kajiado

DISTRICT ENVIRONMENTAL ASSESSMENT REPORT

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in cooperation with Clark University
and the United States Agency
for International Development

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EXECUTIVE SUMMARY

This report, the first in a series of district level studies, considers the relationships between environment and development in Kajiado District. The purpose of these reports is twofold:

(a) to indicate the environmental impact of development;

(b) to indicate the potential environmental constraints on development.

Kajiado District, a semi-arid area, suffers from severe social-environmental pressures. The chapters on the physical and human environment conclude that the district's semi-arid ecosystem, though poor in resources, offers a potentially stable resource base for development. Yet environmental concerns have arisen in recent years because pressures external to the traditional management systems have emerged. These pressures include:

(a) The growth of Nairobi which particularly impacts the area around the Ngong Hills;

(b) The growth of tourism and the consequent legislation to reduce access to national parks and conservation areas;

(c) The immigration and spontaneous settlement of arable farmers from other parts of the country.

The report concludes with a series of suggestions and recommendations which note that the traditional responses for such environmental pressures may not, in themselves, be appropriate to solve Kajiado's resource concerns. Traditional responses include:

(a) education to improve the situation;

(b) improving or opening sufficient numbers of water holes;

(c) diversification of pastoralism, including cultivation, to increase subsistence production.

Although these responses may provide short-term relief and perhaps even halt further resource deterioration, they will probably not provide a cure. Longer-range strategies which the report suggests include methods whereby the benefits of tourism can be shared more equitably with pastoralists in the district; alternative employment

can be created which is derived from livestock marketing such as slaughter houses, dressing plants, and leather tanning; and direct livestock efforts can be undertaken with pastoralists to improve stock and to broaden the range of marketing options for cattle and cattle products.

The suggestions and recommendations are contained on pages 65-69.

FOREWORD

This report is the first in a projected series of district environmental profiles in Kenya. It has been prepared as an experiment in district planning in the conviction that effective availability of resource data will improve resource management in development activities.

The document is a cooperative effort, prepared by Kenya's National Environment Secretariat, in association with Clark University's Program for International Development (USA). Funding has come from the Kenyan Government and the United States Agency for International Development.

The project has come under the supervision of Michael Joram Njenga, Director, National Environment Secretariat, Ministry of Environment and Natural Resources. The first project manager, William Mbote, was transferred to Kenya's Energy Office about half way through the field work stage; Richard Arap-Lelei followed and brought the field work to a sound conclusion; final production of the Kenya version of the report was managed by Moses Wanga. All three project managers have brought highly professional skills of research and information management. Without their good services, the document would be far less comprehensive and relevant. The project managers received vital assistance in data collection, analysis, and presentation from a field team

of the National Environment Secretariat. In addition, cooperation from a number of district officials was greatly appreciated.

Coordination of the Clark University contributions came from Philip O'Keefe, Visiting Professor of Geography and International Development at Clark. His field work and assistance in preparing the first draft helped immeasurably in meeting production deadlines.

Typing, cartography, and printing, both in Kenya and at Clark, have been provided by staff at the National Environment Secretariat and Clark University. There are two editions. In Kenya the National Environment Secretariat has printed and distributed copies for use by central and district planning officials, for assistance in establishing and monitoring base-line resource data in Kajiado, for distribution to field offices of donor agencies in East Africa, and for evaluation by the United Nations Environment Program and other UN offices in Nairobi. Clark University has prepared a second edition (this version) which is identical in text but printed in the U.S. for distribution in North America and Europe.

This report is part of a larger series of publications on themes of resource management in Eastern Africa, including drought management in Botswana, environmental overviews for Zambia, land systems and land potential mapping in Tanzania, fuelwood analysis for the region as a whole, famine in Ethiopia, and incidence of desertification in Sudan. Docu-

ments on all of these activities are available from the International Development Program, Clark University, Worcester, Massachusetts, 01610, U.S.A.

Comments regarding this approach to district planning and resource management will be welcome.

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1. ABSTRACT

Kajiado District, a semi-arid area, suffers from severe social-environmental pressures. The pressures are largely generated externally and can be identified as:

(i) The growth of Nairobi which particularly impacts the area around the Ngong Hills;

(ii) The growth of tourism and the consequent legislation to reduce access to national parks and conservation areas;

(iii) The immigration and spontaneous settlement of arable farmers from other parts of the country.

In addition, the internal pressure of human population growth limits the subsistence production and self-sufficiency of the pastoralists increasing the probability of damage to rangeland ecology. This report describes the social-environmental system, analyses these trends, and considers options for environmentally sound development programmes in the district.

2. INTRODUCTION

2.1 Objective of the Survey

This report, the first in a series of district level studies, considers the relationships between environment and development in Kajiado District. The purpose of these reports is twofold:

(a) to indicate the environmental impact of development;

(b) to indicate the potential environmental constraints on development.

For several reasons, the need for such systematic approaches to the problems of environment and development is rapidly increasing rather than decreasing. First, there is a tendency for planning to become increasingly project focused, defined by the narrow boundaries of project identification and appraisal techniques. Second, this tendency forces attention on isolated, discrete analysis of individual projects ignoring the complex interrelationships between environment and developmental factors for successful development planning. Third, with the decline of regional analysis as a planning framework, environmental appraisal, at district level, reasserts the necessity of considering the local situation, of identifying local prospects and problems in development, and of transmitting this knowledge to Central Government so that it can inform policy decisions. Finally, and perhaps most importantly, such studies can provide a programmatic framework within which policy options can be determined. This programme framework will essentially be a formative planning exercise which will look beyond the five year planning process to substantial issues that will not only affect us and our children but also our children's children and beyond.

2.2 Existing Situation

Kajiado District lies to the south of Nairobi, situated in the edge of the highland plateau. Although it can be identified as a zone of ecological transition, the predominant livelihood system is pastoralism or semi-pastoralism. Compared to other arid and semi-arid areas, the infrastructure and service centres of Kajiado District are well developed. However, comparisons with other arid and semi-arid

areas only hide the real development and environmental problems which stem, in part, from the proximity of Kajiado District to Central Province and Nairobi.

2.3 Internal Organisation of the District

Unlike most other districts, Kajiado is subdivided administratively into "clan sections" rather than geographical locations. There are two divisional headquarters at Ngong and Loitokitok respectively. The central part of the district is treated as a separate division administered from Kajiado. Ngong Division comprises the Keekonyukie section while Loitokitok is mainly Iikisongo and Orokiteng. The Central Division comprises Lookokilani, Matopato, Iidamat, Purko, North and South Kaputiei, Kangere, and Ndalelekutuk. The Olkejuado County Council's area of jurisdiction is coincident with the district.

3. PHYSICAL ENVIRONMENT

3.1 Geographical Location and Physiography

Kajiado District is located between 36° 5' and 37° 55' East and 1° 10' and 3° 10' South. It covers an area of 22,106 square kilometers including Lakes Magadi and Amboseli. Three areas of highland (5000') exist (1) in the Ngong Hills, (2) around the central part of the district, and (3) to the southeast or the slopes of Kilimanjaro. To the northeast are high plains which break upon the Rift Valley. Hillslope gradients exceed 25 percent although the average is around 8 percent. The area is drained by the Athi River to the north and by the Namanga to the south. The southwest is drained by the Fwaso Ngiro and the southeast by the Tsavo. The greater portion of the district is gently undulating except around Loitokitok, Namanga, Ngong. Minor hills and gullies appear around Loitokitok.

3.2 Geology

Most of the Central Kajiado is a basement complex formed in the preCambrian era. The gneisses, schists, quartzites, and limestones have been weathered for more than seventy million years and in some places the underlying rock formation is exposed. The area flanked by Magadi, Kajiado, and Ngong townships consists of tertiary formation. Quarternary volcanics are found in the western side of the district, the south-eastern side of the district, and the area of the Chyulu Hills. Quarternary alluvial deposits occur in the southwest and in the areas around Magadi and Namanga.

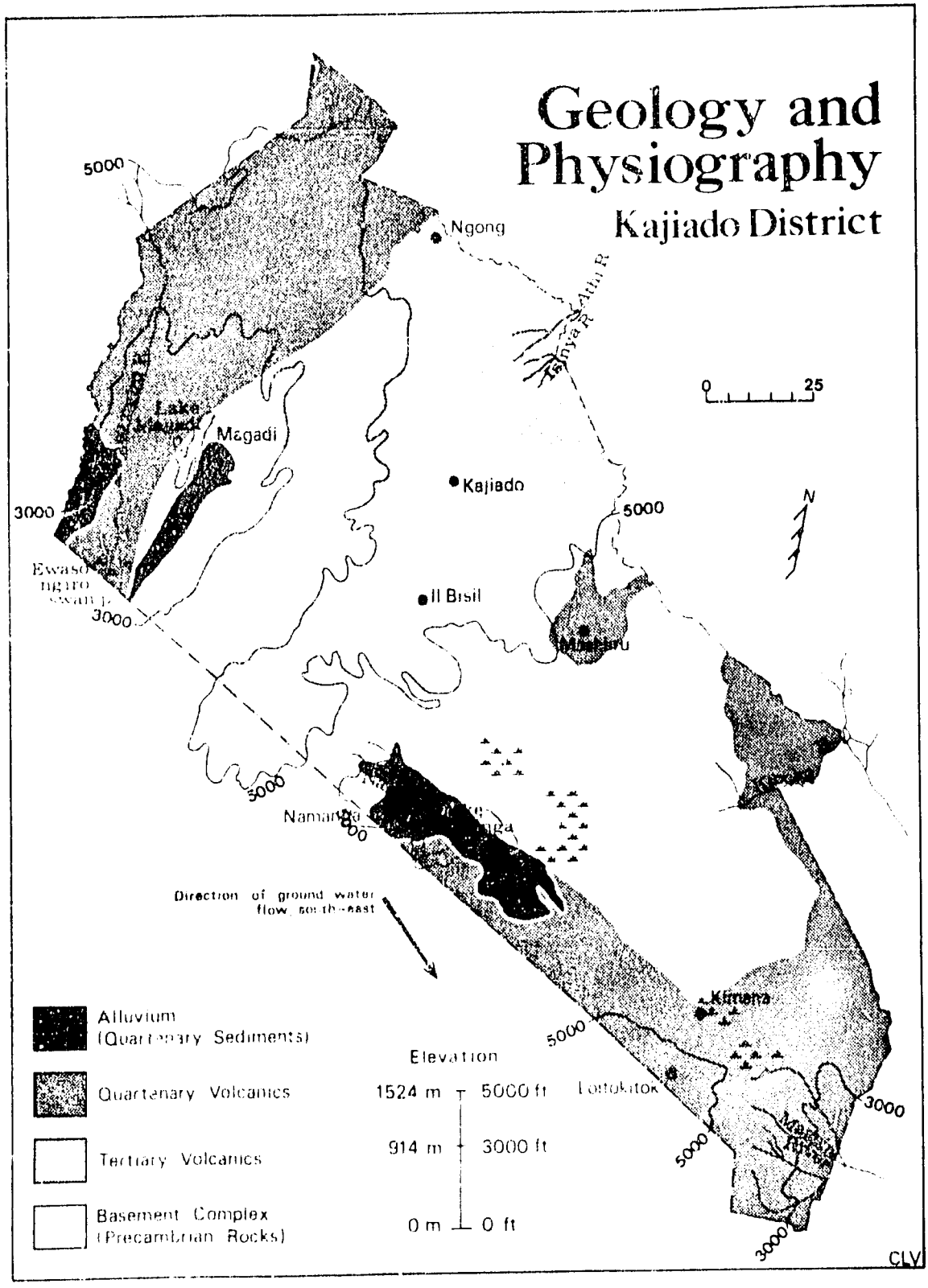
The soils of the alluvial deposits are rich and in general the volcanic soils have better nutrient associations and physical properties than those of the basement complex.

Figure 1 illustrates the solid geology and physiography of Kajiado.

3.3 Soils

The soils of the district vary according to parent material relief, vegetation, climate, and human and animal activity. Over the whole district, the soils are poorly developed. Shallowness of soil prohibits ploughing. Rarely does profile depth exceed one metre. Profiles in the Athi Kapiti plains, near Athi River township, range from 0.5 to 1.0 metres. A slightly smaller range is observable in the Basement Complex

FIGURE 1



SOURCE: 1) Dunne, T. 1977 Intensity and control of soil erosion in Kajiado District: FAO Project Working Document No. 12.

2) The National Atlas of Kenya, 1970

in Amboseli. In the area around Loitokitok, soil depths vary from 0.1 to 0.7 metres. Termite mounds are observable throughout the whole district and soil is frequently moist beneath these mounds, even during the dry season.

Over much of the district, the soil is blocky or subangular blocky. In many areas, excluding the Athi Kapiti Plains, the upper 2 cm of the soil have a thin, brittle structure or are structureless. The greater part of the district is characterised by stones, gravels, and hardpan (duripan). Soil is slightly saline with a pH range of 6.3 to 8.6. The texture of the soil varies over the district from the clay soils of the Athi plain to the sandy soils of North Namanga. Soil consistency varies from very friable to friable. In the areas of black cotton soils, the material is plastic when moist. Table 3.3 outlines the major soil types of the areas. Figure 2(a) illustrates the pedology.

The classification underlying Figure 2 (a) is the physical and chemical properties of the soil. It is important to note that the highland soils, (viz. units 1,2,3,9,10,11,12 and 15), are usually more weathered than the soils of the lowland. Sand soils are generally poorer and more erodable than the clay or loamy soils. Soils of units 6,7,12 and 14 frequently pose drainage problems.

Chemical analysis suggests a soil of reasonable fertility. Infiltration rates, over most of the district, are from moderate to rapid. For example, the zone north of Loitokitok has recorded rates ranging from 5.7 to 15.8 cm/h. Only in black cotton soils is the infiltration rate low. The moisture retention capacity is low in sandy soils and relatively high in loamy soils. In field experiments within the district, loamy soils and sandy clay loams were compared at pf 2.3, retaining 35.6 and 26.5 per v/v basis respectively. Over most of the district, base saturation is average.

3.4 Climate

The lack of a comprehensive climatic data base for Kajiado District makes an analysis of this semi-arid area extremely difficult. No data are available on evapotranspiration, water balance, radiation, soil temperature, windspeed, or hours of sunshine. Even where data are available, such as rainfall and temperature, gross extrapolations are inevitable, especially in describing spatial variations, because recording stations are so few.

