which is not sufficient for crops to mature. The areas with scanty rainfall are marginal areas for food production.

Agricultural activities in the various ecological zones reflect population densities and availability of technology. Shifting cultivation in the rain forest and nomadism in the arid zones have been in Africa for several

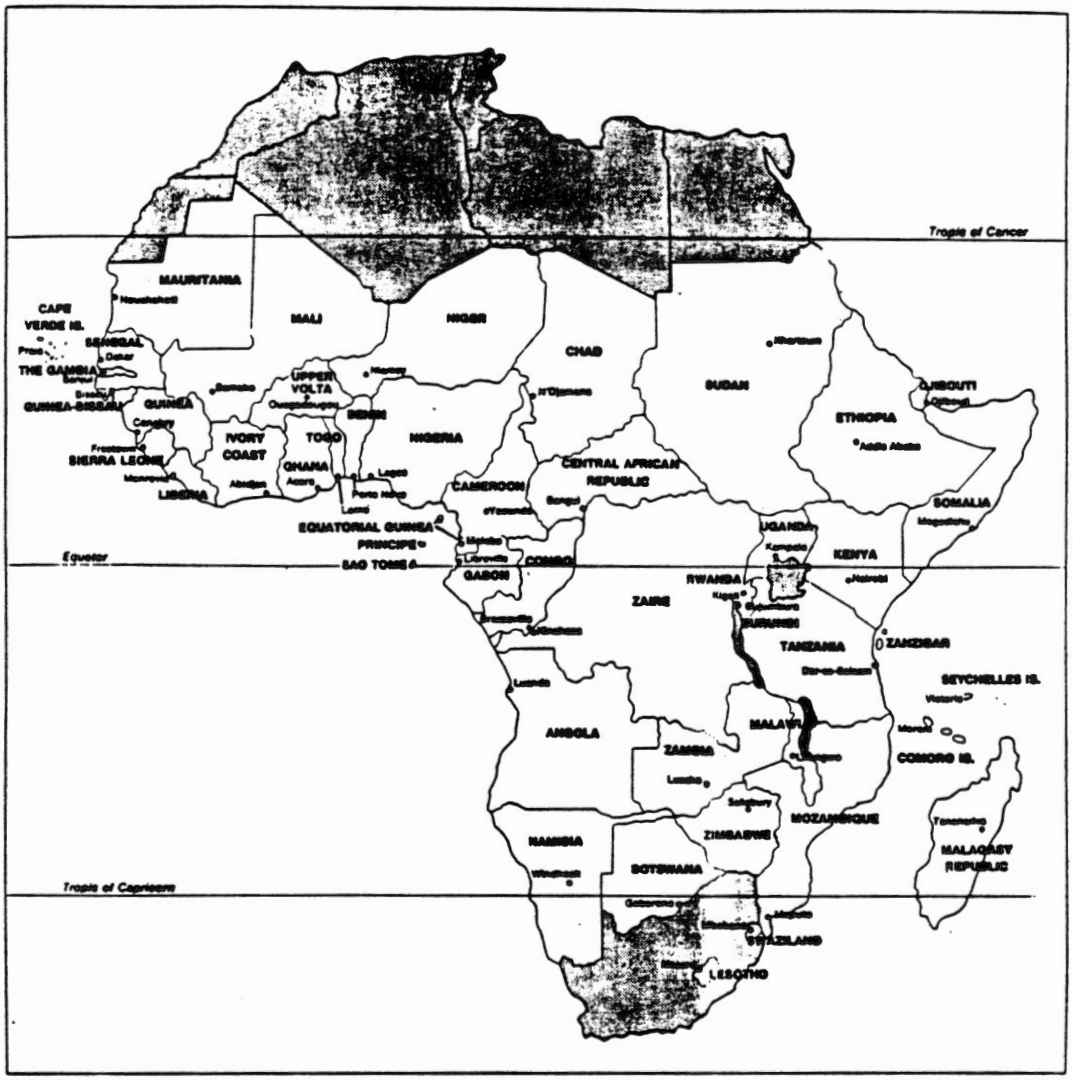

Figure 1. Countries in Sub-Saharan Africa Included in the Study.

Source: Eicher, Carl K. and Doyle C. Baker, (1982).

centuries. Modern forms of agriculture including ranching, commercial plantation, large scale farming and commercial poultry enterprises were introduced during recent decades. However, the distribution of human population and development of livestock is influenced in some ways by the presence of tsetse fly and associated diseases such as trypanosomiasis. Approximately 40.0 percent of Africa's land area is infested by the tsetse fly (Jahnke, 1982).

The Problem

A vast majority of the countries in Sub-Saharan Africa are food deficit countries with beef, milk, butter and livestock products in severe deficit. For instance, during the last two decades, the growth rate in the production of dairy products has been surpassed by total consumption. As the demand for livestock products exceed domestic production, imports are increased to meet the growing demand. Sub-Saharan Africa is spending substantial portions of scarce foreign exchange on food imports, particularly beef, milk, and other livestock products. Food imports compete with capital goods for the available foreign exchange. Thus, domestic investment for development is crowded out.

The World Bank (1986) projected that a majority of the countries in Sub-Saharan Africa will have an annual

population growth rate exceeding 2.0 percent during the 1984-2000 period (Table IV).

Dairy food aid to the region accounted for 16.0 percent of all dairy imports by Sub-Saharan Africa during 1981 (Von Massow, January 1985). West Africa, East Africa and Central Africa imported 46.0, 13.0 and 57.0 percent of their dairy needs respectively in 1981. In 1973, Ghana spent 0.06 percent of its gross national product (GNP) on meat imports, and a decade later (as shown in Table V), increased to 0.25 percent of GNP. In Ethiopia, the expenditures for dairy products rose from 0.01 percent of the GNP in 1973 to 0.18 percent in 1983.

The fact that Sub-Saharan countries import large quantities of food should not be a cause for alarm. In practice, only a few countries meet all of their food needs from domestic production. It is clear that most countries in Sub-Saharan Africa cannot avoid food imports, at least in the short-run (Abalu, 1982). Economic theory provides some clear arguments regarding the potential benefits of international trade based on the principle of comparative advantage. However, one becomes more concerned when a nation depends on external markets for the supply of basic foodstuff that can be grown efficiently within the country.

The issue of self-sufficiency is one in which domestic interest groups often differ. Self-sufficiency could be defined as the capacity of trend production to

Table IV. Population, Food Aid and Official Development Assistance in Selected Sub-Saharan African Countries, 1973-85.

Region and Country	Population (in millions)			Growth Rate Per Year (%)		Hypothetical Size of Stationary Population (millions)	Food Aid in Cereals 1000 Metric Tons		Official Development Assistance (ODA) Received From All Sources (Million Dollars)		As % of GNP	Per Capita Dollars (1984)
	1985*	1990	2000	1973-1984	1980-2000		1974/75	1983/84	1978	1984	1984	
West Africa												
Benin	4.1	5	6	2.8	3.2	20	9	6	62	77	8.0	19.7
Bukina Faso	6.9	7	9	1.8	2.0	31	28	57	159	188	19.7	28.7
Chad	5.0	6	7	2.1	2.5	22	20	69	125	115	NA	23.6
Ghana	13.6	15	20	2.6	3.5	54	33	74	114	216	5.7	17.5
Guinea	6.1	7	8	2.0	2.1	24	49	43	60	123	6.3	20.8
Ivory Coast	9.8	13	17	4.5	3.7	46	4	0	131	128	2.2	13.0
Liberia	2.1	3	4	3.3	3.2	11	3	47	48	133	13.6	62.6
Mali	8.0	9	11	2.6	2.6	36	107	111	163	320	32.0	43.6
Mauritania	1.9	2	3	2.1	2.7	8	48	129	238	168	24.6	101.5
Niger	6.1	7	10	3.0	3.2	36	73	13	157	162	14.8	26.1
Nigeria	95.2	118	163	2.8	3.4	528	7	0	43	33	0.0	0.3
Senegal	6.4	8	10	2.8	2.9	30	27	151	223	333	14.8	52.2
Sierra Leone	3.6	4	5	2.1	2.4	17	10	16	40	61	6.2	16.5
Togo	2.9	4	5	2.8	3.3	16	11	9	103	110	16.7	37.3
Sub-Total	171.9	208	278				429	725	1,166	2,167		
Central Africa												
Cameroon	9.9	12	17	3.1	3.3	51	4	1	178	188	2.5	19.0
Central African Republic	2.6	3	4	2.3	2.8	12	1	8	51	114	18.8	45.1
Congo	1.7	2	3	3.1	3.7	9	2	1	81	98	5.3	53.9

Table IV. (Continued)

Region and Country	Population (in millions) 1984*	1990	2000	Growth Rate Per Year (%) 1973-1984	1980-2000	Hypothetical Size of Stationary Population (millions)	Food Aid in Cereals 1000 Metric Tons 1974/75	1983/84	Official Development Assistance (ODA) Received From All Sources (Million Dollars) 1978	1984	As % of GNP 1984	Per Capita Dollars (1984)
Central Africa (Continued)												
Zaire	29.9	36	47	3.0	3.2	130	1	53	317	314	10.1	10.6
Sub-Total	44.1	53	71				8	63	627	714		
East Africa												
Ethiopia	43.6	49	65	2.8	2.7	204	54	172	140	363	7.7	8.6
Somalia	4.6	6	8	2.8	3.0	30	111	177	212	363	NA	69.4
Sudan	21.5	25	34	2.9	2.9	101	46	450	318	616	NA	28.9
Burundi	4.7	5	7	2.2	3.0	24	6	11	75	141	15.0	30.7
Kenya	20.6	25	35	4.0	3.9	111	2	122	248	431	7.5	22.1
Rwanda	6.0	7	10	3.3	3.6	40	19	25	125	165	10.2	28.2
Tanzania	22.5	27	37	3.4	3.5	123	148	136	424	559	14.7	26.0
Uganda	15.5	18	26	3.2	3.3	84	0	10	23	164	3.3	10.9
Sub-Total	139	162	222				386	1,103	1,565	2,802		
Southern Africa												
Angola	8.8	10	13	3.1	2.7	43	0	69	47	93	NA	10.9
Botswana	1.1	1	2	4.4	3.4	5	5	32	69	103	11.6	99.2
Lesotho	1.5	2	2	2.4	2.6	6	14	50	50	97	17.6	65.8
Madagascar	10.0	12	16	2.8	3.1	48	7	74	91	156	7.0	15.8

Table IV. (Continued)

Region and Country	Population (in millions) 1984*	1990	2000	Growth Rate Per Year (%) 1973-1984	1980-2000	Hypothetical Size of Stationary Population (millions)	Food Aid in Cereals 1000 Metric Tons 1974/75	1983/84	Official Development Assistance (ODA) Received From All Sources (Million Dollars) 1978	1984	As % of GNP 1984	Per Capita Dollars (1984)
Southern Africa (Continued)												
Malawi	6.9	8	11	3.1	3.2	38	NA	3	99	159	13.8	23.2
Mauritius	1.0	1	1	1.4	1.5	2	22	22	44	36	3.5	35.1
Mozambique	13.9	16	21	2.6	3.0	67	34	297	105	259	NA	19.3
South Africa	32.3	36	45	2.4	2.5	94	NA	NA	NA	NA	NA	
Zambia	6.7	8	11	3.2	3.4	35	5	76	185	238	9.8	37.1
Zimbabwe	8.8	10	13	3.2	3.4	33	0	76	9	298	5.8	36.7
Sub-Total	91	104	135				87	699	699	1,439		
SUB-SAHARAN AFRICA	446	527	706				910	2,590	4,057	7,122		

Source: Adapted from World Bank, World Development Report, 1986.

*Derived from Food and Agriculture Organization of the United Nations; Production Yearbook, Vol. 39, 1986. ODA consists of loans and grants made on concessional financial terms by bilateral official agencies and multilateral sources to promote economic development and welfare.

Table V. Imports of Feeds, Cereals and Livestock Products as Percentage of GNP, by Selected Sub-Saharan African Countries, 1973 and 1983.

Country	Total Agricultural Products $1000		Live Animals $1000		Meat & Meat Preparations $1000		Dairy Products & Eggs $1000		Feedstuff $1000		Cereals $1000	
	1973	1983	1973	1983	1973	1983	1973	1983	1973	1983	1973	1983
Cameroon	43379 (2.87)*	133709 (1.70)	2546 (0.16)	5400 (0.06)	1014 (0.06)	5921 (0.07)	4024 (0.26)	9299 (0.11)	311 (0.02)	1329 (0.01)	16503 (1.09)	61574 (0.78)
Central African Republic	14370 (2.37)	27127 (3.87)	5270 (0.87)	10880 (1.55)	499 (0.08)	200 (0.02)	897 (0.14)	1231 (0.17)	29 (0.004)	NA NA	2890 (0.47)	8486 (1.21)
Chad	22947 (4.35)	14330 NA	18 (0.003)	NA NA	320 (0.06)	100 NA	2994 (0.56)	1310 NA	2 (0.0003)	NA NA	4725 (0.89)	12320 NA
Congo	17629 (1.97)	73988 (3.40)	350 (0.03)	2415 (0.11)	3268 (0.36)	14373 (0.66)	1687 (0.18)	7220 (0.33)	199 (0.02)	2200 (0.10)	5093 (0.56)	22900 (1.05)
Ethiopia	20323 (0.19)	136306 (2.81)	26 (0.0002)	110 (0.002)	74 (0.0007)	NA NA	1642 (0.01)	9031 (0.18)	3 (0.00002)	62 (0.001)	3209 (0.03)	85144 (1.75)
Gabon	19615 (2.75)	117325 (4.28)	151 (0.02)	624 (0.02)	2678 (0.37)	31740 (1.15)	1653 (0.23)	9451 (0.34)	105 (0.01)	1827 (0.06)	3028 (0.42)	21896 (0.79)
Ghana	92761 (3.07)	123889 (1.95)	4642 (0.15)	1750 (0.02)	2039 (0.06)	16020 (0.25)	6765 (0.22)	5785 (0.09)	2042 (0.06)	3500 (0.05)	33444 (1.10)	62104 (0.98)
Ivory Coast	163129 (6.56)	384710 (5.74)	31700F (1.27)	75425 (1.12)	3109 (0.12)	16494 (0.24)	15460 (0.62)	50995 (0.76)	456 (0.01)	2154 (0.03)	5586 (2.24)	144084 (2.15)

Table V. (Continued)

