POPULATION-FOOD INTER-RELATIONSHIP IN KENYA: DISTRICT LEVEL ANALYSIS 1980 TO 2000 - A CASE STUDY OF MAIZE AND BEANS

BY

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1989

DECLARATION

THIS THESIS IS MY ORIGINAL WORK AND HAS NOT BEEN PRESENTED FOR A DEGREE IN ANY OTHER UNIVERSITY.

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THIS THESIS HAS BEEN SUBMITTED FOR EXAMINATION WITH OUR APPROVAL AS UNIVERSITY SUPERVISORS.

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This thesis is dedicated to my beloved wife, Emma Atieno Dache and my daughter Brenda Awuor for their inspiration and generous support and encouragement throughout my academic life.

ABSTRACT

The interrelationship between population and food production (maize and beans) in Kenya at district level for the period 1980 to 2000 was investigated. The investigations were based on the 1969 and 1979 population data and the food statistics from the Ministry of Agriculture. Population projections were calculated for the period 1980-2000 to estimate demand for maize and beans for the period under considerations. This was done to test the broad hypothesis that the annual population growth rates in the districts studied will continue to increase upto the year 2000, the annual maize and beans production rates at district levels will be rising, Demand for maize and beans in the different districts will outweigh the supply and that a linear relationship exists between population density and the total amount of maize and beans produced per 1000 population, the total area of land under maize and beans and the total yield per hectare of land under maize and beans.

To test the above hypothesis, some assumptions were made regarding fertility and mortality levels and the area of land under maize and beans and the yields per hectare of under maize and beans. Constant fertility and mortality was assumed in set 1, while a constant fertility but declining mortality was assumed in set 11.

The study was first intended to cover the 42 districts but a sample size of 33 districts was later selected for the study since other districts do not adequately grow these crops.

The results showed regional variations in demand and supply of maize and beans to the year 2000. It also points out that many districts will suffer from shortages of these food crops. The results further showed that the total amount of maize and beans produced per 1000 population, total area of land under maize and beans and the total yield per hectare of land under maize and beans have no impacts on population density.

Recommendations were suggested to ensure enough maize and beans for the population in the future.

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GENERAL INTRODUCTION

1.0 INTRODUCTION

Population growth and its bearing on food production has been topical in the recent years. New developments in agriculture have helped to meet the demand of growing population especially in More Developed Countries (MDCs). The situation in less developed countries (LDCs), especially Africa, has been more serious in the recent years. The food production in Africa has been lagging behind population growth. This lag may be attributed to unfavourable weather conditions, low productivity due to lack of skilled manpower, the diminishing good agricultural land or due to the current attention being paid to industrial cash crops. The low level of food production in Africa combined with high rates of population growth has created an imbalanced in the food supply and demand in many African countries.

Among the African countries, Kenya has the highest population growth rate which vary from region to region within the country, yet it is experiencing shortages of maize and beans, which is one of the country's staple food. This study analyses the future trends of population growth and the trends in the maize and beans production and how population density relates to total maize and beans produced per 1,000 population, the yield of maize and beans and the total area under maize and beans.

1.1 BACKGROUND OF THE STUDY AREA

1.1.1 Physical Background

Kenya lies astride the equator with a total land area of about 583,000 square kilometres. Geographically Kenya can be divided into:-

(a) The flat South-east coastal plain which are usually hot and sparcely populated.

(b) The north-east coastal inland plains with an annual rainfall less than 50mm. The region is of little agricultural value.

(c) The north-west scrubland including Lake Turkana, the region is similar to north-east.

(d) The plateau in the South-west bisected by the Rift Valley, it includes, Mount Kenya Mount Elgon and the Aberdare Mountain range. The plateau is the most fertile part of the country with an annual rain of more than 750mm.
(Jensen, Horellin and Quinn, 1988)" Food and Nutriton in Kenya.

About 38% of the country lies below 500 metres, 34% between 500 to 1000 metres, 26% above 2,500 metres. Much of the land between 150 and 1000 metres is arid or semi-arid, due to shortage of water and high temperature, and is, therefore, sparcely populated.

About 80% of the total population is concentrated in the arable-land area, which comprises 18% of the total. This arable land is used for dairy farming, cash crops cultivation in addition to growing staple food crops. Kenya has mainly two major seasons per year. In parts of the country maximum rainfall occurs from mid-March to mid-May (the long rains): whereas the short rains are from mid-October to early December. As a result, two crops can be harvested per year in these areas. In the Lake Victoria regions , rain falls at any time of the year without a distinct rainy period. (figure 1.1)

The great variation in annual rainfall and the unreliability in the expected time of arrival of the rainy season have a crucial effect on agriculture, especially on subsistence farming. Studies have shown that in four out of every five years, only 15% of the country recieves more than 760mm of rain per annum. This amount of rainfall is very crucial for agriculture in Kenya since it is the minimum for economic agriculture without irrigation. Thus 80% of Kenya is unsuitable for agriculture because of lack of water.

Administratively, Kenya is divided into eight provinces: Each province is divided into districts, of which there are 41 in the whole country. With the Government of Kenya (GoK) relatively new focus on district level planning, the recent shift has been towards decentralizing the planning from central and provincial level down to district level government administration. (Figure 1.2)

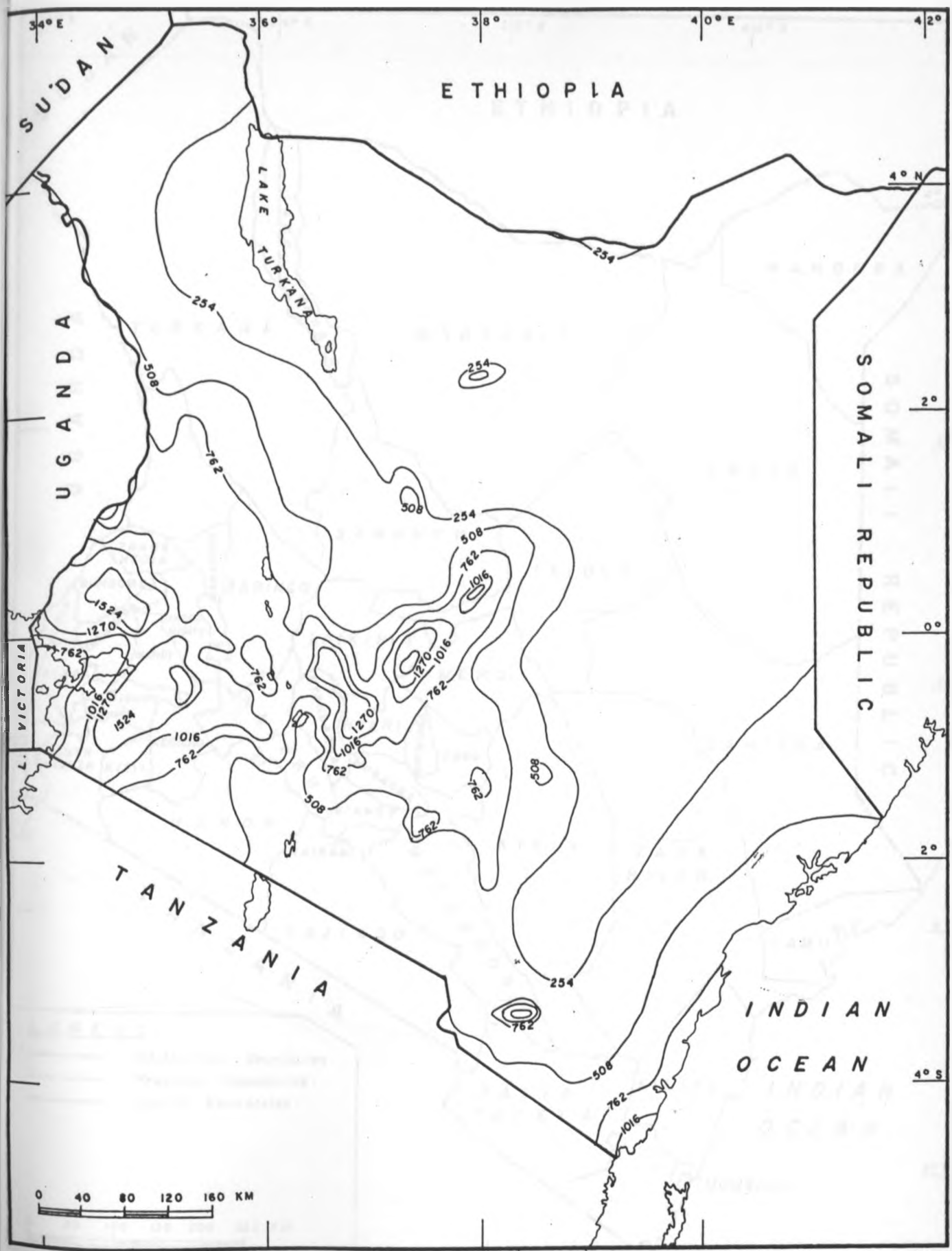


Fig. 1.1 20% PROBABILITY MAP OF KENYA : ANNUAL RAINFALL

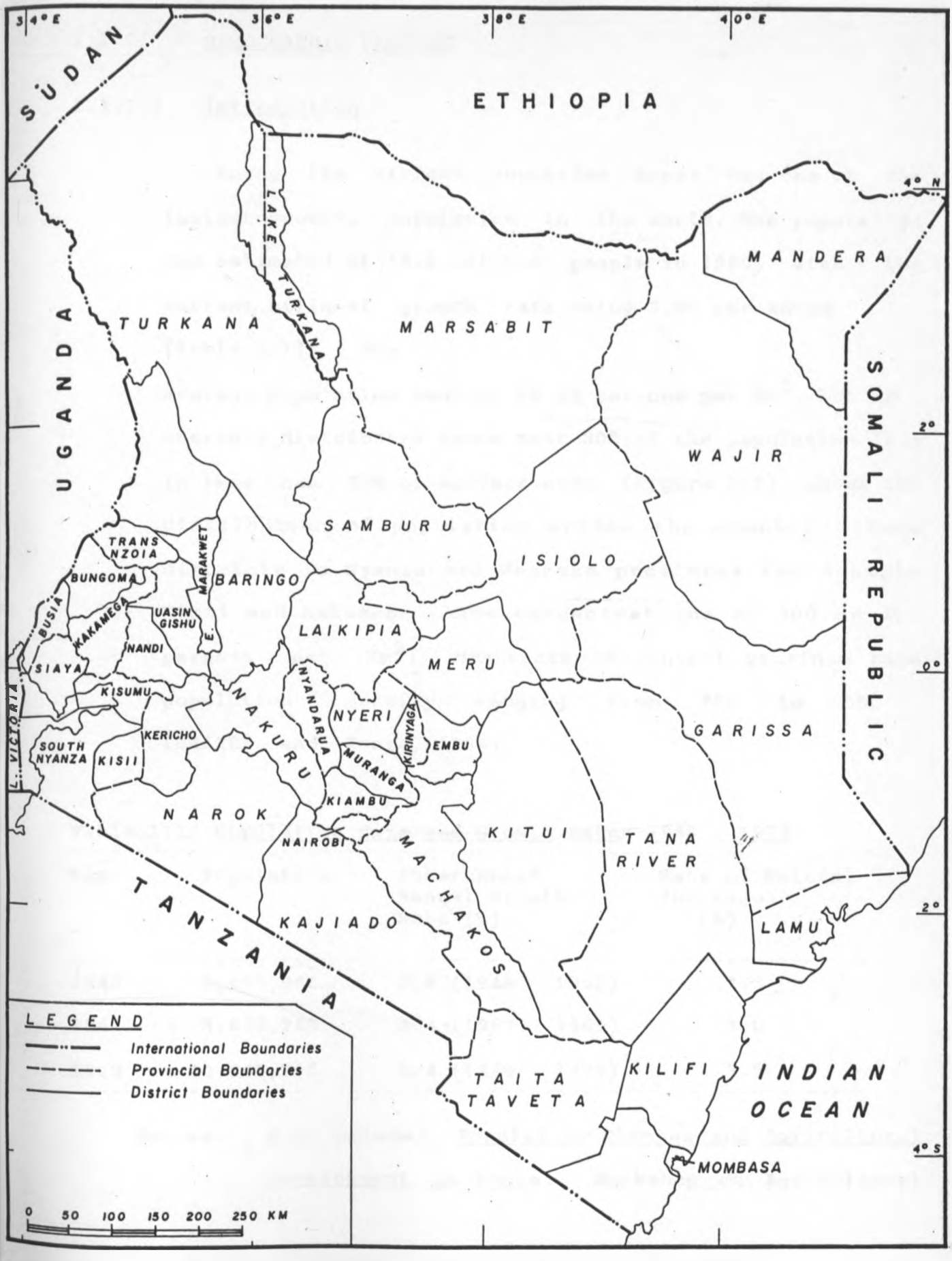


Fig. 1.2 KENYA ADMINISTRATIVE DIVISIONS

1.1.2 DEMOGRAPHIC PROFILE

1.1.2.1 Introduction

Among the African countries Kenya has one of the fastest growing population in the world. The population was estimated at 16.6 million people in 1980, with the current official growth rate being 3.8% per annum (table 1:1). The average population density is 28 persons per Km^2, but is unevenly distributed since over 80% of the population live in less than 20% of surface area (Figure 1:3) shows the distribution of population across the country. Some districts in Nyanza and Western provinces for example Kisii and Kakamega have concentrations of 300 or 400 persons per Km^2. Districts in Central province have population density ranging from 200 to 300 (UNICEF and Kenya, 1984).

Table 1.1: Population Size and Growth rates 1948 - 1979

Year	Population	Intercensal Annual Growth Rate (%)	Rate of Natural Increase (%)
1948	5,405,966	3.4 (1948 - 1962)	2.3
1962	8,636,263	3.4 (1962 - 1969)	3.0
1969	10,942,705	3.4 (1969 - 1979)	3.9

Source: S.H. Ominde, Population Changes and Agricultural Development in Kenya, Workshop on Agricultural

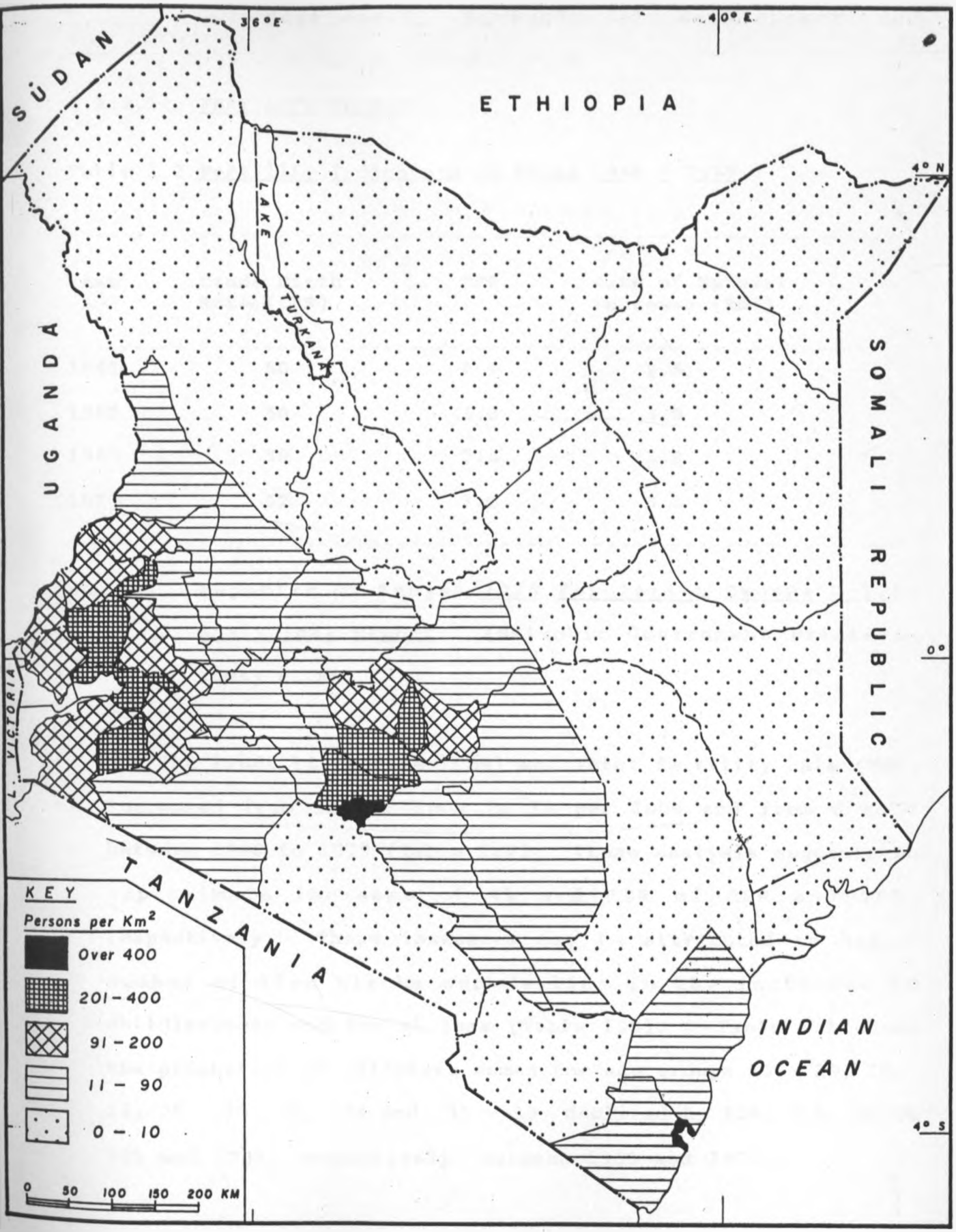


Fig. 1.3 KENYA : POPULATION DENSITY, 1979

Settlement, Agricultural development and Population Nairobi, P. 3.

1.1.2.1 FERTILITY TRENDS

Table 1.2 Fertility Indicators in Kenya 1948 - 1979

Year	Crude Birth Rate (CBR)	TFR	Rate of Natural increase (RNI)
1948	50	6-7	2.5
1962	50	6.8	3.0
1969	50	7.6	3.3
1979	52	7.9	3.8

Source: Republic of Kenya: 1979 Population Census Vol.II Analytical Report. (Nairobi: Government Printers, 1984) P. 86.

The crude birth rate (CBR) and Total fertility rate (TFR) increased from 50 per 1000 to 52 per 1000 and from 6 to 8 between 1948 to 1979 (Table 1:2). These analysis suggests an approximate increase of 4% and 18% of CBR and TFR, respectively. These increases may be attributed to higher number of live births and decline in the incidence of childlessness and foetal loss (Table 1.3). Table 1:3 shows the proportion of childless women for age groups 15 - 19, 20 - 24, 25 - 29, 30 - 34 and 35 - 39 declined by 12%, 41%, 65.9% 73% and 78%, respectively, between 1969 and 1979.

Table 1.3: Proportion of Childlessness among all Kenyan Africa Women by Age group 1962 - 1979

	Age - Groups						
Year	15-19	20-24	25-29	30-30	35-39	40-44	45-49
1962	79.1	36.6	22.3	17.8	15.3	14.4	13.7
1969	75.5	24.7	11.1	8.1	7.6	7.8	7.9
1977	72.8	23.5	7.0	4.1	3.8	3.8	4.5
1979	69.5	21.4	7.6	4.8	3.3	3.3	4.3

Source: R. Henin: Alternative Population Projections for Kenya and its Provinces PSRI University of Nairobi, P.7

1.1.2.2 REGIONAL DIFFERENTIALS

Though the fertility for Kenya as a whole has been discussed above available demographic data shows important differences as shown in Table 1.4.

Table 1.4: Total Fertility Rates, 1969 and 1979 by Province and District Level

REGION	TFR 1969	TFR 1979	CBR
(1)	(2)	(3)	(4)
CENTRAL	6.85	7.5	48.6
Kiambu	7.27	7.55	50.2
Kirinyaga	6.35	7.55	49.2
Muranga	6.95	7.52	47.1

Nyandarua	7.75	8.17	51.7
Nyeri	6.94	7.14	46.2
COAST	4.75	6.02	54.1
Kilifi	4.7	5.91	59.5
Kwale	5.12	6.18	55.8
Lamu	4.62	6.31	49.7
Mombasa	4.34	4.77	45.8
Taita	6.3	7.33	49.8
Tana River	4.07	7.11	56.6
EASTERN	5.92	6.82	52.8
Embu	6.95	7.38	53.7
Isiolo	5.6	5.82	49.6
Kitui	5.58	6.36	53.8
Machakos	5.95	7.21	53.1
Marsabit	4.37	5.54	43.4
Meru	5.96	6.72	52.4
NYANZA	7.58	7.97	59.7
Kisii	8.74	9.09	63.3
Siaya	6.67	7.13	54.6
South Nyanza	7.84	7.9	60.9
Kisumu	6.97	7.76	56.7
WESTERN	8.31	8.6	58.1
Kakamega	8.24	8.6	51.1
Bungoma	8.7	9.1	59.8
Busia	7.83	7.62	60.6
RIFT VALLEY	5.86	7.36	54.1
Baringo	5.82	7.22	57.7

Marakwet	4.73	6.57	50.7
Laikipia	6.05	6.96	51.3
Nakuru	6.87	7.86	53.4
Kericho	7.26	8.23	56.6
Nandi	5.62	7.36	52.7
Narok	5.82	6.43	52.9
Samburu	4.39	6.16	47.7
Trans Nzoia	8.58	8.58	56
Kajiado	4.66	6.06	56.6
Turkana	4.26	5.63	52
Uasin Gishu	6.22	7.24	54.6

Source: J.O.A Osiemo,: "Estimation of Fertility levels and Differentials in Kenya: An Application of Relational Comperts and Coale-Trussell model" Msc. Thesis, PSRI University of Nairobi, 1986. P. 86.