TABLE 3.3

SOIL TYPES IN KAJIADO*

(A)	WELL DRAINED SOILS OF SUBHUMID REGIONS - FRIABLE CLAYS AND LOAMY SANDS
(B)	WELL DRAIN SOILS OF SEMI-ARID REGIONS - CALCAREOUS LOAMS AND SANDY LOAMS
(C)	WELL DRAINED SOILS OF ARID REGIONS - CALCAREOUS LOAMY SANDS AND SAND DUNES
(D)	SOILS WITH SEASONALLY IMPEDED DRAINAGE - CLAYS AND LOAMS WITH LATERITE HORIZONS
(E)	SOILS WITH IMPEDED DRAINAGE - BLACK AND BROWN CLAYS
(F)	ASH AND PUMICE SOILS
(G)	LAVA BOULDERS, SHALLOW STONY SOILS, STEEP SLOPES AND ESCARPMENTS

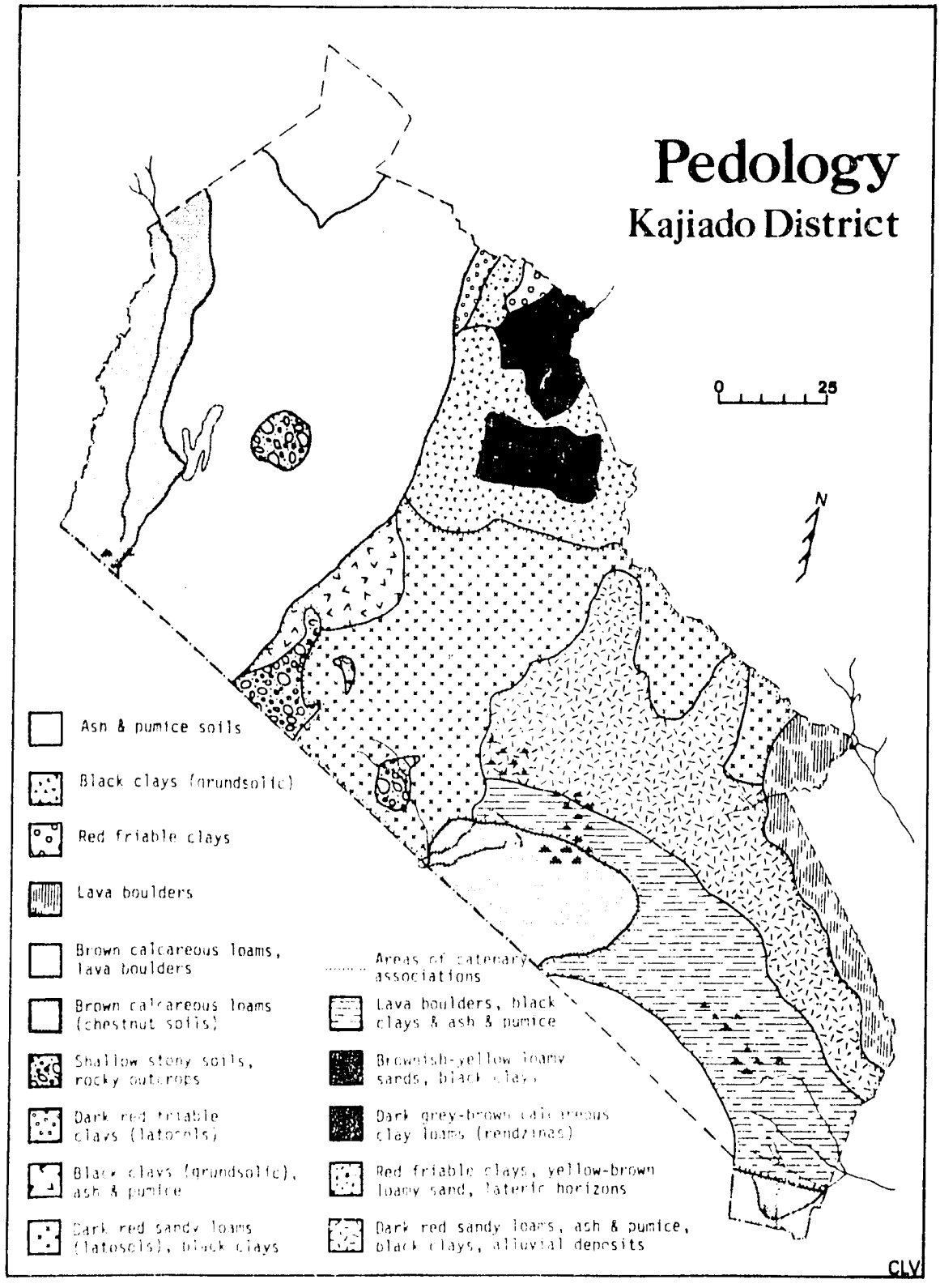
*

Rift Valley Province Regional Physical Development Plan

Ministry of Lands and Settlement, 1973

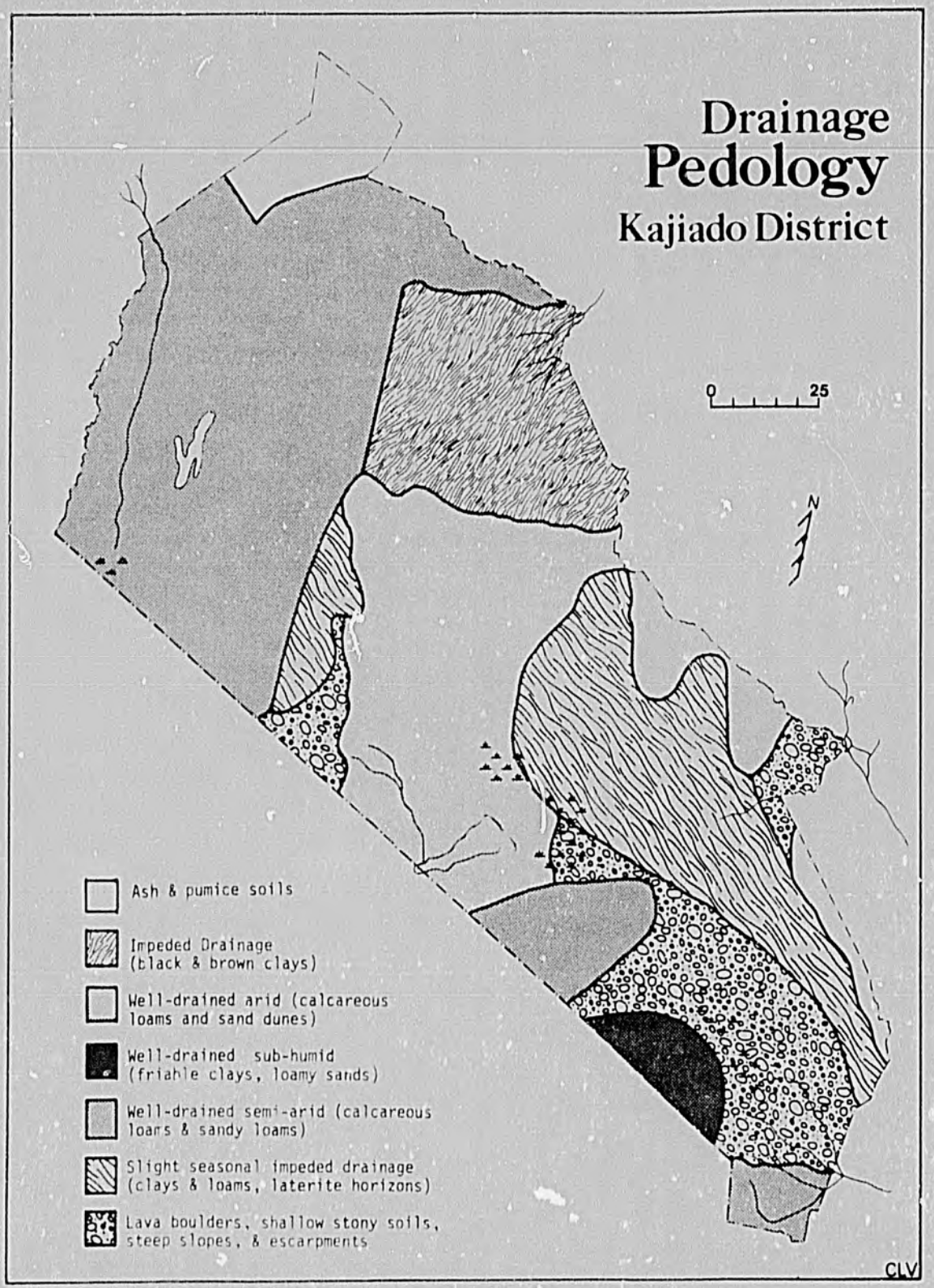
A'

FIGURE 2 (a)



SOURCE: The National Atlas of Kenya, 1970

FIGURE 2(b)



SOURCE: The National Atlas of Kenya, 1970

Rainfall over the whole district, except the Ngong and Loitokitok areas, is below 500 mm per annum. The mean annual rainfall for the district is 765.00 mm although rainfall is actually quite variable. Rainfall in the area is directly related to altitude. Figure 3 shows annual rainfall probabilities at Kajiado and Magadi.

The maximum temperature for the district is 34°C while the minimum is 12°C. The area around Magadi township has the highest temperature while Loitokitok has the lowest (Max. 24°C; Min. 12°C).

Attempts have been made to generate composite greenness maps generated from spectral analysis of Landsat images over time. Such attempts have indicated that greenness is not directly related to rainfall and temperature. The only areas which are consistently verdant are the swamp areas around Amboseli Lake, Ngong township, the lower slopes of Kilimanjaro and Sultan Hameid, east of Kajiado township. The correlation between composite greenness and annual rainfall is low (r= 0.39) although it has been suggested that effective (available) rainfall and composite greenness will be highly correlated. Little work has been completed on evapotranspiration in the area although it should be noted that under normal range conditions, when water is scarce and vegetation forms an incomplete cover, actual evapotranspiration falls below potential evaporation. There is no simple relationship observable in this area between rainfall and rainfall variability (i.e. rainfall is not more variable in areas receiving lower annual amounts) which compounds the difficulties of interpreting composite greenness indices.

Aridity is closely related to the intensity of rainfall. Over much of the district, rain falls at night at an intensity that maximises infiltration and minimises runoff and evaporation. 80 percent of rainfall falls at an intensity equal to or less than 25 mm per hour, an intensity that is less likely to cause runoff and erosion.

Work completed to date suggests that to calculate an available water index (effective rainfall), attention should be focused upon quantity and intensity of rainfall, potential evaporation, surface quality, and soil type.

Figure 4 shows annual potential evaporation throughout the district. The area around Magadi has the highest potential evaporation (2,400 - 2,600 mm per annum). The higher altitudes, around Ngong and Loitokitok, have the

FIGURE 3

ANNUAL RAINFALL PROBABILITIES AT KAJIADO AND MAGADI

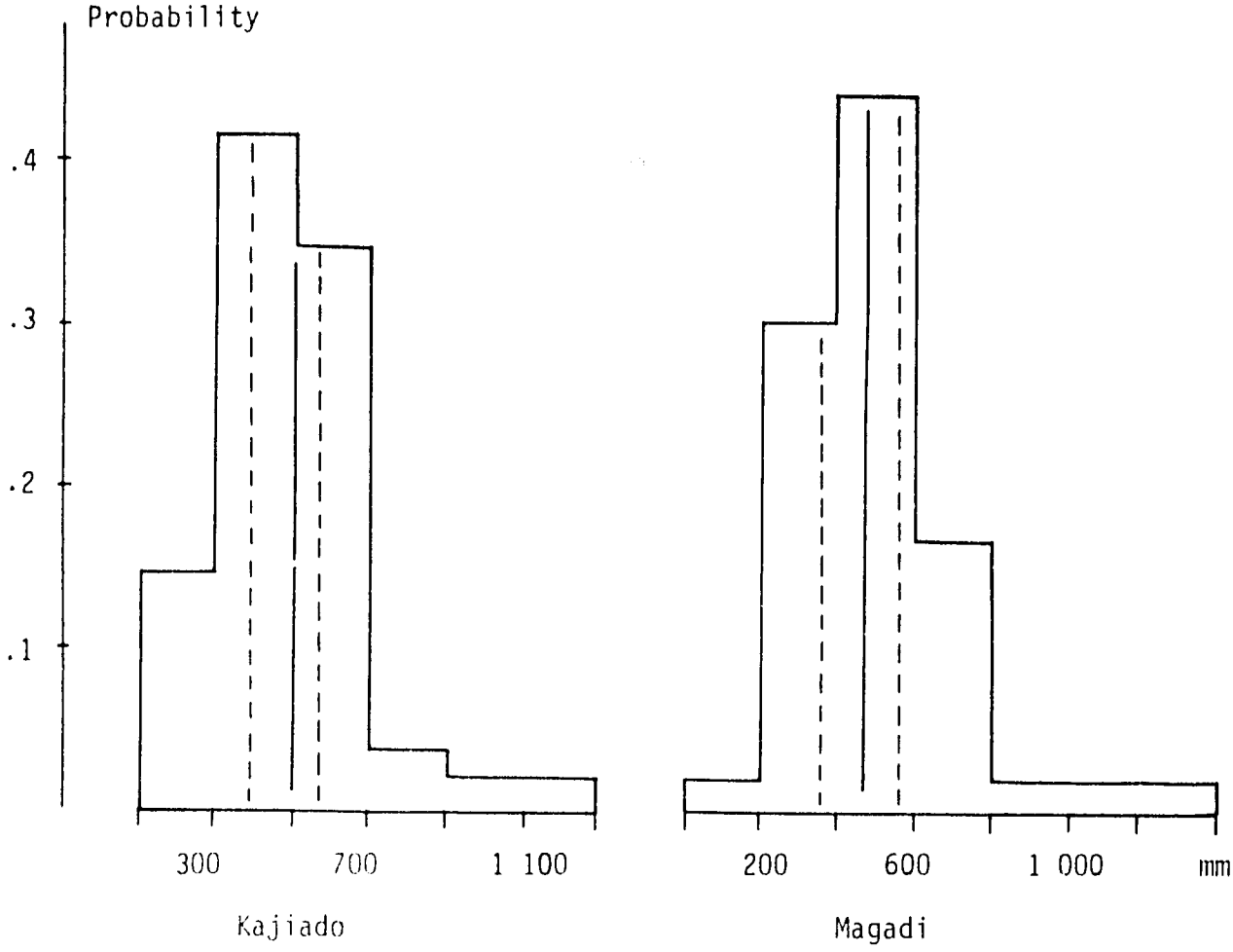
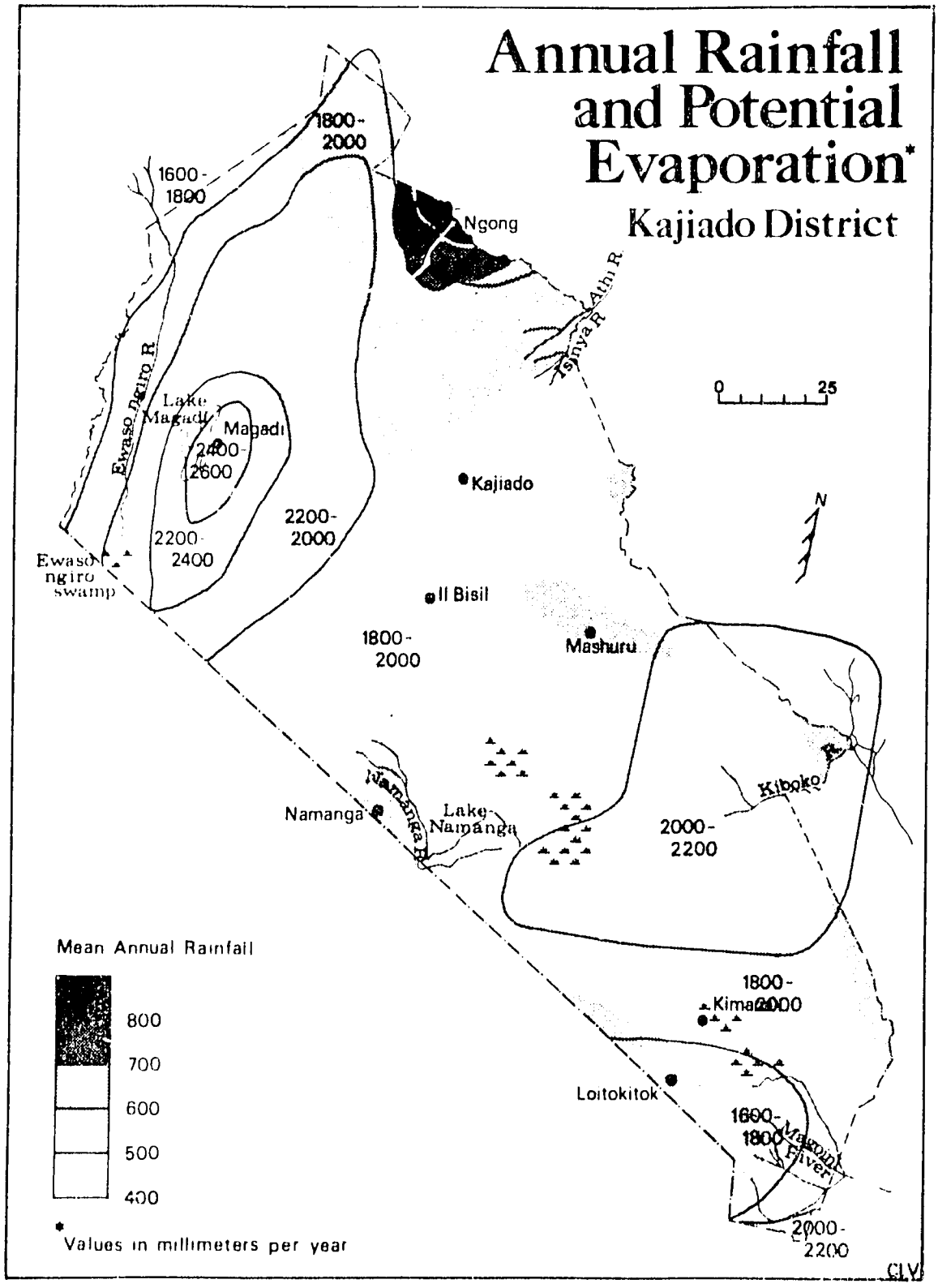


FIGURE 4



SOURCE: Woodhead-Classification of East African Rangeland. Journal of Applied Ecology No. 7 pg. 647-652, 1970.

lowest potential evaporation (1,600 - 1,800 per annum). The available water index would, therefore, be highest in the areas of Loitokitok and Ngong and lowest around Lake Magado.

3.5 Drainage

Drainage, strictly referring to the movement of water through the soil, is a function of slope type, slope gradient, and soil type. Most of the area is well drained including the higher areas around Ngong. Impeded drainage, however, exists in the central portion of the district because of the clay nature of the soil. Severe seasonal flooding has been recorded.