Country	Total Agricultural Products $1000		Live Animals $1000		Meat & Meat Preparations $1000		Dairy Products & Eggs $1000		Feedstuff $1000		Cereals $1000	
	1973	1983	1973	1983	1973	1983	1973	1983	1973	1983	1973	1983
Kenya	79755 (3.51)	139065 (2.16)	3671 (0.16)	640 (0.009)	288 (0.01)	11 (0.0001)	194 (0.008)	4710 (0.07)	1341 (0.05)	1342 (0.02)	11948 (0.52)	37810 (0.58)
Liberia	34870 (10.80)	110714 (11.18)	2205 (0.68)	11138 (11.25)	1964 (0.60)	7082 (0.71)	1658 (0.51)	6803 (0.68)	642 (0.19)	2700 (0.27)	16266 (5.04)	48816 (4.93)
Madagascar	38070 (2.86)	94057 (3.21)	33 (0.002)	110 (0.003)	685 (0.05)	250 (0.008)	4140 (0.31)	4068 (0.13)	274 (0.02)	NA NA	18156 (1.36)	57369 (1.95)
Malawi	20126 (4.52)	25457 (1.83)	116 (0.02)	125 (0.008)	334 (0.07)	166 (0.01)	2189 (0.49)	4312 (0.31)	260 (0.05)	NA NA	4283 (0.96)	7040 (0.50)
Mali	65720 (7.37)	60273 (5.43)	922 (0.10)	NA NA	60 (0.006)	720 (0.06)	4159 (0.46)	3170 (0.28)	NA NA	NA NA	38948 (4.36)	40417 (3.64)
Maurituis	44320 (12.91)	109565 (9.52)	417 (0.12)	545 (0.04)	2671 (0.77)	9518 (0.82)	4751 (1.38)	17159 (1.49)	2624 (0.76)	1268 (0.11)	21304 (6.20)	41090 (3.57)
Nigeria	233072 (1.82)	2020600 (2.81)	34720 (0.27)	112075 (0.15)	58 (0.0004)	65860 (0.09)	35331 (0.27)	143120 (0.19)	2275 (0.01)	32150 (0.04)	77973 (0.61)	700325 (0.97)
Reunion	84994 NA	188116 (9.17)	1284 NA	1857 (0.09)	15789 NA	37854 (1.84)	9066 NA	22825 (1.11)	3744 NA	12096 (0.59)	25578 NA	40299 (1.96)
Senegal	145259 (6.06)	251445 (9.21)	4449 (0.18)	22049 (0.80)	611 (0.02)	600 (0.02)	8020 (0.33)	22231 (0.81)	104 (0.004)	299 (0.01)	70467 (2.94)	111222 (4.07)

Table V. (Continued)

Country	Total Agricultural Products $1000		Live Animals $1000		Meat & Meat Preparations $1000		Dairy Products & Eggs $1000		Feedstuff $1000		Cereals $1000	
	1973	1983	1973	1983	1973	1983	1973	1983	1973	1983	1973	1983
Sierra Leone	40994 (9.10)	53601 (4.54)	2662 (0.59)	12512 (1.06)	984 (0.21)	418 (0.03)	3119 (0.69)	5356 (0.45)	517 (0.11)	318 (0.02)	13123 (2.91)	18870 (1.59)
Somalia	26854 NA	123140 (9.69)	19 NA	NA NA	185 NA	9300 (0.73)	9149 NA	64290 (5.06)	43 NA	NA NA	1957 NA	64290 (5.06)
South Africa	394390 (1.42)	1021266 (1.39)	56980 (0.20)	52256 (0.07)	23561 (0.04)	8508 (0.01)	16798 (0.06)	11903 (0.01)	3782 (0.01)	50699 (0.06)	40693 (0.14)	295414 (0.40)
Sudan	166714 (4.61)	253215 (3.06)	43 (0.001)	365 (0.004)	3 (0.0001)	73 (0.0008)	2495 (0.09)	27683 (0.33)	15 (0.0005)	416 (0.005)	27026 (1.06)	90625 (1.09)
Tanzania	49078 (0.96)	101096 (2.06)	554 (0.03)	2600 (0.05)	550 (0.03)	70 (0.001)	7997 (0.43)	9306 (0.18)	659 (0.03)	NA NA	7825 (0.42)	69525 (1.41)
Togo	18015 (2.65)	86042 (10.89)	283 (0.04)	525 (0.06)	375 (0.05)	6098 (0.77)	676 (0.09)	4272 (0.54)	NA NA	77 (0.009)	4378 (0.64)	25479 (3.22)
Uganda	25758 (0.68)	20655 (0.67)	2340 (0.06)	3180 (0.10)	365 (0.009)	250 (0.008)	5906 (0.15)	7750 (0.25)	1003 (0.02)	NA NA	4666 (0.12)	7450 (0.24)
Zaire	NA NA	138191 (2.74)	NA NA	425 (0.008)	NA NA	25520 (0.50)	NA NA	16310 (0.32)	NA NA	70 (0.0014)	NA NA	73100 (1.45)
Zambia	43407 (1.62)	62411 (1.72)	337 (0.01)	470 (0.01)	8024 (0.30)	NA NA	5328 (0.19)	1500 (0.04)	1160 (0.04)	2230 (0.06)	9092 (0.34)	37533 (1.03)

Table V. (Continued)

Country	Total Agricultural Products $1000		Live Animals $1000		Meat & Meat Preparations $1000		Dairy Products & Eggs $1000		Feedstuff $1000		Cereals $1000	
	1973	1983	1973	1983	1973	1983	1973	1983	1973	1983	1973	1983
Zimbabwe	NA	41076	NA	175	NA	178	NA	3137	NA	1101	NA	9860
	NA	(0.70)	NA	(0.003)	NA	(0.003)	NA	(0.05)	NA	(0.01)	NA	(0.002)

Source: Derived from FAO of the United Nations, Trade Yearbook, various issues.
GNP figures obtained from International Monetary Fund, International Financial Statistics Yearbook, 1986. World Bank, World Development Report, 1981.
GNP figures for 1983 were obtained from the World Bank Atlas, 1986, Washington, DC.

NA = not available

*Imports as percentage of GNP are in parentheses.

meet trend demand within a country (Mangahas, 1985). Depending on food imports for prolonged periods in the face of declining foreign reserves and volatile international markets threatens the political stability of governments in the region (Eicher and Staatz, 1985). Efficiency and equity are key contending factors within macropolicy settings that involve national food strategies. These macro settings involve the functioning of markets for land, labor and capital, domestic and international monetary institutions. It involves sound fiscal policies, including institutions for security, public safety and justice. In addition, these macro settings also include the existence of non-market institutions by which the people, particularly low income people, can have access to food.

The incidence of malnutrition in Sub-Saharan Africa is significant (McMillan and Hansen, 1986). A host of sociocultural and economic reasons which include the lack of purchasing power to obtain the needed proteins and taboos against children eating certain protein foods are the major causes. Early childhood deprivation of much needed proteins has been found to result in significant mental retardation (Selowsky and Taylor, 1973). It is, therefore, important to consider the well established relationship between infant malnutrition and mental retardation on the one hand, and its implications for adult productivity on the other.

It is alleged in the literature (Saouma, 1984, Abalu, 1982 and ILCA 1984) that the problems encountered by the agricultural sector in Sub-Saharan Africa are probably the result of improper management techniques, methods of production, processing, land tenure systems not favorable to modern agricultural development and government policies. In most countries in the region, government policies are increasingly recognized as the major cause for the poor performance of the agricultural sector. Three areas deserve particular attention. These include:

1. The choice between food imports and increased domestic production
2. The role of dualistic agricultural systems, that is the developmenmt of the small farm sector and large scale agricultural enterprises. How can the best features of traditional and modern systems of tenure be combined without leading to the development of an inequitable dualistic structure of peasant and commercial agriculture?, and
3. The implications of population growth and urbanization.

During the last two decades, several international agencies and foreign governments have sponsored numerous studies of agricultural problems and prospects in Sub-Saharan Africa. However, neither the analysis nor the suggested programs have been fully satisfactory (Saouma,

1984). Many of these proposals failed to take into account complexities of the true situations existing in the region. More in depth analysis than currently available is needed to recommend appropriate steps that will bring closer an effective revival of food production in the region. Cereal food aid in West Africa has increased from 429,000 MT during 1974/75 to 725,000 MT in 1983/84. In East Africa, cereal food aid rose from 386,000 MT to 1.103 million MT during the same period. Also, official development assistance (ODA) received by countries in Southern Africa rose from US$699.0 million in 1978 to US$1.439 billion in 1984. Central Africa's ODA received during the same period rose from US$627.0 million to US$714.0 million.

Apparently, the gap between food production and demand is still widening. If improved technology and appropriate agrcultural policies are adopted, the region could increase food production and support higher populations. The situation is complicated by the problem of urbanization. In 1973, the urban population in Central Africa ranged from 21.0 percent in Gabon to 30.3 percent of the total population in Equatorial Guinea. Gabon's urban population rose to 40.9 percent in 1985, and that of Zaire was 44.2 percent of the total population during the same period. Guinea's urban population accounted for 11.2 percent of the country's total population in 1973, and in 1985 the figure almost doubled (22.2 percent). Further

examination of Table III reveals that Nigeria's urban residents increased by only 1.0 percent from the 1973 figure of 22.0 percent.

The basic issue then, is how to expand the marketed surplus as distinct from subsistence production. Making the problem even worse is the fact that urban residents have changed their food habits (FAO, 1984 and Delgado and Miller, 1985). Traditional crops such as millet, cassava and some livestock products are gradually supplanted by imported items such as wheat products, some types of rice, bacon, cheese and other dairy products that cannot easily be produced in the region. An empirical investigation of the microeconomic parameters underlying the substitution process could be useful for policy analysis. However, this issue is outside the scope of this study.

Projections of food production and effective demand in Sub-Saharan Africa for the year 2000 indicate a staggering food deficit, particularly in the major livestock products such as milk, meat and eggs (FAO, 1981). It is appropriate to assess, therefore, the importance of the livestock sector of the region in terms of its contribution to food production. However, most of the traditional livestock production systems in Africa are declining gradually. Environmental degradation and human as well as livestock population pressure contribute to the decline.

The current infrastructure provided for raising

livestock and crops alike cannot support intensive production in the region on a sustained basis. For instance, the range conditions are usually poor in the dry season. The resulting forage shortages cause nutritional deficiency, body weights decrease and may eventually result in the death of animals. Poor management could also be attributed to lack of incentives to provide ground water systems which crops and livestock could utilize. Furthermore, persistent overgrazing denudes the land and erosion hazards deplete soil fertility which also reduce annual crop yields. Also, over the years, development efforts have often stressed technical innovations without an understanding of the potential consequences that can flow from such interventions in the pastoral communities in Africa (Swift, November 1981). To some extent, the outcome of past investments in livestock development projects in the region has been disappointing due to lack of understanding of the economic, social and biological relationships existing in each production system.

Another problem common in the livestock sector in Sub-Saharan Africa is that governments in the region have typically underinvested in agricultural research. According to McIntire (October 1985, pp. 2-6), there is a wide variation in the mean expenditures on agricultural research in Africa, reflecting variations in historical experiences and national per capita income levels. Per

capita expenditures in agricultural research in Sub-Saharan Africa are among the lowest in the world.

The movement of macroeconomic variables in Sub-Saharan Africa tends to point to possible conflicts of policies dealing with food imports. For instance, the annual growth rate of the GNP in Sierra Leone was only 0.6 percent during 1965-84, while inflation rose from 1.9 percent during 1965-73 to 15.4 percent during the 1973-84 period (Table VI). Percentage of GDP in gross domestic investment dropped from 12.0 percent in 1965 to 9.0 percent in 1984. Interest payments in the long-term debt incurred by the government rose from US$2.0 million in 1970 to US$4.0 million in 1984. Similar inflationary pressures and debt service burdens have spread across the region. In Southern Africa, the annual inflation rate during 1973-84 ranged from 9.4 percent in Malawi to 14.4 percent in Madagascar. Domestic investment in Zambia as percent of the GDP declined from 25.0 percent in 1965 to 14.0 percent in 1984, and Senegal's interest payments on the long-term public debt rose from US$2.0 million in 1970 to US$53.0 million in 1984.

The trade and pricing policies pursued by Sub-Saharan nations have a great impact on the pace of future growth in rural incomes and the alleviation of poverty and hunger in the region. However, most governments in Africa have discriminated against agriculture through protection and

Table VI. Macroeconomic Indicators for Selected Sub-Saharan Countries, 1965-1984.