While there is little doubt that the above rates are affected by age misreporting and mis-statement, the order of magnitude of the differences between districts shows genuine fertility differentials. It is observed from table 1:4 that fertility is high in the high/medium agricultural heartland than in the low potential areas. This will increase the constraint of the land availability (high and medium potential agricultural land) because it is these very regions that will continue to experience high fertility, thus increase food (maize and beans) shortage is very real in these regions.

1.1.3 MORTALITY TRENDS

Mortality decline combined with high fertility is a major determinant of accelerated population growth. Crude death rate was estimated at between 18 and 23 per 1000 in 1962, 17 per 1000 in 1969, 14 per 1000 in 1977 and 12 per 1000 in 1979. The decline is attributed to the benefit of modern science and technology. The average life expectancy at birth is 56 years (Table 1:5)

Table 1.5: Life Expectancy at birth 1962 - 1979

Year	Expectation of Life at Birth		
	MALES	FEMALE	COMBINED
1962	40.0	45.0	42.0
1969	46.9	51.2	49.0
1977	51.2	55.8	54
1979	54.1	56.9	56

Source: L.M. Frank: Infant Mortality in Kenya, Evidence from the Kenya Fertility Surveys, PSRI, University of Nairobi, 1979 P. 10 - 11:, CBS, 1979 Population Census.

Kenya's infant mortality rate is 92 per 1,000, which is about midway between the extremely high levels of some African countries and low levels of more developed countries (UNICEF and Kenya, 1984).

Table 1.6: Trends in Infant and Child Mortality

	Pre-1948	1948	1962	1969	1979
Infant mortality (deaths per `000 in first year of life)	---	N.A	N.A	119	92
Early childhood mortality (deaths) per `000 in the first two years of life)	400-500	184	174	157	125

Source: Government of Kenya: Social Perspectives Kenya's High Rate of Population Growth 14:1, Nairobi: CBS, 1977.

Table 1.7: Proportion of Children Dying by Age of mother, 1962, 1969, 1979

Age Group	1962	1969	1977/78	1979
15 - 19	.146	.128	.101	.119
20 - 24	.170	.147	.130	.128
25 - 29	.205	.174	.144	.141
30 - 34	.238	.202	.157	.167
35 - 39	.269	.231	.174	.189
40 - 44	.308	.263	.189	.216
45 - 49	.338	.304	.236	.252

Source:- R.A. Henin: Alternative Population Projections for Kenya and its Provinces (Nairobi, University of Nairobi PSRI 1979) P.12 and Republic of Kenya: Kenya fertility Survey 1977/78, (Nairobi: Ministry of national Planning 1980) P. 104

Table 1:7 indicates that child mortality declined between 1962 and 1979. The general trend is that whereas 146 out of 1000 children died in 1962 for women aged 15 - 19, the number fell to 128 in 1969 and further to 116 by 1979 census and this trend is true for all other age groups.

1.1.3.1 REGIONAL MORTALITY DIFFERENTIALS

There are significant regional variations in child and infant mortality. (Figure 1.4) shows however, that there exists a wide distribution of mortality rates among the districts. The worse-off districts are South Nyanza in Nyanza province and Kilifi District in Coast province with rates of over 200 per 1000, while the best districts are Nyeri and Nyandarua in central province with rates below 60 per 1000. The crucial regional differences are due to factors such as climatic conditions, food availability, access to medical and health services. If the high mortality levels in Nyanza province and Coast province districts is drastically reduced to compare with the better-off districts in Central Province a substantive increase in the total population would be experienced and this would have serious implications on the maize and beans deficit district.

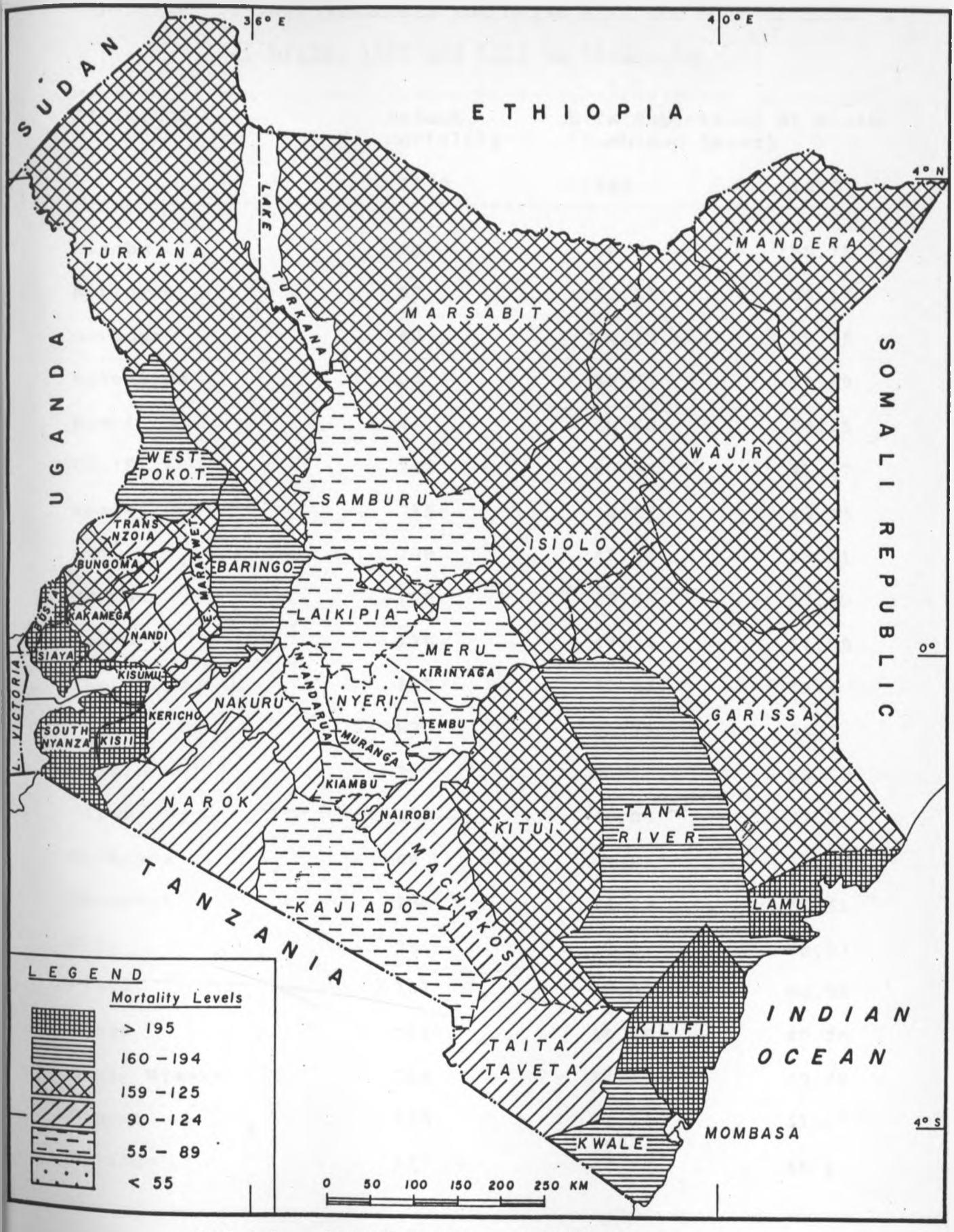


Fig. 1.4 MORTALITY LEVELS

Table 1.8: Infant Mortality estimates 1979 and Life expectancy at birth, 1969 and 1979 by Districts

DISTRICTS	Infant mortality	Life Expectancy at birth (Combined Sexes)	
	1979	1969	1979
Kiambu	70	56.6	58.75
Kirinyaga	82	52.01	56.14
Muranga	68	54.13	58.35
Nyandarua	64	58.77	59.82
Nyeri	49	60.68	64.15
Kilifi	212	40.64	41.37
Kwale	215	44.37	43.14
Lamu	200	49.78	43.51
Mombasa	120	49.88	52.60
Taita	116	42.34	51.09
Tana River	181	42.77	43.6
Embu	83	51.71	56.9
Isiolo	127	40.75	50.09
Kitui	148	46.08	47.1
Machakos	98	51.01	54.86
Marsabit	130	44.92	51.51
Meru	75	52.5	58.33
Kisii	101	50.03	54.95
Siaya	211	35.95	40.28
South Nyanza	216	34.92	39.48
Kisumu	199	37.24	41.66
Baringo	171	47.68	45.1

Marakwet	127	55.45	51.51
Kajiado	87	57.17	58.55
Kericho	91	56.05	56.91
Laikipia	77	54.75	58.3
Nandi	110	51.87	53.92
Narok	95	55.65	55.96
Samburu	77	55.17	53.89
Nzoia	114	46.09	54.74
Turkana	133	48.10	47.59
U. Gishu	92	56.07	57.56
W. Pokot	188	45.95	43.41
Bungoma	140	46.67	54.21
Busia	198	37.00	42.01
Kakamega	143	44.8	51.63

Source: M.K.I. Kibet: Differential Mortality in Kenya. (Nairobi: University of Nairobi PSRI, Msc Thesis, 1981). P. 140.

There is evidence of substative mortality decline between 1969 and 1979 as revealed by life expectancy at birth, though this varies from one district to another.

1.1.4 Internal Migration

This is an important determinant of population characteristics. Kenya is in the early stage of mobility transition. The internal movements in Kenya are economically and socially motivated. This involves a shift of rural

population from less to more prosperous agricultural areas. Such movements has increased pressure in these agricultural core areas. The demand for food has, therefore, increased in these areas which have to feed the poor agricultural areas.

The rural-urban movements has increased food demand in the urban areas which at the same time are not agriculturally productive. Currently there is a shift of population from densely settled high potential areas to less densely populated areas due to increasing population pressure (Ominde, 1981 and Obudho, 1983).

1.2 Agricultural Development and Land use in Kenya

1.2.1 Agricultural Development

Agriculture dominates Kenya's economy. It accounts for 80% of total employment and generates 60% of foreign exchange earning. It comprises over 30% of Gross National Product (GNP) (World Bank, 1981). Agricultural output grew at 4.6 percent between 1964 to 1972. It slowed to 2.6% between 1972 to 1978, and declined further till 1981 when it rose to 6.2% (UNICEF and Kenya, 1984). The food consumption patterns differ by ecological zones, among the cereals maize is consumed every where. The amount vary from 150 to 250g per capita daily. Beans are also found nearly everywhere and is the major source of protein in the diet. The daily consumption varies from 40g to 120g per caput daily (Jansen, 1988).

1.2.2 Land Use

Only 13% of 58,265,000 hectares (total land area) receive consistent rainfall of above 762mm annually. Crop production is restricted to 26 million hectares in the highlands, lands extending to west of Lake Victoria and the narrow coastal strip (Figure 1:5).

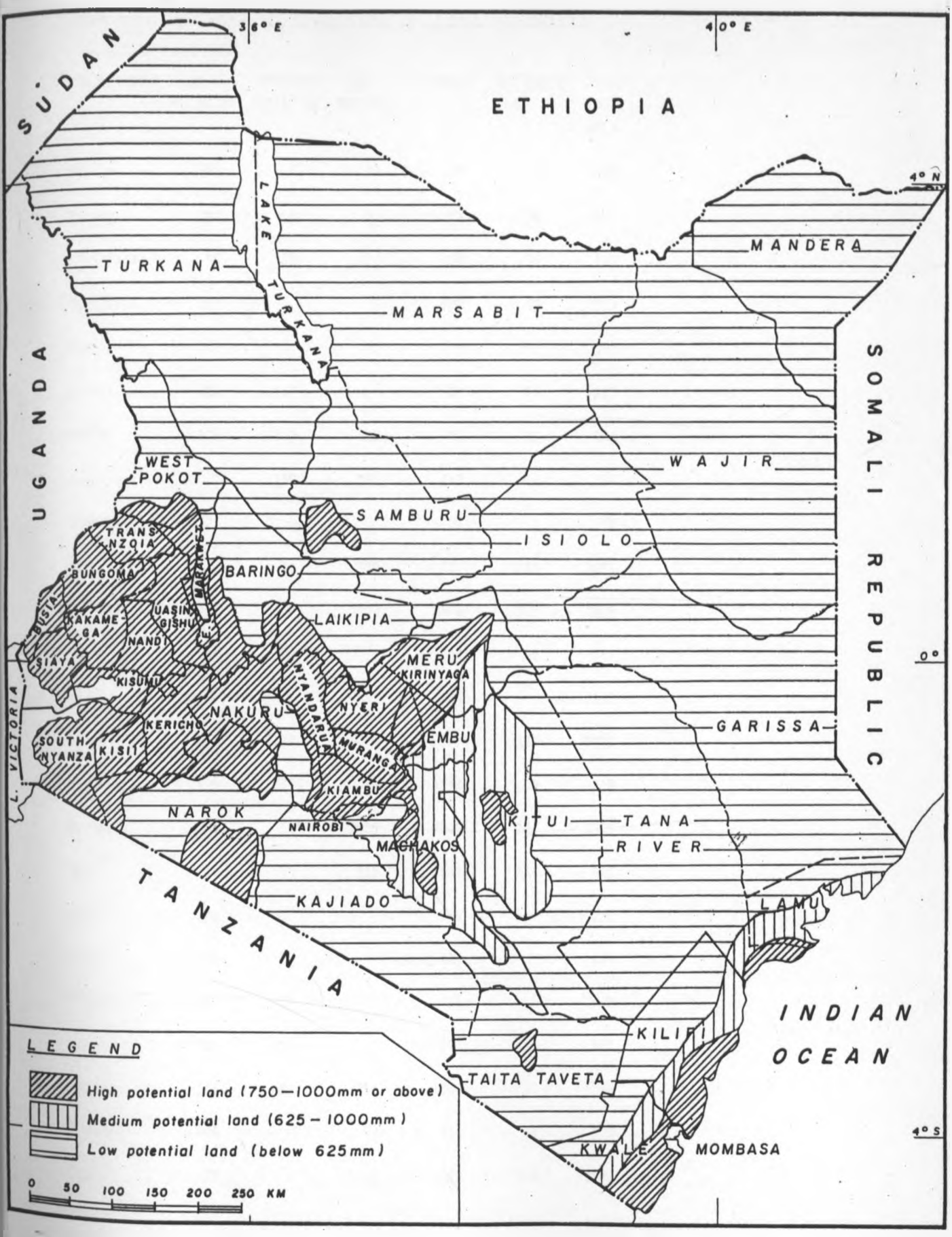


Fig. 1.5 KENYA LAND PRODUCTIVITY POTENTIAL

Table 1.9: Categories of Agricultural land by District '000 Hectares

DISTRICTS	HIGH POTENTIAL	MEDIUM POTENTIAL	LOW POTENTIAL	TOTAL	ALL OTHER LAND	TOTAL LAND AREA
Kiambu	386	5	24	415	78	493
Muranga	386	5	24	415	78	493
Kirinyaga	98	10		108	35	143
Nyandarua	265		5	270	83	353
Nyeri	160		12	172	157	329
Kilifi	104	247	851	1202	39	1241
Kwale	126	162	508	796	30	826
Lamu	7	319	321	647	4	651
Mombasa	21			21		21
Taita	47	10	590	642	1054	1696
T. River	73	50	3393	3524	345	3869
Tsavo	66	186		252	19	271
Isiolo			2561	1561		2561
Kitui	67	1137	1078	2282	657	2939
Machakos	125	771	454	1350	60	1410
Marsabit	4		7045	7049	346	7395
Meru	241	95	315	651	341	992
Kisii	220			220		220
Kisumu	432	29		461		461
Siaya	432	29		461		461
S. Nyanza	566	5		571		571
Baringo	166	84	751	1001	62	1063
Marakwet	104		92	196	77	273
Kajiado	22		1760	1782	314	2096

Kericho	388			388	189	484
Laikipia	138		760	898	74	972
Nakuru	291	39	231	561	141	702
Nandi	334			334	40	274
Narok	988		784	1612	240	1852
Samburu	140		1612	1752	329	2081
Nzoia	788			788	39	247
Turkana	12		5937	5949		5949
U. Gishu	327			327	51	378
Pokot	103		365	468	39	507
Bungoma	253			253	55	308
Busia	163			163		163
Kakamega	325			325	77	325
Total	4705	3157	42185	52047	4867	56914

Source: Republic of Kenya: Kenya Statistical Abstract (Nairobi: Government Printers, 1988), P. 98.

From table 1.9 Busia, South Nyanza, Kakamega, Kisumu and Siaya, Uasin Gishu, Trans Nzoia, Bungoma, Nandi, Kiambu, Muranga and Nyandarua have over 75% high potential areas of their total land each. These districts have the highest percentage of high potential area, and this reflects how crop production is concentrated in these districts. For the whole country, the total high potential and medium potential area is 19% of the total land area. The total low potential area is 81% of the total land area. This crop productive land is

little compared to total land area. The wide variations in climate and altitude, coupled with a variety of soils, largely determine the pattern of Kenya's agriculture.

Table 1.10: Estimated Areas and Values for selected Agricultural Commodity, 1983/84

Agricultural Commodity	Area % Total	Rank	Value % Total	Rank
Milk	46.6	1	16.3	3
Maize and beans	22.6	2	16.6	2
Root crops	7.9	3	8.1	5
Sorghum and Millet	6.7	4	1.5	11
Coffee	2.9	5	21.6	1
Wheat	2.2	6	2.1	10
Cotton	2.1	7	0.4	18
Fruits	1.7	8	3.1	9
Sugar	1.6	9	-3.6	21
Tea	1.1	10	11.9	4
Sisal	0.7	11	1.1	12
Vegetables	0.5	12	3.4	8
Cashew nuts	0.4	13	0.4	15
Groundnuts	0.3	14	0.2	20
Barley	0.2	15	0.4	17
Sunflower	0.2	16	0.2	19
Pyrethrum	0.2	17	0.4	16
Rice	0.2	18	0.5	13
Tobacco	0.1	19	0.5	13

Source: Republic of Kenya: Kenya Economic Survey: (Nairobi: Government Printers, 1985) P. 113.

Table 1:10 shows that in terms of area occupied, dairy farming, (maize and beans), and root crops are the leading. This is in keeping with the large number of small scale farmers who form the majority and who are fairly close to subsistence. In terms of value coffee (21.6%), maize and beans (16.6%, milk (16.3%) and tea (11.9%) are leading.

Table 1.11: Total area under crops 1974 - 1975

Crops	Total are in '000 Hectares	
Cereals	Pure stands	Mixed stands
Local maize	244.6	970.0
Hybrid maize	258.2	242.6
Finger millet	30.5	47.4
Sorghum	16.8	189.6
Other cereals	18.5	83.4
Pulse and nuts		
Beans	49.9	713.6
Cow peas	11.7	259.5
Pigean peas	0.1	115.2
Groundnuts	5.5	14.3
Others	1.1	36.3
Root crops		
English potatoes	48.9	212.3
Sweet potatoes	10.9	21.7
Cassava	41.2	28.7
Others	17.7	24.4

Table 1.11 con'd

Fruits, vegetables and oils		
Bananas	19.6	110.8
Other fruits	1.2	12.4
Vegetables	4.0	52.0
Oil seeds	13.0	11.5
Temporary industry crops		
Sugarcane	55.0	8.7
Pyrethrum	22.4	4.7
Cotton	25.0	45.1
Others	2.6	3.4
Permanent Cash crops		
Coffee	92	19.3
Tea	59	5.8
Coconut	2	49.3
Cashewnuts	5.5	48
Others	23.1	10
Total	1065.5	3362.7

Source: Republic of Kenya: Kenya Statistical Abstract. (Nairobi: Government Printers, 1980), P. 123.

The area occupied by maize when not mixed is larger than area occupied by cash crops. Maize occupies 45% of total cultivated area when not mixed. At the same time area devoted

to pulses and nuts is 7% of the total cultivated when not mixed. Out of this 4.6% is devoted to beans production. This shows that a typical diet of maize and beans can be assumed to provide the minimum daily requirements of the population and staple food for the country.