Few permanent rivers exist in the district. Information on surface water hydrology is scanty and no water pollution monitoring is currently underway in the district. Ground water yield varies throughout the district from 0.01 to 35.77 cubic metres per hour (7870 gallons per hour). Average ground water is reported as good; it is used for domestic, livestock, and irrigation purposes.

3.6 Water Hydrology and Use

Although flow data are lacking for most of Kajiado District rivers, information is available for Kimana and Rikondo Springs. The flow rate for Kimana during dry periods is an average 7.6 cu. ft/sec. The discharge rates of Ewaso Ngiro river was calculated as 2 m^2/sec while a tentative estimation of velocity was given as 0.4 m/sec. Recent analysis of the Ewaso Ngiro suggests that the silt load is low but the bicarbonate content is high. In contrast, chemical analysis of the Loifulclei River, near the Kiman irrigation scheme, indicated that both the carbonate and saline content were low and that no sulphates were evident.

3.7 Vegetation and Forest Resources

The vegetation of the district is determined by altitude and soil type although it has been much modified by animal and human activity. Grazing, forest destruction, and burning for cultivation are obvious examples of such modification. In lower altitudes vegetation is scarce but it increases with altitude.

Figure 5 illustrates the vegetation zones. Zone 1, to the western side of the district, is wooded grassland. In this vegetation association are Digitaria macroblephara, Gymbopogon pospischilli, Combretum zeyheri and Balanites aegyptiaca.

Zone II is wooded and some grasses, Pennisetum Mezianum and hintonia nutaus, are also found. Zone III is woodland. The vegetation association includes Chloris roxburghiana, Themeda triandra; Pennisctum mexianum and Acacia tortilis. Zone IV is grassland and wooded grassland consisting of such species as Digitaria macroblephara, Gymbopogon pospichillii, Cmbretum zeyheri, Balanites aegyptiaca and Acacia drepanolobrium. Zone V, bushland and woodland, primarily displays Pennisetum stranineum Cenchrus ciliaris, Acacia nubica and Acacia tortilis. Zone VI is bushland supporting a vegetation association that includes Pennisetum strmineum, Cynodon plectusta chyns, Acacia mellifera and Balamtes algytiaca. Zone VII is grassland consisting of Digitaria macroblephara and Sporobolus fimbriatus.

Ground cover throughout the district varies seasonally with rainfall and grazing intensity. Canopy cover ranges from less than 1 percent on heavily settled areas to about 30 percent on a few steep hills where potable water is unobtainable and no settlement is possible.

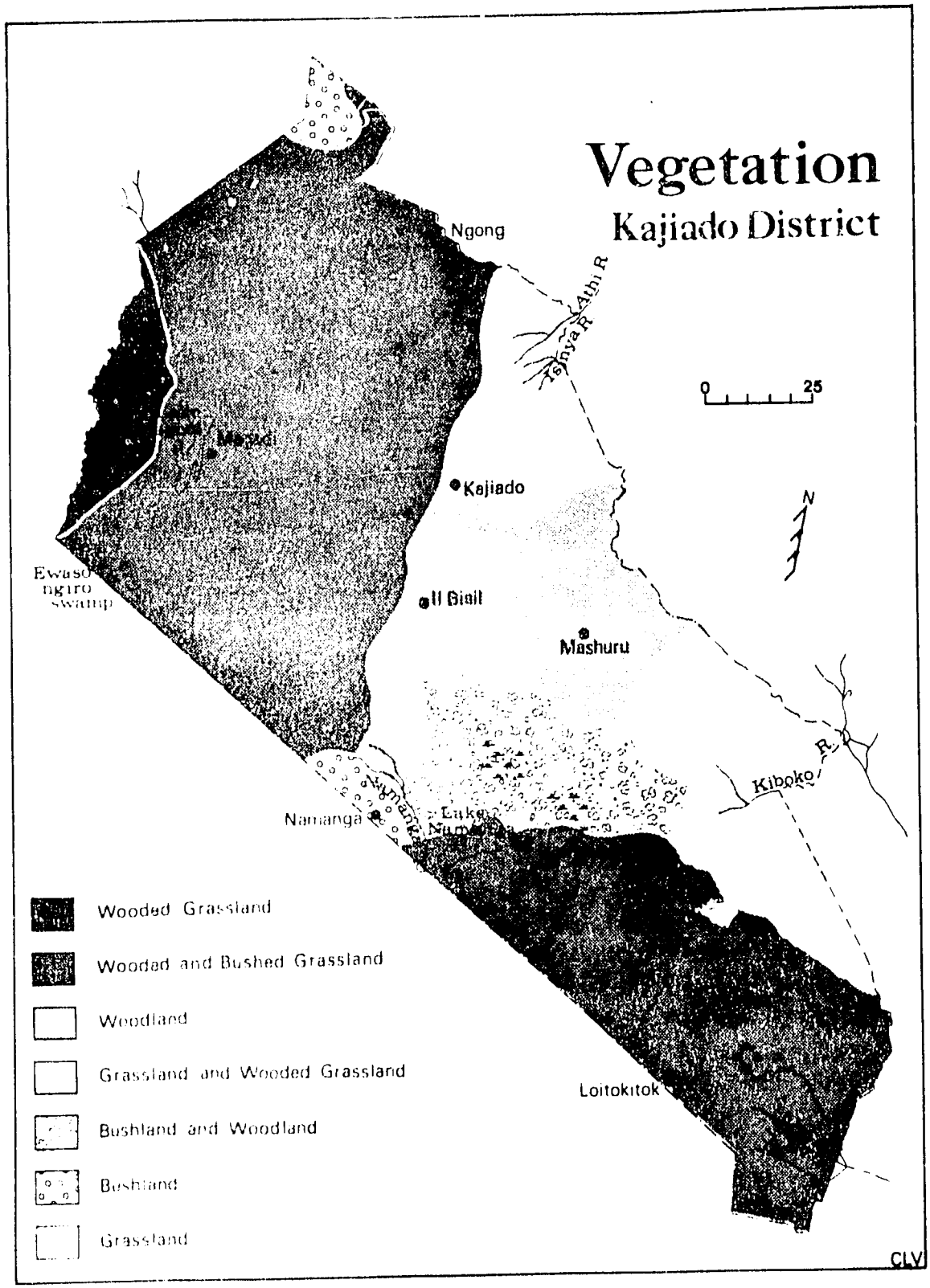
3.8 Wildlife

Wildlife not only exists in the national parks and game reserves but throughout the whole of the district. There are, however, three areas of wildlife concentration, namely, the Kitengela Game Conservation area/Nairobi National Park, the Amboseli National Park, and the West Chyulu Game Conservation area. There are a number of management units that cover the whole district; these are detailed in Table 3.8(b). Table 3.8(a) contains a listing of the species found in Kajiado District.

Recent work indicates that the species specifically vulnerable to drought are wildebeest. Coke's hartbeast and zebras / are not differentially impacted by age or sex characteristics. Areas of wildlife concentration include besides the Parks and Conservation areas, the Western part of the district and the Athi-Ngong and Kajiado area.

In general, game migrates to the higher areas or swamps during the dry season but, during the west season, the game spreads widely across the plains. Although total figures of wildlife density and foraging consumption are not available, it is frequently assumed that the density of wild animals is lower and, therefore, less environmentally damaging than that of domestic herds.

FIGURE 5



SOURCE: 1) The National Atlas of Kenya, 1970

2) The Kenya Soil Surveys

TABLE 3.8(a)

TOXONOMIC NAMES OF WILDLIFE SPECIES FOUND IN KAJIADO DISTRICT

Buffalo - Syncerus caffer Sparrman
Bushbuck - Tragelaphus scriptus Pallas
Crocodile - Crocodilus niloticus Laurenti
Dikdik - Rhynchotragus kirkii Gunther and R. Guentheri Thomas
Duiker, blue - Cephalaphus monicola Thunberg
Duiker, grey - Sylvicapra grimmia Linn
Duiker, red - Cephalophus natalensis A. Smith
Duiker, Hook's black fronted - Cephalophus nigrifrons Gray
Eland - Taurotragus oryx Pallas
Elephant - Loxodonta africana Blumenbach
Gazelle, Grant's - Gazella granti Brooke
Gazelle, Thomson's - Gazella thomsonii Gunther
Gerenuk - Litocranius walleri Brooke
Giraffe - Giraffa camelopardalis Linn. and G. reticulata De Winton
Hartebeest, Coke's - Alcelaphus buselmaphus cokii Gunther
Hartebeest, Hunter's - Damaliscus hunteri Sclater
Impala - Aepyceros melampus Lichtensteir
Klipspringer - Oreotragus oreotragus Zimmerman
Kudu, Greager - Tragelaphus strepsiceros Pallas
Kudu, Lesser - Strepsiceros imberbis Blyth
Leopard - Panthera pardus Linn
Lion - Panther leo Linn
Monkey, blue (Sykes) - Cercopithicus mitis Wolf
Monkey, red (Patas) - Erythrocerus patas Schreber
Monkey, putty nosed - Ceropithicus nictitans Linn
Monkey, black and white colobus - Colobus abyssinicus Oken
Oribi - Ourebia ourebia Zimmermann
Oryx, Beisa - Oryx beisa beisa Ruppell
Oryx, fringe-eared - Oryx beisa callotis Thomas
Ostrich - Struthia camelus Linn
Reedbuck, Bohor - Redunca redunca Pallas
Reedbuck, Chanler's mountain - Redunca fulvorufula chanleri Rothschild
Rhinoceros - Diceros bicornis Linn
Warthog - Phacochoerus aethiopicus Pallas
Waterbuck, common - Kobus ellipsiprymnus Ogilby
Waterbuck, defassa - Kobus defassa Ruppell
Zebra, Burchell's - Equus burchelli Gray
Zebra, Grevy's - Equus grevyi Oustalet

Source: 1) Kenya Rangeland Ecological Monitoring Unit Reports

2) FAO/PBFL, FAO/KWMP and WCMD Report No. 34

3) FAO/KEN: 71/526 Reports 1 - 8

TABLE 3.8(b)

NUMBERS AND NAMES OF WILDLIFE MANAGEMENT UNITS KAJIADO DISTRICT

K 20	SOUTHERN RIFT VALLEY MANAGEMENT AREA
K 20a	Torosei Management Unit
K 20b	Ewaso Ngiro Unit
K 20c	Magadi Unit
K 20d	Elangata Unit
K 20e	Kipeto Unit
K 20f	Suswa Unit
K 20g	Ngong Unit
K 21	ATHI-KAPITI MANAGEMENT AREA
K 21a	Nairobi National Park Unit
K 21b	Kitengela Management Unit
K 21c	Senya Unit
K 21d	North Kaputei Unit
K 22	CENTRAL KAJIADO MANAGEMENT AREA
K 22a	Meto Management Unit
K 22b	Mailua Unit
K 22c	Kajiado Unit
K 22d	Central Kaputei Unit
K 23	EASTERN KAJIADO MANAGEMENT AREA
K 23a	Amboseli Park Management Unit
K 23b	Lolarashi Unit
K 23c	Lengesim Unit
K 23d	South Kaputei Unit
K 23e	Makutano Unit
K 23f	Kimana Unit
K 23g	Kuku Unit
K 23h	Rombo Unit
K 23i	Loitokitok Unit
K 23j	Chyulu Hills Unit

Source: "Hunt Management Program, Kajiado District" Republic of Kenya, Kenya Game Department and UNDP/FAO Wildlife Management Project FAO-KEN 71/526 Report No. 3, 1973.

4. HUMAN ENVIRONMENT

4.1 Population

The 1969 census recorded a total of 85,093 persons in Kajiado District. Until recently, the Central Bureau of Statistics had estimated the average annual growth rate of population at 3.18 percent per annum. This would give the estimated population as of 1979, as 113,800 * persons. Further projections, to 1983, would suggest a population in excess of 134,000. Table 4.1(a) outlines high and low projections for 1989 at 206,000 and 162,000 respectively. Some doubt must be cast on the assumption of an annual national population increase of 3.18 percent. Discussion suggests that a more accurate rate would be around 3.8 percent per annum. However, rates of population increase are significantly lower in semi-arid areas than in the high potential areas. It should be noted, however, that these growth projections do not include immigration, a process that seems to be accelerating throughout the district. Table 4.1(b) and Figure 6 show the population distribution in the district by locations. The overall density is 4 persons per sq. km. Ngong is the striking exception with a population density of 117 persons per sq. km.

Figure 7 shows an age-sex histogram for Kajiado. It displays a form common to population descriptions in underdeveloped countries. First, the number of children, as proportion of the total population, is large. Second, there seems to be evidence of out-migration from the district of both male and females between the ages of 20 - 29, presumably in search of wage employment.

The settlement hierarchy is based upon designation, in ascending order of importance, of local, market, rural, and urban centres. There are 16 local centres, 8 market centres, 1 rural centre, and 3 urban centres in the district. These centres usually provide some form of health and educational facilities.

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*A preliminary and unofficial version of the 1979 census lists Kajiado District at 149,000, thus reinforcing the estimate that a 3.18 percent increase is conservative.

TABLE 4.1(a)

DISTRICT POPULATION PROJECTIONS
RIFT VALLEY PROVINCE
KAJIADO DISTRICT

SET I: LOW PROJECTION — POPULATION IN THOUSANDS

AGE	1978	1979	1980	1981	1982	1983	1984	1989
KAJIADO	114	113	122	126	130	134	136	162
0-5	25	26	27	28	29	30	31	36
6-12	20	21	22	23	23	24	25	29
13-16	11	11	12	12	12	13	13	15
17-59	51	53	55	57	59	61	59	72
60+	3	3	3	3	3	4	4	4
Women aged 15-49	27	28	29	30	31	33	34	37
Implied Births	5.0	5.2	5.4	5.6	5.8	6.0	6.1	7.2
Implied Deaths	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.6

SET III. HIGH PROJECTION

AGE	1978	1979	1980	1981	1982	1983	1984	1989
KAJIADO	126	133	139	144	152	158	166	206
0-5	33	35	36	38	39	41	45	55
6-12	25	26	28	29	30	31	34	42
13-16	12	13	14	14	15	16	17	21
17-59	52	55	57	60	63	65	67	83
60+	2	2	2	2	2	2	3	3
Women aged 15-49	27	28	29	30	32	33	34	42
Implied Deaths	6.4	7.1	7.4	7.7	8.1	8.4	8.8	10.9
Implied Births	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.5

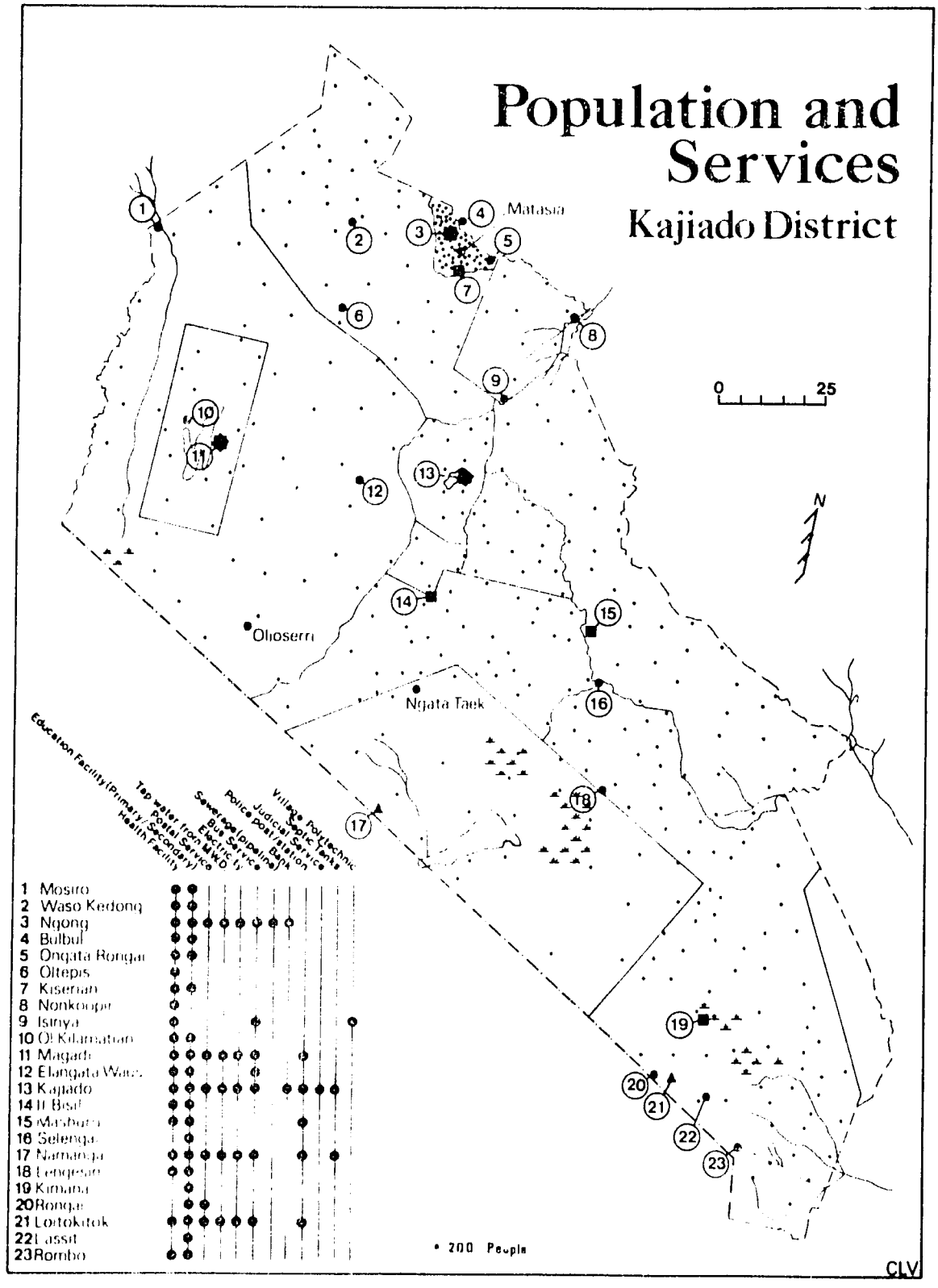
Source: Kenya Statistical Digest, Central Bureau of Statistics, Kenya, 1972, 3