Region and Country	GNP Per Capita		Average Annual Rate of Inflation (Percent)		Percentage of GDP in Gross Domestic Investment		Total Interest Payments in Long-Term Debt (Millions) of Dollars)		Total Long-Term Debt Service as Percentage of GNP	
	Dollars 1984	Average Annual Growth Rate (%) 1965-84	1965-73	1973-84	1965	1984	1970	1984	1970	1984
West Africa										
Benin	270	1.0	3.6	10.8	12	7	NA	17	0.7	3.9
Bukina Faso	160	1.2	2.6	10.6	10	14	NA	7	0.6	2.3
Cape Verde	320	NA	NA	12.6	NA	NA	NA	NA	NA	NA
Chad	NA	NA	NA	NA	9	NA	NA	1	1.0	NA
The Gambia	260	1.0	3.0	10.4	NA	NA	NA	NA	NA	NA
Ghana	350	-1.9	8.1	52.2	18	6	NA	NA	NA	NA
Guinea	330	1.1	3.0	4.5	NA	10	4	21	2.2	5.3
Guinea Bissau	190	NA	NA	9.1	NA	NA	NA	NA	NA	NA
Ivory Coast	610	0.2	4.1	11.7	19	13	NA	NA	NA	NA
Liberia	470	0.5	1.5	6.7	17	20	6	20	5.5	4.3
Mali	140	1.1	7.6	10.4	23	17	NA	7	0.3	1.7
Mauritania	450	0.3	3.9	7.7	14	22	NA	23	1.7	6.2
Niger	190	-1.3	4.0	11.5	15	25	NA	NA	NA	NA
Nigeria	730	2.8	10.3	13.0	19	12	28	1282	0.9	4.6
Senegal	380	-0.5	3.0	9.0	12	15	2	53	1.1	4.2
Sierra Leone	310	0.6	1.9	15.4	12	9	2	4	2.9	1.6
Togo	250	0.5	3.1	8.2	22	23	1	37	0.9	10.1
Central Africa										
Cameroon	800	2.9	5.8	12.8	13	26	5	164	1.0	4.8
Central African Republic	260	-0.1	3.0	13.8	21	12	1	6	1.6	2.0
Congo	1140	3.7	4.6	12.3	22	35	3	78	3.3	13.7
Sao Tome Prin.	330	-1.6	NA	8.3	NA	NA	NA	NA	NA	NA
Zaire	140	-1.6	18.7	48.2	28	NA	NA	NA	NA	NA

Table VI. (Continued)

Region and Country	GNP Per Capita		Average Annual Rate of Inflation (Percent)		Percentage of GDP in Gross Domestic Investment		Total Interest Payments in Long-Term Debt (Millions) of Dollars)		Total Long-Term Debt Service as Percentage of GNP	
	Dollars 1984	Average Annual Growth Rate (%) 1965-84	1965-73	1973-84	1965	1984	1970	1984	1970	1984
East Africa										
Ethiopia	110	0.4	1.8	4.4	13	11	6	31	1.2	1.8
Somalia	260	NA	3.8	20.2	11	NA	NA	3	0.3	2.0
Sudan	360	1.2	7.2	19.3	10	11	13	65	1.7	NA
Burundi	220	1.9	2.9	12.2	6	21	NA	8	0.3	1.9
Kenya	310	2.1	2.3	10.8	14	22	NA	NA	NA	NA
Rwanda	280	2.3	7.7	10.5	10	NA	NA	3	0.1	0.4
Seychelles	NA	NA	NA	14.8	NA	NA	NA	NA	NA	NA
Tanzania	210	0.6	3.2	11.5	15	NA	NA	NA	NA	NA
Uganda	230	2.9	5.6	64.5	11	8	4	32	0.4	1.7
Southern Africa										
Angola	1247	NA	NA	NA	NA	NA	NA	NA	NA	NA
Botswana	960	8.4	4.4	9.8	6	21	NA	15	0.7	3.8
Lesotho	530	5.9	4.4	11.9	11	NA	NA	4	0.5	3.8
Madagascar	260	-1.6	4.1	14.4	10	14	2	31	0.8	5.2
Malawi	180	1.7	4.5	9.4	14	16	3	32	2.1	7.2
Maurituis	1090	2.7	5.6	12.7	17	18	NA	26	NA	7.9
South Africa	2340	1.4	6.0	13.2	28	25	NA	NA	NA	NA
Zambia	470	-1.3	5.8	10.4	25	14	NA	NA	NA	NA
Zimbabwe	760	1.5	1.1	11.4	15	13	NA	NA	NA	NA

Source: Derived from World Bank, World Development Reports 1986, pp. 180-255.

through inappropriate macroeconomic and exchange rate policies (World Bank, 1986). The linkage between macroeconomic and sectoral policies is usually so strong that, it is much better to carry out agricultural reforms in conjunction with other economy wide policies. The above issues put the analyst of price policy in a dilemma.

The preceeding description indicates that the list of factors impeding food security and self-sufficiency in Sub-Saharan Africa is depressingly long; encompassing economic, political, demographic, social, technological and environmental influences.

Procedure

Import demand models will be developed to estimate the import demand equations and demand elasticities for livestock products in Sub-Saharan Africa. The demand elasticities will be estimated for each country using Zellner's (1962) seemingly unrelated regression (SUR) technique. Further details about the above procedures are given in the chapter on methodology.

Objective one will be achieved by estimating import demand equations for the various countries in Sub-Saharan Africa adopting methods developed by Zellner and Leamer and Stern (1970). Finally, the second objective is achieved based on information gathered in this study. This involves

drawing conclusions and policy implications from the data analyzed and estimated demand elasticities. The signs of the estimated regression coefficients are a useful guide in assessing the policy implications.

Organization of the study

This study is divided into five chapters. Chapter one deals with the introduction. A review of the literature pertinent to the study is presented in chapter two. Chapter three deals with discussions of the methodology and theoretical livestock trade issues. In chapter four, detailed analysis of data and estimation of demand elasticities is done. Conclusions and policy recommendations are presented in chapter five. Also included here are suggestions for further research opportunities.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

This chapter presents a review of the literature relevant to agricultural trade in Sub-Saharan African. The chapter is divided into two sections. Section one examines government policies aimed at the agricultural sector. The second section deals with livestock supply response in Sub-Saharan Africa.

Government Policies in the Agricultural Sector of Sub-Saharan Africa

In several instances, sector-specific pricing and tax policies may have lead to the discrimination against agriculture. Government intervention at various stages of production, marketing and consumption of agricultural products and use of inputs, though intended to improve the efficiency of markets, have frequently resulted in greater inefficiences and lower output and incomes (World Bank, 1986). The World Bank (1986) concludes that farm incomes in most African countries are stagnating and little

progress is being made in overcoming the problems of poverty.

Policies designed to improve agriculture's performance can be categorized as:

1. Policies relating to the size and price of food imports coupled with the pricing of agricultural export crops;
2. Policies dealing with intermediate agricultural inputs; and
3. Policies aimed at altering the basic structure of a farmers' production environment including research and development of improved seeds and technology, provision of extension services and rural infrastructural development.

The first two groups of policies are discussed in the sections that deal with macroeconomic policies. Included here are trade, exchange rate and pricing policies. The third category of policies are discussed under supply response of farmers to price.

Macroeconomic Policies

Policies on exchange rate, trade regimes and government spending are economy-wide policies that also influence the performance of the agricultural sector. According to Chhibber and Wilton (September 1986), macroeconomic policy denotes economic policies which play a dominant role in determining the intersectoral allocation

of resources, though these policies are rarely regarded by policy-makers as being directly concerned with agriculture.

Macroeconomic policies have had depressing effects on Sub-Saharan agricultural exports. These negative effects have usually compounded explicit measures to protect domestic manufacturing relative to the agricultural sector. In some other instances, reforms designed to reduce an explicit tax burden on agriculture have been offset by increases in implicit taxation emanating from macroeconomic policies. To further understand these policy implications, this section examines in detail policies relating to exchange rates, trade, and agricultural pricing policies in the subsequent pages.

Trade Policy:

In reviewing the literature (World Bank, 1986, Crockett 1981, Oyejide 1986 and Tshibaka, 1986), it is clear that trade policy in Sub-Saharan Africa and in other LDCs has not been applied consistently. This sends confusing signals to farmers. As Tshibaka (1986) puts it, "changes in exchange rate, trade and other economic policies in Zaire could best be described as erratic". This may have introduced uncertainty in the Zairian financial markets, agricultural sector and economy as a whole. On several occasions, policy measures were adopted to limit the size of agricultural imports. The tax burden on agricultural producers in Sub-Saharan Africa on the

average is 40-45 percent. This burden refers to the ratio of farm gate producer price to economic value at the farm gate (Sikod, 1985). Subsidies on food imports and other services soften the tax impact approximately 10 to 15 percent.

Between 1971 and 1982, the Zairian government instituted significant taxation of major export crops, viz: coffee, cotton, groundnuts and maize. This discrimination against the agricultural sector inflicted heavy costs on the Zairian economy. Also the effects of real exchange rate and trade policies on relative prices have substantial impacts on the structure of incentives. Tshibaka (1986) reports that the domestic price of nontradables (farm and nonfarm) relative to all exportables would increase by approximately 0.52 percent for every 1.0 percent increase in the domestic price of all importables relative to all exportables in Zaire. This implies that a 10.0 percent tariff levied on all imports in Zaire, is equivalent to a 5.2 percent tax on all imports. Since a large proportion of exportables from Zaire are farm products, it means at least half of all the burden associated with protection of importables against foreign competition is borne by both farm and nonfarm export commodities. This squeeze on the export sector hampers efforts to generate enough foreign exchange to meet the import requirements of the agricultural sector and Zairian economy in general.

Exchange Rate Policy:

The role of the real exchange rate in economic developnment must be emphasised. Changes in exchange rate policy have profound effects on a country's domestic relative prices and economic growth. The real exchange rate (the ratio of terms of trade between the traded and nontraded sectors of the economy) provides the signal for resource movements. An exchange rate policy affects domestic prices of traded and nontraded agricultural commodities through its influence on the entire domestic cost structure. In Sub-Saharan Africa, overvaluation of exchange rates by domestic policies is a common phenomenon (Oyejide, 1986 and World Bank,1986).

As shown in Table VII, bursts of worldwide inflation during 1973-74 and 1979-80 followed by global recessions during 1975-76 and 1981-82 are among the reasons that prompted African governments to overvalue their exchange rates in efforts to correct balance of payments dificits (McCalla, 1982 and World Bank, 1986). However, this created an impediment to producers of agricultural crops; and an implicit subsidy for imports of agricultural and nonagricultural goods and services.

Declining real exchange rates make export goods less profitable. As a result producers of exportable farm commodities divert resources to other activities. This leads to a contraction of the export sector and the ability

Table VII: Index of Real Exchange Rates in Selected Sub-Saharan African Countries. (1969-71=100)

Country	1973-75	1978-80	1981-83
Cameroon	75	58	80
Ethiopia	93	64	67
Ghana	89	23	8
Ivory Coast	81	56	74
Kenya	88	69	86
Malawi	94	85	94
Mali	68	50	66
Niger	80	56	74
Nigeria	76	43	41
Senegal	71	60	85
Sierra Leone	100	90	73
Sudan	76	58	74
Tanzania	85	65	51
Zambia	90	79	86
All Sub-Saharan Africa	84	62	69

Note: Data are three year averages. The real exchange rate is defined as the official exchange rate deflated by the ratio of the domestic consumer price deflator to the United States consumption deflator. A fall in the index indicates exchange rate appreciation of the domestic currency.

Source: World Bank, World Development Report 1986. Oxford University Press. 1986. p.67.

of African nations to earn foreign exchange is reduced. Declining real exchange rates also encourages capital flight. With limited foreign exchange earnings, there is a restraint on the importation of consumer goods, capital and intermediate goods. As investment in the agricultural sector is constrained due to limited import capacity, the productive capacity of the whole economy is affected. Between 1970 and 1980, the nominal exchange rate in Nigeria appreciated by 22.5 percent and the real exchange rate by 55.1 percent. Overvaluation and periodic variations in the real exchange rate since the 1970s have drastically reduced production incentives in agriculture and other sectors of the Nigerian economy (Oyejide, 1986).

As the performance of the domestic economy deteriorates, various African governments adopt restrictive trade and exchange rate policies in efforts to correct the balance of payments and budget deficits. However,the basic economic indicators continue to decline. For example in Zaire, the annual growth rate of staple food production fell by 1.6 percent, output of major export crops declined 0.8 percent and the GDP fell by 0.4 percent during the 1971-1982 period.

Import restrictions create biases against agriculture by:

1. Depressing producer prices for agricultural exports.
2. Raising the cost of consumer goods, for example in

Kenya there is a 100.0 percent tariff levied on textiles (Sikod, 1985).

3. Forcing farmers to purchase locally manufactured farm equipment at exhorbitant prices, as in the case of Bukina Faso where there is a 60.0 percent tariff on animal drawn plows and a 58.0 percent tariff imposed on engines used by irrigation pumps; and
4. Lowering prices of food imports which has increased the dependence on food imports by African nations with negative effects on domestic agricultural production.

The synergistic effects of inappropriate sectoral pricing and trade policies, and exchange rate movements frequently exacerbate the general economic bias against agriculture. Host-country (Sub-Saharan African) appreciations in real exchange rates due to inappropriate macroeconomic policies can easily outweigh efforts to improve sectoral policies. During the 1969-71 and 1978-80 period, real exchange rates in Sub-Saharan Africa appreciated by 38.0 percent (Table VII). Ghana, Nigeria, Sierra Leone and Tanzania had large overvaluations of exchange rates.

Agricultural exports from Sub-Saharan Africa are sensitive to exchange rate changes especially when the chance to sell in parallel markets exists. Econometric studies (World Bank, 1986) and Chhibber and Wilton (1986) show that, on the average, for every percentage point fall

in the real exchange rate, agricultural exports decline by 0.6-0.8 percentage points in all LDCs and in excess of one percentage point in Sub-Saharan Africa. These results confirm that supply responses are high in Sub-Saharan Africa.

Exchange rate and import controls are relied on because they exert immediate, direct, and predictable effects on the value of imports and can be used to discriminate between imports as deemed desirable by the government. Trade and exchange rate policies can provide better signals for resource movements in the economy if they depend more on the market mechanism for their effectiveness than on government discretion. Evidence accumulated as early as the Medieval period in Europe has argued against the futility and harmful effects of government trying to legislate concerning prices and the flow of trade (Chalk, 1951).

Pricing Policy:

The main objectives of African governments in designing agricultural policies is to achieve self-sufficiency, increasing employment, farm income and welfare, integrated rural development and generate foreign exchange. In various ways, government interventions in agriculture are intended to directly or indirectly influence production, income, factor use and prices. Sometimes, the effects on prices are intended to benefit

the producer, in some cases the consumer or government. Government intervention in agricultural prices can have either stimulatory or depressing effects on production.

African governments participate directly in the pricing process by providing subsidies to producers or consumers for certain commodities, by imposing import tariffs or quotas and domestic sales taxes, and by establishing regulatory government bodies such as agricultural marketing boards. Rodriguez Jr. (October, 1985) mentioned that the main reasons for government involvement in the pricing process are:

1. Protection of the domestic economy against severe fluctuations on the international market.
2. Equity considerations
3. Lumpiness of costs or benefits associated with an externality incurred by an enterprise, for example pollution control within the economy, and
4. Political pressure from special interest groups. As Bates (November, 1983) commented, food policy in Africa seems to represent a kind of political settlement, one designed to bring peaceful relations between African governments and their urban residents. It is a settlement in which the farmeer tends to bear the costs.

In Zimbabwe, the consumer price for beef is usually set below the domestic producer price. This results in

substantial trade deficits incurred by the Cold Storage Company (CSC) and financed by the government. The CSC is a parastatal agency that monitors and controls domestic beef prices in Zimbabwe. Similarly, milk consumer prices are set below their actual accounting costs. Deficits incurred by the Dairy Marketing Board (DMB) in 1981/82 were Z$18.3 million and increased to Z$38.65 million in 1983/84 (Rodriguez Jr., February 1987). However, Jansen (1982, in Rodriguez 1987) argued that the DMB trading deficit is actually a consumer subsidy. Based on Jansen's analysis, the retail price of milk in Zimbabwe is only 41.0 percent of its border price.