Table 1.12: Projected Per Capita land Availability in 1989 (all land)

DISTRICT	PROJECT POP 1989 ('000')	TOTAL LAND AREA ('000')	PER CAPITA LAND AVAILABILITY (Ha)
Kiambu	940	2,448	2.6
Kirinyaga	422	1,437	3.4
Muranga	865	2,476	2.9
Nyandarua	350	3,528	10.1
Nyeri	726	3,284	4.5
Kilifi	579	12,414	21.4
Kwale	392	8,257	21.1
Lamu	24	6,506	271.1
Mombasa	611	210	0.35
Taita	191	16,959	88.8
T. River	85	36,694	455.2
Embu	370	2,714	7.3
Isiolo	47	25,605	544.8
Kitui	617	29,389	47.6
Machakos	1,322	14,178	10.7
Marsabit	78	7,732	932.5
Meru	1,147	9,922	8.7
Kisii	1,388	2,196	1.6

Table 1.12 cont'd

DISTRICT	PROJECT POP 1989 ('000')	TOTAL LAND AREA ('000')	PER CAPITA LAND AVAILABILITY (Ha)
Kisumu	727	2,093	2.9
Siaya	630	2,523	4.0
S. Nyanza	1,418	5,714	4.0
Baringo	238	10,627	44.7
Marakwet	278	2,722	9.8
Kajiado	162	20,963	129.4
Kericho	1,036	4,890	4.7
Laikipia	102	9,718	95.3
Nakuru	574	7,024	12.2
Nandi	398	2,745	9.6
Narok	208	18,513	89.0
Samburu	127	20,809	163.9
Nzoia	275	2,468	9.0
Turkana	225	60,823	270.3
U. Gishu	406	3,784	9.3
Pokot	137	5,076	37.1
Bungoma	799	3,074	3.9
Busia	398	1,629	4.1
Kakamega	1,696	3,520	2.1

Source: Republic of Kenya: Kenya Statistical Abstract (Nairobi: Government Printers, 1980) P. 98; R. Henin: Population Profiles for the Districts of Kenya: (Nairobi: University of Nairobi PSRI) and R. Henin: Alternative Population Projections for Kenya and its Provinces: (Nairobi: University of Nairobi, PSRI)

Table 1:12 shows that the high/medium agricultural districts such as Kiambu, Muranga, Kisii and Kakamega among others will face untainable situation by the year 1989. These areas will have averagely less than 10 hectares of land per head of population, with most of them being averagely around 4 hectares or less.

1.3 STATEMENT OF THE PROBLEM

Population and food are closely interrelated and the population proplem has sometimes been identified as a food problem. The need to balance population growth and food production has existed throughout human history. The new developments in agriculture in the more developed countries (MDCS) have helped to meet the food demands of a rapidly growing global population.

However, a considerable proportion of the world's population is living in regions of precarious food supply where hundreds of millions of inhabitants are undernourished and millions are faced with possible starvatio (Johnson 1976).

In recent years, weather conditions in several food producing areas have been unfavourable and food production is further threatened by scarcity of fertilizers in many parts of the world particularly Africa. The high rates of population growth have also serious implications for both the production and demand for food in developing countries (Johnson op cit)

Kenya in particular, is one of the countries with highest growth rates. Its problem is often associated with maize and beans shortages, these being the country's staple

food. In the period 1979-1981 and 1984 there was a shortage of these vital commodities and the government was forced to import more to meet the demand.

With the availability of unused agricultural land in the productive Kenyan highland approaching its limits and with the short term prospects of significant food production increases in the semi-arid and arid parts of Kenya being remote,Kenya is likely to continue facing food shortage problem especially if the population growth rate continues to be high. So research is needed to be done at district levels on both food production (maize and beans) and demographic factors to evaluate potential trends in food demand and food supply are in balance vis-a-vis population growth. The rationale for this is that National and provincial shortages have been observed (Mukasa, 1983 and Kibiego, 1988).

1.4 OBJECTIVES

The main objective of this study is to investigate how population change affects maize and beans production regionally and to estimate how population density relates to total amount of maize and beans produced per 1000 persons, the total yield per hectare and the total area under maize and beans. Specifically to:-

1. Project population by districts to the year 2000 in five - year intervals based on different assumptions on fertility and mortality levels.

2. Project maize and beans production to the year 2000

by districts assuming the area and yield per hectare will increase in line with the past trends.

3. Project demand (consumption) of maize and beans by districts to the year 2000 based on different consumption standards.

4. Compare consumption (demand) and production (supply) of maize and beans to determine which districts will have surplus or deficit by the year 2000.

5. Estimate relationship between population density and total amount of maize and beans per 1000 persons, total yield per hectares and the total area under maize and beans.

1.5 JUSTIFICATION OF THE STUDY

From the studies that have been carried out in Kenya, regional differential in the demand and supply of maize and beans exsist (Mukasa, 1983 and Kibiego, 1988). An accurate projection of maize and beans demand and supply at district levels and the estimation of the relationship between population density and the total amount of maize and beans produced per 1000 population, the total yield per hectare of land under these vital crops will be extremely important for the identification of priorities , investiment targets in agriculture and satisfaction of basic food needs for the population and the implimentation of population control measures.

It was hoped that the study will identify the district with surplus or deficit and act as a guiding factor in decision making and policy influencing what to produce, how

much where and the distribution of these commodities.

The relationship between population density and total amount of maize and beans produced per 1000 population, the total area under maize and beans and the yield per hectare of land under maize and beans will assist the government to find out how differential in agricultural perfomance exist due to demographic factors. The recommendations were hoped would assist the Ministries of Agriculture and Finance in central planning.

The study brought into light how population change affects production of maize and beans at district levels. The projections predicted the consequences of future changes in production. It identified districts with excess and those with shortages.

1.6 SCOPE AND LIMITATION.

The study will limited to the demand and supply of maize and bean as opposed to all food crops. Apart from the fact that a study of all food crops would be exhaustive and give a true picture of the food situation in the country, it is too broad to cover adequately given the time available. In addition it was not possible to obtain adequate food statistic data for all the food crops which are reliable enough to allow analysis free from error.

The selection of maize and beans was done on the basis of availability of data that lent themselves to the type of analysis that was envisaged. The study estimates population, maize and beans demand and supply at District level. It was

therefore, a macro-level study based on the 1969 and 1979 national censuses and the food statistics for the last twelve crop years i.e. from 1975/76 to 1986/87.

The study was first intended to cover 42 administrative districts, but after detailed scrutiny of maize and beans data, a sample size of 33 districts was chosen for the study. The other districts do not have reliable data.

The study used only secondary data because of the inadequate financial resources to cover all the 33 districts chosen for study. It was not also possible to collect primary data in all the districts given the time available. The study did not consider such factors of production as temperature, rainfall, humidity, soil type and availability of fertilizers due to unavailability of the reliable data. Time was therefore used as a proxy to represent these factors.

Apart from the fact that a study of all the food crops would be exhaustive and give a true picture of the food situation in the country, it is too broad to cover adequately given the time available. In addition, it is not possible to obtain adequate data covering all the districts.

1.7 LITERATURE REVIEW

The classical Mathusian Views that population would eventually be limited by food production has been refuted by almost two centuries of history since Malthus wrote, that food production kept pace or has grown faster than the population. The recent periodic crisis of food in Africa and Asia has brought new account of hauntings by the Malthusian ghosts. Malthus said, systems of equality which tries to alleviate economic distress are self defeating because such systems would stimulate demographic growth, but, since the supply of agricultural land is limited, the entire population ends up living at the margin of subsistence (Overbreek, 1979).

The Malthusian checks on the population are inevitable unless food production is increased along with reduction in fertility especially in the LDCs or else it will slaken the capital cummulation which will reduce the productivity of the labour force (King, 1966). LDCs are faced with the problem of food per head and the space per head. These problems are attributed to high rate of population growth due to falling death rates unacccompied by a fall in birth rates (Thoday, 1966). To increase the numbers of human race in the LDCs, will depend on the increase in productivity of the land already under crops with proper application of knowledge and technology (Boserup, 1965). But the population growth at anything like the current rate among the LDCs of the world cannot be supported for many generations. The only solution

is to stabilize population growth before a point is reached where food production growth can no longer be keep pace with it (Hutchinson, 1966).

The relationship between population and agricultural development is important because it concerns the basic human needs. The challenge in LDCs like Kenya, is whether agricultural productivity will match the requirements of the demographic situations (Kulkarni, 1981). The population expansion in the LDCs is of a larger magnitude than the one experienced by the MDCs, therefore, the challenge of LDCs is not only to increase agricultural productivity but to increase it by adopting a strategy that will create enough work for the people.

In countries where population have been increasing rapidly, but the rate of industrialization has not been notable, the relationship between population change and agricultural development assumes an enormous importance. Such countries have no systematic association between changes in demographic variables and the total per capita agricultural output (Savoni, 1986). Such studies done in MDCs like Japan cannot be generalized for LDCs like Kenya where food supply comes from expansion of the sown area and by use of traditional methods of production and very little from technological advancements.

The rapid rate of population growth has serious implications on man-land ratio and the availability of food grains since productivity results from expansion of agricultural land especially in the LDCs. Boserup, (1965) and Clarke, (1967) argued that population growth and increasing pressure on the land pre-empts increased food production. Boserup concluded that population growth forces cultivators to give up traditional ways of subsistance farming and more intensive land use becomes necessary with increased use in technology and fertilizers. She said that high population growth rate should automatically mean high food production rate and there should not be a situation of food shortage. Boserup's proposition cannot be generalized in LDCs like Kenya because of the assumption of low technological inputs into agriculture. Under low technological inputs as of present, Kenya will not be able to support and feed even its own present population.

Boserup (1965) further argued that demographic pressure may have been a factor in the transition from the pre-agricultural stage to the agricultural modernization and is the result of overall technological, economic and social changes which are unlikely to take place unless the community is exposed to demographic pressure. Such studies fall short with regard to generalizing problems to the world regions without taking account of the differentials in these regions.

The demographic changes in LDCs are so rapid that evolution of technologies may not keep pace with the population growth, this is worsened by lack of capital to import these technologies.

Sen (1976) when addressing United Nations Commission on food and population said that there seems to be less complacency today about the social and political consequences of birth rates which progressively exceeds death rates and widen the gap between food supplies and population in areas of the world where hunger and malnutrition prevails in a wide scale. Africa in the 1980s is facing a critical economic and socio-political problems due to rapid rate of population growth at the time of falling food productivity. Africa's home grown food supplies have decreased by more than 10% making the continent's food crisis one of the biggest development problems int he world (FAO, 1982).

In the past decade Africa's population growth rate was 3% per annum, while the food production grew at less than 2% annually. (UN,1977). Between 1970 and 1974, Africa was the only region that indicated a population growth that exceeded food production growth of 2.7% and 0.7%, respectively (United Nations, 1984). In 1980, FAO projections revealed that the annual demand for cereals and pulses will continue to exceed production in africa (UN 1984)

The rapid rate of growth of urban centres in LDCs has had serious implications on food production because the inhabitants of these centres are merely consumers and depend on food supplies from the rural areas whose production is already decreasing. The annual urban growth increased from 3.2% to 6.4% between 1970 and 1975 in LDCs compared to the increase from 1.4% to 2.3% between the same period (United Nations, 1977). By 1975, Kenya had an urban growth of 3% per annum. The increasing income and the employment opportunities in the urban centres has contributed to the flow of rural-urban migration which has worsen the urban food demand.

1.7.1 KENYA

Kenya is among the LDCs of the world with the highest annual population growth. This has emerged as an important social and economic constraints of Kenya's development efforts. Whether or not sustainable agricultural development is achieved in Kenya will depend on whether the full food production potential is realized and fully exploited for the benefit of the population. Since the agricultural technique will remain the same or will improve a little in some regions of the country, food situation will become increasingly severe by the end of the century because of the large number of mouths to be fed and the drop in the yields

Sessional Paper No. 4 of 1981 on National Food Policy which was approved by the country's parliament tries to look at the prospects of increasing the production of individual crops (Kenya, 1981). According to the report, approximately 940,000 additional hectares of maize will be required to produce additional maize to meet domestic requirements in 1989. In the face of the projected expansion of maize hectarages, the question of continued land availability must be raised. To be self-sufficient in maize and beans, the production capacity needs to expand by 4.9% and 10.5%, respectively, from 1980. (Kenya, 1981)

According to the Development Plan of 1984 to 1988, production of major food items in Kenya has increased considerably. However, this does not mean that every family in various regions of the country is adequately fed. There are differentials in nutrients intake in many regions of the country due to poverty, inefficiency in food production due to poor method of production or climatic conditions. The Kenyan environmental life support system in the limited agricultural heartland of high and medium potential areas is already far stretched and signs of imminent dangers are already apparent table 1.12 (Ominde, 1988). These include severe environmental stresses leading to loss of soil and forest cover, declining yields and dangers of food shortages. A recent study by Mukasa, (1985) has forecast serious deficits of the availability of staple maize crop by the year 2000. Although a few of the provinces will still have a maize surplus, Kenya

will increasingly rely on huge imports of maize to meet its basic needs.

Kibiego (1988), observed differentials in supply and demand for maize and beans. She revealed that Rift Valley produces more maize than its population can consume, while Eastern province produces more beans than the demand. At the Coast province and Nyanza province there is a situation of high demand for maize and beans while Central province has a shortage in maize but surplus beans. She observed that the demand for maize in all the provinces increases every year as the population changes, but the production (supply) does not follow the same trend. For example the production (supply) of maize in Central province seems to be fixed.

The imbalance between population growth and food production in Kenya can be blamed on the control of land system. Bondestand and Berston, (1981), stressed that population pressure on land in Kenya has less to do with high birth rates but more with uneven ownership of land and lack of peasant control over their produce. The big hands are always interested in increasing production while the small land owners do not produce enough surplus to invest in the improvement of their land.

Ominde (1975), used the ratio of arable land to population and observed that there is scarcity of agricultural land in the well populated districts of Nyanza, Western and Central provinces, but districts like Lamu, Tana River, Laikipia and Samburu have relatively open land of poor quality. Ominde

(1981), observed that although there are still policy options that will enable agriculture to contribute to the basic needs and development needs of the country as a whole, the problem of rapid population growth in the rural areas must be faced. He stated that Kenya must give an urgent attention to the modernization of the rate of population growth and eventual stabilization of the population as a permanent solution to the threat of declining living standards.

Mureithi and Otieno (1975), stressed that there is a likely imbalance in the next decade between agricultural production and population growth in Kenya. They suggested that the problem can be solved either from the demand side by reducing increases in consumers (population growth) or from the supply side by increasing agricultural production. To arrive at such solutions in a LDCs like Kenya is rather complex and takes a longer period, since the majority of Kenyan population have not accepted to limit their family size. Although, the Kenya Fertility Survey, (1977/78) and the Kenya Contraceptive Prevalence Survey, (1984) estimated a decline in the desired family size from 7.2 children to 6.2 children, such a mean family size is still high compared to 2.3 children in Japan where the fertility is low. Increase in agricultural productivity in Kenya is difficult because of the increasing population density (pressure) in the high and medium potential agricultural land. Kenya is, therefore, classified among the countries which will be in the "Critical List" by the year 2000 due to low technological input in agriculture (FAO, 1982).

To increase the agricultural production in Kenya there is need to research into the determinants of population growth and asses the land carrying capacity with special attention paid to dry land research, dry farming methods, and the optimal land use plans and strategies. This is illustrated with government creation of the Ministry of Reclamation and Development of Arid, Semi-arid and wastelands.

1.8 THEORETICAL FRAMEWORK

The impact of Population growth on the food production per capita can be tested under the economic-demographic model set by FAO. The primary function of the model is to measure the indirect effect of changes in economic and demographic enviroment. The model is usually applied when policy makers are intrested on the interaction ans spillover effects of the policy control variables they command (Yotopoulos, 1978).

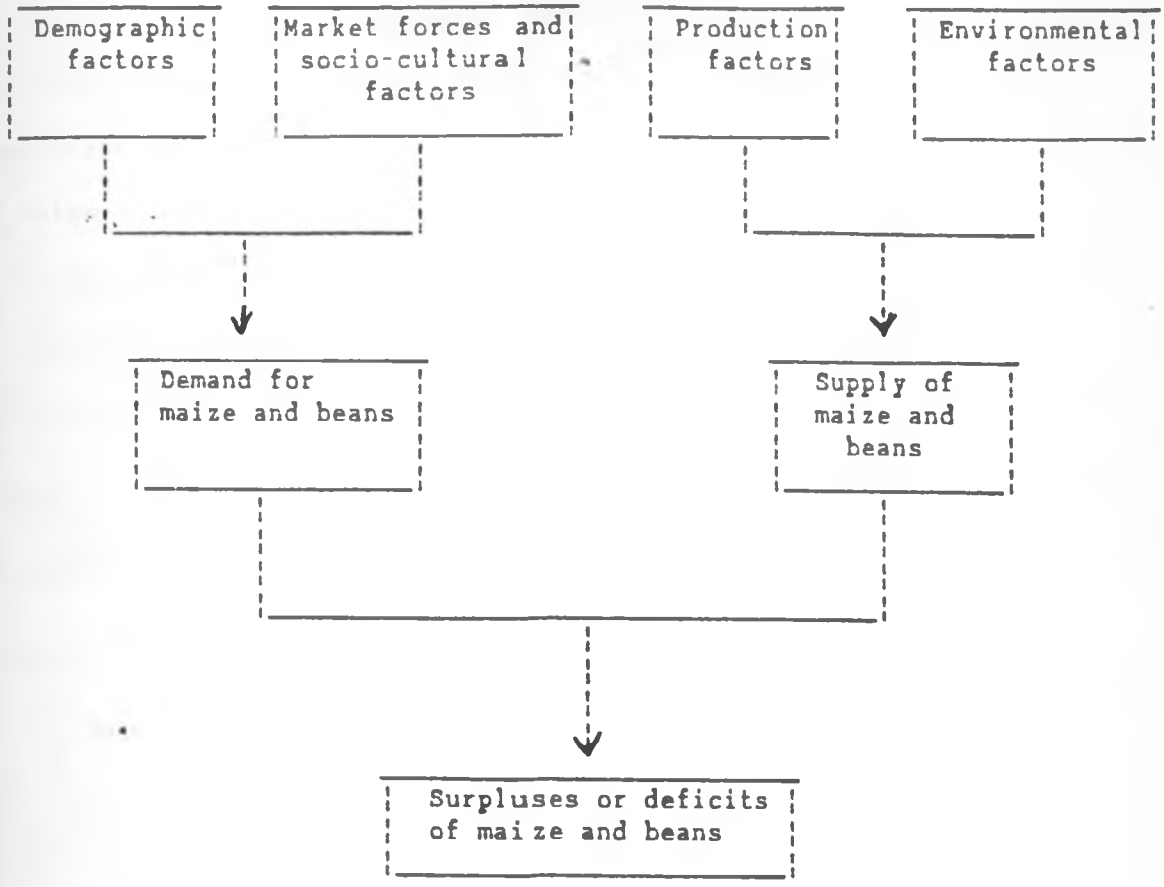
The model requires data on each households, hosehold composition, fertility of the women in the reproductive age, farm mangement survey and the consumption behavior of the hosehold level by making operational the concept of full-expenditure income. However, when a direct impact of the population growth are needed to construct a development plan no economic-demographic model set by FAO is required (Yotopoulos op cit).

This study attempts to test the direct impact of population growth on the maize and beans production per capita (supply). Therefore the FAO economic-demographic model is not applicable. The study is based on Boserup's theory which stipulated that high population growth automatically means high food production per capita. In her theory, she tried to find out

if there could be a situation of food shortage brought about by high population growth. Boserup proposition will be tested on Kenya situation at district level by relating maize and beans production to population growth (total population) between 1980 to 2000. The contention of the study is that Kenya is having a limited high and medium potential arable land, but is experiencing rapid population growth. Maize and beans demand and supply will be compared to find out if shortages exist in these districts.

The theoretical formaulation of the study is that demographic, production, environmental, market forces and socio-cultural factors affect maize and beans production per capita.

1.9 CONCEPTUAL MODEL:



Source: Developed by the author.

Conceptually, the model shows how the interactions between the factors brings about supply and demand for maize and beans. The interaction between production and environmental factors bring about the supply, while the interaction between demographic, market forces and socio-cultural gives the demand.

This study is based on the above model. However, due to lack of reliable data on the production and environmental factors their interactions was represented by time. To arrive at the demand for maize and beans in this study, only the total population was considered. The contributions of the

market forces and the socio-cultural factors towards the demand was not conisdered because of lack of such data.

1.10 CONCEPTUAL HYPOTHESIS

From the above conceptual model the following conceptual hypothesis are drived.-

1. Maize and beans production per capita is affected by demographic factors (e.g. fertility, mortality, migration, population size age structure etc) in any region.

2. Maize and beans production per capita is affected by market and socio-cultural forces in any region.

3. Maize and beans production per capita is affected by production factors (e.g. labour, land and capital) in any region.

4. Maize and beans production per capita is affected by environmental factors (e.g. rainfall, humidity, temperature, drought deafforestation etc) in any region.