TABLE 4.1(b)

POPULATION - RURAL

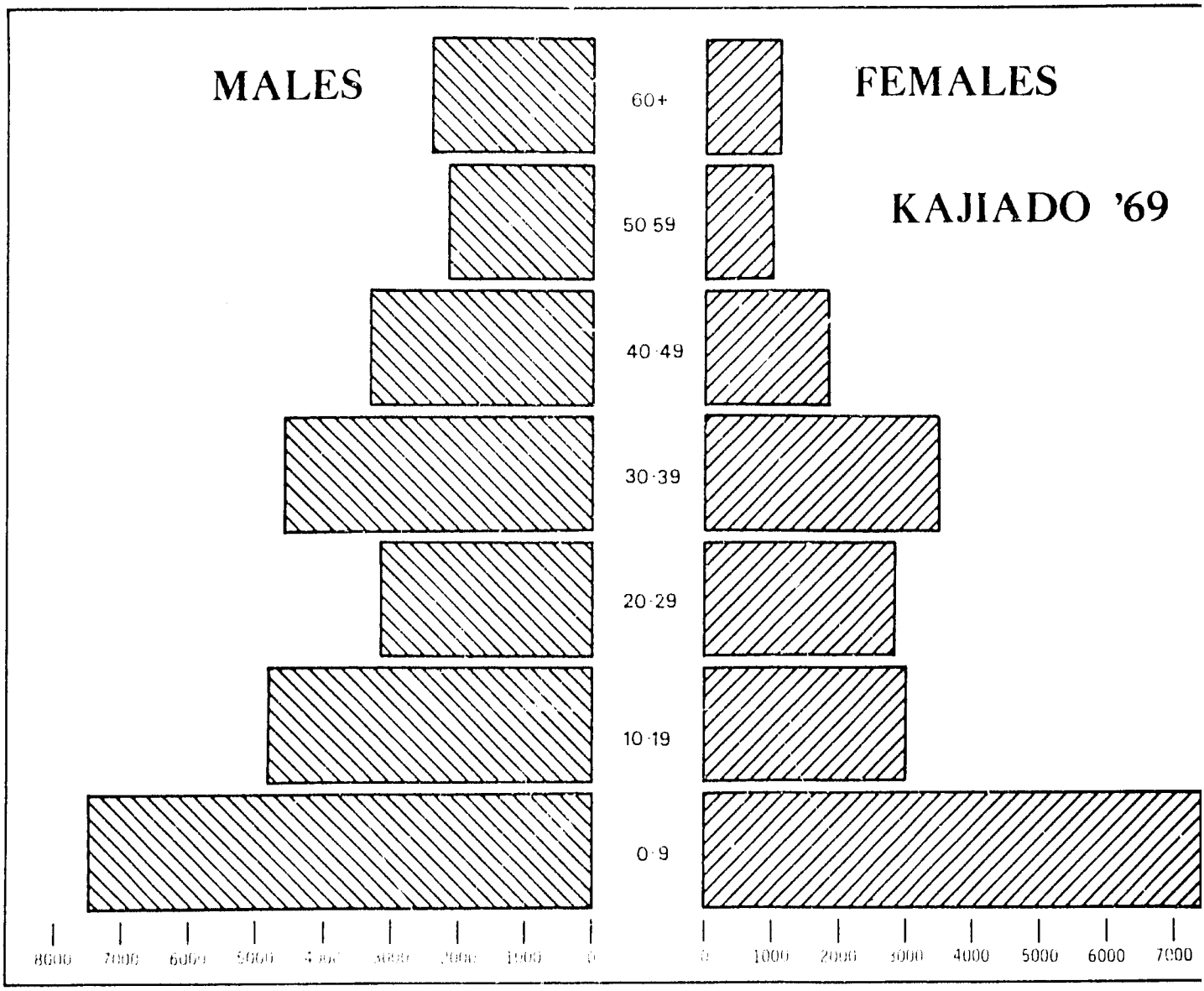
ADMINISTRATIVE UNIT	POPULATION (100 PERSONS)						SQ. KM.	DENSITY 1974
	1962 CENSUS TOTAL	1969 CENSUS				1974 EST. TOTAL		
		ADULT MALES	ADULT FEMALES	CHILD	TOTAL			
KAJIADO DISTRICT	684	226	221	412	859	1,001	22106	4
Kajiado	257	215	213	398	826	926	22096	5
Ngong	103	35	38	86	159	186	158	117
Kitengela	9	8	3	7	18	20	542	3
II Keekonyokie	70	21	23	37	81	95	2334	4
II Lodokolani	67	23	23	41	87	101	4974	2
Magadi	12	7	6	13	25	29	853	3
II Kaputiei	76	25	24	44	93	109	2806	3
Purko	21	3	3	6	13	15	158	9
II Dalale Kutuk	32	6	8	16	31	36	449	8
Matapato	86	20	21	36	77	90	1567	5
Masai Amboseli	-	16	14	23	53	62	3211	2
II Kisongo	164	43	43	77	163	190	4116	4
Chyulu	-	-	-	-	-	-	445	-

FIGURE 6



SOURCE: Ministry of Lands and Settlement.

FIGURE 7



SOURCE: Central Bureau of Statistics

4.2 Land Tenure

Land tenure is also important. Freehold land describes former "Scheduled Areas" (European farming areas under colonial rule) which is now divided into African smallholder schemes. Alienated land is former "Scheduled Areas" that have not been taken over for settlement but which are registered as government land. This land is frequently leased to large scale farmers. Registered trustland are areas, formerly "Native Reserves," where land adjudication has been completed and titles registered in the name of individual owners. Unregistered trustland is land held communally and allocated by customary law; no title deeds are held on such land. Forest reserves are under the control of the Chief Conservator of Forests. National Parks, administered by Central Government, are exclusively reserved for wild game. In contrast, wildlife preservation areas are open to normal usage by the local people.

It is readily apparent from both Table 4.2(a) and Figure 8 that unregistered land is the dominant land tenure situation in Kajiado District. As population grows and immigration accelerates, it is likely that conflict over this unregistered land will increase. Similarly, land invasions of the National Parks will probably increase.

4.3 Agricultural Potential

The potential for arable farming is closely related to altitude, rainfall, and soil type; irrigation potential is dictated by water availability, soil conditions, and financial considerations; range potential is broadly related to vegetation. Arable farming is possible in the higher altitudes of Loitokitok, Ngong, Chyulu Hills, and the eastern side of the Rift Valley where rainfall is adequate. Areas south of Athi River and North of Kajiado township have a lower potential for crop raising. The area to the southeast and around Konza and Magadi has the lowest potential for arable farming. In the rest of the district, there is no potential for cropping husbandry except where irrigation is practical or where lakes and swamps provide effective moisture conditions.

TABLE 4.2(a)

KAJIADO LAND TENURE (Km^2)

TPYE	AREA
FREEHOLD	-
ALIENATED LAND	948
REGISTERED TRUSTLAND	197
UNREGISTERED TRUSTLAND	16,684
FORESTS RESERVES (GOVT. & LOCAL)	13
NATIONAL PARKS, GAMES RESERVES ETC.	3,142
TOWNSHIPS	16
TOTAL AREA DEMARCATED	21,010
TOTAL WATER AREA	142

Source: Statistical Abstract, Kenya, 1977, p.5

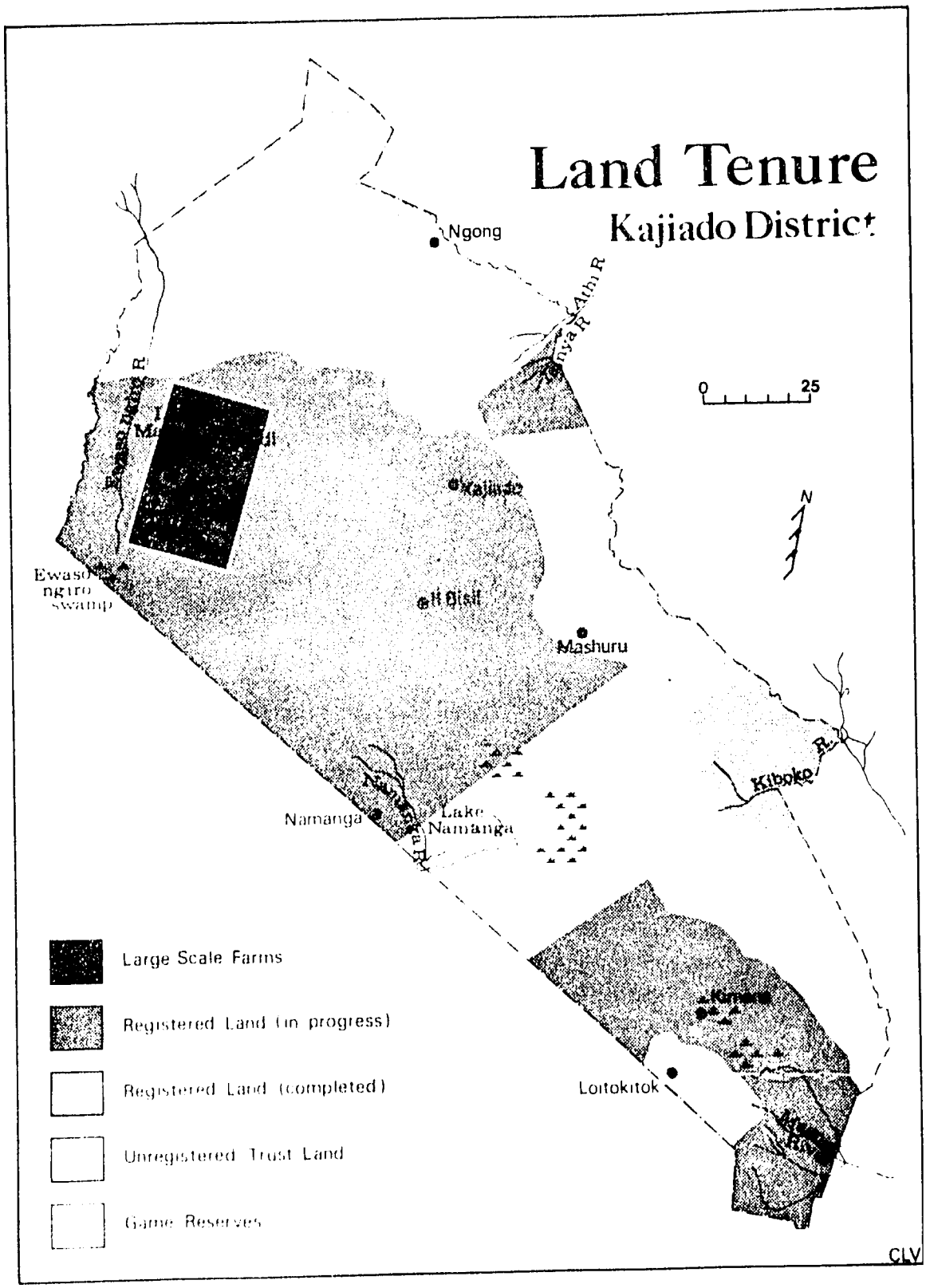
TABLE 4.2(b)

LAND SUITABILITY (ha) - KAJIADO DISTRICT

AREA	TOTAL DISTRICT	NGONG DIVISION	LOITOKETOK DIVISION	CENTRAL DIVISION
Total Area (ha)	2,060,000	605,667	483,154	971,179
Agricultural (ha)	84,000	19,119	39,000	25,881
High Potential (ha)	37,359	12,119	21,000	4,240
Medium Potential (ha)	18,641	5,000	3,000	10,641
Marginal (ha)	28,000	2,000	15,000	11,000
Range & Desert (ha)	1,976,000	586,548	444,154	945,298
Irrigated Area (ha)	1,000	50	400	500
Game Reserve (ha)	38,850	-	-	-
Forested (ha)	768	-	-	-
Cultivated (ha)	60,000	-	-	-

Source: District Development Plan, 79 - 83
Adapted from D.A.O's Data Sheet.

FIGURE 3



SOURCE: National Atlas of Kenya, 1970

The areas of high ranching potential are the Athi and Kapiti Plains, the areas bordering the Chyulu Hills, the lower slopes of the Kilimanjaro ranges, and the Amboseli Game Park. Zones of medium ranching potential include the areas between Ngong, Magadi, and Kajiado townships, the area south of Konza township, around Lake Magadi and the southeastern quarter of the district. The rest of the district has low ranching potential.

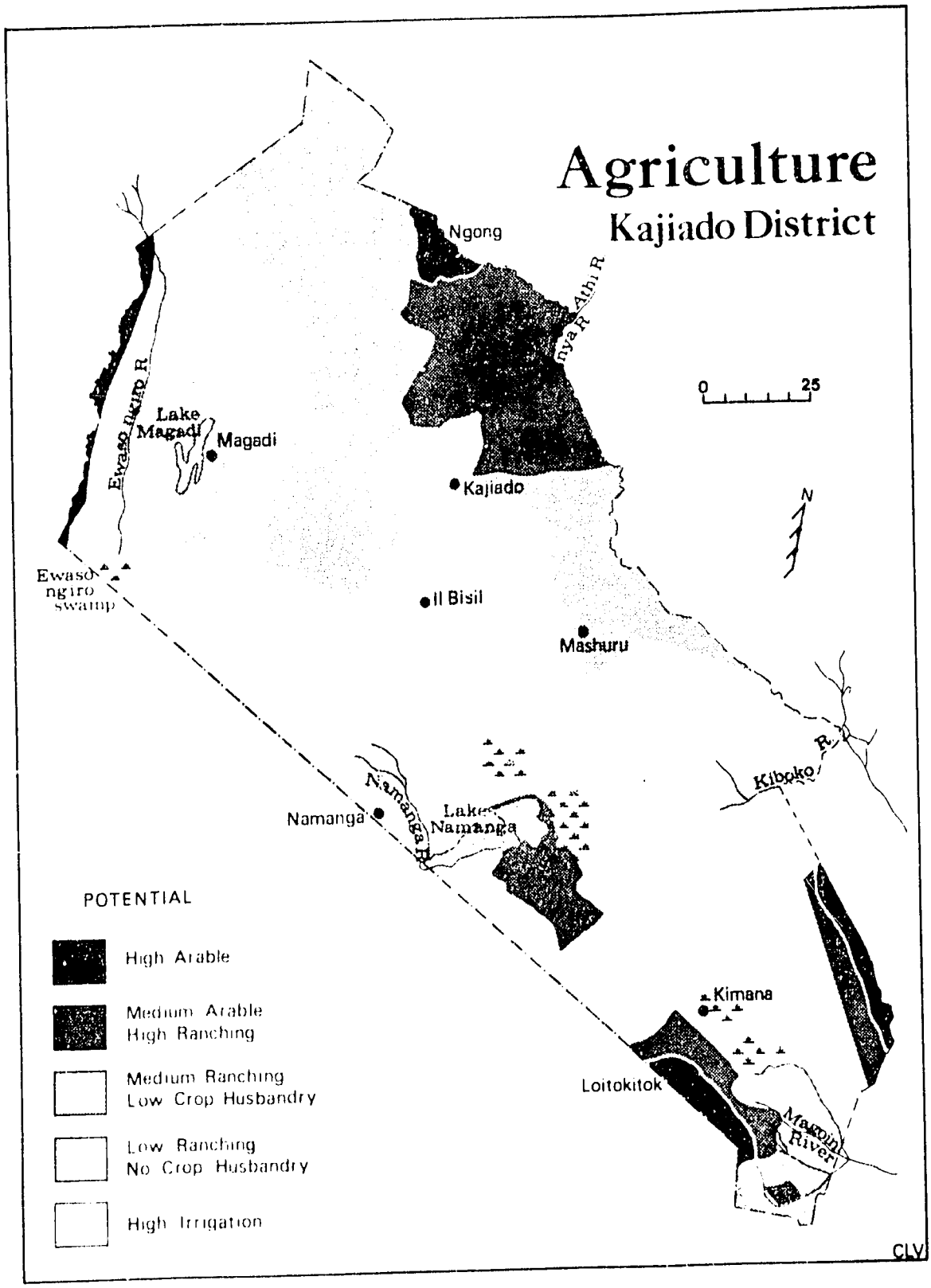
Two factors should be noted in any discussion of land suitability in Kajiado. Firstly, because of the pressure of land, it is not possible to practice shifting cultivation. Secondly, the loss of soil structure, because of declining organic content as continous cropping occurs, is exaccerbated by tractorised cultivation. In such limiting circumstances, farmers should be advised accordingly. Table 4.2(b) and Figure 9 show landsuitability classification of the district.