According to government officials in Sub-Saharan Africa, controlling agricultural prices helps to protect farmers and consumers against unscrupulous middlemen (Tshibaka, 1986 and Oyejide, 1986). In several African countries, official producer prices paid to farmers have consistently been far below those in either the world market or in parallel markets. For example, during 1981 in the Turumbu area of Zaire, uncontrolled farmgate prices for paddy rice were Z3,609 per metric ton compared to the official prices of Z800 per metric ton. For maize, the government set price was Z650 per metric ton while in the 'free' market, maize was selling at Z1,170 per metric ton. In agricultural project areas, Tshibaka (1986) indicated that farmers enrolled in the projects are administratively

required to sell all their produce to the government at official prices. This rule, among other things, may have contributed to lack of interest by farmers to join the maize project in Shaba province. During 1983, some reforms were initiated by the Zairian government to liberalize agricultural prices and lift restrictions on domestic regional trade.

Marketing boards with full monopoly powers are created by African governments to carry out government policies. For instance, in Tanzania, the maize procurement price was only 25.0 percent of the border price in 1985. During the same period, a parastatal marketing agency in Ethiopia controlled approximately 30.0 percent of the total marketable surplus and close to 100.0 percent of the international grain trade. Also, the procurement prices in Ethiopia during 1985 were much lower for wheat, sorghum and maize. These prices were 45.0, 50.0 and 80.0 percent respectively above the farmgate prices. In Ghana, Tanzania and Cameroon, rice prices were only 50.0 percent of the border prices (World Bank, 1986).

Over the years, the Nigerian marketing boards have played an important role in organizing the purchase and export of such cash crops as cocoa, rubber, soybeans, groundnuts and cotton. But Nigerian farmers have been paid well below the world market price for the crops. Oyejide (1986) wrote: "groundnut farmers were paid a price so low

it amounted to a tax of approximately 68.0 percent in 1950, although in 1965, the tax element had reduced to 36.0 percent and in 1982, it was completely replaced by a subsidy". With regards to food crops such as millet, rice, beans and guinea corn, government intervention is limited to setting official guaranteed minimum prices. However, the guaranteed minimum prices served as a below-market safety net rather than as floor prices. Also, these prices are set at fixed levels for several years without change. As a result, the farmgate prices are usually higher than the corresponding guaranteed minimum prices set by the Nigerian government.

Livestock Supply Response of African Farmers to Price

The supply response of African farmers to price fluctuation has attracted considerable attention in recent years. Two common views about the supply response of African farmers to price are: First, African farmers pay little or no attention to prices. That is to say, the farmers production decisions are governed by complex traditional production decisions that cannot be analyzed by means of economic theory. Thus, there are either no existing supply curves for African farmers or where they exist, the supply curves are inconsistent with economic theory; providing a backward bending supply curve (Dean,

1965). The second view asserts that African farmers respond rapidly to price changes, their behavior is consistent with economic postulates and is amenable to economic analysis. The latter view is reviewed below. Proponents of the first view have often offered no empirical support for their conclusions (Medani, 1972).

There are important policy implications for this controversy concerning the supply response of African farmers. The effect of price on production is of critical importance to any economy in which the price mechanism is allowed to operate to balance supply and demand. Knowledge of supply response is very important to any national formulation of agricultural policy. However, many problems are encountered in econometrically assessing the responsiveness of livestock output to prices and other variables. First, a positive correlation between the producer price and marketed output indicates very little about the underlying causal relationships of choices between economic agents such as wage work and work on owned farms, production and leisure and livestock products and crops. Second, the data are of poor quality or are not available . Third, the empirical results depend on the choice of output and price variables. In addition to prices, other important variables affecting a farmer's livestock/cropping production decisions include the farmer's perception of risk, poor transportation network,

inadequate research and extension facilities, unavailability of credit, shortages of fertilizer; drugs and other veterinary services and lack of consumer goods on which the farmer can spend his income. The impacts of all these variables are difficult to emirically spcify and estimate.

The dynamic Supply Function:

In formulating dynamic supply models, economists have often considered expectations about future economic variables in theoretical development. Nerlove's (1958) work has become a standard tool for the estimation of supply functions (Chembezi and Womack, 1987 and Henneberry, April, 1986). Lagged variables are employed to an increasing extent in recent econometric work in attempts to formulate certain relationships more realistically. Supply cannot respond immediately to a change in prices and technology because of the biological nature of production and rigidities, including asset fixity and difficulty of changing production plans in the short-run. The assumption is that adjustment to optimum use of resources in agriculture is spread over time.

A typical agricultural supply response model is generally of the form:

$$Y_{t*} = \alpha + \beta P_{t*} + \gamma Z_t + e_t \qquad (2.1)$$

where:

Y_{t*} = desired output at time t

P_{t*} = expected price at time t

Z_t = other exogenous factors, including prices of substitutes and non-price variables

e_t = error term,

The α, β and γ are the regression coefficients to be estimated.

The traditional short-run supply function assumes that $Y_{t*} = Y_t$ and $P_{t*} = P_{t-1}$; the assumption is that farmers fully adjust to their desired output each season according to the price level in the preceding season. However, this assumption may be inaccurate. A farmer may not, for example, be able to expand his crop acreage or number of animals during the present period because of capital constraints. The use of a Nerlovian partial adjustment model as specified below allows for the possibility of adjustment lags:

$$Y_t - Y_{t-1} = \theta(Y_{t*} - Y_{t-1}) \qquad (2.2)$$

$$0 \leq \theta \leq 1$$

The constant θ is the coefficient of adjustment. Substituting equation (2.1) into equation (2.2) yields:

$$Y_t = \alpha\theta + \beta\theta P_{t-1} + (1-\theta)Y_{t-1} + \gamma\theta Z_t + \theta e_t \qquad (2.3)$$

The Ndzinge, Marsh and Greer (1984) study used a rational distributed lag model within the framework of adaptive expectations and partial adjustment models to estimate supply responses of Botswana beef cattle producers. Their working hypotheses is that fluctuating beef prices and range conditions influence the production and marketing decisions of beef cattle producers in Botswana. Results from their analysis indicate a positive relationship between lagged price and inventory. This is supported by economic theory, that is, cattle inventories are viewed as a stock good and normal responses of producers to a price increase would be to increase herd size. Their analysis also show that producers respond to both biological and market forces. When producers are building up (decreasing) their breeding herds, the number of animals marketed is reduced (increased).

The principal findings of other supply response studies (Bond, 1983, Medani 1970, and Khalifa and Simpson, 1972) in Sub-Saharan Africa include the following:

1. The long-run own-price elasticities tend to be larger than those for the short-run and of fairly sizeable magnitudes (0.33-3.72). The price elasticities to some of the equations with cross-price effects provide some support for the view that an overall increase in agricultural producer prices does lead to overall

increases in agricultural output.

2. With few exceptions, the own-price elasticities are positive and significant from an economic and statistical stand point even within the shortrun.
3. The results from the various studies also contradict the view that subsistence farmers have only income goals and that they therefore react perversely to changes in producer prices, and
4. The findings tend to suggest that spare capacity suitable for crop cultivation often exists and that increasing producer prices can lead to increased productivity per acre.

Despite these findings, Doran, Low and Kemp (1980), concluded that beef cattle producers in Swaziland were not responsive to prices and as a result argued that many livestock development projects were counter productive. For instance, response to some livestock development programs exacerbated rather than improved the overgrazing situation which emanated from a declining offtake rate. Swaziland's stocking rate of 34 animals per square kilometer is one of the highest in Africa (Low and Kemp, 1977). In the Western Sudanese province of Danfur and Kordofan, overgrazing is blamed for the expansion of the desert at the rate of 820,000 hectres per year (Low, 1978).

In summary, the above findings about supply response

suggest that the nomad pastoralist is not the noble savage living contently a way of life unchanged for a thousand years. Instead he desires the goods and services provided by the modern sector of the economy and is prepared to sell livestock and livestock products to finance his needs. As Jarvis (1974) noted, since livestock are utilized for both consumption and capital goods purposes, changes in economic and noneconomic variables can elicit varying responses.

Chapter Conclusions

The analysis in this chapter show that in various African countries, quantitative import restrictions on food crops and other commodities tend to be used largely for dealing with short-term balance of payments adjustment difficulties. Whenever foreign reserves are deteriorating, African governments put long lists of commodities under specific import licenses regulations. This reflects large positive rates of protection or implicit taxation for the commodities concerned. Protection of food crops often does not indicate stability and consistency in policy intensions. Consequently, large production incentives do not necessarily result in positive and sustained supply response.

Reductions of price controls would allow prices to reflect the true costs of resources and would encourage the

expansion of activities in line with changing incentives. Fewer investment controls would help reduce barriers to entry, encourage foreign direct investment and ease tecnological progress. The problems encountered by the agricultural sector in Africa are probably the result of improper management techniques, methods of production, processing, land tenure systems not favorable to modern agricultural development and government policies. Another problem common in the livestock sector in Sub-Saharan Africa is the fact that governments in the region have consistently underinvested in agricultural research.

CHAPTER III

METHODOLOGY

Introduction

This chapter presents the theoretical framework for estimating beef, milk, cheese and butter import demand equations and demand elasticities in selected Sub-Saharan African countries. Key components relevant to the econometric estimation of import demand equations and several questions unanswered by economic theory are identified and addressed. These include the precise specification of the functional form of the import demand models, definition of the dependent and explanatory variables in the models and the statistical technique employed.

The chapter is divided into three sections. Section one contains the model specification. Section two deals with sources of the data and computation of the variables. The third section contains the a priori expectations for the direction of effects of the independent variables.

Model Formulation

The demand for livestock products Y_t at any time t is equal to the difference between domestic demand D_t, and and supply S_t for the commodity. The import demand curve represents an excess demand. We assume here that livestock imports and domestically produced livestock products are perfect substitutes.

The functional form for the demand for a particular livestock product derived from a general utility function is specified as:

$$Y_t = f(P_{it}, P_{jt}, I_t, R_t, T, Q_t) \qquad (3.1)$$

where:

P_{it} = the own-price of the livestock product in real terms

P_{jt} = the prices of other livestock (substitute or complementary) products in real terms

I_t = per capita income in real terms

R_t = the real foreign exchange rate

T = time trend, and

Q_t = domestic production (inventry) of livestock products.

The analysis in this study covers the period 1961 to 1986; thus t = 1, 2, ..., 26. Because of its flexibility, a log-linear functional form is chosen for the estimation of the import demand equations. In using the

constant elasticity models, the elasticities are obtained directly from the regression equations. A simultaneous estimation of a set of regression equations in selected Sub-Saharan African countries will be conducted. In particular, we will treat systems of the following form:

$$Y_i = X_i\beta_i + \varepsilon_i, \qquad i= 1, 2,.....,M \tag{3.2}$$

where : Y_i and ε_i are of dimension (T x 1), X_i is (T x K_i) and β_i is (K_i x 1).

The set of M regression equations is written as :

$$\begin{aligned} Y_1 &= X_1\beta_1 + \varepsilon_1 \\ Y_2 &= X_2\beta_2 + \varepsilon_2 \\ &\cdots\cdots\cdots\cdots \\ Y_M &= X_M\beta_M + \varepsilon_M \end{aligned} \tag{3.3}$$

or alternatively;

$$Y = X\beta + e \tag{3.4}$$

where the definitions of Y, X, β and e are obvious from equations (3.3); and where their dimensions are (MT x 1), (MT x K), (K x 1) and (MT x 1) respectively with $K = \Sigma_{i=1}^{M} K_i$.

The general assumptions of equation (3.2) are :

1. $E(\varepsilon_i) = 0$, for i = 1, 2, ..., M
2. $E(\varepsilon_i\varepsilon_j) = \sigma_{ij}I_T$ for i,j = 1, 2 ,....., M

3. X_i is nonstochastic and of full column rank.

The errors for any particular equation satisfy ideal conditions, have zero expectation and are both nonautocorrelated and homoscedastic. However, there may be correlation between the disturbances in different equations. Such error specifications are reasonable when estimating a number of related economic functions such as demand equations for a number of related commodities, consumption functions for subsets of the population (Judge et al, 1985 and Schmidt, 1976), internal and external factors in international trade settings including global macroeconomic linkages and world market demand and supply shocks (Raney, 1986).

In this case, it would seem probable that since equation (3.2) represents a system of import demand equations for livestock products, then factors contributing to the stochastic error term in one equation also contribute to contemporaneous disturbances in other equations. In this time series data, the disturbances are both serially and contemporaneously correlated. When equation (3.3) is treated as a single equation, we can estimate β and hence all β_i by using generalized least squares (GLS). Under the assumptions of our model, the best linear unbiased estimator (BLUE) of β_i based upon Y_i is the ordinary least squares (OLS) estimator:

$$\hat{\beta}_i = (X_i'X_i)^{-1}X_i'Y_i \qquad (3.5)$$

However, the use of GLS enables us to utilize the entire sample. According to Judge et al (1985), if X is of rank K and Σ is known and of rank M, the GLS estimator exists and is given by:

$$\hat{\beta} = (X'\Omega^{-1}X)^{-1}X'\Omega^{-1}Y \qquad (3.6)$$

The possible gain in efficiency resulting from jointly considering all the equations in the system led Zellner (1962) to call equation (3.3) " a set of seemingly unrelated regression equations". However, one should realize that in most applications, Σ is unknown so that the estimator β-hat cannot be used. Therfore, we utilize the estimated generalized least squares estimator (EGLS):

$$\tilde{\beta} = [X'(\hat{\Sigma}^{-1}\otimes I]^{-1}X'(\hat{\Sigma}^{-1}\otimes I)Y \qquad (3.7)$$

where the estimator $\hat{\Sigma}$ is based on OLS residuals and possess the characteristics

$$\hat{\sigma}_{ij} = T^{-1}\hat{\varepsilon}_i'\,\hat{\varepsilon}_j \quad ; \; i,j = 1, 2, \ldots\ldots, M \qquad (3.8)$$

As Johnston (1984), Judge et al (1985) and Pyles (1987) noted, the asymptotic normality of β-tilda implies that the traditional t and F tests for linear hypothesis are

asymptotically valid. Also, if the errors are normally distributed, then β-tilda is both asymptotically efficient and is a uniformly minimum variance unbiased estimator (UMVUE), thus the t and F tests are valid in finite samples.

Data Sources and Computation of the Variables

The data used in the empirical estimation of the import demand equations and demand elasticities were obtained from the Food and Agricultural Organization of the United Nations (FAO) data tapes and other published sources. In particular, the data for imports of livestock and livestock products (both in quantity and value) and domestic production came from the FAO data tapes covering the period 1961 to 1986. Data on foreign exchange rates, income, population and the consumer price indices (CPI) for various countries were taken from the International Financial Statistics (IFS) yearbook published in 1986 by the International Monetary Fund (IMF). All the data are measured on an annual basis.