1.11 OPERATIONAL HYPOTHESIS

In this study some hypothesis have been formulated to explain the balance between the de.and and supply of maize and beans and the relationship between population density and some selected maize and beans production variables. It is hypothesised that:-

1. The high population growth rate will cause an imbalance between the demand and supply of maize and beans during the period 1980 to 2000 at the district levels.
2. The total amount of maize and beans produced per 1000 population will have impact on pupulation density at district levels.
3. The total area under maize and beans at district level will have impact on pupulation density.
4. The total yield per hectare of land under maize and beans at district level will have impact on pupulation density.

CHAPTER TWO

DATA SOURCE AND METHODOLOGY

2.1 Introduction

In this chapter, we deal with the methods that were used for data collection, quality and analysis. The methodology applied in the study is mainly projections. Projection is a statistical extrapolation which is the logical consequence of extending into the future the mathematical operation of fitting a line of trend to past data.

Projections indicates what would be the expected course of events if the same conditions that affected the series of data in the past prevail in the future. In general usage, the word projections includes modifications in the trend resulting from changes introduced in the assumptions at particular points in time. Projections are principally used in economic and social planning.

Population projections are relatively simple[1] calculation based on assumption about trends in fertility, mortality and migration. The projections can be prepared for total population of a nation, administrative division or specific localities within it. The usefulness of the results of projections depends ultimately on the quality and availability of accurate population data for the base period distributed by age and sex.

2.2 RELEVANCE OF POPULATION PROJECTIONS TO FOOD DEMAND

Growth of food demand is determined by population growth. An increase in population would automatically increase the demand for food. However, the rate of increase of demand for food also depends on other factors like changes in the consumption patterns. The age composition of the population and the population size affects food demand since different age groups require different calories and proteins. If the proportions of the young children in the total population is increasing, this would affect, the caloric - protein requirements in the population.

2.3 THE SOURCE OF DATA

The study used secondary data that were obtained from the GoK Publications, which included the Kenya population censuses of 1969 and 1979, the Ministry of Agriculture district annual reports and the Statistical Abstracts 1980.

2.4 TYPE OF DATA AND METHOD OF DATA COLLECTION

The food statistics data that were used in the study were those collected by the Ministry of Agriculture field staff. The field staff, compiles the information on the hectarages, yields and the production of both food and industrial crops from the locations. These are then compiled to give the district data. This information is then sent to Ministry of Agriculture headquarters on annual basis.

Both 1969 and 1979 censuses, were conducted by canvasser

method. The list of all the persons present in the household or other living quarters at the night of the census stayed in the household. The schedules were completed by the enumerators on the basis of the answers given by the respondents who were in most cases heads of the households.

2.5 QUALITY OF DATA

Data on food crops (maize and beans) that were obtained from the Ministry of Agriculture had gaps due to missing of data. As such, interpolation techniques were used for the years without the data. This is not justifiable as in the case of population data because there are no consistent changes in the trend of production. Such estimates are, therefore, approximations. The population data used in the study are affected by over and under-enumeration, coverage and content errors, age mis-statement and misreporting. The data was corrected for under and over-enumeration of young children (Kenya, 1979 and 1981). The corrected figures for the census date were then updated to June 30, 1980 by a pro-rata increase of 3.3 per cent. .pa

2.6 TECHNIQUES OF ANALYSIS

The study is organized in such a way that its major thrust is analytic. As stated earlier in this chapter,the methodology applied in this thesis involve projections. The demographic, agriculture and consumption (demand) projections techniques

were applied.

2.6.1 POPULATION PROJECTIONS

The population was projected based on different assumptions about fertility and mortality. Fertility and mortality trends in Kenya and here districts have been discussed in details in chapter one. The district level projections were done from the period from 1980 to the year 2000. The 1980 population by age group and sex which forms the starting point of the projections was based on the population enumerated in the census held in August 1979. The 1979 census figures were updated to 30 June 1980. Two sets of district level projections were made based on constant fertility and mortality and on constant fertility and declining mortality levels between 1980 and the year 2000.

2.6.1.1 POPULATION PROJECTIONS BASED ON CONSTANT FERTILITY AND MORTALITY LEVELS 1980 - 2000: SET I

The set I projections in this study was adopted from population projection for Kenya 1980 - 2000. The projections were based on the "ratio method". The ratio method catered for internal migration in the country. The calculations for the district level projections were based on the changes during the 10 years between 1969 and 1979. They incorporates the migration patterns. The net changes during this period, a

result of the natural growth rates and migration rates were projected into the future.

To arrive at the distribution of population by use of "ratio method", the percentage distribution of the population to the total (National or Provincial) by size or age structure in each district as revealed in the 1969 and 1979 censuses were computed. One-tenth of the difference between the percentage distribution for each district was the basis of the annual change. Projections of the population say 6 years from 1979 is estimated by adding the percentage population in each district (1979) to the product of six times the annual change. The resulting percentage of each district population in the total of Kenya or province is reduced to absolute numbers from aggregate.

2.6.1.2 POPULATION PROJECTIONS BASED ON THE ASSUMPTION OF CONSTANT FERTILITY LEVELS BUT DECLINING MORTALITY 1980 - 2000 SET II

The standard method used was component methods. The age - sex distribution of the initial population was used as the base. The estimates of the future populations were arrived at by applying age and sex specific fertility, mortality and migration rates to each sub-group of the population. The specific birth rates were applied to women only and children were separated into males and females to give linkage between the population of the two sexes and allow for the losses from

first age groups largely by deaths. The life expectancy at birth was projected to improve by 0.3%, 0.4%, 0.5%, and 0.6%, in the period 1981-1985, 1986-1990, and 1996-2000.

The method offers a more realistic approach of estimating growth of population because changes in the rates of fertility, mortality and migration can be postulated in the model - Migration is incorporated in the model by assuming that all migrations takes place at the end of each projections period so that migrants are not influenced by fertility and mortality rates prevailing at the place of destination (Kpedekpo, 1982). It was also assumed that the age specific net migrations estimated in 1979 will remain constant between 1980 and the year 2000.

2.6.1.3 COMPUTATIONAL PROCEDURES

(1) Total female births = E faPa

where:

fa = Age specific birth rates of the base year.

Pa = Female population in the five - year age group.

(2) Expected number of female births in the future years

$$= E\ fa\ {}^{P}Pa$$

Where

$${}^{P}Pa = {}_{n}S_{x}.Pa$$

${}^{P}Pa$ = Projected female population

${}_{n}S_{x}$ = Female survival ratio between age x and x+n obtained from Coale and Demery life table

(3) Projected number of total births

$$\frac{5(B^{x} + B^{x+5})}{2}$$

Where

B^{x} = Total number of births in year x

B^{x+5} = Total number of births in year x + 5

(4) Projected female births = $\frac{5K(B^{x} + B^{x+5})}{2}$

K = The proportion of female births to total birth

(5) Projected female population $= \frac{5(B^x + B^{x+5})}{2} \; {}_nS_x$

(6) Projected female population including migration of the projection period

$$\frac{5K(B^x + B^{x+5})}{2} \; {}_nS_x - \frac{5K(B^x + B^{x+5})}{2} \; {}_nS_x \cdot ASMR.$$

$$= \frac{5K(B^x + B^{x+5})}{2} \; {}_nS_x \; [1 - ASMR]$$

Where

ASMR = Age specific migration rate.

The procedure for projecting the male population is similar to that of female population except in three respects. First, the survival ratio used in Step 1 are for male population. Secondly, the total births is multiplied by a factor representing the proportion of male births to the total births. Thirdly, the age specific migration rates used in step 6 are for the male population.

(7) The respective sets of projections were then added to obtain the projections for the total population.

Table 7.2: Calculation of Projections of Female Population of Kiambu District by Age (1980 5)

Age Group Years	Population 1980	Survival Ratio 1980/85	Projected Population 1985	Age Specific Net migration Rate	Age Specific Net Migrants	Projected Population 1985 Including Migration
Births	83333	0.9535	106704			
0 4	75741	0.9844	79450			79454
5 9	62847	0.9948	74559	0.002125	150	74717
10 14	53814	0.9941	62520	0.018	1125	61395
15 19	37381	0.9914	52701	0.01349	711	51990
20 24	28357	0.9896	37960	0.004000	149	37709
25 29	22938	0.9884	28052	0.012589	353	28405
30 34	18612	0.9860	22672	0.007854	168	22832
35 39	1405	0.9841	18366	0.003145	58	18424
40 44	11941	0.9788	15760	0.010311	163	15923
45 49	9135	0.9788	11600	0.011542	135	11823
50 54	7144	0.9778	8861	0.003238	29	8890
55 59	6610	0.9351	6837	0.000557	59	6896
60 64	4904	0.8971	6181	0.019637	121	6302
65 69	4600	0.8345	4471	0.01222	55	4416
70 74	3379	0.7522	3912	0.12619	494	3418
75+	3379	0.4805	4117			4117
Total	435081		544762		1000	447462

Source: Compiled by the author based on 1979 Census Data

This method is used to project the population by five - year age group and sex for all other districts up to the year 2000.

2.6.2 PRODUCTION PROJECTIONS

Domestic production of maize and beans were projected on the basis of the assessment of the trends in the area under maize and beans and the yields. The statistical extrapolation of the area under maize and beans and the yield per hectare was based on the linear function with time as an explanatory variable. The following is the model that was used to project both the area under maize and beans and the yields.

(i) $A_t = a + bt$

Where

A_t - is the area under maize or beans

a - a constant

b - Coefficient to be estimated

t - time variable

(ii) $Y_t = a + bt$

Y_t - Is the yield per hectare for maize or beans.

The projected production Q_{t+n} has been calculated from the formula

$$Q_{t+n} = A_{t+n} \cdot Y_{t+n}$$

A_{t+n} - the corresponding projected area under maize or beans.

Y_{t+n} - Projected yield per hectare of maize or beans.

The model assumes, the production will increase in constant amount each time, and that time is zero at the base year but increases by one each successive period.

2.6.3 MAIZE AND BEANS CONSUMPTION (DEMAND) PROJECTIONS

The consupmption (demand) projections were done on the basis of population size. It was assumed that a 10% increase in population would result into a 10% increase in the consumption (demand). Two alternative consumption (demand) projections were made referred to in the thesis as set I and set II. Set I projections were based on the recommended diet in Eastern Africa where the staple food is grains and pulses. Set II, was based on the Required Daily Allowance (RDA) to meet the minimum caloric requirements per adult- equivalent.

2.6.3.1 SET I: MAIZE AND BEANS CONSUMPTION (DEMAND) PROJECTION 1980 - 2000

Kenya and its districts was assumed to follow consumption standards recommended in Eastern Africa where the staple food is grains and pulses. The consumption (demand) is estimated to the year 2000

Table 2.3: Recommended diet in Eastern Africa where the staple food is grains and pulses

Age group	Grains (Cereals: Maize, millet) gms	Pulses (peas, beans, grams)	Oil (groundnuts, Simsim) gms
0 - 5 months	0	0	0
6 - 12 months	227	0	0
1 - 5 years	369	114	142
6 - 15 years	268	159	207
15 - 45 years	824	28	37
45+ years	511	37	45

Source: Republic of Kenya: Nutrition in Eastern Africa, a manual for teachers and others: (Nairobi, Ministry of Health, 1976) P. 63.

Note: The age groups 0-4, 5-9, 10-14, 15-19 .... etc. was split into single years using sprague interpolation formula.

Table 2.4: Methodology of Calculation of Maize and beans (consumption) according to age group for Kiambu 1985

Age group	Total Population 1985	Grams/day for different age groups	Kg/day for different age groups
1	2	3	4
1 - 5 years	174937	369	64552
6 - 15 years	272580	268	73051
15 - 45 years	321796	824	265160
45+ years	99187	511	50685
Total consumption (demand)			453448kg/day

Source: Compiled by the author

Note:

Infants under age 1 year were excluded. It was assumed that infants do not consume much of these crops or if they do, then it is minimal. The infants were estimated by splitting the population in the 0 - 4 age group by sprague interpolation formular then subtracted from the total population.

Table 2:4 shows that 453448 kg, per day of maize was consumed in Kiambu in 1985. Considering the whole year, 1985, the total amount of maize consumed was (453448 x 365)/1000 which is 165509 tons, an average of 193kg per person per year. This method is used when projecting maize consumption (demand) upto the year 2000, beans consumption (demand) is projected in similar way, except the number of grams per day in column 3 is the standard recommended for pulses.

2.6.3.2 SET II: MAIZE AND BEANS CONSUMPTION (DEMAND) PROJECTIONS 1980 - 2000

A typical diet of maize and beans was assumed to provide the minimum daily nutrients requirements. Table 2.5 shows the quantities of these commodities comprising the diet. This standard diet was applied on regional basis assuming that all the districts take the same diet and that the price and taste of these commodities remains the same between 1980 and the year 2000.

A working person in Kenya was assumed to have an average body weight. The RDA of energy (calories) was then set at 2250 per adult - equivalent. It was then assumed that the RDA of other nutrients would be met if the energy requirements were met from (maize and beans), (Anzangi and Bernard, 1977).

Table 2.5: Regional Calculation of Diet Required to meet minimum caloric requirements per adult-equivalent -

Type of Food	% of diet[a]	Required calories per day per adult	calories per kg. conversion Factor[c]	Required Daily Amount in Kg.	Required Annual Amount in Kg.
Maize	70	1,575	3,200	0.49	179.65
Beans	30	675	3,200	0.21	77.00
Total	100	2,250[b]			

[a]By assumptions stated in chapter I.

[b]Caloric requirements based on Anzangi and Bernard.

[c]Caloric converstion based on Anzangi and Bernard.

Source: Anzangi and Bernard: Population Pressure in Kenya: a Preliminary Report: 1977

The required annual amount in Kg was multiplied by total population in each district in five - year intervals to the year 2000. This was then converted to tonnes by dividing the total annual requirements in Kg. by 1000.

2.7 RELATIONSHIP BETWEEN POPULATION DENSITY AND MAIZE AND PRODUCTION VARIABLES

Multiple regression model was used with population density as a dependent variable and total amount of maize and beans produced per 1000 population, total area under maize and beans and total yields per hectare of maize and beans as independent variables.

A linear structural equation that represents the hypothetical relationship that underlined the regression model is written as

$$Y_t = Bo + B_{1t}X_{1t} + B_{2t}X_{2t} + B_{3t}X_{3t} + e_t \quad t = 1, 2, 3.$$

Where

Y_t - population density

(X_{1t}, X_{2t}, X_{3t}) are the explanatory variables (Total maize and beans produced 1000 persons, Total area under maize and beans and yield per hectare of maize and beans).

B_i - regression coefficients

e_t - error terms (assumed to be normally distributed and independent.

For n observations (n = 33 districts) the model under considerations then becomes

$$\begin{vmatrix} Y_1 \\ Y_2 \\ Y_3 \\ \vdots \\ Y_n \end{vmatrix} = \begin{vmatrix} 1 \\ 1 \\ 1 \\ \vdots \\ 1 \end{vmatrix} + B_1 \begin{vmatrix} X_{11} \\ X_{12} \\ \vdots \\ X_{12} \end{vmatrix} + B_2 \begin{vmatrix} X_{21} \\ X_{12} \\ \vdots \\ X_{2n} \end{vmatrix} + B_3 \begin{vmatrix} X_{31} \\ X_{32} \\ \vdots \\ X_{3n} \end{vmatrix} + \begin{vmatrix} e_1 \\ e_2 \\ \vdots \\ e_n \end{vmatrix}$$

By using OLS method one can compute for each value "Y" regression curve corresponding to each explanatory variable.

Multiple regression analysis gives the values of the estimates of the regression weights and also their standard errors. Hence, predicted criterion ("Y") can be obtained and the relationship between the predicted value gives us multiple correlation coefficients R.

This is obtained from the relation

$$R^2 = 1 - \frac{E\,(Y_1 - \hat{Y}_i)^2}{E\,(Y_i - \bar{Y})^2}$$

R^2 - coefficient of determination

$$\hat{Y}_t = \hat{B}o + \hat{B}_1 X_{1t} + \hat{B}_2 X_{2t} + \hat{B}_3 X_{3t}$$

2.7.1 TESTING SIGNIFICANCE

The significance of multiple correlation may be tested by calculating a variance ratio (F), F - ratio is defined as the ratio of predicted to non-predicted variance. The predicted variance has degree of freedom r and non-predicted has a degree of freedon n-r-1. The F, ratio is therefore, of the form

$$F_r^{n-r-1} = \frac{R^2}{r} \Big/ \frac{1 - R^2}{n-r-1}$$

F distribution is used for ,testing the quality of two estimated variances. The F-test suggest that there exists a relationship between multivariate analysis of variance and multiple regression method.

2.7.2 LIMITATIONS OF THE TECHNIQUES USED IN THE ANALYSIS

Though the various techniques have been found to produce plausible results, it should be noted that they have their own limitations. As noted earlier in the study, techniques have their own weakness which might lower the quality or validity of the results so obtained in the analysis.

The population projection techniques applied in the analysis assumed constant migration rates to the year 2000.Set 11 projection assumed that migration takes place at the end of the projection period. It is difficult to ascertain from this assumption what would happen to those migrants before the projection period. Set 11 projection applied in the analysis assumes that a decline in mortlity happens uniformly throughout the districts. This assumption may not be realistic due to differential decline among the districts with the province. The total population obtained from this analysis may be an over-estimate.

The production projection based on the past trends of area and yield of land under maize and beans assumed favourable agricultural conditions, absence of hostilities and peasant destabilization. It is difficult to determine what the production would be in case of certain catastrophe such as drought,since it does not consider other factors of production such as temperature, rainfall, humidity, soil type etc. The technique simply uses time as a proxy to represent these factors.

The assumption that Kenya follows the recommended diet in Eastern Africa where the stable food is grains and pulse may not be realistic, because not all ethic groups follow the same level. It was also difficault to determine how much calories (energy) is contributed by the grains and pulse apart from maize and beans. The second technique of consumption projection based on required daily allowance to meet the minimum caloric requirements per adult-equivalent refered to as Set 11 tends to over-estimate the nutritional requirement by ignoring the intra-individual and inter-individual differences. This may have resulted into higher deficits or surpluses given in this thesis under set 11.

CHAPTER THREE

ANALYSIS AND RESULTS

3.1 PROJECTIONS, DISTRICT LEVEL ANALYSIS OF MAIZE AND BEANS PRODUCTION (SUPPLY) AND CONSUMPTION (DEMAND) COMPARED 1980- 2000 AND ESTIMATION OF THE RELATIONSHIP BETWEEN POPULATION DENSITY AND PRODUCTION VARIABLES.

The purpose of this chapter is to discuss in details, various projections and to compare the production (supply) and consumption (demand) of maize and beans to the year 2000. The chapter is divided into five sections. First section analyses the man-land ratio (all land) and the population pressure on the high/medium potential agricultural land. The second part discusses projections of population and of (maize and beans) in order to help project future annual growth rates and the demand of each crop. The third section compare consumption (demand) and supply under different assumptions of fertility and mortality levels. The Fourth section discusses maize and beans availability by the year 2000. Lastly, the relationship between population density with total amount of maize and beans produced per 1000 population, total area under maize and beans and the total yield of land under maize and beans based on 1979 population and food data are discussed.

3.2 Projected man-land ratio (all land) and the pressure on high / medium potential agriculturel land by districts by the year 2000.

Appendix 1, table 1V and appendix 11 tables 1a, 1b, 11a and 11b show projected per capita land availabilty in various districts and the population pressure on high/medium potential agricultural lands in the same districts. The heavily populated as well as cultivated regions have less than 7 hectares (all land) per head of population or less. The country's potential supporting capacity would, therefore, be very critical by the end of the century due to low technological inputs in agriculture. The country and its districts would not be able to support and feed the population if fertility rates remains high. It is only the pastoral districts such as Samburu, Narok e.t.c which would still have enough land (all land) that can relieve population pressure.

The projected population density in the high/medium potential agricultural land by the year 2000 is alarming (appendix 11, table 1a and 11a). The heavily populated as well as cultivated districts such as Kiambu, Muranga, Kisii and Kakamega, among others, have population density on high/medium potential agricultural land and ranging from 402 to 947 persons per km^2.

The situation in the pastoral districts would still be promising with the density ranging from 67 and 100 person km^2 in Narok and Samburu districts.

3.3 Projected population, maize and beans production (supply) by the year 2000.

Appendix 1 (tables 1 and 11), appendix 11 (tables 111a and 111b) show projected total population based on different assumptions about fertility and mortality levels, projected maize and beans production (supply) based on past trend in area and yield of land under maize and beans. The annual population growth rate is higher than the annual maize and beans production growth rate between 1980 to the year 2000. Some districts show higher production growth rate, but produces less than their requirements quantitatively.

The annual production rate of maize and beans varies from one district to another with some districts indicating negative rates, for example South Nyanza - 3.6% per annum (maize), Taita-Taveta - 2.1% per annum (beans). A general look across the districts show that Eastern Province districts will have fairly high beans production while Rift-Valley districts will produce more of maize followed by Western Province districts.