4.4 Agricultural Activities

Mixed farming, involving both the raising of crops and livestock, is practised around Loitokitok and Ngong. Crop rotation is particularly common in Namanga, Kimana, and Ngong including production of maize, beans, potatoes, onions, cotton, coffee, tomatoes, and fodder. Cabbage is grown in small irrigation areas.

Mixed farming, which includes rotating livestock with crops, is recommended because it maintains a balanced exploitation of the soil resource. In all cases, the amount of organic matter declines if cropping is carried out without livestock rotation. Soil deterioration including infiltration rates, water retention capacity, porosity, aeration, and nutrient supply capacity decrease, thereby limiting production. This situation is frequently aggravated by the physical deterioration of the soil which has been pulverised during cultivation. Because of a decline in fertility, organic and chemical fertilisers have been strongly recommended, especially in the Olkeranation area. Organic manures are significantly more beneficial than chemical fertilizers in that, beyond providing nutrients, they improve soil structure and do not pollute the environment.

FIGURE 9



SOURCE: Ministry of Agriculture

No crop diseases of major importance have been recorded except blight. Table 4.4 indicates that the total area under crops was 13,770 hectares in 1978; maize and beans were the most significant crops.

4.5 Irrigation

The feasibility of any irrigation initiative is determined not merely by climatic, edaphic, and hydrological constraints but by the socio-economic conditions existent in the district.* The three areas were irrigation (both furrow and sprinkler) is currently practised are:

(1) Kiserian and Ongata Rongai area of Ngong division

(2) Kimana area of Loitokitok

(3) Namanga area (including Mile 9)

The water for the Ngong irrigation schemes is obtained from boreholes and pumped to sprinkler systems. Water for Kimana comes from the impounded streams and rivers of the lower Mt. Kilimanjaro slopes which is conducted to the field in canals and furrows. Namanga area (including Mile 9) is pumped into furrows. All three areas predominantly grow horticultural crops because of the high capital costs, and, therefore, repayment of irrigation technology.

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*Examples of these factors include:

Climate: temperature, rainfall intensity, windspeed potential evapotranspiration, relative humidity,

Edaphic: pH, electrical conductivity, sodium absorption rate, bicarbonate content, water retention, infiltration, erosion,

Hydrologic: pH, salinity availability and probability of source, discharge,

Social: land tenure, changing institutional frameworks,

Economic: B/C ratio, debt. market price.

TABLE 4.4

CROP PRODUCTION YEAR 1976-1978

CROP		1976	1977	1978
Maize	Ha.	6367	5436	6839
	Tons	14529	12679	16414
Beans	Ha.	4106	4399	5600
	Tons	5577	5939	7830
Potatoes	Ha.	915	770	590
	Tons	7574	6444	7885
Onions	Ha.	60	100	100
	Tons	6048	1008	1008
Cotton	Ha.	150	500	550
	Tons	82	300	360
Coffee	Ha.	21	41	41
	Tons	14	28	28
Fodder	Ha.	40	40	50
	Tons	200	200	200

Source: Kajiado District Data Sheet
Ministry of Agriculture

4.6 Livestock

It is generally accepted that there is a relationship between indices of composite greenness and the distribution of biomass, especially large animals. When, however, one considers the distribution of domestic livestock, it is necessary to emphasise other factors, such as the siting of national parks, group ranch boundaries, boreholes, railheads, and marketing centres which influence the spatial distribution of herds.

Much of Kajiado District is used for animal husbandry. Ranches occupy almost 50 percent of the district but exclude the higher altitudes of Ngong and Loitokitok, the Amboseli game reserve, the Kitenga conservation area, the West Chyulu conservation area, the area west of Ngong and the Magadi concession. In other words, high potential land, producing revenues from either arable farming or tourism, is excluded from ranch demarcation. Most ranches are group ranches; only a few are individual owned. Table 4.6(a) shows the number and area of group and individual ranches by division and livestock inventory. Most authorities argue that, with the exception of the national parks, game reserves, and the Magadi concession, the area is overgrazed. Current calculations suggest that the carrying capacity for the district is 6 hectares per livestock unit. In recent years, alternative estimates of the area have been provided. For example, if it is assumed that net primary productivity is related to rainfal according to the linear relationship:

$$\text{Productivity } (g/m^3) = 0.75 \text{ rainfall (min)} - 100$$

Then the carrying capacity, assuming rainfall between 400 - 500 mm, will be 80 kg. liveweight per hectare. This assumes good management, for in areas of low or erratic rainfall, potential forage production is estimated as low as 2 kg. dry matter per millimetre of rainfall per hectare.

Domestic stock include cattle, sheep, and goats frequently in competition with Grants gazelle, Thomson's gazelle, impala, eland, giraffe, steenbok, warthog, wildebeests, and dikdiks. Table 4.6(b) gives the livestock inventory by location. Ranch water is supplied from boreholes and pipelines as well as streams. Financial assistance for the development of water resources is provided by the Agric-Finance Corporation, the livestock Development Fund, and the

TABLE 4.6(a)

NUMBER AND AREA OF INDIVIDUAL AND GROUP RANCHES, BREAKDOWN ACCORDING TO DIVISIONS, LIVESTOCK INVENTORY, AND THE NUMBER OF FAMILIES COMPOSING THE GROUPS -- KAJIADO DISTRICT

TYPE	District	Central Division	Ngong	Loitokitok
INDIVIDUAL RANCHES	144	81	15	48
Area (hectares)	105,564	82,105	15,030	8,428
Cattle	66,794	33,330	8,500	24,960
Goats and Sheep	181,383	97,733	21,250	62,400
GROUP RANCHES				
Number of households	48,001	22,692	8,665	16,444
Area (hectares)	1,000,941	445,298	386,489	172,156
Cattle	307,244	152,694	62,148	91,811
Sheep and Goats	692,960	360,851	92,589	229,528
Total small holdings	37,275	N/A	13,275	24,000

Source: District Development Plan 1979-83 adapted from District Data Sheet, Ministry of Agriculture.

TABLE 4.6(b)

LIVESTOCK INVENTORY (1979) - KAJIADO DISTRICT

AREA	LIVESTOCK
Whole District	1,248,531
Keekonyokie location	59,494
Lodokelani location	67,439
Purko location	7,812
Illdamat location	11,640
Kangerre location	18,364
Kisongo location	114,136
Kaputai location	76,991
Matapala location	41,011
Amboseli game reserve	-
Dalalekutuk location	-
Ngong location	-

Source: Kajiado District Annual Reports, 1979
Ministry of Agriculture.

County Council. Table 4.6(b) contains data from the 1979 District Livestock Inventory. Additional data in this inventory indicated that there were substantially greater numbers of sheep than cattle in the area (sheep - 582,362: zebu cattle - 374,038: Grade cattle - 950: Goats - 291,181: Donkeys - 17,978: Pigs - 250:). The average number of cattle per capita is 3.3 while average sheep/goat per capita is 7.7. The overall livestock culling rate is about 10 percent. Most of the cattle are local Zebu. Plans exist to upgrade local stock, especially by cross breeding with other stock (for example, sahiwal) to produce beasts whose performance is good under current ecosystem conditions. This is important for evidence available suggests that average stocking rates for ranches is 2.20 livestock units per 6 hectares which clearly exceeds estimated carrying capacities of 1 LSU per 6 hectares. Particular sites greatly exceed this stocking figure. (See Table 4.6(c)) .

Most of the animal husbandry is a pastoralist or semi-pastoralist activity. Dairying, which may involve paddock systems and zero grazing, is only practised around Ngong and Loitokitok.

4.7 Forestry

Forestry is not a dominant economic activity. Forests exist in the Namanga Hills, Loitokitok, and Ngong. The Namanga Hills forest, covering an area of 11,768 hectares, is a shrub-grass complex that has not been gazetted. Similarly, the ungazetted Loitokitok forest, covering 765.8 hectares, has been reduced to a scrub-grass complex, particularly because of illegal felling of trees for charcoal; current efforts for reforestation are focussed upon exotic softwoods such as cypress, pine, and gum trees. Ngong forest has been partially gazetted but its 2,500 hectares is gradually being reduced by settlement, both controlled and spontaneous.

4.8 Industrial Activities

Large scale industry in the district is concentrated around the major mineral deposits of soda and limestone. The Magadi Soda Company operates at Lake Magadi although it is a transnational corporation based in Europe. The processing plant exists to produce soda ash (sodium carbonate) and salt (sodium chloride). Annual production of sodium carbonate

TABLE 4.6(c)

DISTRICT RANCHES, HECTERAGE, LIVESTOCK STOCKING RATE, CATTLE DIPS

RANCH	CATTLE DIPS (D) NO. AND BOREHOLES (BH)		HECTERAGE (ha)	LIVESTOCK INVENTORY	STOCKING RATE ANIMALS/6ha	
Olkincs	1D		6,304	5,592	5.3	6
Empuyiankat	2D	1BH	14,891			
Embolioi	1D	2BH	23,696	9,823	2.48	6
Empuyiankat (I.R.)						
Emarti Ole Narau	1D	1BH	13,065	4,732	2.17	6
Iimanea	1D	1BH	12,194	4,952	2.43	6
Erankau			8,804	1,319	0.89	6
Iimaroro Mashuru		3BH	29,239	11,376	2.33	6
Arroi	1D	4BH	14,130	6,600	2.80	6
Nkama			41,956	14,586	2.08	6
Poka	2D	2BH	8,816	3,959	2.69	6
Mbilini	2D	1BH	14,407	5,511	2.29	6
Mboko	2D	1BH	18,478	7,229	2.34	6
Olkarka	2D		10,278	4,113	2.40	6
Merueshi	2D	2BH	18,605	6,567	2.11	6
Kiboko	2D	2BH	15,686	4,949	1.89	6
Kimona/Tikindo	2D		25,119	13,391	3.19	6
Nkoile	2D	2BH	5984.5*	646	0.64	
Rilonito			25,949	6,949	1.60	6
Elangatawuas	1D	1BH	39,498	60	0.009	6

$\bar{X}$ = 2.20 animals per 6 hect.

Source: Ministry of Agriculture.

is 212,000 tonnes and of sodium chloride, 42,000 tonnes; production expansion, to 500,000 and 80,000 respectively, is envisaged. The Magadi Soda Company employs over 600 people and provides facilities, including a school and a hospital, for employees. There is little problem with water supply but fuel costs are rapidly escalating. Magadi Soda Company has an energy bill that exceeds 12 million Kenyan shillings for diesel. The major waste product is mud which is pumped back into Lake Magadi.

Limestone quarries are operated by four companies:

(1) East African Portland Cement Co.

(2) Kenya Marble Quarries Ltd.

(3) Athi River Mining Co. and

(4) Kenya Gypsum Ltd.

All four companies have processing plants in either Athi River or Nairobi because of the insufficiency of electricity and water supply in Kajiado District. All quarries obtain water from boreholes operated by the companies and electricity is provided by diesel fuelled generators. Kenya Marble Quarries Ltd., because of their proximity to Kajiado township, also have access to the local power transmission facilities. Lack of power hampers expansion of production although East African Portland Company Ltd. is planning output increases from 200,000 to 300,000 tonnes per annum.

Waste products from the quarries include volcanic ash, hard gneiss, schist, and lowgrade limestone. East African Portland Cement Company Ltd. is currently investigating the possibility of processing a portion of the land waste for sized aggregates. It is also possible that a proportion of lowgrade limestone can be returned to the crushed limestone system if technology is improved. The employment generated by the quarries is small; less than 300 persons and no real increase is expected.

Kajiado District has nine slaughter houses maintained by the Olkejuado County Council or private individuals. They only employ 2 or 3 persons and slaughtering is by hand. Slaughter houses usually have a hides and skins banda attached where cleaning

and drying processes are carried out. Both meats and hides are destined for Nairobi. Waste products are usually dumped into a pit. Locations of slaughter houses are:

Ongata Rongai	2	Bissil	1
Ngong	1	Loitokitok	1
Kajiado	1	Magadi	1
Namanga	1	Kiserian	1

Basket weaving and Maasai handicrafts are usually done by women. Women's groups* are organised for handicraft production which is geared to the tourist trade. Figure 10 shows the distribution of small scale industries in Kajiado.

4.9 Manpower and Employment

The total number of persons employed in the modern sector is 5235; 1915 persons are registered as self-employed. Table 4.9(a) shows monthly earnings for different wage groups; the mode is 400-599 shillings per month. The following table, Table 4.9(b) contains data on wage employment by industry. The dominant sector is "Government Services" although agriculture, quarrying, and tourism show considerable expansion from 1972 to 1976. Work is, however, generally unskilled. Table 4.9(c) indicates that over 80 percent of the workforce has not received education beyond standard IV. Conversely, only 0.14 percent have received education up to Form VI, the level for university entrance. There is little to distinguish the formal education of male workers. With so few formal qualifications, people in search of wage labour generally head towards urban areas seeking employment as general labourers or guards. For example, 22.1 percent of the migrants from Kajiado sought such employment in Nairobi.