Dependent Variables

The quantities of beef, milk, cheese, butter and livestock form the dependent variables in each of the import demand models as appropriate. The variables of total livestock units (TLU) was constructed by aggregating

cattle, sheep and goats together. Each of the animals were converted into livestock units (LU). Conversion factors are in appendixes A and B. The TLU per capita is TLU divided by the population in the country. The variable for total dairy products in liquid milk equivalents (LME) consists of milk, butter and cheese added together. The individual dairy products were converted into LME.

Independent Variables

Relative Prices: The unit values of the various imported livestock products are used as proxies for prices. The unit values are deflated by the CPI for the particular country in question. The CPI is used because other indexes, such as the GDP deflator did not have sufficient observations to be included in the models. Even though unit values do not measure exactly the internal prices in a country, they do measure border prices with some accuracy (Raney, 1986). Also, unit values account for concessionary sales such as food aid and other price related trade policies. With regards to the prices for livestock, beef and total dairy products, a weighted aggregate price (Laspeyres) index was constructed for each set of products using the quantities of each product as a weighting factor. The Laspeyres formula (Im) is given by:

$$I_m = \frac{\sum_{t=1}^{T} P_t Q_0}{\sum_{t=1}^{T} P_0 Q_0} \qquad (3.9)$$

where : P_o = base period price

Q_o = base period quantity and

P_t = current year prices.

One of the problems encounted in the contruction of indices is the selection of a base period. Tomek and Robinson (1985) and Yamane (1964) suggest that if a single year cannot be considered as normal (which simply means choosing a year which reflects a situation wherein the economy is neither in a trough of recession or peak of boom); then an average of several years may be considered as such. In this study, the period 1976-79 was used as base period since no single year could be considered as a normal period. In addition to the own-prices of the dependent variables, prices of related livestock products are included in the import demand models to measure their potential effects on the dependent variable. That is to determine the degree of substitutability or complementarity between the products.

Income: Per capita income is used as a proxy for personal disposable income by an individual. This variable gives an estimate of the income elasticity for imported livestock products in Sub-Saharan African countries. The real GDP figures measured in national currency units were divided by the population to obtain per capita income.

Real Exchange Rate: This is defined as the nominal

foreign exchange rate deflated by the ratio of the United States CPI to the domestic consumer price index. Raney (1986) asserts that the exchange rate elasticity is invariant with respect to the formulation of other variables in a log-linear model. However, in a linear model, the estimated exchange rate elasticity is very difficult to interpret if it differs from the specification of other variables in the model.

Including the exchange rate as a separate variable in the model enables economists to observe the differential impacts of exchange rate and price changes. Warner and Kreinin (1983) argue that exchange rates and prices may have different effects because of the following reasons: first, exchange rate changes may be considered to have effects that are more transitory and/or reversible than price changes, thus inducing a different kind of response. Secondly, exchange rate changes may be more visible and market participants may be more aware of them than price changes. Finally, exchange rate changes may be measured more accurately than price changes. Pegged exchange rates are changed periodically so that the real exchange movements may be hidden for considerable periods of time. Thus, price changes tend to be more visible, more transitory and more accurately measured than exchange rates.

Time and Domestic Inventory: The time variable is

introduced in addition to other explanatory variables to measure the effects of technological changes, tastes and preferences. The domestic production is included as an explanatory variable because the markets for imported livestock products and domestically produced livestock products are highly segregated. Imports are mainly consumed in urban centers while domestic products are consumed mostly in rural areas (Nwoko, May 1986, Mbogoh, July 1984 and Von Masssow, January 1985). Also, both imported livestock products and those produced locally are assumed to be perfect substitutes.

Ideally, livestock imports and domestic production should be treated in a simultaneous equation framework; with the price mechanism providing an equilibruim solution. However, since most of the countries in Sub-Saharan Africa are small countries without much influence in international trade, we assume these nations take the prices of imports as given. Also, we assume that the supply price elasticities are infinite so that the equations can be properly estimated as reduced forms.

Expected Sign of the Coefficient of the Explanatory Variables

Table VIII provides a summary of the expected direction of effects of the explanatory variables.

Table VIII: A priori Expectation for the Sign of the Coefficient for the Independent Variables.

Variable	Effects on Livestock Imports
P_{it}	(-)
P_{jt}	(+) or (-)
I_t	(+)
R_t	(-) or (+)
T	(+) or (+)
Q_t	(-)

However, because of the large number of countries in the study and varied levels of development, it becomes difficult to determine the correct sign of some of the parameters in the estimated equations. For some variables, the hypothesized relationships are straight forward.

The negative sign for the own-price elasticity of livestock products indicates we are dealing with downward sloping import demand curves. An increase in per capita income is expected to have a positive effect on the importation of livestock products. Thus, imports are expected to increase with increases in income since we expect imported livestock products to be normal goods.

The real foreign exchange rate may either have a positive or negative effect on imports depending on its definition and country concerned. If the exchange rate is defined as units of domestic currency per unit of foreign currency (for example the United States dollar); an appreciation of the domestic currency is expected to increase the importation of livestock products whose prices are denominated in dollars. But, a depreciation of the domestic currency is expected to have the reverse effect. Expected changes in the exchange rate also have perverse effects on the value of trade as established in the J-curve literature (Warner and Kreinin, 1983). Anticipatory changes in the exchange rate do have a marked effect on the volume of current imports in a country. Theory suggests

that as the domestic (foreign) currency depreciates, importers of dollar denominated imports will reduce their foreign purchases as the relative prices of foreign goods increase.

The time variable is expected to be either positive (in which case imports increase over time due to population increases, technological changes, tastes and preferences and other demand shifters), or negative due to the implementation of import substitution policies through increases in investment to expand domestic production.

Chapter Conclusions

The chapter presented a specification of the model to be used in the estimation of the import demand equations and demand elasticities for milk, butter, cheese and livestock in various African countries. Zellner's (1962) seemingly unrelated regression technique will be used to estimate the equations. The estimation period is from 1961 to 1986. Testable hypotheses were developed and chapter four will provide the results to the tests.

CHAPTER IV

EMPIRICAL RESULTS

Introduction

The import demand equations and demand elasticities for milk, butter, cheese and beef for selected Sub-Saharan African countries are estimated using the seemingly unrelated regression technique. As balance of payments deficits worsen in Sub-Saharan Africa, there are attempts to cut down on the flow of imported livestock products. However, there are conflicting issues about controlling imports in LDCs. Ajayi (1975) argues that restriction of imports not only reduces tax revenues derived from imports, but also have unintended side effects which include excerbation of inflationary pressures in the domestic economy. The effectiveness of pricing and international trade policy depends highly upon the direction and magnitudes of the underlying elasticities (Kreinin, 1967 and Khan and Ross, 1977).

Systems of import demand equations are estimated for each country and results are provided below. The empirical results are discussed under three broad groupings which include dairy products, beef and livestock imports.

Dairy Products

This category of imports include fresh cow milk, whole milk (which is either evaporated, dry or condensed), skim milk, butter and cheese.

Cow milk Imports

For 10 out of 14 countries, the regression coefficient for price of fresh cow milk (Pcowmilk) has a negative sign as expected (Table IX). Increases in the price of cow milk has negative effect on imports. In Central African Republic (CAR), Cote D'ivoire, Mali, Niger and Sierra Leone, the estimated coefficient for own-price is significant at the 5 percent level. A positive relationship exists between income (GDPPC) and cow milk imports in Benin, CAR, Ghana, Mali and Sierra Leone. This implies increases in income lead to increases in cow milk imports. The existence of an inverse relationship between income and cow milk imports in Cameroon, Gabon, Cote D'ivoire, Mauritania, Niger, Nigeria, Senegal, South Africa and Zaire may be attributed to the import substituttion policies adopted by these countries. Another possible explanation could be the substitution effects existing between cow milk and other livestock products. In five of the countries (Benin, Gabon, Cote D'ivoire, Mauritania and Senegal) in table IX, fresh cow milk and butter (Pbutter) are complements; while they are substitutes in CAR, Mali, Nigeria and Zaire.

Table IX. Fresh Cow Milk Imports: Parameter Estimates of Regression Equations*

Country	Independent Variables									
	Intercept	Pcowmilk	Milkinv	Reforex	GDPPC	Pbutter	Pcheese	Pskimilk	Pwholmlk	Time
Benin	-9.201	-0.429 (1.675)	0.295 (0.232)	-2.028 (1.253)	2.192 (1.793)	-1.306 (1.783)	na	na	na	na
Cameroon	17.119	-0.246 (0.731)	-1.048 (1.742)	4.091 (3.506)	-2.445 (3.356)	na	na	-0.570 (2.183)	na	na
Central African Republic	-15.790	-1.598 (3.260)	2.131 (2.537)	-1.749 (1.343)	0.880 (1.147)	0.624 (1.280)	na	0.870 (1.781)	na	na
Gabon	10.181	-0.332 (1.602)	-0.458 (1.106)	3.275 (4.511)	-2.833 (6.777)	-0.363 (1.001)	na	na	na	na
Ghana	-1.426	0.032 (0.107)	-0.301 (0.369)	-2.035 (1.628)	1.299 (5.375)	na	-1.928 (3.930)	na	na	na
Cote d'ivoire	1.412	-0.602 (4.225)	0.487 (0.933)	1.757 (3.660)	-1.201 (3.030)	-0.133 (1.044)	na	na	na	na
Mali	34.287	-2.204 (2.704)	-3.129 (1.859)	-2.193 (1.226)	1.622 (1.403)	1.301 (1.400)	na	na	na	na
Mauritania	38.337	0.549 (0.829)	-1.773 (1.274)	4.592 (2.295)	-4.570 (4.552)	-0.164 (0.351)	na	na	na	na
Niger	18.498	-1.447 (3.734)	-1.566 (1.293)	1.834 (1.634)	-1.281 (1.901)	na	na	na	-0.121 (0.243)	na

Table IX. (Continued)

Country	Independent Variables									
	Intercept	Pcowmilk	Milkinv	Reforex	GDPPC	Pbutter	Pcheese	Pskimilk	Pwholmlk	Time
Nigeria	18.694	0.902 (1.782)	na	-2.622 (1.793)	-1.816 (8.348)	0.833 (1.997)	na	na	0.184 (0.341)	na
Senegal	4.023	0.993 (58.297)	0.199 (1.721)	0.546 (4.969)	-0.926** (11.321)	-0.093 (5.580)	na	na	na	0.041 (16.146)
Sierra Leone	-42.814	-0.485 (3.289)	3.981 (4.316)	1.967 (3.816)	1.118 (8.654)	na	na	na	-0.763 (2.525)	na
South Africa	-83.378	-0.700 (1.230)	6.620 (1.826)	-0.542 (0.110)	-2.540 (3.315)	na	na	1.490 (1.270)	na	na
Zaire	53.761	-0.845 (1.686)	-4.181 (1.168)	11.282 (3.614)	-7.432 (3.929)	1.086 (1.854)	na	na	na	na

*The quantity of cow milk imported forms the dependent variable.
**This is the deflated gross domestic product (GDP).
The absolute values of the t-ratios are in parentheses

Pcowmilk = price of cow milk
Milkinv = domestic milk production
Reforex = real foreign exchange rate
GDPPC = GDP per capita
Pbutter = price of butter
Pcheese = price of cheese
Pskimilk = price of skim milk
Pwholmlk = price of whole milk
All the prices are in real terms
na = not available; the variable was not included in the regression model

Table IX. (Continued)

For the analysis in this table and Tables IX-XVI, the system weighted MSE, system weighted R^2 and degrees of freedom obtained by the Seemingly Unrelated regression technique are listed below:

Country	System weighted MSE	System weighted R^2	Degrees of Freedom
Benin	0.8284	0.7396	79
Botswana	0.9863	0.7014	32
Cameroon	0.7827	0.9723	59
Central African Republic	0.8601	0.9097	91
Chad	0.8051	0.8546	46
Ethiopia	0.9238	0.8911	72
Gabon	0.9167	0.9071	95
The Gambia	0.9774	0.8252	78
Ghana	0.9301	0.9142	121
Cote d'ivoire	0.8861	0.9661	119
Kenya	0.7124	0.9640	37
Lesotho	0.9994	0.8063	27
Malawi	0.5839	0.7132	77
Mali	0.8128	0.4751	73
Mauritania	0.8542	0.8379	89
Niger	0.9575	0.7303	68
Nigeria	0.9041	0.8827	109
Senegal	0.9226	0.9981	89
Sierra Leone	0.9461	0.9786	113
South Africa	0.8125	0.8705	65
Sudan	0.8822	0.8452	61
Tanzania	0.9137	0.7965	79
Zaire	0.8543	0.9154	90
Zambia	0.8441	0.9044	57

Whole Milk Imports

Table X contains the estimated parameters for whole milk import demand equations in some African countries. Increases in (depreciation of the domestic currency) the foreign exchange rate (Reforex; the ratio of domestic currency to the United States dollar deflated by the CPI) have depressing effects on the importation of whole milk for Cote d'voire, Ethiopia, The Gambia, Ghana, Nigeria (for evaporated whole milk), Uganda, Zaire and Zambia. For members of the Communaute Franco-Africain (CFA) whose currencies are pegged to the French franc, and majority of them with a positive relationship between the real foreign exchange rate (Reforex) and whole milk imports, an appreciation of the CFA induces increases in imports of whole milk. The CFA being a strong currency, the positive effects of the real foreign exchange rate on whole milk imports is in accordance with a priori expectations. In the former British colonies, for example Ghana and Nigeria [with independent and flexible exchange rate systems (IMF, 1985)], Kenya (with currency pegged to the SDR), and The Gambia (whose currency is pegged to the pound sterling as the intervention currency), the sign of the real foreign exchange rate variable could be positive or negative depending upon the strength of these currencies. The a priori expectation of the sign of the foreign exchange rate