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3.4 MAIZE AND BEANS PRODUCTION (SUPPLY) AND CONSUMPTION (DEMAND) COMPARED:

DISTRICT LEVEL ANALYSIS 1980 - 2000

KIAMBU DISTRICT

Table 3.4a: Projected maize production (supply) and consumption (demand)

Year	Maize Production (Tons)	Maize Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	54,748	133,761	126,468	-79,013	-71,720
1985	74,995	165,509	154,320	-90,514	-79,325
1990	106,896	207,760	188,550	-100,514	-81,654
1995	144,181	257,143	2303,382	-112,962	-86,201
2000	186,865	315,724	281,625	-128,859	-94,760

Source: Compiled by the author

Table 3.4b: Projected beans production (supply) and consumption (demand)

Year	Beans Production (Tons)	Beans Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	6,140	19,926	54,100	-13,786	-47,960
1985	10,135	24,534	66,015	-14,399	-55,880
1990	16,053	30,184	80,657	-14,131	-64,604
1995	23,006	37,012	98,552	-14,006	-75,546
2000	30,991	45,183	120,473	-14,192	-89,482

Source: Compiled by the author

Tables 3.4a and 3.4b show that Kiambu will have a deficit in both maize and beans by the year 2000. Maize and beans production is projected to increase at the rate of 6.1% and 8.1%, respectively, while the consumption rate is projected at 4.3% per annum between 1980 to the year 2000. From the analysis the production rates seem higher than the consumption rate during the same period of time, however, the amount produced will be much lower than the districts domestic requirements. For example, the district will produce 186,865 tons of maize and 30,991 tons of beans, but will require over 315,724 and 302,999 tons of maize and 120,473 and 129,616 tons of beans depending on the assumption about fertility and mortality levels by the year 2000. The district will, therefore, have a deficit of 94,760 tons of maize and 14192 tons of beans.

KIRINYAGA DISTRICT

Table 3.5a: Projected maize production (supply) and consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	53,196	57,786	53,494	-4,590	-298
1985	62,094	69,268	64,103	-7,174	-2,009
1990	72,244	83,627	76,910	-11,383	-4,666
1995	81,314	100,799	92,395	-19,485	-11,081
2000	89,304	121,610	111,080	-32,306	-21,776

Source: Compiled by the author

Table 3.5b: Projected beans production (supply) and consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	11,682	8,826	22,889	+2,856	-11,202
1985	15,638	10,615	27,422	+5,023	-11,784
1990	20,489	12,663	32,901	+7,826	-12,412
1995	25,236	15,183	39,524	+10,053	-14,288
2000	27,878	18,211	47,518	+11,667	-17,640

Source: Compiled by the author

Kirinyaga district will not meet its domestic maize requirements throughout to the year 2000 but will have sufficient beans (set1). Maize and beans production will grow at projected rates of 2.6% and 4.7% respectively from 1980. The consumption will however, increase at a projected rate of 3.3% and 4.8% per annum depending on the assumptions about fertility and mortality levels.

The district will produce 89,304 and 27,878 tons of maize and beans by the year 2000, but will require over 111,080 and 18,211 tons of maize and beans respectively. The district will, therefore, have deficits of over 21,776 tons of maize and a surplus of 11,667 tons of beans (set1)

MURANGA DISTRICT

Table 3.6a: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	59575	143617	119153	-84042	-59578
1985	69073	176014	145724	-106941	-76651
1990	80373	216150	174800	-135778	-98024
1995	90441	265931	219094	-175490	-128653
2000	99276	327008	268639	-22732	-169363

Source: Compiled by the author

Table 3.6b: Projected Beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	14202	20387	50917	-6185	-36715
1985	19107	24414	62337	-5307	-19107
1990	25813	28432	76316	-2619	-50503
1995	33157	36733	93724	-3576	-60567
2000	41138	44652	114918	-3514	-73780

Source: Compiled by the author

The annual growth rate of maize and beans production from 1980 is projected at 2.6% and 5.3%, respectively, while the consumption (demand) rate is projected at 3.7% and 4.3% depending on the assumptions about fertility and mortality levels.

The district will produce a projected amount of 99276 tons (maize) and 41138 tons (beans) but will required over 268639 and 114918 tons of maize and beans. The district will therefore have a deficit of over 169363 and 73780 tons of maize and beans by the year 2000.

NYANDARUA DISTRICT

Table 3.7a: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	32252	44452	42615	-12200	-10362
1985	36628	53019	50816	-16391	-14188
1990	41942	63248	60656	-21306	-18714
1995	47081	76285	72413	-29204	-25332
2000	52042	91432	86486	-39385	-34439

Source: Compiled by the author

Table 3.7b: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	3437	7442	18230	-4005	-14793
1985	4481	8904	21788	-4423	-17257
1990	10867	10788	25947	+79	-15257
1995	15200	12601	30977	+2599	-15777
2000	19680	15026	36997	+4654	-17317

Source: Compiled by the author

The demand (consumption) of maize is projected to be higher than the production throughout the years under study. Beans consumption on the other hand is projected higher than the production from 1980 to 1985, but starts to decline below the production level from 1990 to the year 2000 (set 1). Tables 3.7a and 3.7b show that production of both maize and beans is projected to increase at 2.4% and 8.7% per annum while the consumption increase at about 3.6% during the same period when constant fertillity and mortality levels are assumed and at 4.5% per annum when the fertility is assumed constant and the mortality level gradually declines.

The district is projected to produce about 52047 tons (maize) 19680 tons (beans) by the year 2000, but will require over 91432 tons (maize) and 36997 tons (beans) when constant fertility and mortality levels are assumed, and 113919 tons (maize) and 48732 tons (beans) when declining motality level is assumed.

NYERI DISTRICT

Table 3.8a: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	37917	93587	89592	-55661	-51675
1985	44475	113708	107462	-69233	-62987
1990	52200	130977	129064	-78777	-76864
1995	59402	164861	154297	-105459	-9489
2000	66080	169076	186490	-102996	-120410

Source: Compiled by the author

Table 3.8b: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	13694	15707	38325	-2013	-24631
1985	15267	18288	459706	-3021	-30703
1990	16109	21505	55211	-5396	-39102
1995	18835	26064	66005	-7229	-47170
2000	20438	30635	79776	-10197	-59338

Source: Compiled by the author

Tables 3.8a and 3.8b show that Nyeri district by the year 2000 will have a deficit of over 120, 410 tons (maize) and 59,338 (beans) under constant fertility and mortality levels, and 194866 tons (maize) and 91188 tons (beans) under gradual decline in the mortality level.

The annual rate of increase of both maize and beans is estimated at 2.8% and 2.0% per annum repectively, while the consumption of both is projected at 3.7% per annum. The district is thus expected to produce about 66080 tons (maize) and 20438 tons (beans), but will require over 186490 tons and 79776 of maize and beans under 260945 tons (maize) and 111626 tons (beans) with gradual decline in mortality level is assumed.

KILIFI DISTRICT

Table 3.9a: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	24017	103511	792625	-79494	-55245
1985	42212	109682	96414	-67470	-54202
1990	70795	134436	117434	-63641	-46639
1995	105428	164412	143046	-58984	-37618
2000	147428	201194	174333	-53766	-26905

Source: Compiled by the author

Table 3.9b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
	Set1	Set2	Set1	Set2	
1980	2810	11952	33907	-9142	-31097
1985	6362	14570	41247	-8208	-34882
1990	10629	17629	50236	-7000	-39607
1995	14702	21418	61192	-6716	-46490
2000	18637	26029	74576	-7392	-53939

Source: Compiled by the author

Tables 3.9a and 3.9b show shortages of both maize and beans in the district throughout the years under consideration. The annual rate of increase of maize and beans production by the year 2000 is projected at 9.1% and 9.5% respectively, while the consumption is projected to increase at 3.9% per annum. The above rates show that the production of both maize and beans is higher than the rate of consumption but quantitatively, the amount produced will be less than the demand. For example, Kilifi district will produce 147,428 tons (maize) and 18,637 tons(beans) but will require over 174,333 tons (maize) and 74,576 tons (beans) when the fertility and mortality levels are assumed constant, and 125,705 tons (maize) and 53,774 tons (beans) when the mortality level is assumed to gradually decline upto 2000.

The district will thus have a deficit of 53,766 tons (maize) and over 55,939 tons (beans).

KWALE DISTRICT

Table 3.10a: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	20460	60469	53155	-40009	-32695
1985	33594	73623	64670	-40029	-31076
1990	51796	90209	78787	-38413	-26991
1995	71982	110371	95672	-38389	-23690
2000	94152	134881	117001	-40729	-22849

Source: Compiled by the author

Table 3.10a:Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	1037	8036	22739	-6999	-21702
1985	2008	9806	27664	-7798	-25656
1990	3190	11876	33704	-8686	-30514
1995	4335	14425	40926	-10090	-36591
2000	5444	17568	50051	-12124	-44607

Source: Compiled by the author

Tables 3.10a and 3.10b show that Kwale district will not be able to meet its domestic demands of maize and beans throughout to the year 2000. The tables further show that the production of both maize and beans is projected to increase at 7.6% and 8.3% per annum, while the consumption of the same is projected to increase at 4.0% per annum. Thus, theoretically, the production rate is higher than the consumption rate, but practically what the district is expected to produce will be much less than its requirements.

The district will for example produce 94152 tons (maize) and 5444 tons (beans), but is projected to require an average of above 117001 tons (maize) and about 17568 tons (beans), when the fertility and mortality levels are assumed to remain the same. When the fertility is assumed to be constant while the mortality gradually declines, the district will require 125705 tons (maize) and 53774 tons (beans).

It can be concluded that the district will have a deficit of over 40729 tons and 44607 tons of maize and beans respectively by the year 2000.

TAITA - TAVETA DISTRICT

Table 3.11a: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	10404	28571	27223	-18169	-16819
1985	16613	35289	32676	-18676	-16063
1990	24916	42741	39267	-17825	-14351
1995	34818	51488	47194	-16670	-12376
2000	46322	62908	56680	-16586	-10358

Source: Compiled by the author

Table 3.11b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	1590	4471	11645	-2881	-10055
1985	1870	5356	13978	-3486	-12108
1990	2205	6390	16798	-4185	-14593
1995	2524	7681	20189	-5157	-17665
2000	2826	8820	24247	-5994	-21421

Source: Compiled by the author

Like Kwale district, Taita-Taveta shows shortages of both maize and beans throughout from 1980 to the year 2000. Tables 3.11a and 3.11b show that production of both maize and beans is projected to increase at 7.5% and 2.9% per annum respectively by the year 2000. The demand (consumption) is projected to increase at a maximum rate of 3.7% per annum during the same period. Though the rate seems higher than the demand especially of maize, the district quantitatively will produce less than its domestic requirements. For example, Taita-Taveta will produce only 46332 tons (maize) and 2826 tons (beans) while it will require about over 56880 tons (maize) and over 8820 tons (beans) by the year 2000 when constant fertility and mortality levels are assumed. When constant fertility but declining mortality levels are assumed, the district will require 59484 tons (maize) and 25446 tons of beans. The district will, therefore, have a shortage of over 10358 tons and 13162 tons of maize and over 5994 tons and 22620 tons of beans according to the different assumptions about ferility and mortality levels.

EMBU DISTRICT

Table 3.12a:Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	36994	52665	48401	-15721	-11457
1985	51539	64897	59624	-13358	-8085
1990	68005	80531	73542	-12526	-5537
1995	82494	99665	90712	-17171	-8218
2000	95006	123416	111945	-28410	-16939

Source: Compiled by the author

Table 3.12b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	20233	7934	20705	+12299	-472
1985	25369	9808	25506	+15561	-137
1990	31812	12028	31459	+19784	+353
1995	38280	14816	38805	+23464	-525
2000	44772	18254	47888	+26518	-3116

Source: Compiled by the author

Tables 3.12a and 3.12b show that maize production in the district is far below the districts' requirements; while beans production will be enough to make the district self-sufficient and still have surplus according to set1 of consumtion projections. The tables show that production of both maize

and beans by the year 2000 is projected to increase at 4.7% per annum and 4.0% per annum respectively, while the consumption rate is projected to increase at 4.3% per annum.

From this study, the analysis shows that the rate of production is higher than the rate of increase in the consumption except for beans. Though the rates are higher especially for maize, the amount of maize projected to be produced by the year 2000 will be less than the districts requirements. The district will produce 95006 tons of maize, but will require over 111945 tons and 147911 tons according to the different assumptions on fertility and mortality levels. Beans on the other hand will be sufficient.

From tables 3.12a and 3.12b, the district will have a deficit of over 28410 tons (maize) and a surplus of 26518 tons of beans when constant fertility and mortality is assumed by the year 2000 and a deficit of 52905 tons and 18501 tons of maize and beans respectively when constant fertility but decline in mortality level is assumed.

ISIOLO DISTRICT

Table 3.13a: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	2573	9719	8007	-7146	-5434
1985	3656	11543	9752	-7887	-6096
1990	4696	15665	12052	-10969	-7356
1995	5380	17599	14799	-12219	-9419
2000	5710	22243	18640	-16533	-12930

Source: Compiled by the author

Table 3.13b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	17.4	1145	3425	-1128	-3405
1985	37.2	1420	4172	-1382	-4135
1990	63.2	1835	5156	-1772	-4993
1995	95.7	2122	6331	-2026	-6235
2000	134.4	2673	7974	-2539	-7840

Source: Compiled by the author

Isiolo is a shortage district in both maize and beans as is shown in tables 3.13a and 3.13b. The tables show that the district will produce a projected amount of maize and beans of 5710 tons and 134 tons respectively by the year 2000, but will require over 18640 tons and 19925 tons of maize and over 2673 tons and 8524 tons of beans according to the different assumptions about fertility and mortality.

Though the production rates of both maize and beans are higher than the consumption rates, that is 4% and 10.2% per annum compared to 3.8% and 3.9% of consumption by the year 2000, the amounts produced will be less than the demand quantitatively. The district will thus have a deficit of over 12930 tons (maize) and 2539 tons of beans when constant fertility and mortality levels are assumed and 14219 tons (maize) and 8390 tons (beans) with gradual decline in mortality level.

KITUI DISTRICT

Table 3.14a: Projected Maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	49056	92099	85576	-43043	-36320
1985	60902	111383	103215	-50481	-42313
1990	73783	13221	124645	-60562	-50862
1995	84524	196543	150544	-112019	-66020
2000	93392	199755	182538	-106363	-89146

Source: Compiled by the author

Table 3.14b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	18327	12518	36608	+5809	-18281
1985	18984	16877	44153	+2107	-23169
1990	19789	20300	53320	-511	-33531
1995	20577	26818	64400	-6241	-43825
2000	21348	29489	78080	-8141	-56732

Source: Compiled by the author

Tables 3.14a and 3.14b show shortages in maize throughout to the year 2000, except for beans from 1980 to 1985. From the tables, the production rates of maize and beans between 1980 and the year 2000 is projected at 3.2% and 0.7% per annum, while the consumption is projected to increase at 4% per annum.

The district will produce 93392 tons (maize) and 21348 tons (beans), but will require over 182538 tons (maize) and 29489 tons of beans when constant fertility and mortality levels are assumed and will require 204222 tons and 87362 tons of maize and beans respectively with gradual decline in mortality level. The district will thus have a deficit of over 89146 tons (maize) and over 8141 tons (beans) by the year 2000.

Table 3.15a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	90729	204038	188702	-113309	-97973
1985	98826	250310	231473	-151484	-132647
1990	109395	254042	284326	-144647	-174931
1995	120463	381140	295669	-260677	-175206
2000	132030	470138	429188	-338108	-297158

Source: Compiled by the author

Table 3.14b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	72317	31008	80722	+41309	-8405
1985	78617	38184	99019	+40433	-20402
1990	86034	49199	121628	+36835	-35594
1995	92942	57239	149581	+35703	-56639
2000	99342	70052	183597	+29290	-84255

Source: Compiled by the author

From the two sets of consumption projections, Machakos district has a shortage of maize through out to the year 2000, but will have enough beans according to set1 projections. Maize and beans production is projected to increase at 1.9% and 1.5% per annum by the year 2000, while the consumption rate is projected at 4.0% during the same

period. The rate of increase of beans production seems lower than that of consumption, but quantitatively the amount produced will be higher than the demand according to set1.

The district will produce 132030 tons of maize and 99342 tons of beans by the year 2000, but will require over 429188 tons of maize and over 70052 tons of beans (set1) during the same period of time. These requirements will leave the district with a deficit of over 297158 (maize) and a surplus of 29290 tons (beans) when constant fertility and mortality levels are assumed.

The district will, however, require 467558 tons (maize) and 20001 tons (beans) when fertility is assumed constant while the mortality declines upto the year 2000.

MARSABIT DISTRICT

Table 3.16a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	3947	20712	18010	-16765	-14063
1985	8587	26813	23293	-18226	-14706
1990	16862	34839	30093	-17977	-13231
1995	27883	43364	37132	-15481	-9249
2000	41650	58738	50380	-17088	-8730

Source: Compiled by the author

Table 3.16b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	1576	2661	7704	-1085	-6128
1985	4029	3454	9966	+574	-5938
1990	8595	4435	12873	+4160	-4278
1995	14836	5593	15884	+9243	-1048
2000	22742	7399	21551	+15343	+1191

Source: Compiled by the author

Tables 3.16a and 3.16b show that maize and beans production is projected to increase at 11.8% and 13.3% per annum, while the consumption is estimated to increase at 5.1% and 5.4% per annum according to the different assumptions about fertility and mortality. The production rates are higher than the consumption rates under the different assumptions, but quantitatively the amount of maize produced by the year 2000 will be less than the requirements. The district will produce 41650 tons of maize and 22742 tons of beans but will require over 50380 tons (maize) and over 7399 tons of beans when constant fertility and mortality levels are assumed and 530074 tons and 22754 tons of maize and beans under constant fertility but declining mortality levels. The district will therefore have a deficit of over 8730 tons and 488427 tons of maize and a surplus of 15343 tons of beans (set1).

MERU DISTRICT

Table 3.17a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	204720	169373	152165	+35147	+525335
1985	231306	206125	184855	+25181	+46451
1990	264001	252220	224927	+1781	+39074
1995	296095	307825	273621	-11730	+22474
2000	327588	375926	333037	-48338	-5449

Source: Compiled by the author

Table 3.17b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	57942	24035	65093	+33457	-7601
1985	70306	29301	76090	+41005	-5784
1990	83284	35439	96219	+47845	-12935
1995	92888	43047	117047	+49841	-24166
2000	99105	52303	142466	+46802	-43361

Source: Compiled by the author

Tables 3.17a and 3.17b show that Meru district will have a surplus in both maize and beans upto the year 1990, after which the maize demand will outstrip the production. The tables further reveals that the beans production (quantitatively) will be higher than the demand throughout to

the year 2000. The tables show maize and beans production rate by the year 2000 to be projected at 2.4% and 2.7% respectively while the consumptions are projected at 3.9% per annum under constant fertility and mortality levels, and at 4.2% when the fertility is assumed constant while mortality declines gradually.

The tables show that the district will produce 327588 tons and 99105 tons of maize and beans by the year 2000, but will require over 333037 tons and 351620 tons of maize and over 52303 tons and 150415 tons of beans according to the different fertility and mortality assumptions.The district will thus have a deficit of 48338 tons and 24032 tons of maize and a surplus of 46802 tons of beans (set1)

KISII DISTRICT

Table 3.18a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	117666	187626	171731	-69960	-54065
1985	168989	233740	205740	-64751	-36751
1990	244497	269915	246604	-25418	-2107
1995	329120	324633	295633	+4497	+33487
2000	433363	420128	354692	+13235	+78660

Source: Compiled by the author

Table 3.18b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	17215	28311	73463	-11096	-56248
1985	24949	34514	88011	+9565	-63062
1990	34952	41112	105492	-6160	-70540
1995	45330	49192	126465	-3862	-81135
2000	56081	58878	151731	-2797	-95650

Source: Compiled by the author

The tables show that the consumption level of maize will be higher than the production upto 1990, after which the maize consumption will start to decline below the production level through to the year 2000. Beans production level on the other hand will be below the consumption level throughout to the year 2000.

The district will produce 433363 tons of maize and 56091 tons of beans representing an annual increase in production of 6.5% and 5.9% of maize and beans respectively by the year 2000. The district will, however, require 420128 tons and 379168 tons of maize and over 58878 tons and 162000 tons of beans according to the different fertility and mortality assumptions. The district will, therefore, have a surplus of 13235 tons of maize and a deficit of over 2797 tons of beans under constant fertility and mortality levels and a surplus of 54195 tons and a deficit of 106119 tons of maize and beans respectively with gradual decline in mortality levels.