4.10 Infrastructure

4.10.1 Service Centers

The distribution of services is tied to settlement categorisation. "Urban" settlements are those

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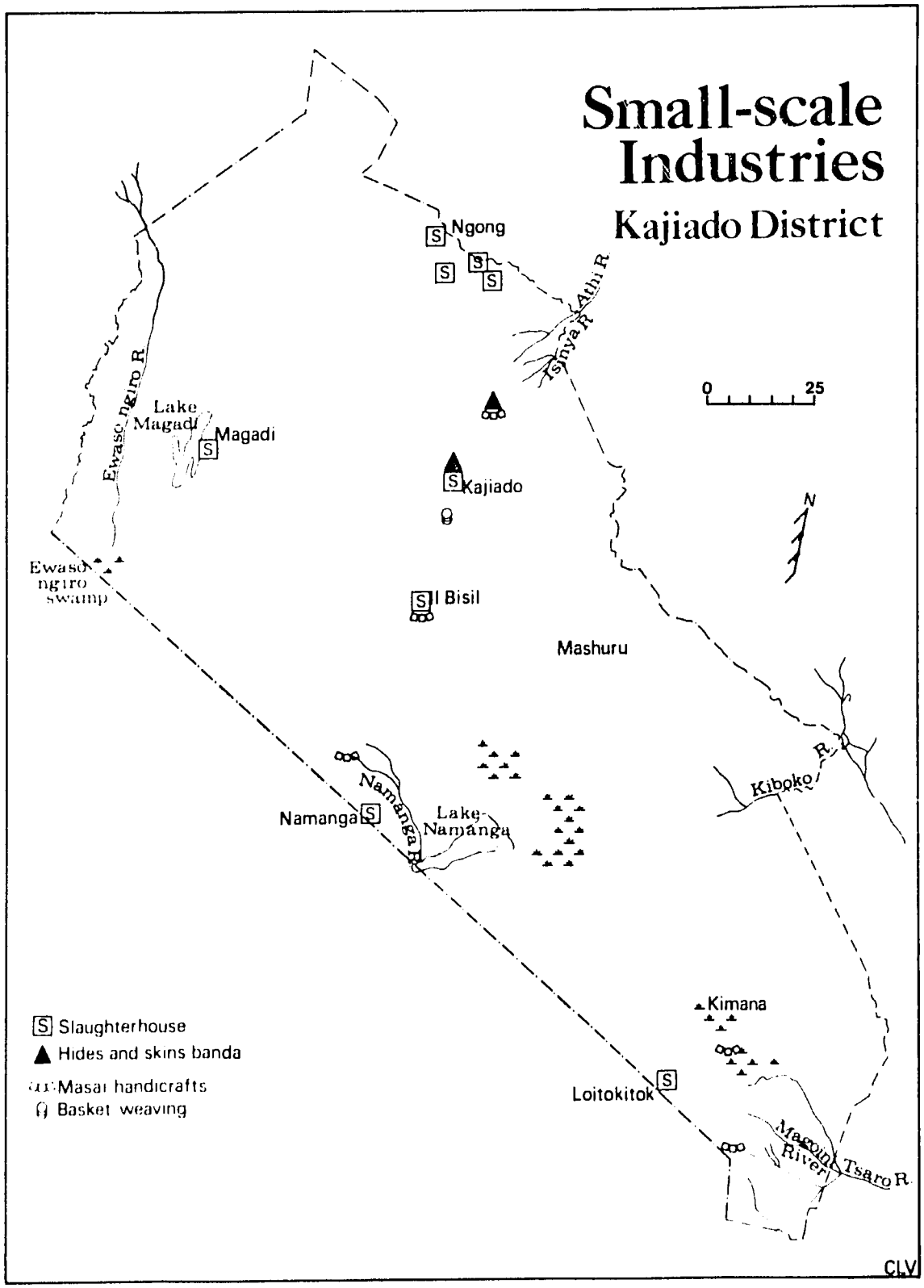
*Organised production groups are found at Isinya, Bissil, Mile 9, Malcumo, Kenya Marble Quarry, Ikisanjami.

FIGURE 10



SOURCE: Central Bureau of Statistics

TABLE 4.9(a)

WAGE GROUPS (1977) - KAJIADO DISTRICT

WAGE (SHILLINGS PER MONTH)	NUMBER OF PERSONS
Under 150	68
150 199	64
200 399	1030
400 599	1035
600 799	841
800 999	442
1000 1499	261
1500 1999	137
2000 2999	94
3000 5999	49
6000 and over	29
Total	4050

Source: Central Bureau of Statistics.

TABLE 4.9(b)

WAGE EMPLOYMENT BY INDUSTRY 1972 - 76 KAJIADO DISTRICT

SECTOR	1972	1973	1974	1975	1976
AGRICULTURAL AND FORESTRY	418	366	632	622	693
MINING AND QUARRYING	423	278	590	634	649
MANUFACTURING	218	196	269	302	203
ELECTRICITY AND WATER	14	10	24	32	33
CONSTRUCTION		109	219	444	219
TRADE, RESTUARANTS, HOTELS	457	391	566	497	539
TRANSPORT COMMUNICATION	18	13	15	21	22
FINANCIAL SERVICES	7	-	3	7	10
GOVERNMENT SERVICES	1,647	1,804	1,921	2,155	2,327
TOTAL	3,209	3,227	4,229	4,714	4,695

Source: Central Bureau of Statistics.

TABLE 4.9(c)

FORMAL EDUCATION AND EMPLOYMENT

MALE	FEMALE	FORMAL EDUCATION LEVEL
40.12	43.91	Standard 1 - IV
4.11	2.58	Standard V - VIII
5.83	2.07	Form 1, II
0.74	0.12	Form III, IV
0.29	0.10	Form V, VI
51.20	48.80	TOTAL

Source: Central Bureau of Statistics

with resident populations in excess of 2,000 "Rural centres" are designed to serve populations of 40,000 with administrative, commercial, and social services. "Market Centres" are usually small trading nodes serving a catchment area of less than 15,000 persons. Education and health facilities are found throughout this hierarchy of service centres. Administrative offices for local government exist, at district level, in Ngong, Kajiado, and Loitokitok. The District Court sits in Kajiado. Postal facilities exist at Kajiado, Namanga, Ngong, Magadi, Loitokitok and Rangai while banking services are provided at only Kajiado and Ngong. Electric supplies are available in Ngong, Kajiado, Namanga, Magadi and Loitokitok but it is a somewhat erratic, low voltage service that is only suitable for domestic use.

4.10.2 Water Supply and Sewerage

The only piped sewerage system is at Ngong. Other urban and rural centres use septic tanks. The 1978-83 Physical Plan envisages the construction of sewerage and drainage infrastructure at Kajiado, Loitokitok, and Ougato Rangai. It is also hoped that tractor-trailer units will be obtained that will facilitate refuse collection, currently undertaken by individual collectors who use wheelbarrows.

Tap water is supplied to Ngong, Magadi, Kajiado, Namanga, and Loitokitok by the Ministry of Water Development. All other centres rely upon boreholes for water supply. No single authority is responsible for borehole maintenance.

4.10.3 Transport Network

Road networks emphasize the connection to Nairobi rather than intradistrict communication. Roads radiating from Nairobi to Ngong, Namanga, Kiboko, Magadi and to a lesser degree, Loitokitok, are of good standard whereas those running east-west, serving the remainder of the area, tend to be little more than tracks. Poor access is one of the major problems noted by health and education officers in the district.

A railway, from Konza to Magadi, is under the private maintenance of the Magadi Soda Company. There are two airstrips, at Magadi and at the Mount Kilimanjaro base camp near Loitokitok.

4.10.4 Education Facilities

Education facilities are widely distributed throughout the district. Primary schools are provided in all the service centres. There are 60 government-maintained primary schools and 18 church-funded or private company schools. Total enrollment in the 86 primary schools is approximately 20,000 children. In sharp contrast, the number of secondary schools in the district is only 11, creating a severe problem for CPE (Certificate of Primary Education) school leavers. Table 4.10.4 shows details of the school system.

An alternative for further education is the Village Polytechnic. There are three in the district, namely:

(1) LISENYA (Central Division):
Male students.
Subjects: masonary, carpentry, mechanics, leatherwork, and metal work.

(2) METO (Central Division):
Female students.
Subjects: tailoring, home economics, and animal husbandry.

(3) OTLASIKA (Loitokitok Division):
Co-educational.
Subjects: masonary, carpentry, tailoring, home economics, and agriculture.

Records of Village Polytechnic intake are not available so it is difficult to assess how well they alleviate the problem of early school leavers. There is also no record of follow-up with graduate students to determine job placement.

The Village Polytechnics are the result of selfhelp projects. The vocational training of adults is carried out at the Masain Training Centre and the Ngong Farmers' Training Centre.

Preschool education depends upon the initiative of the local population. There are 44 nuseries in the district with an enrollment of approximately 1,800 infants. Nurseries with enrollments of more than 32 children may eventually be adopted by local County Councils.

TABLE 4.10.4

SCHOOL SYSTEMS

1977

TEACHERS		SECONDARY AND PRIMARY
Kenyan Citizens	-	25 qualified teachers
		9 unqualified teachers
Non-Kenyan	-	7 qualified
		3 unqualified
TOTAL		44 TEACHERS

PRIMARY SCHOOLS

68 Government maintained primary shcools

18 private schools

Total enrollment for primary schools - 19,229

SECONDARY SCHOOLS

3 maintained	2 unaided
Total classes: 22(aided)	Total classes: 7(unaided)
Enrollment 849	Number of students - 178 (unaided schools)

Total number of secondary classes - 29

Total number of secondary teachers - 11

Source: Central Bureau of Statistics.

Educational institutions in the district suffer from a variety of problems which include, of course, the lack of qualified teachers. However, poor access, poor premises, inadequate furniture and equipment, and erratic water supplies do not make rural schools attractive employment opportunities for qualified personnel.

4.10.5 Diseases and Health Facilities

Kajiado District has 4 hospitals, 10 health centres, and 14 dispensaries. Table 4.10.5(a) contains a list of health institutions in the district. Some of the health centres and dispensaries have in-patient facilities contributing to a high bed capacity. Areas away from established health facilities are served by a weekly mobile health clinic. Public health officials are stationed in some health centres to supervise public hygiene, especially market sanitation. Family planning facilities are located at Kajiado District Hospital.

The majority of the health institutions are Government funded and maintained. Church groups and private companies also maintain health facilities. Inadequate vehicle transport and poor roads limit efficient service. Health officials frequently note that the local population prefers traditional to modern medical practice.

Table 4.10.5(b) details the statistics on disease from 1976 - 1978. Gastro-enteritis, clinical malaria, and upper respiratory tract infection (URTI) are the most commonly reported infectious diseases. The highest number of deaths occuring from infectious diseases were by lobar pneumonia and tuberculosis. Figure 11 indicates the location of health facilities and the spatial epidemiology of malaria, trypanosomiasis, marasmus, conjunctivitis, and brucellosis.

4.11 Cooperative Movements

There are 12 active cooperatives in the district. Specifically, by division, there are:

Central Division - 3 savings and credit coops

Ngong Division - 1 savings and credit coop
1 cattle marketing coop
1 butchers' coop
1 farmers' coop

Loitokitok - 1 wholesale coop
4 farmers' coops

TABLE 4.10.5(a)

DISTRICT HEALTH INSTITUTIONS - 1978

1. Kajiado District Hospital
2. Loitokitok Hospital
3. Magadi Soda Company Hospital
4. Rombo Mission Hospital
5. Bissel Health Centre
6. Elangata WUAS Health Centre
7. Mashimou Health Centre
8. Mile 46 Health Centre
9. Namanga Health Centre
10. Ngong Health Centre
11. Rombo Health Centre
12. Kiserian Health Centre
13. Oloosels Health Centre
14. Athi River Health Centre
15. Enkorika Health Sub-Centre
16. Amboseli Dispensary
17. Isanya Dispensary
18. Iengishi Dispensary
19. Mbirikani Dispensary
20. Meto Dispensary
21. Olguluini Dispensary
22. Olkirematian Dispensary
23. Ewasso Kedong Dispensary
24. Kenya Marble Quarry Dispensary
25. Oloika Dispensary
26. Oltepesi Dispensary
27. Oltukai Dispensary
28. Shombele Health Centre

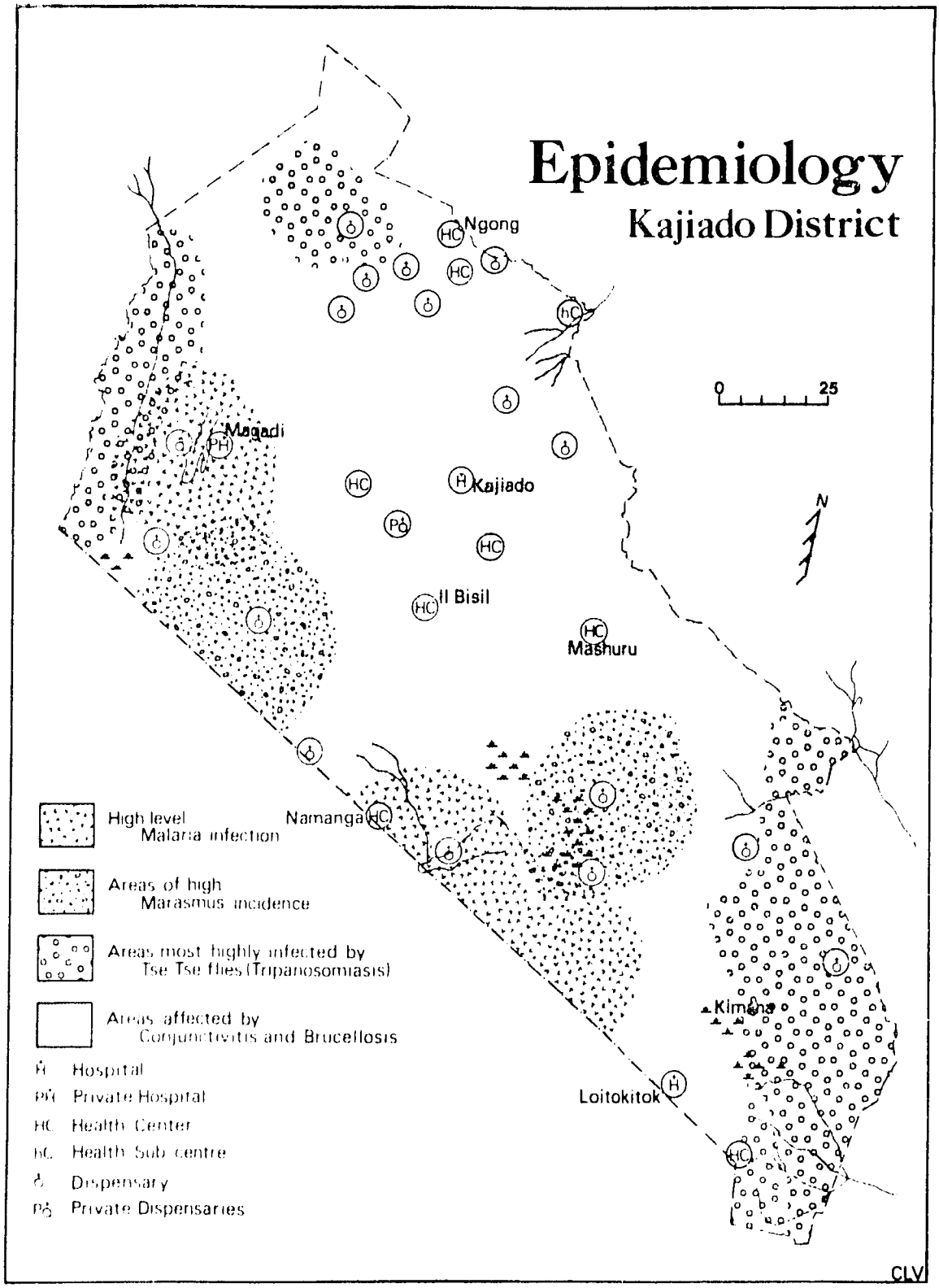
TABLE 4.10.5(b)

DISEASE - KAJIADO DISTRICT - 1976/78

DISEASE	1976	1977	1978
Anthrax	-	-	47
Amoebiasis	91	164	247
Ankylostomiasis	100	246	63
Brucellosis	154	403	247
Whooping Cough	150	43	346
Taeniasis	100	458	479
Cerebro Spinal Fever	-	2	-
Infectious Hepatitis	25	14	18
Kela-azar	-	8	30
Trachoma	51	101	61
Salmonethosis	-	1	-
Tetanus	-	4	1
Mumps	203	385	369
Menengitis	-	15	-
Measles	410	739	450
T.B. Pulmonary	101	198	97
T.B. Other Forms	37	42	36
Malaria ST.	142	198	89
Malaria Clinical	4,374	6,358	5,689
Dysentery	899	649	667
Influenza	591	1,379	880
Pneumonia (all types)	2,223	2,223	777
Gastro enteritis	1,483	1,845	801
Syphilis	170	146	164
U.R.T.I.	-	4,848	5,213
Plague	-	-	164
Leprosy	-	1	-
Gonorrhea	1,700	1,787	1,025
Marasmus			
Conjunctivitis			
Intestinal parasites (e.g. Ascnas Lumbricoides)			
Kwashiokor			

Source: Ministry of Health.

FIGURE 11



SOURCE: 1) National Atlas of Kenya, 1970

2) Ministry of Health

Ngong and Loitokitok divisions, the high potential areas, have the farmers' cooperatives. Ngong's proximity to Nairobi makes it an ideal location for meat suppy to the city - hence the butchers' cooperative and cattle marketing co-operative. The butchers' cooperative was the first in Kenya, formed in 1963.

There are no detailed records available from the various cooperatives and it is, therefore, difficult to gauge the effectiveness and scope of these instititions. For example, the paucity of banking facilities in the district must be partially offset by the savings and credit cooperatives... but how effectively? For various reasons, including mismanagement and the impact of the 1974-75 drought, the cooperative system is disintegrating. Cooperative officers blame the lack of trained staff and the lack of formal management training for the future of cooperatives.

This chapter has described the physical and human environment of Kajiado District. While this semi-arid ecosystem offers a relatively stable, if poor, resource base, the environmental problems that arise reflect pressures external to the traditional management system. It is these pressures that are examined in chapter five.