Table X. Whole Milk Imports: Parameter Estimates of Regression Equations*

Country	Independent Variables										
	Intercept	Pwholmlk	Milkinv	Pbutter	Reforex	GDPPC	Pskimilk	Pcheese	Pcowmilk	Pdwmlk	Time
Benin[1]	-14.623	-0.117 (0.471)	2.127 (3.394)	na	0.098 (0.154)	0.271 (0.619)	na	na	-0.017 (0.460)	na	na
Cameroon[1]	5.431	-0.907 (2.424)	na	na	1.808 (1.213)	-1.515 (1.860)	na	na	-0.252 (1.044)	na	na
Central African Republic[1]	-10.606	-0.299 (1.966)	1.530 (4.356)	-0.190 (1.810)	0.542 (0.856)	0.398*** (1.072)	-0.339 (1.954)	na	na	na	na
Cote d'ivoire[1]	-27.852	-0.854 (4.231)	3.797 (7.708)	na	-0.400 (0.630)	0.875 (1.588)	na	na	0.605 (2.284)	na	na
Cote d'ivoire[3]	-11.596	0.293 (1.033)	2.351 (3.557)	-0.479 (2.689)	0.701 (1.027)	-0.386 (0.748)	na	na	na	na	na
Ethiopia[1]	-5.983	1.347 (4.355)	na	na	-2.123 (1.055)	2.767 (2.180)	-1.112 (1.683)	-1.710 (2.711)	na	na	na
Gabon[1]	14.490	-0.358 (0.919)	-1.232 (3.458)	-1.738 (3.734)	3.184 (5.007)	-2.717 (6.894)	1.193 (3.544)	na	na	na	na
The Gambia[1]	-6.488	0.232 (1.188)	1.818 (2.734)	na	-1.008 (1.481)	-0.378 (2.183)	0.152 (1.417)	na	na	na	na
Ghana[1]	4.183	-3.089 (9.138)	-3.272 (1.817)	na	-8.513 (3.427)	4.598 (5.848)	na	-3.722 (3.840)	1.146 (2.018)	na	0.257 (3.138)
Kenya[1]	64.218	-2.120 (0.804)	-5.250 (1.111)	na	6.717 (0.756)	-0.197 (0.206)	na	-1.232 (0.848)	na	na	na

Table X. (Continued)

Country	Independent Variables										
	Intercept	Pwholmlk	Milkinv	Pbutter	Reforex	GDPPC	Pskimilk	Pcheese	Pcowmilk	Pdwmlk	Time
Kenya[2]	-101.608	-10.480 (3.591)	4.981 (0.772)	na	16.745 (1.843)	0.334 (0.239)	na	2.728 (1.492)	na	-0.085 (0.077)	na
Malawi[1]	-24.229	0.328 (0.861)	2.792 (4.513)	-0.770 (1.735)	0.722 (0.608)	1.043 (1.138)	na	na	na	na	na
Mali[1]	43.936	-0.253 (0.392)	-3.021 (2.366)	-0.117 (0.524)	1.562 (1.290)	-1.133*** (1.253)	na	na	na	na	na
Mauritania[1]	15.986	-1.901 (4.960)	-0.507 (1.058)	0.830 (5.057)	0.048 (0.070)	-1.130 (2.952)	na	na	1.450 (3.534)	na	na
Mauritania[3]	10.663	1.120 (1.531)	na	-0.377 (0.773)	1.716 (0.728)	-1.921 (1.656)	na	na	-0.663 (0.905)	na	na
Niger[1]	25.147	-0.823 (2.945)	-1.600 (2.084)	-0.185 (2.144)	2.558 (2.899)	-1.968 (3.543)	na	na	na	na	na
Nigeria[3]	-118.868	-0.422 (0.548)	10.008 (3.352)	na	0.736 (0.311)	-0.110 (0.326)	na	1.259 (4.167)	-0.845 (0.954)	na	na
Nigeria[1]	22.631	-0.297 (0.782)	0.159 (0.100)	1.568 (5.564)	-1.418 (1.123)	1.650*** (6.406)	na	na	1.068 (3.662)	na	na
Sierra Leone[1]	2.616	-0.846 (3.379)	na	0.172 (2.038)	1.320 (2.148)	0.380 (5.666)	-0.119 (1.014)	na	na	na	na

Table X. (Continued)

Country	Independent Variables										
	Intercept	Pwholmlk	Milkinv	Pbutter	Reforex	GDPPC	Pskimilk	Pcheese	Pcowmilk	Pdwmlk	Time
Tanzania[3]	33.219	3.083 (3.065)	-0.853 (0.548)	na	0.595 (0.305)	0.279 (0.294)	0.348 (1.081)	na	na	na	na
Uganda[3]**	62.979	6.501 (2.523)	-1.305 (2.744)	8.222 (1.851)	-5.996 (-0.522)	4.621*** (0.633)	na	na	na	na	na
Zaire[1]	11.664	-1.836 (2.910)	-0.624 (0.289)	0.589 (1.969)	-5.907 (3.067)	3.523 (3.169)	2.506 (4.607)	na	na	na	na
Zambia[1]	-64.650	0.065 (0.150)	5.437 (2.532)	-0.744 (1.689)	-0.501 (0.312)	3.362*** (4.772)	na	na	na	na	na
Zambia[2]	20.058	-0.373 (3.131)	-1.651 (0.622)	-0.628 (1.423)	6.228 (3.707)	0.410 (0.517)	na	na	na	na	na

*Dependent variable is the quantity of whole milk imported.
1 = whole milk, evaporated
2 = dry whole milk
3 = whole milk, condensed

**OLS estimates. F-Value = 2.782. The F-value is significant at the 25 percent level. Adjusted $R^2 = 0.5269$. $R^2 = 0.8226$

***This is the deflated GDP used as proxy for income

Pdwmlk = price of dry whole milk in real terms.
The absolute values of t-ratios are in parentheses.
Other variables are as defined in Table IX.

variable depends on the country considered. For countries with strong currencies, such as the CFA and currencies pegged to the United States dollar, the expected sign on the foreign exchange variable is predictable. For countries with soft currencies, and those pegged to the Special Drawing Rights (SDR), the sign of the real foreign exchange rate could be positive or negative depending on the strength of the currency at the time considered.

In Cote d'ivoire, Ethopia, The Gambia, Malawi, Mauritania, Tanzania, Uganda and Zambia, the increases in whole milk prices (Pwholmlk) seem to have positive effects on whole milk imports. The trade policy instruments used by governments in these countries cause this phenomenon. Also, food aid and food imports on concessionary terms could be possible explanations.

Skim Milk Imports

The parameter estimates for imports of skim milk in Sub-Saharan Africa are shown in table XI. The domestic milk inventory (Milkinv) is expected to have negative effects on the importation of skim milk. That is, as domestic milk production increases, imports of skim milk are expected to be reduced. This scenario holds in Chad, Gabon, Sierra Leone and Tanzania. However, in Camaroon, CAR, Ethopia, The Gambia, Ghana, Lesotho, Nigeria, South Africa, Sudan and Zaire, domestic milk production increases with increases in skim milk imports. Again, food policies,

Table XI. Skim Milk Imports: Parameter Estimates of Regression Equations*

Country	Independent Variables									
	Intercept	Pskimilk	Pbutter	Reforex	GDPPC	Milkinv	Pwholmlk	Pcheese	Pcow milk	Time
Cameroon	-16.804	-2.575 (1.869)	-1.706 (1.858)	3.461 (0.553)	-1.240 (0.300)	3.167 (1.736)	na	na	4.912 (3.075)	na
Central African Republic	-1.018	-1.143 (1.955)	0.488 (2.532)	-2.725 (2.039)	1.418** (1.717)	0.568 (0.479)	0.474 (0.802)	na	na	na
Chad	170.991	0.993 (0.752)	0.125 (0.585)	1.190 (0.276)	-0.549 (0.221)	-13.575 (2.649)	na	na	na	na
Ethiopia	-132.812	-1.577 (3.639)	na	-1.357 (0.952)	1.589** (1.323)	9.546 (4.076)	na	0.305 (1.061)	na	na
Gabon	10.640	-0.705 (1.422)	-0.620 (0.923)	2.303 (2.025)	-1.454** (1.661)	-1.702 (3.561)	na	na	na	0.197 (6.832)
The Gambia	-29.044	-1.241 (4.070)	na	0.046 (0.028)	-0.138 (0.324)	3.454 (2.143)	-0.071 (0.139)	na	na	na
Ghana	-15.791	-0.743 (3.542)	na	4.048 (3.667)	0.176 (1.183)	2.401 (3.181)	0.316 (3.047)	na	na	na
Kenya	-3.370	-3.107 (7.472)	na	11.702 (2.343)	-0.668 (1.606)	na	-0.993 (0.623)	1.693 (1.752)	na	na
Lesotho	12.254	1.759 (2.123)	na	-7.993 (3.085)	-0.899 (1.630)	0.490 (0.354)	na	na	na	na

Table XI. (Continued)

Country	Independent Variables									
	Intercept	Pskimilk	Pbutter	Reforex	GDPPC	Milkinv	Pwholmlk	Pcheese	Pcow milk	Time
Nigeria	-54.319	0.443 (2.015)	na	0.599 (0.612)	-0.331 (2.143)	5.256 (4.043)	-0.582 (1.753)	0.767 (5.801)	na	na
Sierra Leone	71.733	0.914 (4.043)	na	0.925 (0.760)	-0.554 (2.688)	-0.6552 (4.329)	na	-0.219 (0.894)	na	na
South Africa	-7.950	0.523 (0.679)	na	3.014 (0.789)	0.307 (0.490)	1.082 (0.361)	na	na	-0.475 (1.705)	na
Sudan	-8.4463	-0.6707 (1.984)	-0.2096 (2.125)	-0.2297 (0.263)	-0.0250** (0.093)	0.9250 (1.710)	na	na	na	na
Tanzania	33.926	-0.475 (1.529)	na	-2.436 (1.899)	0.290 (0.295)	-1.935 (1.207)	na	na	0.687 (1.077)	na
Zaire	-32.550	-0.992 (2.102)	na	3.945 (1.394)	-1.370 (0.850)	4.597 (1.710)	na	na	0.087 (0.431)	na

*Quantity of skim milk imported forms the dependent variable.
**Deflated GDP.
The t-ratios (absolute value) are in parentheses.
Other variables are defined in Table IX.

agricultural trade policies, tastes, habits, age distribution, population, preferences, measurement errors in variables and model specification are possible explanations for the wrong sign.

Butter and Cheese

The parameter estimates for imports of butter are shown in table XII. In Benin, Chad, Gabon, Malawi, Senegal, Sierra Leone, South Africa, Tanzania, Zaire and Zambia, butter and cheese are complementary goods. In the rest of the countries in table XII, butter and cheese are substitute goods. With the exception of Botswana, CAR, Ghana, Senegal, Zambia and Zaire, the price coefficient of butter (Pbutter) has a negative sign as expected. This shows we are not dealing with an inferior good. Even though butter prices increase with increases in butter imports in the other countries (Botswana, CAR, Ghana, Senegal, Zaire and Zambia), this does not mean butter is an inferior good. Probably, food imports under concessionary terms, food aid and other policies may have a significant effects on the importation of butter.

The parameter estimates for cheese imports are in table XIII. For 18 out of the 20 countries in table XIII, the price coefficient of cheese (Pcheese) has a negative sign as expected. Butter and cheese are substitute goods in CAR, Ethopia, The Gambia, Nigeria, South Africa and Zaire. Butter and cheese are substitutes and complements

Table XII. Butter Imports: Parameter Estimates of Regression Equations*

Country	Independent Variables										
	Intercept	Pbutter	Pskimilk	Pcheese	Reforex	GDPPC	Milkinv	Time	Pcowmilk	Pwholmlk	Pdwmlk
Benin	1.681	-1.029 (3.598)	na	-0.633 (2.439)	-0.213 (0.465)	0.454 (1.663)	na	na	na	1.051 (2.896)	na
Botswana	10.712	1.642 (3.854)	na	na	-0.191 (0.320)	-0.019 (0.123)	na	0.020 (1.047)	na	na	na
Cameroon	-5.026	-0.032 (0.186)	-0.059 (0.346)	na	-1.781 (1.543)	1.196** (1.680)	0.675 (2.255)	na	na	na	na
Central African Republic	6.380	0.622 (2.232)	na	0.010 (0.033)	1.471 (1.692)	-1.007 (2.143)	na	na	-0.274 (1.260)	na	na
Chad	3.104	-0.908 (6.374)	na	-0.166 (0.605)	2.400 (1.622)	-1.479 (1.955)	na	na	na	na	na
Cote d'ivoire	6.556	-1.605 (9.271)	na	0.830 (2.856)	2.032 (4.839)	-0.797 (2.395)	na	0.102 (8.174)	na	na	na
Ethiopia	-8.210	-2.295 (2.858)	-2.430 (2.063)	na	4.288 (0.985)	-1.418 (0.408)	na	na	na	na	na
Gabon	7.286	-0.403 (1.525)	na	-0.149 (0.976)	2.690 (4.704)	-2.169 (7.263)	na	na	0.046 (0.315)	na	na
The Gambia	4.758	-0.228 (0.352)	na	0.519 (1.038)	0.651 (0.581)	-0.368 (1.723)	na	na	na	na	na
Ghana	10.371	0.756 (0.740)	-1.279 (2.298)	1.673 (1.522)	6.281 (2.348)	-0.958 (1.761)	na	na	na	na	na

Table XII. (Continued)

Country	Independent Variables										
	Intercept	Pbutter	Pskimilk	Pcheese	Reforex	GDPPC	Milkinv	Time	Pcowmilk	Pwholmlk	Pdwmlk
Malawi	1.191	-0.982 (2.155)	na	-0.036 (0.152)	0.788 (1.007)	-0.110 (0.244)	na	na	na	na	na
Mali	4.664	-0.800 (1.497)	na	0.551 (1.407)	0.714 (0.532)	-0.856 (1.105)	na	na	na	na	na
Mauritania	5.825	-1.393 (1.816)	na	0.642 (0.976)	4.078 (1.161)	-2.225 (1.017)	na	0.209 (2.516)	na	0.134 (0.126)	na
Nigeria	17.444	-0.254 (0.182)	na	0.456 (0.590)	-0.719 (0.186)	-1.382 (2.365)	na	na	na	1.782 (1.593)	na
Senegal	2.005	0.901 (28.309)	na	-0.089 (2.008)	0.857 (4.610)	-1.192 (9.090)	0.394 (1.941)	na	-0.011 (0.358)	na	na
Sierra Leone	5.719	-0.313 (2.427)	0.703 (2.813)	-0.653 (3.383)	-3.249 (2.135)	0.397 (2.205)	na	na	na	na	na
South Africa	-19.499	-2.625 (2.931)	na	-4.203 (2.139)	-6.369 (1.997)	2.728 (3.636)	na	na	0.716 (1.389)	na	na
Sudan	-115.187	-1.771 (3.232)	-3.657 (2.254)	0.712 (1.086)	4.987 (1.336)	2.719 (2.482)	6.713 (2.553)	na	na	na	na
Tanzania	-1.947	-0.111 (0.589)	1.313 (2.859)	-2.356 (0.841)	-6.496 (1.752)	3.557 (2.082)	na	na	na	na	na
Uganda***	-35.043	-11.351 (4.461)	na	na	1.848 (1.303)	3.239 (3.571)	na	na	na	na	1.799 (2.220)

Table XII. (Continued)

Country	Independent Variables										
	Intercept	Pbutter	Pskimilk	Pcheese	Reforex	GDPPC	Milkinv	Time	Pcowmilk	Pwholmlk	Pdwmlk
Zaire	3.652	0.410 (1.100)	na	-0.874 (2.094)	-0.761 (0.553)	0.775 (1.094)	na	na	na	na	na
Zambia	8.068	0.025 (0.094)	na	0.175 (1.377)	3.127 (2.470)	-0.304 (1.298)	na	na	na	na	na

*Quantity of butter imported forms the dependent variable.
**Total deflated GDP used as proxy for income.
***OLS estimates with first order autoregressive scheme assumed. $R^2 = 0.6042$ Degrees of freedom = 12 Estimated rho = 0.1922

na = not available. The variables were not included in the regression equation.
pdwmlk = price of dry whole milk in real terms
Other variables are as defined in Table IX.