KISUMU DISTRICT

Table 3.19a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	29278	187626	95617	-80100	-66339
1985	31004	233740	112620	-97895	-81612
1990	33008	269915	132731	-119590	-99723
1995	34846	324633	156495	-145898	-121646
2000	36512	420128	184004	-177411	-147492

Source: Compiled by the author

Table 3.19b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	2111	28311	40903	-10351	-38792
1985	3409	34514	48176	-13608	-44767
1990	4887	41112	56779	-15024	-51892
1995	6205	49192	66945	-17260	-60740
2000	7364	58878	78968	-20265	-71604

Source: Compiled by the author

Tables 3.19a and 3.19b show that Kisumu district has a shortage in terms of maize and beans all through to the year 2000. The tables show that the district will produce 36512 tons and 7364 tons of maize and beans by the year 2000 representing an annual increase of 1.1% and 6.3% respectively. The district will however, require over 1284004 tons and 58878 tons of maize and beans representing an increase in

consumption (demand) of 3.2% when constant fertility and mortality levels are assumed and 3.5% when fertility is assumed constant while the mortality gradually declines.

From the tables it can be concluded that the district will have a deficit of 147492 tons and over 20265 tons of both maize and beans by the year 2000.

SIAYA DISTRICT

Table 3.20a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	50854	103131	94560	-52277	-43706
1985	55096	122464	112181	-67368	-57085
1990	60354	146293	133186	-85939	-72832
1995	65414	174489	158209	-109075	-92795
2000	70274	208230	188055	-137956	-87935

Source: Compiled by the author

Table 3.20b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	21696	14903	40451	+6793	+11245
1985	37953	17741	47988	+37355	+20212
1990	55494	20952	56974	+39402	+34542
1995	68154	24854	67679	+43304	+478
2000	77666	29493	80445	+48173	-2779

Source: Compiled by the author

Tables 3.20a and 3.20b show that Siaya district will have a shortage of maize by the year 2000, while beans will be sufficient. The district will produce 70274 tons and 77666 tons of maize and beans , but will require over 188055 tons and over 29493 tons of maize and beans during the same period. The production of both maize and beans will be 3.6% and 6.4% per annum by the end of the century, while the demand will increase at over 4% according to the different fertility and mortality assumptions.

The district will thus have a deficit of over 87935 tons of maize and a surplus of 48173 tons of beans by the year 2000. Thus for the district to be able to be self-sufficient in maize, the production must increase at over 4% per annum.

SOUTH - NYANZA DISTRICT

Table 3.21a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	129940	180760	162498	-50820	-32558
1985	122567	202333	192566	-79766	-69999
1990	113505	256068	228363	-142563	-114858
1995	104615	305506	271360	-200891	-166745
2000	95897	364694	322606	-264797	-226709

Source: Compiled by the author

Table 3.21b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	14707	25653	69513	-10928	-54806
1985	18984	16877	44153	+2107	-23169
1990	16340	35962	97689	-19622	-81349
1995	16932	42630	116082	-25698	-99150
2000	17319	50548	138004	-33229	-155323

Source: Compiled by the author

Tables 3.21a and 3.21b show that the situation in South Nyanza will be very serious especially in maize production, since the district is projected to have a negative growth rate of production by the year 2000. The situation is not very favourable with beans production either. The distict will produce 95897 tons and 17319 tons of maize and beans respectively, but will require over 32260 tons and 50548 tons of maize and beans when the fertility and mortality is assumed constant by the end of the century. This therefore, implies that the district will have a deficit of over 226709 tons and 33229 tons of maize and beans.

The production rates are estimated at -1.5% and 0.8% per annum of maize and beans respectively compared to an increased rate of consumption of 3.5% per annum. These low rates of production over consumption are alarming. The decreased production can be blamed on the current attention now being paid to sugar cane production.

BUNGOMA DISTRICT

Table 3.22a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	173011	100841	91914	+72170	+81097
1985	272352	122888	112001	+149464	+160351
1990	392658	150455	136598	+242203	+256060
1995	528377	183740	166640	+345137	+362237
2000	681009	225138	203389	+455871	+477620

Source: Compiled by the author

Table 3.22b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	20596	15074	39319	+5522	-18723
1985	27654	18433	47913	+9221	-20259
1990	36671	22347	58434	+14324	-54773
1995	45902	27395	71285	+18507	-25383
2000	55349	33345	87005	+22004	-31656

Source: Compiled by the author

From tables 3.22a and 3.22b, it is evident that Bungoma district will have a surplus of both maize and beans throughout to the year 2000 (set1). The production rate of both maize and beans by the year 2000 is projected at 6.9% and 4.9% respectively, while the rate of increase of consumption (demand) during the same period of time is projected at 4.0%

per annum when the fertility and mortality levels are assumed constant.

By the year 2000, the district will produce 681009 tons and 553489 tons of maize and beans respectively,but will require over 203389 tons and 33345 tons of maize and beans when constant fertility and mortality levels are assumed, but with declining moratality level accompanied by constant fertility, the district will require 216103 tons and 92444 tons of maize and beans. The district will, therefore, have a surplus of over 455871 tons and 22004 tons of maize and beans respectively.

BUSIA DISTRICT

Table 3.23a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	88080	60640	54709	+27440	+33371
1985	86369	74215	66934	+12154	+194395
1990	81640	91411	81954	-9771	-317
1995	74035	112328	100381	-38293	-26346
2000	63552	13811	123007	-74559	-59455

Source: Compiled by the author

Table 3.23b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	6312	8657	23404	-2345	-17092
1985	10147	10630	28633	-483	-18486
1990	13909	12942	35060	+967	-21151
1995	16527	15521	42941	+695	-26414
2000	19599	19370	52620	+229	-33021

Source: Compiled by the author

Tables 3.23a and 3.23b show Busia district was able to meet its domestic rquirements of maize from 1980 to 1985, while in the same years the district had shortages in beans . The rate of increase in maize and beans production between 1980 to the year 2000 was projected at -1.6% and 5.2% per annum respectively, while the rate of increase of consumption (demand) during the same period is projected at 4.1% per annum.

The district will produce 63552 tons and 19599 tons of maize and beans, but will require over 13811 tons and 19370 tons of both maize and beans. From the above figures it can be deduced that the district will have a deficit of over 74559 tons of maize and a surplus of 229 tons of beans (set1) when constant fertility and mortality levels are assumed by the year 2000. However, when fertility level is assumed constant while the mortality level gradually declines, the district will have a deficit of 75913 tons and 40061 tons of maize and beans respectively.

KAKAMEGA DISTRICT

Table 3.24a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	329294	202192	188214	+127102	-141080
1985	390732	240184	223572	+150539	+23169
1990	470878	287280	265822	+183898	+205056
1995	554778	327204	316105	+212074	+238673
2000	642421	409066	376068	+233355	+266353

Source: Compiled by the author

Table 3.24b: Projected beans Production (Supply) and consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	22569	31018	80514	-8449	-57954
1985	40442	37264	95639	+3178	-55197
1990	70030	44067	113713	+25963	-43683
1995	105671	52346	135222	+55325	-27551
2000	153363	62197	160874	+91166	-107511

Source: Compiled by the author

It is evident from tables 3.24a and 3.24b that Kakamega district has an advantage of high production of both maize and beans. The district will produce 6426421 and 153363 tons of maize and beans by the year 2000. This represents an increase of 3.3% and 9.6% per annum from 1980. The district will, however, require over 376068 tons and over 62197 tons of maize

and beans by the year 2000 assuming constant fertility and mortality levels; and 232326 and 22067 tons of maize and beans under the assumption of constant fertility but declinig mortality levels. The district, therefore, will have a surplus of over 233355 and 91166 tons of maize and beans by the end of the century.

BARINGO DISTRICT

Table 3.25a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	18715	41333	37291	-22618	-18576
1985	22069	55935	42296	-33866	-20227
1990	25355	58261	52578	-34906	-27223
1995	27636	69217	62471	-41581	-34838
2000	28912	82266	74919	-53354	-46007

Source: Compiled by the author

Table 3.25b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	2867	5943	15952	-3076	-13085
1985	3191	7114	18949	-3923	-15758
1990	3582	8430	22492	-4848	-18910
1995	3960	10045	26724	-6085	-22764
2000	4321	11971	32049	-7650	-27728

Source: Compiled by the author

Tables 3.25a and 3.25b show that the district will produce 28912 and 4321 tons of maize and beans by the year 2000. This production represents an increase of 2.2% and 2.1% per annum respectively from 1980. During the same period the consumption will increase by 3.5%. This high consumption rate over the production rates means high demand. The district by the year 2000 will require over 74919 and 11971 tons of maize and beans when the fertility and mortality level remains constant but when mortality level declines gradually, the district will require 79803 and 34138 tons of maize and beans respectively. From these, the district will have a deficit of over 46007 and 7650 tons of maize and beans by the year 2000.

ELGEYO - MARAKWET DISTRICT.

Table 3.26a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	45693	29717	26793	+15976	+18900
1985	51489	31285	28336	+20204	+23153
1990	58628	32249	29128	+26379	+29500
1995	65652	33649	30390	+32003	+35262
2000	72560	35129	31719	+37431	+40841

Source: Compiled by the author

Table 3.26a: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	5573	4204	11461	+1369	-5888
1985	7688	4494	12122	+3194	-4434
1990	10271	4611	12460	+5660	-2189
1995	12787	4825	13000	+7962	-213
2000	15327	5049	13569	+10278	+1758

Source: Compiled by the author

Marakwet district will produce 72560 tons of maize and 15327 tons of beans by the year 2000. This represent an annual growth rate of 2.3% and 5.1% from 1980. The district will however, require over 31719 tons of maize and 38103 tons of beans under constant fertility and mortality levels and over 38103 tons of maize and 16299 tons of beans under constant fertility but declining mortality levels. The district a surplus of over 3743 tons of maize and 10278 of beans by the year 2000.

KAJIADO DISTRICT.

Table 3.27A: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	17912	30854	27625	-12941	-97131
1985	21513	39582	35403	-18069	-14027
1990	25083	51857	47708	-26774	-20625
1995	27616	64462	58741	-36846	-31125
2000	29112	84431	75505	-55319	-46393

Source: Compiled by the author

Table 3.27b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	30115	4357	11817	+25758	+18298
1985	58794	5646	15203	+53148	+43391
1990	84250	7225	19553	+77025	+64697
1995	98151	9940	25128	+88211	+73023
2000	100503	12050	32300	+88453	+68203

Source: Compiled by the author

Unlike, Marakwet, Table 3.27a and 3.27b show that Kajiado district will have shortage of maize throughout to the year 2000, while beans will be sufficient. The district will produce 29119 tons and 100503 tons of both maize and beans repectively. This will represent an increase of 2.4% and 6.0% per annum from 1980. The district will, however, require over

75505 tons and 83064 tons of maize and over 12050 tons and 35533 tons depending on the assumption on fertility and mortality by the year 2000.

The district will thus have a deficit of over 46392 and 53952 tons of maize and a surplus of over 68208 tons of beans by the end of the century.

KERICHO DISTRICT.

Table 3.28a Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	193843	128299	115628	+65544	+78215
1985	226425	154469	139484	+71954	+8694
1990	259444	159121	168316	+100328	+91128
1995	283899	226279	203260	+57621	+80639
2000	299789	273795	245617	+25994	+59172

Source: Compiled by the author

Table 3.28b: Projected Beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	3874	18631	49463	-14757	-45589
1985	4970	22595	59668	-17625	-54698
1990	6293	27148	72002	-20855	-65709
1995	7563	32798	86950	-25235	-79387
2000	8780	39638	105069	-30858	-96289

Source: Compiled by the author

Table 3.28a and 3.28b shows that Kericho district will have sufficient maize throughout to the year 2000, but will have a shortage of beans during the same period of time. The district will produce 299789 tons and 8780 tons of maize and beans respectively by the year 2000; but will require over 245617 and 262356 tons of maize and over 105069 and 112230 tons of beans depending on the aaumption on fertility and mortality levels.

The district will therefore have a surplus of over 25994 tons and 37433 tons of maize and a deficit of over 30858 tons and 103450 tons of beans depending on the assumption about fertility and mortality levels.

LAIKIPIA DISTRICT.

Table 3.29a : Projected maize Production (Supply) and consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	25564	27753	25106	-2189	+458
1985	34259	36613	33216	-2354	+1043
1990	45725	48421	37258	-2696	+8467
1995	57858	64002	58677	-6145	-819
2000	70658	84642	77600	-13984	-6942

Source: Compiled by the author

Table 3.29b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	2906	4021	10740	-1115	-7834
1985	4979	5359	14209	-380	-9230
1990	7620	7058	15938	+562	-8318
1995	10319	9354	25101	+965	-14784
2000	13074	12400	38196	+679	-20122

Source: Compiled by the author

From Tables 3.29a and 3.29b, the district will have enough maize from 1980 to 1990 (set 11) and a shortage between 1980 to 1985 of beans. The district will produce 70658 and 13074 tons of maize and beans by the year 2000 representing a growth rate in production of 5.1% and 7.5% per annum from 1980. The district will however, require over 77600 and 82900 tons of maize over 12400 and 35463 of beans depending on the assumption about fertility and mortality by the year 2000. The district therefore will have a deficit of over 6942 and 12242 tons of maize a surplus of 679 tons (set 1) of beans by the year 2000.

NAKURU DISTRICT

Table 3.30a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	87882	108646	97135	-20764	-9253
1985	107670	143690	125832	-36020	-18162
1990	133175	181116	162878	-59941	-29702
1995	159536	235946	211025	-76410	-51489
2000	186752	306215	273876	-119463	-87124

Source: Compiled by the author

Table 3.30b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	14728	15413	41552	-686	-26824
1985	16156	20361	53828	-4205	-37672
1990	17848	25993	69676	-8145	-51828
1995	19439	33764	90272	-14325	-70833
2000	22930	43896	117158	-20966	-94228

Source: Compiled by the author

Though Nakuru district is among the most fertile districts in the Rift-Valley, tables 3.30a and 3.30b show that throughout the years under study from 1980 to the year 2000, the district will have shortage of both maize and beans. the district will produce 186752 and 22936 tons of maize and beans. It will however, require over 273876 and 295867 tons of maize and over 43896 and 126565 tons of beans.

From the tables, the rate of growth of maize and beans production between 1980 to the year 2000 is projected at 3.8% and 2.2% per annum respectively. The consumption rate between the same period of time is projected at over 4.2% per annum. From the foregoing analysis, the district will have a deficit of over 87124 and 109115 tons of maize and over 20960 and 103635 tons of beans by the year 2000.

NANDI DISTRICT

Table 3.31a: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	176675	61090	54974	+11558	+121701
1985	195405	75022	67700	+120383	+127705
1990	214974	92732	83459	+122242	+131515
1995	230178	114338	102895	+115840	+127283
2000	241302	141049	126908	+1100253	+114394

Source: Compiled by the author

Table 3.31b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	1429	8691	23517	-7262	-22088
1985	1384	10783	28961	-9399	-27577
1990	1305	13271	35701	-12068	-34498
1995	1203	16405	44016	-15202	-42813
2000	1076	20285	54289	-19209	-53213

Source: Compiled by the author

From tables 3.31a and 3.31b, its evident that Nandi district has an advantage of high maize production but inadequate beans production. The tables show that the district will produce 241302 and 1076 tons of maize and beans by the year 2000. This represents an increase of 1.6% and -1.4% per annum from 1980. The district will however, require over 126908 and 1237320 tons of maize and over 20285 and 58742 tons of beans depending on the assumption about fertility and mortality levels by the year 2000. The increase in the consumption rate by the year 2000 is projected at 4.2% per annum. The rate of increase of maize production seems lower than the demand (consumption) rate, but quantitatively the district will produce more maize than it requires.

NAROK DISTRICT

Table 3.32a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	37909	43099	38862	-5190	-935
1985	52806	54944	49633	-2138	+3173
1990	66563	70410	63484	-3847	+3079
1995	74915	90058	81185	-15143	-6270
2000	77862	115313	103916	-37451	-26054

Source: Compiled by the author

Table 3.32b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	940	6154	16624	-5214	-15684
1985	2022	7919	21232	-5897	-19210
1990	3684	10106	27156	-6422	-23472
1995	5690	12954	34724	-7264	-29039
2000	8041	16618	44453	-8577	-36412

Source: Compiled by the author

From the tables 3.32a and 3.32b the district will produce 77862 and 8041 tons of maize and beans respectively by the year 2000. This will present an increase in production of 3.6% and 10.7% per annum from 1980. From the above analysis, the production rates are higher than the consumption rates of 5% during the same period of time; though quantitatively the amount produced will be much less than the requirements. The district will require over 103916 and 111756 tons of maize and over 16618 and 47807 tons of beans respectively by the year 2000 under the different assumptions about fertility and mortality levels. The district will, therefore, have a deficit of over 26054 and 33894 tons of maize and 8577 and 55848 tons of beans.

Table 3.33a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	1759	15456	13973	-13697	-12214
1985	2100	17521	15867	-15421	-13767
1990	2348	19641	17983	-17293	-15635
1995	2397	22796	21051	-20399	-18672
2000	2447	25982	24177	-23535	-21730

Source: Compiled by the author

Table 3.33b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	99	2212	5977	-2113	-5878
1985	97	2533	6788	-2436	-6691
1990	94	2936	7693	-2842	-7599
1995	91	3434	9005	-3343	-8914
2000	88	3981	10342	-3893	-10254

Source: Compiled by the author

Samburu district, being a pastoral district, pays very little attention to agriculture. This is evident from the tables 3.33a and 3.33b. The district will produce merely 2447 and 88 tons of maize and beans by the end of the century. These production will represent an increase in production of 1.7% and -0.5% per annum respectively. The district will however, require 24177 and 258655 tons of maize and over 10342 and 110647 tons of beans depending on the assumptions about fertility and mortality levels by the year 2000.

The low rate of production between 1980 and the year 2000 indicates that the district will have a shortage of both maize and beans. The district will, therefore, have a deficit of over 21730 and 25620 tons of maize and 10254 and 110559 tons of beans depending on the different assumptions about fertility and mortality levels by the year 2000.

TRANS NZOIA DISTRICT

Table 3.34a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	155288	53394	48270	+101894	+107018
1985	177862	70782	64186	+107080	+220756
1990	207792	94015	85037	+113777	+122755
1995	239626	124076	112461	+115530	+127165
2000	273363	165879	150051	+107484	+123312

Source: Compiled by the author

Table 3.34b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	51539	7790	20649	+43749	+30890
1985	48506	10435	27457	+38071	+21049
1990	44331	13803	36377	+30528	+7954
1995	41283	18462	48108	+22821	-6825
2000	37863	24481	64188	+10382	-26325

Source: Compiled by the author

Tables 3.34a and 3.34b show that the district will produce 273363 and 37863 tons of maize and beans respectively by the year 2000. This will represent an increase in production of 2.8% and -1.5% per annum of maize and beans frm 1980. The district will however require over 150051 and 161010 tons of maize and over 24481 and 68877 tons of beans depending on the assumptions about fertility and mortality levels by the year 2000. Though the rate of production is lower than that of consumption of 5.7%, the district will produce enough of these crops quantitatively. The district will, therefore, have a surplus of over 123312 tons of maize and 10382 tons of beans

UASIN-GISHU DISTRICT

Table 3.35a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	124368	62519	55620	+61849	+68748
1985	158667	78549	70091	+80118	+88576
1990	204122	99624	88399	+104498	+115723
1995	252444	125276	111512	+127168	+140932
2000	303635	158119	140727	+145516	+162908

Source: Compiled by the author

Table 3.35b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	3299	8754	23793	-5455	-20494
1985	5206	9734	29983	-4528	-24777
1990	7715	13993	37815	-6278	-30100
1995	10363	17698	47702	-7335	-37339
2000	13149	22390	60200	-9241	-47051

Source: Compiled by the author

From tables 3.35a and 3.35b it is evident that Uasin-Gishu district is favoured with adequate maize supply, but the beans supply seems inadequate. The district, by the year 2000, will produce 303635 and 13149 tons of maize and beans representing an increase in production of 4.5% and 6.5% per annum from 1980. The requirements (consumption) of these commodities is

projected to increase at 4.7% and 4.83% per annum depending on the assumptions about fertility and mortality levels. The rate of production of beans from the above analysis is higher than the rate of increase in demand, but quantitatively the amount produced will be far much lower than the demand, for example, the district will require over 22390 and 70512 tons of beans depending on the assumption about fertility and mortality levels and in the method of consumption projection.

It can therefore be concluded that Uasin-Gishu district by the year 2000 will have a surplus of over 145516 tons of maize and a deficit of over 9241 tons of beans.