5. ANALYSIS OF ENVIRONMENTAL TRENDS AND PROBLEM IDENTIFICATION

5.1 Population Growth and Impact

Kenya's population is estimated at 15 million persons. The annual growth rate has been estimated at 3.6 percent per annum although recent evidence suggests that annual population growth rates could be as much as 3.9 or 4 percent.

Three population series have been calculated for Kenya under the following assumptions:

SERIES A: No change in total fertility rate from the period 1971 - 1975 period

SERIES B: A steady decline in mortality leading to a life expectancy at birth of 60 by the year 2000

SERIES C: Total fertility rate falling by the year 2000

Series A assumes that family planning will have no significant impact on the rate of population growth. This is not an unreasonable assumption considering that many Kenyans still live in impoverished conditions in rural areas where children are regarded not as a constraint but as additional labour. Series A, in fact, could be an under-estimate because it is calculated as a growth rate of 3.6 percent per annum.

Series B assumes that the total fertility rate will drop by 47 percent by 2000. Such a scenario requires the successful implementation of family planning programmes so that the fertility rate drops by some 67 percent by 2000. Such programmes are unlikely to be undertaken.

Table 5.1(a) shows the total projected population, from 1968-2000 under three scenarios. Under Series A assumptions, population will double by 1995. Under all projections, population doubles by 2005. Such projections would imply some 12-18 million children by 2000 who would require educational and health facilities. Moreover, the total labour force by 2000 of some 11 million people (16-60 years) would require employment opportunities. Authorities have suggested that perhaps as few as 30 percent of this

TABLE 5.1(a)

POPULATION PROJECTIONS 1968 - 2000

YEAR	TOTAL PROJECTED POPULATION 1968-2000 SERIES A (1000)	TOTAL PROJECTED POPULATION 1968-2000 SERIES B (1000)	TOTAL PROJECTED POPULATION 1968-2000 SERIES C (1000)
1968	10,438	10,438	10,438
1969	10,858	10,858	10,858
1970	11,247	11,247	11,247
1971	11,694	11,694	11,694
1972	12,091	12,091	12,091
1973	12,504	12,504	12,504
1974	12,935	12,935	12,935
1975	13,413	13,413	13,413
1976	13,853	13,842	13,839
1977	14,384	14,314	14,302
1978	14,875	14,806	14,782
1979	15,427	15,313	15,270
1980	16,053	15,877	15,790
1981	16,657	16,393	16,278
1982	12,283	16,926	16,781
1983	17,933	17,476	17,299
1984	18,607	18,044	17,834
1985	19,310	18,635	18,387
1986	20,048	19,198	18,891
1987	20,813	19,778	19,408
1988	21,609	20,375	19,940
1989	22,434	20,990	20,487
1990	23,302	21,617	21,047
1991	24,211	22,218	21,552
1992	25,155	22,836	22,069
1993	26,136	23,470	22,599
1994	27,155	24,123	23,141
1995	28,213	24,795	23,698
1996	29,336	25,430	24,172
1997	30,503	26,081	24,655
1998	31,717	26,748	25,149
1999	32,980	27,433	25,651
2000	34,286	28,131	26,164

Source: Physical Planning Department, Kenya, 1978, p.10
Ministry of Lands and Settlement.

population could expect to find employment. Assuming full employment, the ratio of dependents to total population (under Series B) is 0.48 implying that each member of the potential labour force will need to provide for one dependent person. With unemployment, the situation is more stark.

The total "surplus" rural population by 2000 has been estimated at 6.5 million, assuming an agricultural carrying capacity of 22.5 million and improved agricultural technology. These figures, from the Ministry of Lands and Settlement, are questioned by the IBRD Agricultural Sector Survey (1973), which estimates rural carrying capacity as 14.5 million implying that some 14 million people will have to be accommodated in urban areas. This suggests an urban growth rate of 8 percent per annum.

The impact of this demographic transition will be acutely felt in Kajiado District in two processes, namely:

(a) The expansion of urbanisation in Ngong as the suburbanisation of Nairobi accelerates;

(b) Increasing loss of dry grazing areas as pastoralists and arable farmers settle in peripheral, marginal lands.

These two processes will accelerate the destruction of traditional pastoral systems which are already under pressure.

The urban population of Kenya is concentrated in two large cities of Mombasa and Nairobi and this trend is likely to continue to 2000. Available projections suggest that 84 percent of the population will be residing in the six major towns, 50 percent will be in Nairobi.

Ngong Division already can be analysed as a satellite of the Nairobi metropolitan area. Most of the division is arable farmland but this is likely to disappear with a rapid expansion of urban settlement. The area, however, has limited environmental potential as an urban area, especially if increased urbanisation is largely expansion of the urban poor.

Energy needs for the urban poor population will be primarily from wood. The dependency of urban households on charcoal for domestic purposes will continue

during the next two decades. No systematic provision has been made in current plans to conserve energy, especially the forest resources. Deforestation, especially in Ngong, is likely to accelerate as the urban population continues to grow.

At present, the urban poor, including the underemployed and the urban nutrient-deficient groups, spend more than 50 percent of their income on food purchases. With increasing population and increasing food consumption, land-use intensification will accelerate. Land-use intensification will be supported through a heavy reliance on industrial inputs, especially fertilizers and pesticides. Inevitably, such intensification will increase the price of food, increasing the hardship of the urban poor. Furthermore, land-use intensification, will, nationally, reduce annual wood production, perhaps depleting the standing mass by as much as 50 percent exacerbating an energy shortage. If Ngong experiences rapid urban growth, as a peripheral settlement to Nairobi, then the urban experience could be environmentally damaging. Severe problems with piped water supply, sewerage, and soil waste disposal will be experienced. Careful attention should be paid to the process of immigration to Kajiado District, especially Ngong Division, over the next ten years.

While Kajiado District is usually seen as a pastoral area, there are significant pockets of arable farming. Historically, there has been much discussion over the appropriateness of Maasai land-use practices. The Kenya Land Commission noted that Kikuyu farmers were already occupying land in Dagoretti area and that cultivation was expanding as:

> "Many Masai marry Kikuyu wives who frequently bring members of their family along with them, and the Masai husband, as a relation-in-law, seldom or never objects. In this way agricultural settlement begins." (Great Britain, 1934, p. 192)

In the Loitokitok area, the immigration of non-Maasai farmers occured later than that around Dagoretti and Ngong. In the period between the end of World War II and the Emergency, the area under cultivation increased as some local Maasai and also government officers - mostly Kikuyus and some Luo - cleared shambas and invited relatives to join them and also as other people moved to the area from the overcrowded locations in Central and Western Kenya. With

the declaration of the Emergency, the majority of the farmers were repatriated to their home regions and the area under cultivation declined.[1] The area under crops did not expand rapidly again until after independence when people were able to move freely and land adjudication enabled individuals to own title to land and to cultivate under conditions of relatively secure tenure. The process of land adjudication has resulted in some areas being demarcated as individual holdings, and others as group ranches. The individual holdings are located mainly on the slopes of Mt. Kilimanjaro below the Tanzanian-Kenyan border and the Ngong Hills.

The belt of individual holdings was designed to act as a barrier to movement between Tanzania and Kenya. The original land owners were Maasai chiefs, Government officers, and others who realised the value of obtaining individual title to land and many acquired large tracts. Initially, the local Maasai cultivated small portions of their land but once its monetory value became evident, they rapidly subdivided it and rented or sold portions to immigrant non-Maasai farmers. The area has become almost completely cultivated over less than a decade.

Today these lower slopes of Mt. Kilimanjaro are almost entirely cultivated and farmers are beginning to buy or rent land in better-watered localities in the plains, for example, at Kimana and Rombo. As population pressure increases, so this process of cultivation of more isolated areas with favourable soil and water conditions, especially swamp margins, is likely to accelerate.

A second change in the pattern of land use in the Kajiado District since 1945 has resulted from the creation of national parks. The parks enclose grazing and water resources which are available year round and the exclusion of Maasai from the parks has reduced the dry season grazing resources available to them and increased the pressure on remaining resources. Many Maasai argue, however, that, should drought conditions return they will, if necessary, move their animals into the Chyulu Hills, Amboseli National Park, and Tsavo National Park despite the prohibition against it.

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[1]Some Kikuyu farmers went through a ceremony of initiation into Maasai society and were thus eligible to remain in the area and continue cultivation.

These two pressures, namely:

(a) the growth of pressure on arable farming through immigration from Central and Western Province; and

(b) the restriction of grazing areas because of the creation of National Parks;

are external pressures which, like the growth of Nairobi, structurally constrain the internal dynamics of environmental and developmental processes in Kajiado District.

The major constraints upon pastoralists' activities are rainfall which leads to seasonal variations in the availability of water and pasture, and recurrent drought with its threat of famine. Pastoralists have developed a number of strategies designed to reduce the negative effects of irregular seasonal rainfall and of current drought including:

1. seasonal movements. Pastoralists recognise areas which offer sustenance during different seasons and move their herds according to the availability of water and pasture. During the rains, the herds disperse over the rangelands while in the dry season, and in periods of drought, they concentrate in localities which continue to afford grazing and water resources.

2. herding a variety of animals. Most pastoralists herd a variety of animals, being a combination of cattle or camels and/or sheep and goats; each species grazes different ecological niches and has different economic and social values.

3. maintenance of herd size. Pastoralists require sufficient numbers of livestock to ensure their basic subsistence obligations and drought losses, and therefore, they attempt to maintain large herds.

4. control of grazing areas. Of fundamental importance to the survival of pastoralists within the environmental constraints is access to dry season water and grazing areas. These may include swamp lands and valleys of perrenial streams within the rangelands and also hillslope and other areas at the more humid margins of the rangelands.

In order to secure access to these areas, pastoralists resisted, by force if necessary, any attempts by other pastoralists or by farmers to occupy their traditional dry season retreat areas.

5. social relations. Pastoralists maintain a variety of social linkages both within their own society and between themselves and adjacent communities. With the family, clans, and age groups exist mutually supporting activities designed to reduce the effects of inclement environmental conditions, disease, or external threats. Contact beyond the group in the form of trade of animals, exchange of animal products for grain etc., are important, particularly during periods of drought, as means of supplementing their income and diet.

The arrival of the Europeans resulted in significant changes in the patterns of pastoral land use. The impact was felt more by the country because the Rift Valley became the focus of much European immigration and land alienation.

In the post-World War II period, the Government assumed more interest in the arid and semi-arid areas culminating the Swynnerton Plan (Swynnerton, 1954) which sought strategies to exploit the resources of the rangelands more fully while stopping the destruction of the environment. The Swynnerton Plan identified overstocking as the cause of the problems, as it led to destructive overgrazing, and suggested the implementation of grazing schemes in which careful livestock management was to be enforced. This implied regular sale of livestock, selective breeding and culling, rotational grazing patterns, and the provision of water and veterinary services.

The schemes encountered many problems due to the methods used to initiate them and due to the choice of areas of implementation. They were started in the most degraded areas and thus a great deal of attention had to be paid to land reclamation - usually through immediate reductions in the number of livestock. This was actively opposed by the pastoralists for a number of reasons:

1. population was already at a subsistence level and no alternative means evolved to bridge the gap between the implementation of the scheme through reduced livestock numbers and the time when the presumed benefits would appear;

2. the reduction in livestock numbers disrupted the social relationships which depended upon livestock such as loans, bride price, etc.;

3. to comply with the quotas on livestock, many families had to split their herds and thus the family;

4. the schemes were too large and cut across traditional clan areas and so the herders felt little allegiance to them or the district administrations which were responsible for them;

5. the reduction in stock numbers affected those with the largest herds the most and, as these were often the leaders, the schemes were opposed by the most influential members of the society.

In those areas where the regulations governing the schemes were strictly enforced, there was some improvement in the health of the livestock and in the quality of the rangeland. The gains achieved were, however, shortlived as in the early 1960's two events combined to disrupt the grazing schemes. First, the drought of 1960 forced the abandonment of the rotational grazing system on which range rehabilitation depended and second, with the approach of independence, the discipline which had been necessary to make the scheme function could not be maintained and the schemes disintegrated.

In the post independence period, government policy has encouraged greater economic return from the rangelands through encouraging subsistence ranchers to become more commercial and through stimulation of the tourist industry via the National Parks.

The impact of population growth and the consequent increasing demands for productive agricultural land is felt by the pastoralists as well as by the farmers. The nature of the landholding system in Kajiado District is such that farmers either own or rent their land. Due to the landholding which prevails in Kenya, once a

farmer has acquired access to a piece of land, he assumes total control over the land use of the plot. As a consequence, land which comes under cultivation is no longer available to herders as a grazing resource. The occupation of higher potential land by farmers therefore reduces the dry season grazing resources available to the pastoralist.

Existing projections suggest that, given current population growth, the carrying capacity of the area will be exceeded very rapidly unless a major social and political transformation occurs. Table 5.1(b) shows a range of dates at which livestock population demands are likely to exceed the capacity of the environment under different conditions. The most optimistic date is 2074 if all land is available for grazing, the productivity of the range is increased by 50 percent, the population continues to grow at only 2.2 percent per annum and the stocking rate is reduced to 1.0 SSU/Adult. This is a most unlikely scenario.

At the other extreme, the earliest date is 1984 if grazing resources are limited due to agricultural expansion, rangeland productivity is not improved, the population grows at 2.5 percent per annum (or 3.0 percent per annum) which is perhaps the current rate, and the stocking rate is 3.5 SSU/Adult which is 16 percent below the current level. This is not an unlikely scenario.

An optimist might look for an improvement of the carrying capacity by 25 percent, the land use system permitting grazing the whole area, a reduction in the stocking rate to 2.0 SSU/Adult and the population growth rate being 2.5 percent per annum. Under these conditions, 2025 would be the date at which demand would exceed supply.

A more likely scenario for the next 10 years would be: population growth at 2.5 percent per annum; stocking rate reduced to 3.5 SSU/per adult; range productivity increased by 25 percent; and herders retaining access to all land (except Zone II and III)*. The year 2001 would be the estimated break even point under such conditions.

The parameters most likely to affect the balance between supply of and demand for resources are the

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*See Appendix II.

TABLE 5.1(b) DATE AT WHICH LIVESTOCK POPULATION WILL OUTSTRIP THE CARRYING CAPACITY OF KAJIADO DISTRICT UNDER DIFFERENT STOCKING RATES, LEVELS OF TECHNOLOGY, LAND USE AND POPULATION GROWTH RATES

LAND USE SYSTEM	ALL LAND AVAILABLE FOR GRAZING			ZONE II LAND NOT AVAILABLE FOR GRAZING			ZONE II AND III LAND NOT AVAILABLE FOR GRAZING			ZONE II & III, ¼ OF ZONE IV NOT AVAILABLE FOR GRAZING		
LEVEL OF RANGELAND TECHNOLOGY	CURRENT CARRYING CAPACITY	CURRENT CAPACITY +25%	CURRENT CAPACITY +50%	CURRENT CARRYING CAPACITY	CURRENT CAPACITY +25%	CURRENT CAPACITY +50%	CURRENT CARRYING CAPACITY	CURRENT CAPACITY +25%	CURRENT CAPACITY +50%	CURRENT CARRYING CAPACITY	CURRENT CAPACITY +25%	CURRENT CAPACITY +50%
STOCKING RATE SSU/AE (1) POPULATION GROWTH RATE												
3.5 SSU/AE 2.2% p.a.	1997	2008	2017	1994	2004	2013	1993	2002	2011	1985	1995	2003
3.5 SSU/AE 2.5% p.a.	1996	2006	2014	1994	2003	2010	1003	2001	2009	1984	1994	2002
3.5 SSU/AE 3.0% p.a.	1995	2003	2010	1993	2001	2007	1992	1999	2006	1984	1994	2000
2.0 SSU/AE 2.2% p.a.	2024	2035	2043	2020	2031	2040	2018	2029	2038	2010	2021	2030
2.0 SSU/AE 2.5% p.a.	2020	2030	2037	2018	2027	2034	2016	2025	2033	2009	2018	2026
2.0 SSU/AE 3.0% p.a.	2017	2025	2031	2015	2022	2028	2014	2021	2027	2008	2016	2021
1.0 SSU/AE 2.2% p.a.	2055	2066	2074	2052	2062	2070	2050	2060	2068	2042	2053	2061
1.0 SSU/AE 2.5% p.a.	2048	2058	2066	2046	2055	2062	2045	2053	2061	2037	2046	2054
1.0 SSU/AE 3.0% p.a.	2040	2049	2055	2038	2045	2051	2037	2044	2050	2031	2038	2044

NOTE (1) STOCKING RATE IS IN STANDARD STOCK UNITS PER ADULT EQUIVALENT

stocking rate and the rate of population growth. The latter is most difficult to influence and thus the most effective strategy is to reduce the stocking rate. Such reduction would seriously affect the subsistence base of Kajiado District but without such reduction, secondary environmental impact would occur.