Table XIII. Cheese Imports: Parameter Estimates of Regression Equations*

Country	Independent Variables								
	Intercept	Pcheese	Pbutter	Reforex	GDPPC	Pskimilk	Pcowmilk	Pwholmlk	Time
Benin	1.859	-0.561 (2.389)	-0.119 (0.433)	-0.286 (0.663)	0.645 (2.535)	na	na	0.383 (1.152)	na
Cameroon	4.606	-1.109 (30.647)	-0.037 (0.551)	1.079 (2.674)	-0.675 (3.171)	na	0.313 (3.776)	na	na
Central African Republic	4.871	0.035 (0.212)	0.277 (1.587)	0.237 (0.314)	0.065 (0.164)	na	na	na	na
Chad	-0.260	-0.942 (5.544)	-0.019 (0.210)	0.280 (0.317)	0.287 (0.586)	-0.329 (0.939)	na	na	na
Cote d'ivoire	8.131	0.065 (0.556)	-0.206 (3.734)	0.549 (3.566)	-0.336 (2.924)	na	na	0.132 (1.444)	0.050 (12.685)
Ethiopia	-3.574	-1.020 (3.397)	0.772 (2.815)	-6.835 (7.566)	5.694 (9.808)	na	na	0.350 (2.692)	na
Gabon	10.351	-0.750 (4.154)	-0.412 (1.133)	1.808 (2.654)	-1.611 (4.348)	na	na	1.296 (3.397)	na
The Gambia	2.980	-0.630 (1.339)	0.630 (1.025)	0.199 (0.186)	-0.275 (1.359)	na	na	na	na
Ghana	-6.676	-1.984 (4.165)	-0.654 (1.451)	-1.716 (1.649)	1.208 (5.129)	na	na	na	na

Table XIII. (Continued)

Country	Independent Variables								
	Intercept	Pcheese	Pbutter	Reforex	GDPPC	Pskimilk	Pcowmilk	Pwholmlk	Time
Kenya	8.985	0.462 (0.631)	na	1.833 (0.242)	-0.678 (1.003)	0.581 (0.658)	na	na	na
Malawi	1.973	-0.6134 (2.815)	-0.534 (1.243)	0.277 (0.426)	0.147 (0.387)	na	na	0.460 (1.781)	na
Mali	3.392	-1.006 (3.015)	na	1.845 (2.010)	-1.153 (1.942)	na	0.401 (1.193)	na	na
Mauritania	0.070	-0.772 (1.727)	-0.206 (0.682)	1.356 (1.113)	-0.483 (0.863)	na	-0.239 (0.593)	na	na
Niger	2.002	-1.120 (3.824)	-0.084 (0.349)	2.247 (2.902)	-1.111 (2.208)	na	na	na	na
Nigeria	9.521	0.558 (1.416)	0.155 (0.204)	2.168 (1.039)	-0.409 (1.380)	na	na	na	na
Senegal	9.392	-0.133 (0.608)	-0.214 (1.732)	1.429 (1.705)	-1.003 (1.528)	na	-0.058 (0.544)	na	-0.043 (1.455)
Sierra Leone	5.687	-0.290 (1.635)	-0.129 (0.775)	0.407 (0.587)	0.125 (1.321)	na	0.332 (1.750)	na	na
South Africa	-4.686	-5.815 (6.107)	0.615 (1.536)	2.429 (1.217)	0.229 (0.561)	1.583 (3.779)	na	na	na

Table XIII. (Continued)

Country	Independent Variables								
	Intercept	Pcheese	Pbutter	Reforex	GDPPC	Pskimilk	Pcowmilk	Pwholmlk	Time
Sudan	-0.816	-0.694 (1.034)	-1.028 (1.786)	-7.824 (2.391)	0.346** (0.613)	0.850 (0.514)	na	na	na
Tanzania	-2.503	-1.189 (0.543)	-0.001 (0.010)	1.334 (0.461)	1.005 (0.741)	na	na	na	na
Zaire	5.748	-2.104 (6.285)	1.759 (5.974)	-0.331 (0.266)	0.691 (1.070)	na	0.323 (2.020)	na	na
Zambia	-6.377	-0.645 (2.136)	-0.425 (0.746)	-4.812 (2.482)	2.658 (3.626)	na	na	na	0.244 (3.008)

*Quantity of cheese imported forms the dependent variable.
**This is the deflated GDP used as proxy for income.
Other variables are as defined in Table IX.

in both South Africa and Zaire. Technological developments, age distribution of population and differences in income levels are probable reasons for this phenomenon. Thus, different polices are needed in controling the importation of livestock products.

For all dairy products imported in Sub-Saharan Affrica, the weighted price index for dairy products (Daindex) has a negative sign (Table XIV), except in Muaritania, Nigeria and Zaire which have a positive sign. Increases in the domestic milk inventory (Milkinv) is expected to have a negative effect on dairy imports. But, in 9 out of the 23 countries in table XIV, increases in the domestic production of milk has positive effects on dairy food imports. The time variable, which is a proxy for tastes, preferences and technology has a positive relationship with dairy food imports in the region. Probably most African countries do not have the technology needed to produce some of the imported dairy products. Most governments in Sub-Saharan Africa implement conflicting (though sometimes unintentional) policies in dealing with dairy development and marketing (Rodriguez Jr, February 1987, Von Massow, January 1985 and Mbogoh, July 1984). Also, model specification error and trade policies are possible explanations for the wrong sign on the milk inventory variable. Model specification error might include the use of multi-equation models instead of single equation

Table XIV. Imports of Dairy Products: Parameter Estimates of Regression Equations*

Country	Independent Variables					
	Intercept	Daindex	Milkinv	Reforex	GDPPC	Time
Benin	-8.808	-0.157 (0.452)	1.827 (3.766)	0.011 (0.019)	0.302*** (0.737)	na
Cameroon	14.501	-0.902 (4.478)	na	1.496 (1.588)	-1.164 (2.326)	na
Central African Republic	1.029	-0.574 (2.334)	1.223 (3.519)	-0.342 (0.564)	0.599 (1.618)	na
Chad	119.296	-0.062 (0.071)	-9.311 (2.117)	1.640 (0.460)	-0.714 (0.357)	na
Cote d'ivoire	28.481	-1.570 (9.338)	-0.783 (1.216)	1.803 (4.154)	-1.264 (3.298)	0.203 (9.145)
Ethiopia	15.494	-1.933 (3.718)	na	-0.985 (0.679)	0.551 (0.485)	0.184 (3.461)
Gabon	17.971	-0.445 (1.161)	-1.145 (4.031)	1.566 (1.947)	-1.337 (2.279)	0.073 (2.619)
The Gambia	-5.962	-0.005 (0.023)	1.848 (2.886)	-0.768 (1.094)	-0.419 (2.434)	na
Ghana	1.463	-1.078 (6.112)	1.441 (3.419)	2.751 (4.591)	0.731 (7.353)	na
Kenya	98.512	-4.675 (1.820)	-4.584 (0.770)	19.031 (1.301)	-1.340 (0.901)	na
Malawi	-24.024	-0.016 (0.035)	2.983 (4.829)	-0.923 (0.887)	1.999 (2.327)	na
Mali	47.602	-0.554 (0.764)	-3.049 (2.774)	1.274 (1.532)	-0.757 (1.584)	na
Mauritania	26.496	0.057 (0.098)	-1.157 (1.766)	1.401 (1.225)	-1.820 (3.186)	na
Niger	28.578	-0.854 (2.680)	-1.193 (1.710)	2.223 (2.582)	-1.730 (3.175)	na
Nigeria	-13.717	0.600 (2.517)	2.105 (1.608)	0.563 (0.592)	-0.460 (3.204)	na

Table XIV. (Continued)

Country	Independent Variables					
	Intercept	Daindex	Milkinv	Reforex	GDPPC	Time
Senegal	12.102	-0.242 (0.625)	0.172 (0.160)	2.549 (3.308)	-2.029 (3.601)	na
Sierra Leone	15.188	-3.113 (4.686)	na	7.646 (3.229)	3.469 (7.987)	0.165 (4.033)
South Africa	27.591	-0.112 (0.098)	-1.185 (0.398)	-1.895 (0.499)	0.672 (0.970)	na
Sudan	-4.404	-0.980 (2.315)	1.176 (1.317)	0.031 (0.025)	0.124 (0.334)	na
Tanzania	52.027	-0.379 (1.616)	-3.409 (2.712)	-3.366 (2.387)	1.650 (2.203)	0.065 (2.210)
Uganda**	7.185	-0.528 (0.592)	-0.224 (2.258)	-0.483 (0.389)	1.149 (1.508)	na
Zaire	-25.975	0.053 (0.187)	4.121 (2.932)	-0.173 (0.108)	0.936 (1.020)	na
Zambia	47.798	-0.697 (2.305)	-3.658 (1.500)	3.449 (2.933)	0.441 (0.747)	0.118 (3.391)

*Total dairy products (in LME) imported form the dependent variables.
**Ordinary Least Squares (OLS) estimates: F-Value = 8.433 Adjusted R^2 = 0.7880
***This deflated GDP was used as proxy for income.
The absolute values of t-ratios are in parentheses

Daindex = price index for dairy imports in real terms
Other variables are as defined in Table IX.

models, measurement errors and excluding variables that should have been included in the model.

Beef Imports

Table XV has the estimated coefficients for the beef import demand equations. With the exception of Cote D'ivoire, Kenya, and Malawi increases in domestic beef inventory (Beefindex) reduces beef imports in several Sub-Saharan African countries.

In 9 out of the 16 countries in table XV, the demand relationships are price inelastic (that is the absolute value of the own-price elasticity is less than 1). This means an increase in the price of imported beef will increase the proportion of consumer expenditures spent on beef. With high income groups spending more on beef than low income groups (Rodriguez Jr, 1987 and McCalla and Josling, 1985); increases on beef prices put more pressure on the former group.

Income elasticity ranges from a low of 0.207 in Ghana to a high of 10.167 in Uganda. Beef is highly elastic (absolute value of elasticity greater than 1) in most (9 out of 16) countries in Sub-Saharan African. In CAR, Gabon, Cote D'ivoire, Malawi, Senegal, Tanzania, Uganda and Zaire, chicken meat (Pchicken) and beef are substitutes, while they are complements in all other countries in table XV.

Table XV. Beef Imports: Parameter Estimates of Regression Equations*

Country	Independent Variables					
	Intercept	Beefindex	Reforex	Beefinv	GDPPC	Pchicken
Benin	14.545	-2.292 (3.765)	1.854 (0.922)	-0.399 (0.186)	-0.374 (0.222)	-0.171 (0.619)
Cameroon	8.791	-0.763 (4.712)	-2.423 (1.797)	-0.792 (1.782)	1.652 (1.462)	-1.022 (2.252)
Central African Republic	-1.969	-0.484 (2.418)	-4.777 (4.405)	-0.143 (0.463)	4.005 (6.125)	0.459 (3.085)
Cote d'ivoire	21.153	-2.164 (7.373)	5.749 (4.000)	1.655 (2.792)	-4.659*** (4.761)	1.187 (2.215)
Gabon	31.705	-0.774 (1.547)	2.797 (2.310)	-1.796 (0.833)	-2.742 (2.647)	0.655 (0.672)
Ghana	20.481	-0.924 (3.411)	-0.447 (0.373)	-1.085 (0.422)	0.207 (1.568)	-0.073 (0.301)
Kenya	-51.306	-1.075 (2.429)	4.787 (0.611)	3.704 (1.179)	3.047 (2.708)	-0.051 (0.090)
Malawi	-12.562	-0.652 (2.026)	-0.083 (0.119)	1.405 (2.881)	0.702 (1.360)	0.126 (0.219)
Nigeria	4.640	4.028 (3.845)	-7.307 (1.730)	na	-3.718 (3.855)	-0.095 (0.074)

Table XV. (Continued)

Country	Independent Variables					
	Intercept	Beefindex	Reforex	Beefinv	GDPPC	Pchicken
Senegal	15.223	-0.745 (3.871)	0.960 (1.923)	-0.486 (0.805)	-0.502 (1.289)	0.287 (2.984)
Sierra Leone	23.967	-0.225 (1.050)	-0.574 (0.752)	-2.168 (2.275)	0.215 (0.812)	-0.272 (1.324)
South Africa	-5.826	2.424 (1.742)	13.928 (4.366)	-0.176 (0.052)	0.730 (0.714)	-2.047 (2.656)
Tanzania	0.633	-3.159 (6.503)	5.608 (1.809)	-0.360 (0.139)	-0.643 (0.451)	1.165 (1.312)
Uganda**	114.646	-1.442 (2.892)	10.097 (1.847)	-5.806 (2.680)	-10.167 (2.240)	4.788 (5.731)
Zaire	20.082	-0.182 (0.357)	-0.984 (0.356)	-1.062 (0.546)	1.070 (0.608)	0.165 (0.618)
Zambia	-8.997	-0.716 (3.734)	11.313 (4.375)	na	4.795 (9.993)	-0.458 (2.558)

*Dependent variable is quantity of beef imports. These include beef and veal, canned beef and dried beef
**OLS estimates. Dependent variable is for quantity of canned beef imported. Adjusted $R^2 = 0.8805$ F-Value = 12.790
***This is the deflated GDP used as proxy for income.
The t-statistics (in absolute values) are in parentheses.
Beefindex = price index for the total beef imported in real terms
Beefinv = domestic beef production is the beef inventory.
Pchicken = price of chicken in real terms
Other variables are as defined in Tables IX-XIV.