WEST POKOT DISTRICT

Table 3.36a: Projected maize Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	29655	33332	29564	-3677	+91
1985	32915	43609	38776	-10694	-5861
1990	36328	57232	50774	-20904	-14446
1995	39008	75050	66578	-36042	-27570
2000	40953	98456	87331	-57503	-46378

Source: Compiled by the author

Table 3.36b: Projected beans Production (Supply) and Consumption (demand)

Year	Production (Tons)	Demand (Tons)		Imbalance due to Demand (Tons)	
		Set1	Set2	Set1	Set2
1980	2702	4603	12647	-1901	-9945
1985	3200	6084	16588	-2884	-13388
1990	3661	7950	21720	-4289	-18059
1995	3944	10452	28481	-6508	-24537
2000	4047	13746	37358	-9699	-33311

Source: Compiled by the author

Tables 3.36a and 3.36b show that West Pokot district will not be able to meet its domestic requirements for maize and beans by the year 2000. The district will produce 40953 and 4047 tons of maize and beans, but will require over 87331 and 12936 tons of maize and over 13746 and 55337 tons of beans by the year 2000. This therefore implies that the district will have a deficit of over 46378 tons of maize and over 9699 tons of beans depending on the assumption about fertility and mortality levels.

From the above tables, the rate of increase of production of both maize and beams by the year 2000 is projected at 1.6% and 2.0% respectively while the rate of increase of the consumption at 5.4%. The low rate of production over the consumption means a serious problem on self sufficiency in maize and beans by the year 2000.

3.5 ESTIMATION OF PER CAPITA MAIZE AND BEANS AVAILABILITY BY THE YEAR 2000.

Whether or not a sustainable agricultural development is achieved in the various districts under study, will depend on whether the full food production is realized and fully exploited for the benefit of the total population. Sessional paper no.4 of 1981 on the National food policy looks at the prospects of increasing the production of individual crops in the country so as to be self sufficient in food production.

In this thesis, it was assumed that an average working person of average body size in Kenya requires a per capita consumption standard of about 500g (maize) and 210g (beans) a day. This formula was used to measure the degree of maize and beans sufficiency in the studied districts by the year 2000 based on the estimated (projected) productions of these commodities. The per capita maize and beans availability was estimated based on constant fertility and mortality levels and declining mortality levels by the year 2000.
The results appear in 3.38.

Table 3.38: Per Capita Maize And Beans Availability By The Year 2000 Based On Different Assumptions About Fertility And Mortality.

District	Constant Fertility Constant Mortality		Constant Fertility Declining Mortality	
	Per capita maize & beans (grams/day)		Per capita maize & beans (grams/day)	
	Maize	Beans	Maize	Beans
KIAMBU	312	52	304	50
KIRINYAGA	378	126	268	90
MURANGA	173	72	149	62
NYANDARUA	282	107	225	85
NYERI	167	52	125	39
KILIFI	397	50	390	50
KWALE	379	22	369	21
TAVETA	386	24	383	22
EMBU	398	187	317	149
ISIOLO	142	3.3	141	3.1
KITUI	241	55	226	52
MACHAKOS	145	109	139	105
MARSABIT	390	213	385	210
MERU	461	139	455	139
KISII	570	74	560	73
KISUMU	93	19	90	18
SIAYA	176	20	174	18
S.NYANZA	140	25	125	23
BARINGO	183	27	79	25
MARAKWET	416	278	410	260
KAJIADO	180	623	173	597

LAIKIPIA	432	80	420	78
NAKURU	320	39	311	34
NANDI	890	4	866	3
NAROK	350	36	344	33
KERICHO	573	17	564	15
SAMBURU	44	2	40	0.2
NZOIA	850	117	835	114
U.GISHU	1012	44	908	39
W.POKOT	220	22	156	18
BUNGOMA	1559	127	1540	124
BUSIA	242	69	225	64
KAKAMEGA	800	191	773	183

Source: Compiled by the author

Note: Based on projected population and projected maize and beans production.

On the basis of these findings, three major maize and beans production areas can be identified as;

1. Maize and beans deficit areas (per capita consumption below 500 and 210 grams/day of maize and beans respectively. These includes Kiambu, Kirinyaga, Muranga, Nyandarua, Nyeri, Kilifi, Kwale, Taveta, Embu, Meru, Marsabit, Isiolo, Kisumu, Siaya, S.Nyanza, Baringo, Laikipia, Busia, Narok, Pokot, Nandi (bean), Nakuru and Samburu (maize and beans), Kakamega (beans),Bungoma (beans),Kericho (beans), Uasin-Gishu (beans), Marakwet (maize), Nzoia (beans), Kajiado (maize) and Kisii (beans). 2. Relatively self-

sufficient maize and beans areas. These includes Kericho and Kisii (maize), Marakwet and Kajiado (beans)

3. Maize surplus areas which includes Nzoia, Bungoma Kakamega, Nandi and U.Gishu

3.6 INTER-RELATIONSHIP BETWEEN POPULATION DENSITY AND MAIZE AND BEANS PRODUCTION VARIABLES.

No studies have attempted to relate population density and food production in Kenya to determine which variables explain the high population density especially in the intensely settled as well as farmed districts. In this section multiple regression analysis of the relationship between population density (Y_t)and the total maize and beans produced per 1000 population (X_{1t}), total area under maize and beans in hectares (X_{2t}) and total yield per hectare of maize and beans (X3t) have been undertaken. An equation that can permit predictions as to how changes in these variables in the system affect population density was constructed.

The significance of these explanatory variables was tested by calculating a varience ratio (F). F ratio is defined as the ratio of the predicted to the non-predicted varience. The predicted variance has a degree of freedom r and non-predicted variance has a degree of freedom n - r - 1. Also tested in this section is the presence of serial correlation using Durbin - Watson test. The test involves the calculation of a test statistic based on the residuals from the ordinary least - square procedures. This tests the null hypothesis that no serial correlation is present.

3.6.1 REGRESSION ANALYSIS RESULT

As already stated in chapter two, the model used in the study is of the form

$$Y_t = a + b_0 x_1 + b_1 x_2 + b_2 x_3 + \text{etc.}$$

where

Y_t - Population density

x_1 - Total amount of maize and beans produced per 1000 population.

x_2 - Total area under maize and beans.

x_3 - Total yield per hectare of land under maize and beans.

By fitting this additive model to the data using OLS, the following relation was obtained:-

$$Y_t = 208.4 - 0.1301x_1 + 0.023x_2 - 0.138x_3$$

X's values are actual values of the model and not measured from their perspective means. The regression coefficients in the above model is a hypothesized association with population density for a change in the accompanying explanatory variables when allowance has been made for other variables. The first term on the left hand side of the linear prediction equation is the hypothetical value of population density when the other variables have zero order.

The significance of multiple correlation was tested by applying F - ratio test defined as:-

$$F = \frac{R^2/K}{\quad}$$

$K = 3$
$n = 33$

$(1 - R^2)/n - K - 1$

where (K, n - K - 1) are degrees of freedom, R^2 is multiple correlation coefficients, K is the number of explanatory variables and n is the sample size.

Table 3.39: STATISTICS FOR BIVARIATE REGRESSION GENERATED BY SUBGRAM REGRESSION

Multiple R	0.2051	Analysis of Variance	OF	SS	F
R^2	0.0421	Regression	3	109069	0.469
Standard error	278.6	Residual	29	2483209	

Variables	B	B	Std errors	F
X_1	-0.1301	-0.2203	0.313	0.494
X_2	0.023	0.165	1.37	0.016
X_3	-0.1383	-17.98	23.15	0.603
Constant	208.4			

Source: Computer Printout

Regression coefficients

$X_1 = 0.0416$

$X_2 = 0.0421$

$X_3 = 0.027$

Durbin - Watson statisic 2.206

Table 3.40: Correlation coefficients

	Y	X_1	X_2	X_3
Y	1.000	-0.149	-0.002	-0.164
X_1	-0.149	1.000	0.285	0.184
X_2	-0.002	0.285	1.000	-0.090
X_3	-0.164	0.184	-0.090	1.000

Source: Computer Printout

The population density is negatively related to total amount of maize and beans produced per 1000 population and to the total yield per hectare of maize and beans, but is positively related to the total area under maize and beans (table 3.39). The low correlation coefficients show that multicollinearity does not exist.

The analysis shows that population density is negatively correlated to total amount of maize and beans produced per 1000 population, total area under maize and beans and the total yield per hectare of maize and beans. The degree of correlation is estimated as 14.9%, 0.2% and 16.4% respectively.

The test of significance at 95% confident interval shows that all the explanatory variables are insignificant. The estimates of subsets of regression coefficients were also statistically insignificant when F (ratios) were compared to the table values. The Durbin - Watson statistics suggest acceptance of null hypothesis of zero first order auto correlation of the residuals.

The association of population density with variables (X_1, X_2 and X_3) was studied by fitting an additive regression model to population density and food (maize and beans) statistic data. The analysis shows low and weak association of these variables with population density.

In this section it was not possible to obtain conclusive results because of weak relationship. It can thus be concluded that population density in Kenya is not linearly related to total amount of maize and beans produced per 1000 population, total area under maize and beans and total yeild per hectare of the land under maize and beans. These variables have therefore no impact on population density.

SUMMARY

Projected maize and beans consumption (demand) and production (supply) in different districts have been compared in the period 1980 to the year 2000. The analysis shows that almost half of the districts will have shortages of both maize and beans. The per capita maize and beans availability has been projected based on a low level maize and beans consumption of 500g/day and 210g/day, respectively. Out of the 33 districts only five will have surplus of maize and two be relatively self - sufficient in beans by the year 2000. The rest of the districts will have deficits.

The last section analyses the relationship between population density and total amount of maize and beans produced per 1000 population, total area under maize and beans and total yield of land under maize and beans. It was observed that there is no linear relationship between population density and these explanatory variables.

The next chapter deals with summary, conclusion, and recommendations for further research.

CHAPTER FOUR

CONCLUSION AND RECOMMENDATIONS

The main objective of this study was to find out how population size affects food production especially of maize and beans in Kenya at district levels by the year 2000. The study also examined how population density as per the 1979 population census relates to the total amount of maize and beans produced per 1000 population, the total area devoted to maize and beans and the total yield of land under maize and beans obtained from the 1979 food statistics from the ministry of agriculture district annual reports.

The idea was to find out if there would be an imbalance between population (consumption) and maize and beans production by the year 2000. The analysis was carried out by projecting both population and maize and beans production from the year 1980 to the year 2000. The population was projected under assumptions about fertility and mortality trends (chapter 2). Maize and beans production projections were under assumptions about past trends on area and yield of land under maize and beans (chapter 2).

The consumption (demand) was projected based on recommended levels in Eastern Africa where the staple food is grain and pulses (set1) and also on the required daily allowance to meet minimum caloric requirements per adult - equivalent (set2).

The present chapter summarises the pattern of consumption in the various districts in the country by the year 2000, except for the districts that were not included in the study. Secondly it makes some fundamental recommendations that are pertinent to policy formulation at regional level. Finally, the chapter will highlight areas for further research on not only the actual problem under study but also other closely related problems.

4.1 THE MAJOR FINDINGS.

4.1.1 PROJECTED REGIONAL POPULATION BY THE YEAR 2000

As postulated in our first hypothesis, the study reveals considerable regional variations in the annual population growth rate. The study shows that the projected annual population growth rate by the year 2000 would be relatively high in the intensely settled as well as intensely farmed agricultural districts.

Since over 80% of the projected population by the year 2000 will be rural, such an annual increase will mean more pressure on the available agricultural land especially in the high and medium potential agricultural areas. This suggests that the situation by the year 2000 would be serious and demanding.

It has been observed that there will be regional variation in the man - land ratio in the country. The study reveals that only the pastoral districts will still have enough land by the year 2000. The situation will, however, be untenable in the heavily populated districts.

The projected high annual population growth rate indicates that substantial regular family planning programmes should be strengthened in all regions, more especially in the high and medium potential agricultural areas to reduce the fertilty levels. The idea is mainly to have the population growth rate that match or be lower than the rate of production of food especially (maize and beans) which form the major staple food for the majority of the rural population.

4.1.2 FOOD PRODUCTION: POLICY RECOMMENDATIONS

High rates of food (maize and beans) production in the districts is inhibited by limited availability of good agricultural land. Appendix 2 shows that the area under maize and beans is projected to increase at a very high rate per annum for the districts to achieve maximum production. These projected high rates of expansion of the area devoted to these crops cannot be afforded by majority of the districts except the pastoral, the arid and semi - arid adistricts. The only possible alternative is to increase the yeild per hectares.

It is observed from appendix II table II, that majority of the districts portray alow negative increase in the yield per hectare of maize and beans. This trend of development is serious for a LDC like Kenya which has low technological inputs in agriculture but is experiencing accelerating population growth due to high fertility. To be self - sufficient in maize and beans by the year 2000, there is an urgent need to increase yield per hectare of the area already under maize and beans. This can be through the use agricultural innovations as increased intercropping, increased multiple cropping, increased use in volume and efficiency of fertilizers, introduction of high yielding seeds and reduction of post harvest losses by provinding adequate and efficient storage facilities.

4.1.3 MAIZE AND BEANS REQUIREMENTS BY THE YEAR 2000: POLICY RECOMMENDATIONS

Rate of population growth is the principle factor affecting maize and beans requirements (chapter three and Appendix I). The varied annual rate of population growth based on different assumptions about fertility and mortality levels (appendix I table III) show how consumption (demand) will vary by the year 2000. It was observed that the consumption (demand) and production (supply) increase every year, though beans production in all the districts is less than that of maize quantitatively. The analysis shows that almost half of the districts under study will have shortages of both maize and beans, except the following which will have surplus:- Embu (Beans), Siaya (Beans), Kakamega (Maize and

beans), Marakwet (maize and beans), Kajiado (Beans), Kericho (maize), Laikipia (Beans), Nandi (maize), Nzoia (Maize and Beans) and Uasin Gishu (maize).

To achieve the total projected maize and beans requirements under different assumptions about fertility and mortality levels, the high population growth in all the districts should be reduced below the rate of maize and beans production (food).

To provide adequate food (maize and beans) to feed the fast expanding population, rural areas should be developed by providing infrastructures such as health facilities, educational facilities and good roads etc. because good health, sound education and good road network are needed for proper agricultural development. The GoK should as a matter of urgency develop agricultural potentials in the rural areas to reduce rural-urban migration which depletes rural areas of economically active population which in turn lowers the productivity

4.1.4 PER CAPITA MAIZE AND BEANS AVAILABILITY BY THE YEAR 2000: POLICY RECOMMENDATIONS

Maize and beans sufficiency in Kenya was measured using the projected production by the year 2000. A low level per capita consumption of 500g/day of maize and 210g/day of beans was assumed to be the standard consumption for Kenya and its districts. The study identified three major maize and beans production areas (chapter three section 3.5). From the above analysis it can be concluded that over 60% of the rural population will not be able to meet their basic maize and

beans needs assuming that maize and beans comprises 70% and 30% of the rural nutrition. The districts in the relatively self-sufficient category will quickly turn into deficit category with any slight change in normal farming conditions given the current rate of population growth and the depressed state of rural production.

For an active drive towards self-sufficiency to prevent the districts from falling into deficit category, the government should aim at increasing the yields so that the rate of production can offset the projected high rate of population. This alternative is more relevant considering the fact that the high and medium potential agricultural land is already facing untenable pressure due to high rate of population growth (appendix II table Ia, Ib, IIa and IIb).

4.2 CONCLUSION

It is clear that in the case of Kenya a high rate of population growth does not mean high rate of food production per capita. There has been shortage of maize and beans in the past and the shortages have been projected to the future. Boserup's proposition is not therefore true in the case of Kenya. She did not consider other parameters like limited availability of arable land, lack of capital to import the technology and limited financial resources to urrigate the semi and arid areas. Food shortage problem in Kenya may be solved by increase of production and reduction of population growth. Kenya should in the long run work on the fertility reduction to avoid future food problems. If Kenya does not

give priority to both increasing food supply and reducing food demand by reducing high population gorwth rate, it will still continue to face food shortages both in the short and the long run.'

A district level, the following is expected to have surpluses of maize and beans. Embu (beans), Siaya (beans), Kakamega (maize and beans), Marakwet (maize and beans), Kajiado (beans), Kericho (maize), Laikipia (beans), Nandi (maize), Trans Nzoia (maize and beans) and Uasin Gishu (maize). The surpluses will be distributed among other districts which are expected to have deficits, but this will not be enough to satisfy them. South Nyanza, Kisumu and Siaya, Kisii, Busia, Bungoma, Kakamega, Kiambu, Kirinyanga, Muranga, Nyandarua and Nyeri districts have a high proportion of high and medium agricultural core areas but they have high pressure on their land. So there is little hope that in the near future there will be any increase in maize and beans production per capita in these districts. With the arid and semi arid irrigation schemes, there is some hope that maize and beans production per capita will increase.

Finally, to ensure equitable distribution from the districts with surpluses to districts with deficits. The government should provide adequate roads to ease the transport problem among the district. It should also provide adequate and modern storage facilities in both the surplus and deficit districts to avoid the post harves losses. Provision of adequate storage facilities especially in the deficit districts will prevent exploitation by the middlemen or

brokers who buy these commodies from the surplus districts and sell them at inflated market price in the deficit districts. These recommendations will ensure enough maize and beans supply in all the districts.

RECOMMENDATIONS FOR FURTHER RESEARCH:

1. To understand fully the impact of population growth in food production per capita a detailed research is needed on the normative regional diets rather than a standard maize and beans applied in this study.
2. A research is needed on the impact of the urban population growth on maize and beans production per capita.
3. A research is needed on the impact of rural-rural migration on maize and beans production per capita especially in the heavily populated and farmed districts.

APPENDIX I

TABLE I

Projected Total Population under the Assumption of Constant Fertility and Mortality Levels: 1980 - 2000

DISTRICT	YEARS				
	1980	1985	1990	1995	2000
Kiambu	735841	897635	1097785	1341733	1640609
Kirinyaga	311346	372992	447951	538261	647283
Muranga	695440	850147	1041871	129951	1569802
Nyandarua	249003	296841	354700	423604	506094
Nyeri	519822	623368	749407	890688	1083501
Kilifi	461676	561399	684458	833975	1016643
Kwale	308919	375732	458202	558432	680840
Taveta	157699	189242	227631	273673	328778
Embu	282630	348057	429741	530247	654551
Isiolo	46648	57178	70269	86307	109954
Kitui	496519	598716	723725	8743947	1060327
Machakos	1097195	1345556	1654486	2032977	2499136
Marsabit	104387	135003	174522	215835	292303
Meru	889099	1079933	1315149	1600360	1948416
Kisii	1007185	1206182	1447172	1735572	2082544
Kisumu	556809	655632	773417	912135	1076216
Siaya	548581	656646	773179	918689	1092210
S. Nyanza	945006	1119571	1328918	1579470	1878108
Baringo	217238	258004	306594	364448	433358
Marakwet	155451	164395	169159	176564	184366
Kajiado	161385	207588	267300	343708	442041
Laikipia	146583	193901	267075	338645	441008

TABLE I CONT'D

Kericho	676974	815586	984172	1187701	1434207
Nakuru	566965	734364	951675	1233598	1601655
Nandi	321312	395624	488284	602278	743170
Narok	227466	290663	371968	475915	609438
Samburu	81314	92401	104400	121843	139628
Nzoia	283053.	376312	499173	660629	881656
U. Gishu	324365	408687	516028	651251	822237
W. Pokot	172543	226302	296611	389115	510626
Bungoma	540305	658171	803543	980568	1197144
Busia	319599	390889	479092	586964	719542
Kakamega	1099654	1305787	1554088	1848592	2199933

Source: Compiled by the author based on the 1969 and 1979 Census data.

TABLE II

Projected Total Population under the Assumption of Constant Fertility and Declining Mortality, 1980 - 2000

	1980	2000
Kiambu	749931	1683328
Kirinyaga	333169	9134228
Muranga	765479	1820145
Nyandarua	258548	632884
Nyeri	590668	1449693
Kilifi	475282	1027367
Kwale	340057	698360
Taveta	167533	330468
Embu	342926	821730
Isiolo	54081	110696
Kitui	502400	1134565
Machakos	1123584	2597546
Marsabit	116208	294485
Meru	897538	1953445
Kisii	1103248	2106498
Kisumu	567628	1116410
Siaya	554686	1095578
S. Nyanza	957706	2096289
Baringo	219286	443351
Marakwet	164196	211681
Kajiado	163072	461462
Laikipia	149634	460557

Kericho	678358	1457534
Nakuru	626086	1643706
Nandi	339562	762887
Narok	234825	620865
Samburu	90100	143697
Nzoia	289108	894502
U. Gishu	342705	915740
W. Pokot	173435	718667
Bungoma	557688	1200571
Busia	328020	774806
Kakamega	1102223	2278307

Source: Compiled by the author based on 1979 Census data

TABLE III

Projected Annual Population Growth rate 1980 - 2000

DISTRICT	Costant Fertility Constant Mortality	Constant Fertility Declining Mortality
Kiambu	3.64	4.1
Kirinyaga	3.32	4.8
Muranga	3.7	4.3
Nyandarua	3.32	4.5
Nyeri	3.32	4.42
Kilifi	3.6	3.8
Kwale	3.58	3.62
Taveta	3.33	3.51
Embu	3.8	4.3
Isiolo	3.62	3.71
Kitui	3.42	4.0
Machakos	3.7	4.1
Marsabit	4.7	4.82
Meru	3.56	3.91
Kisii	3.3	3.6
Kisumu	2.98	3.3
Siaya	3.11	3.4
S. Nyanza	3.10	3.9
Baringo	3.15	3.5
Marakwet	0.79	1.3
Kajiado	4.6	5.2
Laikipia	5.04	5.7

TABLE III CONT

Kericho	3.4	3.8
Nakuru	4.71	4.8
Nandi	3.8	4.1
Narok	4.49	4.8
Samburu	2.27	2.5
Nzoia	5.16	5.6
U. Gishu	4.23	4.91
W. Pokot	4.91	7.1
Bungoma	3.62	3.8
Busia	3.68	4.3
Kakamega	3.14	3.6

Source: Compiled by the author

TABLE IV

Projected per capita land a availability by the year 2000,(all land), based on constant fertility and mortality assumption and constant and Declining Mortality.