Livestock Imports

The livestock imports include cattle, sheep and goats. Parameter estimates of the import demand models are in table XVI. With the exception of Benin, CAR, Gabon, Cote D'ivoire, Kenya, Swaziland and Uganda, livetock price coefficients (Rumindex) have a nagative sign. This implies that increases in livestock prices induce a decrease in livestock imports. In countries where livestock prices and livestock imports have a positive relationship, it is possible that imports are increased to build up the domestic inventory. Jarvis (1974) reported that since livestock are utilized for both consumption and capital goods purposes, changes in economic and noneconomic variables can elicit varying responses.

In most Sub-Saharan African countries, intra-regional livestock trade enables livestock to move from areas of surplus to those with deficits; for example, from the Sahel zone to the West African coastal countries (Burfisher and Missianen, August 1987 and Bekure and McDonald, January 1985). The movement of livestock is done either by trekking or trucking. Substantial trading of cattle, sheep and goats occur on border towns with neighboring countries (HTS, 1979). Rodriguez's (1985) study of Zimbabwe's beef pricing policies reveal that increases in cattle producer

Table XVI. Live Animals Imported: Parameter Estimates of Regression Equations*

Country	Independent Variables					
	Intercept	Rumindex	Reforex	GDPPC	Domlivn	Time
Benin	35.995	0.693 (2.648)	0.234 (0.376)	-0.839 (1.776)	-2.063 (4.428)	na
Botswana	-27.734	-0.757 (2.066)	-0.211 (0.126)	0.090 (0.373)	2.114 (2.838)	na
Cameroon[1]	-9.264	0.083 (0.084)	-17.005 (2.723)	12.212 (3.116)	0.693 (0.408)	na
Central African Republic	1.701	0.811 (5.078)	-3.271 (5.284)	1.996 (5.672)	0.284 (1.271)	na
Cote d'ivoire	-7.281	0.162 (0.338)	-3.218 (3.063)	3.527 (4.578)	2.288 (0.900)	0.146 (1.266)
Gabon[2]	7.249	0.297 (3.418)	0.137 (0.342)	-0.258 (0.731)	0.232 (0.382)	na
Ghana[1]	215.900	-3.628 (4.870)	-5.015 (1.484)	2.464 (5.704)	-14.260 (5.649)	na
Kenya[1]	239.007	1.012 (0.959)	-7.254 (0.399)	-0.661 (0.131)	-14.117 (0.655)	na
Lesotho	56.175	-1.548 (7.101)	0.348 (0.605)	0.988 (5.815)	-3.414 (4.559)	0.118 (4.486)
Niger[2]	-15.722	-0.656 (0.561)	0.261 (0.189)	-0.615 (0.790)	1.452 (1.377)	na
Nigeria	-258.453	-1.406 (4.474)	-0.638 (0.455)	1.172 (4.851)	17.428 (4.188)	na
Senegal	81.722	-3.594 (1.165)	-4.077 (0.929)	3.793 (1.514)	-3.490 (1.184)	na
Sierra Leone	21.099	-0.113 (5.213)	0.113 (2.038)	0.021 (1.678)	-0.265 (0.875)	0.035 (5.155)
South Africa	23.881	-0.379 (0.459)	1.373 (2.048)	0.471 (1.489)	-0.702 (0.690)	na
Sudan	-13.110	-0.387 (1.703)	-2.506 (2.021)	-0.384 (1.540)	1.090 (1.400)	na

Table XVI. (Continued)

Country	Independent Variables					
	Intercept	Rumindex	Reforex	GDPPC	Domlivn	Time
Swaziland***	131.263	3.876 (2.806)	-1.729 (1.433)	-0.861 (1.873)	-10.102 (5.339)	na
Uganda**	-160.152	1.248 (3.463)	-0.820 (0.288)	5.125 (2.128)	10.465 (2.613)	na
Zaire	-124.325	-2.125 (5.173)	-2.838 (0.637)	4.641 (1.567)	9.980 (3.318)	na
Zambia	-11.385	-0.860 (5.811)	-4.523 (1.289)	1.291 (1.385)	0.807 (0.354)	na

*Includes cattle, sheep and goats. All converted into livestock units using the conversion factors in Appendix 3.1. The Total Livestock Units (TLU) form the dependent variables.

**OLS estimates. F Value = 25.942 Adjusted R^2 = 0.9258
Only data for cattle imports was available

1. Lncaput = TLU divided by population gives the TLU per caput.
2. Includes only cattle imports.

Absolute values of t-ratios are in parentheses.
***OLS estimates with a first order autoregressive process assumed
R^2 = 0.9124 Degrees of freedom = 15 Estimated rho = -0.1987

Rumindex = price index (in real terms) of the livestock importer
Domlivn = domestic livestock inventory
Other variables are as defined in Tables X - XV.

prices induce an increase in cattle inventories as farmers withdraw cattle supplies to increase their herds and take advantage of high prices. In 9 out of 20 countries in table XVI, increases in domestic production of livestock (Domlivn) induces a reduction on livstock imports. Nigeria, Cote D'ivoire, Uganda and Zaire are major consuming areas. Apparently, high prices for imported livestock do not affect their demand. Botswana is a substantial livestock producer in Southern Africa, but the domestic livestock inventory has a positive relationship with livestock imports. The exporting of livestock to South Africa could be one of the possible reasons. In 6 out of the 19 countries in table XVI, increases in income (column 5) has a depressing effect on livestock imports.

Policy Implications

The empirical results from the estimated import demand equations indicate that changes in foreign exchange rates have signifcant impacts on trade flows involving livestock products in Sub-Saharan Africa. The analysis shows that the foreign exchange rate could be used as an effective policy instrument to control the importation of milk, beef, butter, cheese and livestock in several African countries. Depreciation of the domestic currencies significantly reduces importation of livestock products across Sub-

Saharan Africa. For example, a 10 percent depreciation of the domestic currency will reduce cow milk imports in Benin, CAR, Ghana, Mali, Nigeria and South Africa by 20.28, 17.49, 20.35, 21.93, 26.22 and 5.42 percent respectively, assuming all other variable are held constant (Table IX).

In a vast majority of countries in the region, increases in the price of a particular type of livestock elicits varying responses. But in most cases, price increases have negative effects on the product importation. Thus, this supports the hypothesis that policies targeted on livestock prices would have significant effects in altering the pace of livestock development in Sub-Saharan Africa. Polices designed to increase beef prices (assuming all other variables are held constant) by 10 percent will reduce beef imports in Benin, CAR, Ghana, Malawi and Sierra Leone by 22.92, 4,84, 9.24, 6.52 and 2.25 percent respectively (Table XV). The analysis reveals varying degrees of substitutability or complementarity among the various livestock products.

The income variable has also proven to be a significant determinant of livestock imports in Sub-Saharan Africa. Even though the direction of effects is mixed, for a majority of the countries, increases in income induces increases of the imports studied. A 10.0 percent increase in incomes (assuming all other variables are held constant) induce increases in dairy food imports in Benin, CAR,

Ghana, Malawi, Sierra Leone, South Africa, Tanzania, Uganda, Zaire and Zambia by 3.02, 5.99, 7.31, 19.99, 34.69, 6.72, 1.24, 16.50, 11.49, 9.36 and 4.41 percent respectively (Table XIV). Thus, by increasing the purchasing power of the people, the food insecurity problem could be reduced substantially. This could be achieved by diversifying agricultural production and removing the trade policy biases against the agricultural sector. However, a 10.0 percent increase in incomes (assuming all other variables are held constant) elicits decreases in dairy food imports in Cameroon, Chad, Cote D'ivoire, Gabon, The Gambia, Kenya, Mali, Nigeria and Senegal by 11.64, 7.14, 12.64, 13.37, 4.19, 13.40, 7.57, 4.60 and 20.29 percent respectively.

In several African countries, increases in the domestic inventory has depressing effects on the importation of livestock products. Efforts to increase domestic livestock production (Domlivn) by 1.0 percent in Benin, Ghana, Kenya, Lesotho, Senegal, Sierra Leone, South Africa and Swaziland, (assuming other variables are held constant) will reduce livestock imports by 2.06, 14.26, 14.12, 3.41, 3.49, 0.27, 0.70 and 10.10 percent respectively (Table XVI). Since most African countries have predominantly agrarian economies, efforts should be made to step up investment in agricultural research and thus expand production).

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

This study has identified and quantified import demand relationships for milk, butter, cheese,beef and livestock in several African countries.

During the past two decades, per capita agricultural production in Sub-Saharan Africa has been surpassed by population growth. Thus, there is an increasingly frequent shortage of food supplies throughout the region. Calamities such as drought and famine in Ethopia, Sudan and other parts of Sub-Saharan Africa are reminders of the African food situation. There is a serious threat that the gap between food production and demand may widen further.

Livestock production is vital to the subsistence and economic development of Sub-Saharan Africa. However, the infrastructure provided for raising livestock and crops alike cannot support intensive production on a sustained basis. Poor range conditions and inappropriate livestock management practices cause overgrazing which leads to depletion of soil fertility and reduction in crop yields.

The macroeconomic policies (which include trade and

price policies) pursued by Sub-Saharan African governments have a great impact on the pace of future growth in rural incomes and the alleviation of poverty and hunger in the region. Several factors which impede food security and self-sufficiency in Tropical Africa involve economic, political, social, demographic, technological and environmental influences. The deteriorating balance of payments deficits in recent years rekindled the consideration of trade policy's impact on Sub-Saharan African agricultural development. Various African goverments adopted trade policy instruments such as tariffs, export duties and quantitative restrictions on imports and exports. For example, in Nigeria, export duties ranging from 5 to 60 percent were applied to agricultural exports such as cocoa, coffee, rubber, cotton, rubber, palm kernels and groundnuts during the 1960s and early 1970s. In Zaire, 52.6 percent of total government revenues during the 1970-78 period came from tax revenues collected from international trade transactions.

Even though in several Sub-Saharan Africa countries the agricultural sector contributes in excess of 20 percent of the GDP, governments in the region have typically underinvested in agricultural research. Many African governments are working with the help of the international agricultural research centers such as IITA to improve the efficacy of investment in development schemes by tailoring

programs around the farming systems research approach.

Conclusions

In estimating the import demand equations and demand elasticities for milk, butter, cheese, beef and livetock, the seemingly unrelated regression technique was used. A log-linear functional form was chosen so that the elasticities could be obtained directly from the regression equations.

The empirical results from the estimated import demand equations support the hypothesis that changes in foreign exchange rates have signifcant impacts on trade flows involving livestock products in Sub-Saharan Africa. The analysis shows that the foreign exchange rate could be used as an effective policy instrument to control the importation of milk, beef, butter, cheese and livestock in several African countries. Depreciation of the domestic currencies significantly reduces importation of livestock products across Sub-Saharan Africa.

In a vast majority of countries in the region, increases in the price of a particular type of livestock product elicits varying responses. But in most cases, price increases have negative effects on the product importation. Thus, this supports the hypothesis that policies targeted on livestock prices would have

significant effects in altering the pace of livestock development in Sub-Saharan Africa. The analysis reveals varying degrees of substitutability or complementarity among the various livestock products.

The income variable has also proven to be a significant determinant of livestock imports in Sub-Saharan Africa. Even though the direction of effects is mixed, for a majority of the countries, increases in income induces increases of the imports studied. Thus, by increasing the purchasing power of the people, the food insecurity problem could be reduced substantially. This could be achieved by diversifying agricultural production and removing the trade policy biases against the agricultural sector. Efforts should be made to equalize or make more neutral the systems of incentives for all traded goods. This will encourage the expansion of those activities that can save or earn foreign exchange at a lower cost, especially export and import substituting agriculture.

Income increases in Sub-Saharan Africa could have beneficial effects to the United States farm sector, especially the feedgrain industry. Efforts to increase livestock production (for example, poultry and pork) could increase demand for feedgrains from the United States. Also, increases in food consumption in Sub-Saharan Africa will probably include tastes for higher value commodities which are often unavailable or could only be produced at

high costs in the region, and which the United States can provide cheaply.

In several African countries, increases in the domestic inventory has depressing effects on the importation of livestock products. Since most African countries have predominantly agrarian economies, efforts should be made to step up investment in agricultural research and thus expand production.

Limitations of the study and suggestions for further research

The analysis in this study has highlighted the need for more in depth research in individual countries. The empirical results are mixed. However, afew generalizations can be made across countries and among the various commodities. This study has revealed that trade policy instruments such as the foreign exchange rate is an effective policy instrument to control the importing of livestock products. Income increases could lead to reductions in the food insecurity problems in Sub-Saharan Africa, and thus increase rural welfare for a vast majority of the people. Pricing policy targeting prices of beef, milk, butter, cheese and livestock could significantly alter the pace of livestock development in Sub-Saharan Africa.

Data problems necessitated the limiting of the study to milk, butter,cheese, beef and some ruminants (cattle, sheep and goats).

The estimated demand elasticities could be used in simulation analysis to extend the research and estimate the the impact of potential government policies on the importation of livestock products and development of the livestock sector in Sub-Saharan Africa.

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APPENDIXES

APPENDIX A

CONVERSION FACTORS FOR CHANGING DAIRY PRODUCTS INTO LIQUID MILK EQUIVALENTS (LME)

Appendix A: Convertion Factors for Changing Dairy Products into Whole Liquid Milk Equivalents (LME)

Commodity	Conversion Factor
Fresh milk	1.0
Dry Milk (Skim or Whole)	7.6
Milk, (Condenced or Evaporated)	2.0
Cheese or Curd	4.4
Butter	6.6
Butter-oil	8.0
Other Dairy Products	2.0

Source: Von Massow (October, 1985).

APPENDIX B

CONVERSION FACTORS FOR CHANGING LIVESTOCK INTO LIVESTOCK UNITS (LU)

Appendix B: Conversion Factors for Changing Livestock into Livestock Units (LU)

Species	Conversion Factor
Cattle	0.7
Chickens	0.01
Goats	0.1
Pigs	0.2
Sheep	0.1

Source: Jahnke, (1982).

VITA

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