District	Per Capita Land Availability (Ha)	
	Costant Fertility Constant Mortality	Constant Fertility Declining Mortality
Kiambu	1.88	1.45
Kirinyaga	2.22	1.57
Muranga	1.58	1.36
Nyandarua	6.97	5.57
Nyeri	3.03	2.26
Kilifi	12.2	12.09
Kwale	12.14	11.83

Taveta	51.55	51.23
Embu	4.14	3.3
Isiolo	232.7	230.67
Kitui	27.7	25.92
Machakos	5.67	5.45
Marsabit	249.1	240.1
Meru	5.09	4.89
Kisii	1.055	1.02
Kisumu	1.95	1.88
Siaya	2.31	2.26
S. Nyanza	3.40	2.73
Baringo	24.5	23.98
Marakwet	14.8	12.84
Kajiado	47.4	45.37
Laikipia	21.7	21.08
Kericho	3.41	3.35
Nakuru	4.4	4.27
Nandi	3.69	3.6
Narok	30.4	29.8
Samburu	148.6	144.8
Nzoia	2.8	2.76
U. Gishu	2.8	2.76
W. Pokot	9.93	7.06
Bungoma	2.57	2.5
Busia	2.26	2.1
Kakamega	1.6	1.55

Source: Compiled by the author based on the Projected Population.

APPENDIX II

Table 1a

Projected District Level Figures on Population and High and Medium Agricultural Land Based on the Assumption of Constant Fertility and Mortality Levels by the Year 2000

District	Total H/m Potential	Population ('000)	% of Kenya's		Density H/ Potential land
			H/M Pot Land	Population	
Kiambu	391	1641	3.9	4.4	419
Kirinyaga	108	647	1.1	1.7	599
Muranga	391	1570	3.9	4.2	402
Nyandarua	265	506	2.7	1.4	191
Nyeri	160	1084	1.6	2.9	678
Kilifi	351	1017	3.5	2.7	290
Kwale	288	681	2.9	1.8	237
Taveta	52	329	0.52	0.9	633
Embu	252	655	2.5	1.8	260
Isiolo	-	110	-	0.3	-
Kitui	1204	1060	12.1	2.8	88
Machakos	896	2499	9.00	6.7	279
Marsabit	4	292	0.04	0.8	7300
Meru	336	1948	3.4	5.2	580
Kisii	220	2083	2.2	5.6	947
Kisumu	461	1076	4.6	3.0	233
Siaya	461	1092	4.6	2.9	237
S. Nyanza	571	1878	5.7	5.0	329
Baringo	250	433	2.5	1.2	173
Marakwet	104	184	1.05	0.5	177
Kajiado	22	442	0.2	1.2	2009

Laikipia	130	441	1.3	1.2	339
Kericho	380	1434	2.8	3.5	377
Nakuru	330	1602	3.3	4.3	485
Nandi	234	743	2.4	2.0	485
Narok	908	609	9.1	1.6	67
Samburu	140	139	1.4	0.4	100
Nzoia	208	882	2.1	2.4	424
U. Gishu	327	822	3.3	2.2	251
W. Pokot	103	511	1.04	1.4	496
Bungoma	253	1197	3.2	3.4	473
Busia	163	720	1.9	2.2	442
Kakamega	325	2200	5.9	4.2	677

Source: Compiled by the author based on the Projected Population.

Table 1b

Projected District Level Figures on Population and High and Agricultural Land Based on Constant Fertility and Declining Mortality Levels by the Year 2000

District	Total H/m Land (1000 Km^2	Population ('000)	% of Kenya's		Density Potential land
			H/M Pot Land	Population	
Kiambu	391	1683	3.9	4.6	430
Kirinyaga	108	913	1.1	2.4	845
Muranga	391	1820	3.9	4.7	466
Nyandarua	269	633	2.7	1.7	239
Nyeri	160	1450	1.6	3.4	906
Kilifi	351	1027	3.5	2.9	293
Kwale	288	698	2.9	1.9	243
Taveta	52	331	0.52	0.93	637
Embu	252	822	2.5	2.1	326
Isiolo	-	111	-	0.3	-
Kitui	1204	1135	12.1	3.0	94
Machakos	896	2598	9.0	6.9	290
Marsabit	4	295	0.04	1.0	7350
Meru	336	1954	3.4	5.4	583
Kisii	220	2107	2.2	5.9	958
Kisumu	461	1116	4.6	3.4	242
Siaya	461	1096	5.7	3.2	239
S. Nyanza	571	2096	5.7	5.4	367
Baringo	250	443	2.5	1.4	177
Marakwet	104	212	1.05	0.55	240
Kajiado	22	462	0.2	1.33	2100

Laikipia	130	461	1.3	1.4	355
Kericho	380	1458	2.8	3.8	284
Nakuru	330	1644	3.3	4.5	498
Nandi	234	763	2.4	2.4	326
Narok	908	621	9.1	1.8	68
Samburu	140	144	1.4	0.4	103
Nzoia	208	895	3.3	2.4	430
U. Gishu	327	916	3.3	2.4	280
W. Pokot	103	719	-	2.3	698
Bungoma	253	1201	3.2	3.6	475
Busia	163	775	1.9	2.4	476
Kakamega	325	2278	5.9	5.1	701

Source: Compiled by the author based on the Projected Population

Table IIa

Projected Spread Pressure on High/Medium Potential Land Based on the Assumption of Constant Mortality and Fertility, 1980 and the Year 200

District	Density per Km^2 High/ Medium Potential Land		% Increase 1980 - 2000
	1980	2000	
Kiambu	188	419	123
Kirinyaga	288	599	108
Muranga	178	402	126
Nyandarua	94	191	103
Nyeri	325	678	109
Kilifi	132	290	120
Kwale	107	237	122
Taveta	304	633	108
Embu	112	260	132
Isiolo	-	-	-
Kitui	41	88	115
Machakos	122	279	129
Marsabit	2600	7300	180
Meru	265	580	119
Kisii	458	947	108
Kisumu	121	233	93
Siaya	119	237	99
S. Nyanza	166	329	98
Baringo	87	173	99
Marakwet	149	177	19

Kajiado	732	2009	175
Laikipia	113	339	200
Kericho	178	377	112
Nakuru	172	485	182
Nandi	137	318	132
Narok	25	67	168
Samburu	58	100	72
Nzoia	136	424	212
U. Gishu	99	251	154
W. Pokot	-	496	-
Bungoma	213	473	122
Busia	196	442	126
Kakamega	338	677	1004

Source: Compiled by the author based on the Projected Population Density.

Table IIb

Projected Spread Pressure on High/Medium Potential Land Based on Constant Fertility but Declining Mortality Levels, 1980 and the Year 200

District	Density per Km^2 High/ Medium Potential Land		% Increase 1980 - 2000
	1980	2000	
Kiambu	192	430	-
Kirinyaga	308	845	124
Muranga	196	466	138
Nyandarua	98	239	144
Nyeri	369	906	146
Kilifi	135	293	117
Kwale	118	243	106
Taveta	323	637	97
Embu	136	326	140
Isiolo	-	-	-
Kitui	42	94	124
Machakos	126	290	130
Marsabit	2900	7350	153
Meru	267	583	118
Kisii	501	958	91
Kisumu	123	242	97
Siaya	120	239	99
S. Nyanza	168	367	118
Baringo	89	177	99
Marakwet	158	240	52

Kajiado	741	2100	183
Laikipia	115	355	209
Kericho	179	284	57
Nakuru	189	498	164
Nandi	145	326	125
Narok	26	68	162
Samburu	64	103	61
Nzoia	139	430	209
U. Gishu	105	280	166
W. Pokot	168	698	316
Bungoma	221	475	115
Busia	201	476	137
Kakamega	339	701	107

Source: Compiled by the author based of the Projected Population Density.

TABLE III

Projected Increase Rates of Area and Yields of Land under Maize and Beans Between 1980 - 2000

Districts	Rates of Area and Yield per Hectare 1980 -2000			
	Maize		Beans	
	Area	Yield	Area	Yield
Kiambu	3.4	2.5	2.1	5.98
Kirinyaga	3.41	-0.82	4.9	-0.2
Muranga	3.42	-0.88	4.2	1.09
Nyandarua	2.7	-0.28	8.4	0.34
Nyeri	3.3	-0.57	2.5	-0.52
Kilifi	3.01	6.18	9.8	-0.4
Kwale	6.5	1.18	8.6	-0.29
Taveta	4.6	2.8	3.3	-0.41
Embu	5.7	-0.8	3.9	0.04
Isiolo	6.33	-2.4	6.6	3.6
Kitui	4.5	-1.2	0.94	-0.17
Machakos	1.2	0.69	2.1	-0.51
Marsabit	6.4	5.4	5.6	7.8
Meru	2.5	-0.17	4.5	-1.74
Kisii	4.2	2.3	5.9	0.37
Kisumu	-0.56	1.7	7.2	-0.93
Siaya	1.94	-0.25	-1.8	8.2
S. Nyanza	-0.21	0.04	2.01	-1.2
Baringo	4.0	-0.02	2.4	-1.2
Marakwet	2.5	-0.15	5.3	-0.24
Kajiado	4.3	-1.85	2.1	-3.4

Laikipia	4.5	0.61	7.3	0.21
Kericho	3.8	-1.63	4.5	-0.28
Nakuru	3.4	0.34	2.2	-0.47
Nandi	2.9	-1.3	-2.7	1.28
Narok	6.3	-2.7	8.3	2.4
Samburu	4.8	-3.6	0.2	0.78
Nzoia	2.0	0.82	-0.5	-1.04
U. Gishu	3.8	0.7	6.4	0.56
W. Pokot	2.9	-1.3	4.2	-2.2
Bungoma	3.97	1.2	4.7	-2.3
Busia	1.9	3.8	7.6	-2.3
Kakamega	0.5	2.8	5.0	4.6

Source: Compiled by the author based on the Projected Trends of the area and the yields of land under Maize and Beans.

Table IVa

Projected Maize Production (Supply) From 1980 to 1985, 1990, 1995 and 2000 in Tons

DISTRICT	Maize Production (Tons)			
	1985	1990	1995	2000
Kiambu	74995	10895	144181	186865
Kirinyaga	62094	72244	81314	89304
Muranga	69073	80373	90441	99276
Nyandarua	36628	41942	47081	52047
Nyeri	44475	52200	59402	66080
Kilifi	42212	70795	105867	147428
Kwale	33594	51796	71983	94152
Taveta	16613	24916	34818	46322
Embu	51539	68005	82494	95006
Isiolo	3656	4696	5380	5710
Kitui	60903	73783	84524	93392
Machakos	98826	109395	120463	132030
Marsabit	8587	16862	27883	41650
Meru	231306	264001	296095	327588
Kisii	168989	244497	329120	433363
Kisumu	31004	33008	34846	36515
Siaya	55096	60354	65414	70274
S. Nyanza	122567	113505	104615	95897
Baringo	22069	25355	27636	28912
Marakwet	51489	58628	65652	72960
Kajiado	21513	25083	27616	29112
Laikipia	34259	45725	57858	70658

Kericho	226425	259444	283899	299789
Nakuru	107670	133175	159536	186752
Nandi	195405	214974	230178	241302
Narok	52806	66563	74913	77862
Samburu	2100	2348	2397	2447
Nzoia	177863	207792	239626	273363
U. Gishu	158667	204122	252444	303635
W. Pokot	32915	36328	39008	40953
Bungoma	272352	392658	52887	681009
Busia	86369	81640	74035	63552
Kakamega	390723	470878	554778	642421

Source: Compiled by the author based on the Ministry of Agriculture Food Statistics.

Table IVb

Projected Beans Production (Supply) From 1980 to 1985, 1990 1995 and 2000 in Tons

DISTRICT	Beans Production (Tons)			
	1985	1990	1995	2000
Kiambu	10135	16053	23006	30991
Kirinyaga	15638	20489	25236	29878
Muranga	19107	25813	33157	41138
Nyandarua	4481	10867	15200	19680
Nyeri	15267	16109	18835	20438
Kilifi	6362	10629	14702	18637
Kwale	2008	3190	4335	5444
Taveta	1870	2205	2524	2826
Embu	25369	31812	38280	44772
Isiolo	37	63	96	134
Kitui	18984	19789	20577	21348
Machakos	78617	86034	92942	99342
Marsabit	78617	86034	92942	99342
Meru	70306	83284	92884	99105
Kisii	24949	34952	45330	56081
Kisumu	3409	4887	6205	7364
Siaya	37953	55494	68157	77666
S. Nyanza	15514	16340	16932	17319
Baringo	3191	3582	3960	4321
Marakwet	7688	10271	12787	15327
Kajiado	58794	84250	98151	100503
Laikipia	4979	7620	10319	13074

Kericho	4970	6293	7563	8780
Nakuru	16156	17848	19439	22930
Nandi	1384	1305	1203	1076
Narok	2022	3684	5690	8041
Samburu	97	94	91	88
Nzoia	48506	44331	41283	37863
U. Gishu	5206	7715	10363	13149
W. Pokot	3200	3661	3944	4047
Bungoma	27654	36671	45902	55349
Busia	10147	13909	16527	17999
Kakamega	40442	70030	107671	153363

Source: Compiled by the author based on the Ministry of Agriculture Food Statistics.

Table V

Projected Rate of increase of Maize and Beans Production Between 1980 - 2000

District	Annual Rate of Increase of Production 1980 - 2000	
	Maize	Beans
Kiambu	6.1	8.1
Kirinyaga	2.5	4.7
Muranga	2.6	5.3
Nyandarua	2.4	8.7
Nyeri	2.8	2.0
Kilifi	9.1	9.5
Kwale	7.6	8.3
Taveta	7.5	2.9
Embu	4.7	3.9
Isiolo	3.8	10.3
Kitui	3.2	0.76
Machakos	1.8	1.6
Marsabit	11.9	13.4
Meru	2.4	2.7
Kisii	6.5	5.9
Kisumu	1.1	6.3
Siaya	1.6	6.4
S. Nyanza	-1.5	0.8
Baringo	2.2	2.1
Marakwet	2.3	5.1
Kajiado	2.4	6.0

Laikipia	5.1	7.5
Kericho	2.2	4.1
Nakuru	3.8	2.2
Nandi	1.6	-1.4
Narok	3.6	10.7
Samburu	1.7	-0.5
Nzoia	2.8	-1.5
U. Gishu	4.5	6.9
W. Pokot	1.6	2.0
Bungoma	6.9	4.9
Busia	-1.6	5.2
Kakamega	3.3	9.2

Source: Compiled by the author.

APPENDIX III

TABLE Ia

Projected Maize (consumption/demand based on Constant Fertility and Mortality 1980 - 2000

District	(Consumption/Demand) Requirements 1980 and 2000			
	1980		2000	
	Set I	Set II	Set I	Set II
Kiambu	133761	126464	315724	281625
Kirinyaga	57768	53494	121610	111080
Muranga	143617	119153	327008	268639
Nyandarua	44452	42615	91432	86486
Nyeri	93578	89592	169076	186490
Kilifi	103511	79262	201194	174333
Kwale	60469	53155	134881	117001
Taveta	2857	27223	62908	56680
Embu	52665	48401	123416	111945
Isiolo	9719	8007	22243	18640
Kitui	92099	85576	199755	182538
Machakos	204038	188702	470138	42[illegible]188
Marsabit	20712	18010	58738	50380
Meru	169573	152165	37596	333037
Kisii	187626	171731	420128	354697
Kisumu	109387	95617	213923	184004
Siaya	103131	94560	208230	188055
S. Nyanza	180760	162498	364694	322606
Baringo	41333	37291	82266	74919
Marakwet	29717	26793	35129	31719

Kajiado	30854	27625	84431	75505
Laikipia	27753	13973	84642	24177
Kericho	128299	115628	273795	24517
Nakuru	108646	97135	306215	273876
Nandi	61090	54974	141049	126908
Samburu	15456	13973	25982	24177
Nzoia	53394	48270	165879	150051
U. Gishu	62519	55620	158119	140727
W. Pokot	33332	29564	98456	87331
Bungoma	100841	91914	225138	203389
Busia	60640	54709	138111	123007
Kakamega	202192	188214	409066	376068
Narok	43099	54974	141049	126908

Source: Compiled by the author.

Set I: Based on consumption standard of the recommended levels in Eastern Africa where the staple food is grains.

Set II: Based on the standard consumption of required daily allowance to meet the minimum caloric requirement per adult equivalent. This tends to under-estimate maize consumption/requirements.

TABLE Ib

Projected Beans (consumption/demand based on Constant Fertility and Mortality 1980 - 2000

District	(Consumption/Demand) Requirements 1980 - 2000			
	1980		2000	
	Set I	Set II	Set I	Set II
Kiambu	19926	54100	45183	12073
Kirinyaga	8826	22884	18211	47518
Muranga	20387	505917	44652	114918
Nyandarua	7442	18230	15026	36997
Nyeri	15707	38325	30635	79776
Kilifi	11952	33907	26029	79576
Kwale	8036	22739	17568	50051
Taveta	4471	11645	8820	24247
Embu	7934	20705	18254	49888
Isiolo	1145	3425	2673	7974
Kitui	12518	36608	29489	78080
Machakos	31008	80722	70052	183597
Marsabit	2661	7704	7399	21651
Meru	24035	65093	52303	142466
Kisii	28311	73463	58878	151731
Kisumu	12462	40903	27629	78968
Siaya	14903	40451	29493	80445
S. Nyanza	25653	69513	50548	138004
Baringo	5943	15952	11971	35049
Marakwet	4204	11461	5049	13569
Kajiado	4357	11817	12050	32300

Laikipia	4021	10740	12400	33196
Kericho	18631	49463	39638	105069
Kericho	15417	41552	43896	117158
Nandi	8691	23517	20285	54289
Narok	6154	16624	16618	44453
Samburu	2212	5977	3981	10342
T. Nzoia	7790	20649	24481	64188
U. Gishu	8754	23793	22390	60200
W. Pokot	4603	12647	13746	37358
Bungoma	15074	39319	33345	87005
Busia	8657	23404	19370	52620
Kakamega	31018	80514	62197	160874

Source: Compiled by the author.

Set I: Based on the Recommended diet in Eastern Africa where staple food is grains

Set II: Based on the required daily allowance (RDA) to meet the minimum caloric requirements per adult-equivalent. This tends to over-estimate the consumption of beans.

Table II

Projected Maize and Beans Consumption (demand) based on Constant fertility and declining mortality levels using (RDA)

District	Maize and Beans Requirements (Consumption/ Demand 1980 and 2000			
	1980		2000	
	Maize	Beans	Maize	Beans
Kiambu	134988	57745	302999	129616
Kirinyaga	59970	25654	164417	70334
Muranga	137768	58942	327626	140151
Nyandarua	46539	19908	113919	48732
Nyeri	106320	45481	260945	111626
Kilifi	85551	36597	184926	79107
Kwale	61210	26184	125705	53774
Taveta	36156	12900	59484	25446
Embu	61727	26405	147911	63273
Isiolo	9735	4164	19925	8524
Kitui	90432	38685	204222	87362
Machakos	202245	86516	467558	200011
Marsabit	20917	8948	530074	226754
Meru	161557	69110	351620	150415
Kisii	198585	84950	379168	162200
Kisumu	102173	43707	200954	85964
Siaya	99844	42711	197204	84360
S. Nyanza	172387	73743	377332	161414
Baringo	39472	16885	79803	34138
Marakwet	29555	12643	38103	16299

Kajiado	29353	12557	83064	35533
Laikipia	26934	11522	82900	35463
Kericho	122104	52233	262356	112230
Nakuru	112696	48209	295867	126565
Narok	42269	18082	111756	47807
Nandi	61121	26146	139320	58742
Nzoia	52039	22261	161010	68877
Samburu	16218	6938	25865	110647
U. Gishu	61687	26388	164833	70512
W. Pokot	31218	13355	129360	55337
Bungoma	100384	42942	216103	92444
Busia	59044	25258	139465	59660
Kakamega	198400	84871	410095	175430

Source: Compiled by the author.

Note: The table is based on required daily allowance (RDA) to meet minimum caloric requirement per adult-equivalent. It tends to over-estimate nutritional requirements

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