5.2 Soil and Water Conservation

The human and livestock trends described in the preceding section clearly identify the most important environmental problem in Kajiado District. Consequently, attention should continue to be focused upon the closely related issues of soil and water conservation.

Soil erosion, by both wind and water, is viewed as an important problem by local residents who cite the lack of vegetation cover, consequent upon overstocking, as the major cause. In low lying areas, a combination of sparse vegetation and overgrazing accentuates the problem while, in high areas, over cultivation of steep slopes and high intensity rainfall increases the probability of soil erosion. Even though 80 percent of the rainfall is low intensity, the 20 percent of high intensity rains cause severe problems. Recent research has reported significant rates of erosion from overgrazing, varying from 0.3 cm per annum to 1.2 cm per annum. The rate of soil formation is 0.001 cm per annum, substantially lower than the erosion rate, so that, in time, mining of soil is inevitable. Although the loss of organic matter (therefore structure), moisture retention, capacity, and absorbed nutrients are serious consequences, the most important soil characteristic altered during erosion is the soil depth. In the two areas (Ngong and Loitokitok) where erosion hazard was documented by the Agricultural Department, terraces are being dug. Some strip cropping is also being practiced in these areas. However, damage to the terraces by animals is constantly reported.

Erosion by wind (Aeolian erosion) is observed and, in fact, a large amount of dust is reported near Kajiado township during the dry season. Thomas Dunne (1977) writes "The current rate of removal will eventually remove most profiles completely and thereby limit production. This will not happen in the next few years, however, and so there is time to develop

intelligent land management programmes based upon an understanding of the ecology and values of the pastoralist nomads (Maasai people of the district). The control measures suggested include:

(a) Immediate destocking over the whole district and then controlled stocking and grazing;

(b) Installing erosion control measures such as bench terracing, terracing, and trash lining strip cropping in crop production areas;

(c) Rigorous forestation programmes;

(d) Planting grasses, for example, Panicum Makarikariensis, along the edges of terraces and protecting them from animals;

(e) Resting overgrazed areas;

(f) Judicious cultivation of hillslopes (slopes with high gradients should be closed);

(g) Good planting of ranches, farms, and game parks.

While it is possible to recommend a series of strategies to cope with problems of soil erosion, it is difficult to provide a similar series of strategies for water management. In arid and semi-arid areas, rainfall seldom meets the evaporative demand and, consequently evapotranspiration is accentuated, relative to streamflow, as an outward flow in the local hydrological cycle. Evapotranspiration outflows are not susceptible to simple management techniques. However, attention should be placed on limiting outflow of streams, especially after storms, by planning low cost barrages in selected areas. Spreading systems that will recover water and suspend soils, though difficult to design, are necessary to reduce soil and water loss and increase resource conservation. Without efficient system design, there is a possibility that disease vectors will increase as units of standing water provide breeding grounds for parasites.

In discussion of environmental problems in Kajiado District, it is important that drought be

considered. The period 1972-1976 was a period of reduced rainfall in the district but the severity of impact of the drought was partly due to the inability of farmers and pastoralists in the area to cope with drought.

The pastoralists' dry-season resources had been severely curtailed prior to 1972 through the extension of national parks and the expansion of cultivation. While some pastoralists had adjusted to the situation by taking up cultivation themselves, the majority had continued with their traditional pastoral economy. When the drought came, the area available for grazing was limited and deaths to livestock were widespread. As the process of expansion of the area under cultivation is continuing, the Maasai human and animal population will become more vulnerable to future drought. There is some indication that younger Maasai are looking to a mixed agro-pastoral economy in the future, but in the absence of some form of land use planning, they may be prevented from realising this objective by the expansion of non-Maasai agriculture.

The non-Maasai farmers of the region are new to the area and are in a process of adjusting to its socio-economic and environmental conditions. The farming population is already large enough to create a situation of land shortage, which, together with soil erosion, is seen as giving rise to major problems in the near future. In response to this land shortage, many farmers are moving to the lower-lying drier areas and cultivating land along river valleys and around the edges of swamps. The evidence from the recent drought suggests that those farming in the drier areas were least able to meet their subsistence needs. They required famine relief. Any increase in the numbers of people farming in the drier areas will not only reduce the dry season grazing resources of the pastoralists but will also increase the farming population at risk to drought.

For both pastoralists and farmers, the situation is serious. There is room for expansion of agriculture, particularly along river valleys where irrigation may be possible. But it is limited and can provide only a short-term respite from the area's problem of land shortage. The use of such areas for agriculture would certainly interfere with the pastoral system of the area and further reduce its viability. Some form of

land use planning is required for such areas, planning which will evaluate the regional costs and benefits of each land use and the importance of these riverine and swamp resources to each. Uncontrolled or ill-conceived land use changes in the area will only serve to increase the vulnerability of the population to drought.

Both the pastoralist and farming people of the area are actively seeking ways to reduce their vulnerability to drought. Most of these strategies can be accomplished with local resources, though some require specific help from the Government. The emphasis upon local efforts to reduce the impact of drought is to be encouraged but the Government should be consciously seeking ways in which it can assist local people in meeting these objectives. These would include:

(i) Provision of grain storage facilities;

(ii) Technical assistance with the creation of reliable water supply; and

(iii) Technical assistance with the choice of drought-resistent crops.

The probability of flooding in the area is low although, in 1974 and 1978, floods occurred in Chyulu, Emali, and Loitokitok Division.

5.3 Burning, Chemical Use, and Human Diseases

Burning vegetation to produce charcoal, as a means of cleaning bush, and as a control mechanism for tick population is common, frequently occurring on an annual basis. Burning reduces nitrogen, sulphur, and phospherous which are lost to the atmosphere and increases the rate of oxidation of organic substances in the soil. The loss of organic matter is accomplished by the physical deterioration of the soil, lowering rainfall acceptance, water infiltration rates, water retention, and aeration. In some cases, burning also destroys soil organisms and, especially in saline soils, raises the pH value. Unless such burning is controlled and sufficient recovery time is allowed for the ecological niche, land degradation will occur.

Although agricultural chemical use is greatly increasing in the district, no reports of pesticide poisoning were discovered. Pesticide use includes insecticides, fungicides, herbicides, molluscides,

and acaricides. Acaricides are used in cattle dips where bacdip, servin, delnar and coopertox are employed. Possible pollution, in both soil and water, are not currently monitored in the district. Such a monitoring programme should be initiated that would look for chemical impacts of heavy metals, chlorinated hydrocarbons, carbonates and organo-phosphates.

The human population suffers diseases associated with poverty. Provision of sanitary conditions, especially a hygenic water supply, would greatly increase the health of the population. In future years, unless current trends are reversed, there will be a growing probability of food shortages in the district. No industrial pollution of any meaningful magnitude exists in Kajiado District.

This chapter has summarised the environmental trends in the District. The most striking trend is the struggle for the existing land resources which will become more, rather than less, severe. It is to strategies for dealing with this resource scarcity, and consequent resource depletion, that we now turn.

6. SUGGESTIONS AND RECOMMENDATIONS

6.1 Summary and Range of Options

The conclusion reached in this report suggests that the critical environment and development problem in Kajiado District is access to resources. Bluntly stated, the pastoralists are in a resource clutch.

The frequent responses to the problem are:

(1) education will improve the situation;

(2) sufficient reliable water holes will need to be established;

(3) diversification of pastoralism to include cultivation will increase subsistence production.

6.1.1 Education and Water Supply

Education, per se, at best will only provide a "band-aid" solution; at worst, it will only serve the interests of the teachers. Emphasis on water hole construction is non-developmental and could as easily exaccerbate the problem as provide an adequate solution to the complex issue of integrated resource management of arid rangeland. It is on the diversification of pastoralism that we must focus to sketch out future options.

6.1.2 Subsistence Pastoralism

In the absence of specific measures designed to ensure the protection of the basic resources required for subsistence pastoralism - access to water and availability of adequate areas of dry season pasture - there will be a rapid deterioration in the pastoral economy. It is probable from the data available on livestock numbers and subsistence needs, that for the Maasai to have subsisted from their livestock during the drought, greater numbers would have been required at the onset of the difficulties. As the population grows, so the number of animals required to provide the subsistence needs of the people will increase. For subsistence pastoralism to be viable, more animals will be needed in the future and this will place more pressure on the grazing resources.

A number of processes not directly associated with pastoralism are actively reducing the quality of the land resources available for pastoralism. The critical resources are not those available in the extensive plains areas during the wet season but the more localised dry-season pasture and water reserves. The areas where these are found are also important for wildlife and are often suitable for agriculture, either rainfed or under irrigation. The returns from agriculture and wildlife related activities in these localities may be greater than those from pastoralism but it is upon these relatively limited areas that the productivity of the adjacent rangelands depends.

As cultivation and tourist activities occupy these areas, so the ability of the land to support the subsistence herds is reduced. The process is likely to accelerate in the next decade and consequently the future viability of pastoralism must be questioned.

6.1.3 Mixed Agricultural and Pastoral Economy

It is clear that pastoralism is seen as continuing to be a viable economy if cultivation is increased. The basic resource necessary for this, i.e. cultivable land, is in extremely short supply. The vast majority of such land is already occupied and the remaining pieces are largely protected land, for example, the summits of Ngong Hills. The only alternative is to purchase cultivable land but land prices in the area are too high to permit this alternative to be taken up by the majority.

It is likely, therefore, that pastoralism will continue to decline, unless Government/Mission/AID Agency assistance is given to improve the water resources in the pastoral zone.

If the Maasai intend to diversify their pastoral economy through increased cultivation, they will have to be far more active in assuming control over the remaining areas of agricultural potential. Should they not do so, then non-pastoralists will.

The dangers to the pastoral system from expansion of agriculture have been outlined above. Should the more fertile dry-season grazing areas

be farmed by Maasai it is possible that arrangements whereby herds could graze upon the crop residues during the dry season might evolve. It is likely that such arrangements could be made between Maasai and other agricultural groups.

For a mixed pastoral/agricultural economy to function, the available resources will have to be utilized to ensure the viability of both activities. Pastoralism is dependent upon the availability of dry season grazing and water resources and thus agricultural activities will have to be controlled to conserve these. In the absence of control, agriculture will continue to expand and eventually become, not a compatible, but a competitive land use. The future of pastoralism will be threatened. It should also be noted that as farmers move into less favourable areas, they become more susceptible to the effects of drought. There is a danger, therefore, that such expansion will not only place farmers at risk but also the entire set of pastoral communities whose lands are occupied.

6.1.4 Alternatives Associated with Tourism

The Maasai, while bearing the costs involved with supporting wildlife, do not receive adequate compensation from tourist activities. Traditionally, pastoralism and wildlife were compatible land uses. In recent times, a number of processes have upset this harmony: national parks which exclude pastoralists have severely curtailed dry season grazing resources; increasing human and animal population is making greater demands for grazing and land resources.

The Ministry of Tourism and Wildlife has begun to experiment with the idea of making payment to ranches for water and grazing resources used by the wildlife. These payments may encourage ranchers to reduce the numbers of domestic stock and to increase the wildlife population on the ranches. However, as these payments are made to the GR Committees. efforts will have to be made to inform GR members that the fees are being paid and that livestock numbers should be controlled to maximize the fees. Unless individual members obtain benefits from these payments, little success in limiting livestock numbers is expected.

Other activities associated with tourism include the locating of lodges, tented camps, etc. on ranches such that the income to pastoralists from tourism may be increased.

While it is probable that the presence of wildlife on a ranch is compatible with Maasai herding activities and compensation revenues will prove an acceptable accommodation of pastoral and wildlife land uses, the presence of tourists may be more disruptive to the Maasai way of life.

6.1.5 Commercialised Pastoralism

A number of commercial ranches exists in Kenya, but no concerted effort has been made to commercialise subsistence pastoralism. In the absence of adequate income earning opportunities, increasing numbers of Maasai are engaging in cultivation or moving to towns in search of jobs. The problems associated with the former have already been discussed while realistically, in view of the high urban unemployment rates, the latter alternative will not be viable.

A commercial livestock industry may, however, be able to absorb those looking for work and alter the basis of subsistence pastoralism if it is organized such that it meets the needs of the Maasai.

The Maasai economy is based upon cattle rearing; their subsistence food supply is obtained from the livestock. An integrated livestock industry which includes a slaughter house, tannery, meat dressing plant, etc. might provide a viable alternative to subsistence pastoralism which is compatible with both the cultural and environmental constraints of the area.

Livestock would remain the basis of the economy, the rangelands would continue to be economically productive, and the benefits of cattle sales and production would accrue locally to the benefit of the Maasai. A range of jobs could be provided including slaughter house work, the dressing plant, and also leather tanning.

Clearly a large number of conditions must be met before a scheme might be viable. A suit-

able scale of operation would have to be developed and the quality of animals and their hides would have to be upgraded. However, it could provide an alternative for the Maasai which would not involve total disruption of their socio-economic system and which would capitalize upon their expertise in livestock management and upon their intimate understanding of the resources available in the rangelands.

APPENDIX I - EXISTING WATER SUPPLY

LOCATION/SITE OF FACILITY	TYPE OF FACILITY (PROBLEMS & REMENDS)	SPONSORING AGENCY	MAINTAINING AGENCY	PEOPLE OR AREA SERVED	LEVEL OR COMPLETION AND OPERATION
OLTEPESI	Bore-hole	Ministry of Water Development (MOWD)	MOWD	500 people families	Completed and operating
OLOIKA WATWE	River - Intake PROBLEM: Maintenance is very poor and the pipeline is blocked Intake filled by silt.	Magadi Soda Company	Self-help	600 people (families)	Completed
MAPARASHA	Spring - Intake PROBLEM: Poor maintenance. Intake filled with silt. Some burst and cut.	Individuals (Ranchers)	Individual Ranches	300 families (formerly county council)	Completed
NKAMA	Three Bore-Hole	Portland Cement (2) Agricultural Finance Cooperation, A.F.C. (1)	Group Ranches	400 families & 600 cattle	Completed The A.F.C.'s BH is not functioning.
MBILINI	One Bore Hole: One Connection from Nultres Railway lines.	Group Ranches	Group Ranches	300 families & 400 cattle	Completed
EYARTI	One Bore-Hole	Group Ranches	MOWD	300 families & 400 cattle	Completed

APPENDIX I - EXISTING WATER SUPPLY (Cont'd)

LOCATION/SITE OF FACILITY	TYPE OF FACILITY (PROBLEMS & REMENDS)	SPONSORING AGENCY	MAINTAINING AGENCY	PEOPLE OR AREA SERVED	LEVEL OF COMPLETION AND OPERATION
	Adjacent to the present one. Two more bore-holes are to be drilled at Ngong to serve the pipeline.	MOWD	MOWD	Area 3000	Completed and in operation
NAMANGA W/S	Bore-hole PROBLEMS: not experienced.	MOWD	MOWD	1,500	Completed and in operation
LOITOKITOK	River-Intake gravity flow to town. No problems	MOWD	MOWD	3,000	Completed and in operation
LASSIT/WS	River Intake. Pumping device. PROBLEMS: Stealing of pumping equipment.	MOWD	MOWD	2,000	Completed and in operation
ESOKOTA	Bore-hole	County Council	County Council	400)	All in operation
BIESSEL NO. 1	Bore-hole	County Council	County Council	400)	
BIESSEL NO. 3	Bore-hole	County Council	County Council	400)	
NGATATAEK	Bore-hole	County Council	County Council	350)	
LUANOTA	Bore-hole	County Council	County Council	300)	
*OROLE	Bore-hole	County Council	County Council	350)	
ESOKOTA NO. 2	Bore-hole	County Council	County Council	200 families)	
MAILWA	Bore-hole	County Council	County Council	350)	

APPENDIX I - EXISTING WATER SUPPLY (Cont'd)

LOCATION/SITE OF FACILITY	TYPE OF FACILTIY (PROBLEM & REMENDS)	SPONSORING AGENCY	MAINTAINING AGENCY	PEOPLE OR AREA SERVED	LEVEL OF COMPLE-TION & OPERATION
EMPUNYAKATI	One Bore-hole. One private one has also been drilled but is not functioning.	Group Ranches	Group Ranches & County Council	4000 families & 4000 cattle	Completed
TOROSEI	River Weir	R.T.C. Kajiado	R.T.C. Kajiado	400 families 5000 cattle	Completed being expanded
OLKERAMATIAN	River	R.T.C. Kajiado	R.T.C. Kajiado	500 families 1000 cattle	Completed. A large project is under funding consideration
MEIO	Spring Weir (at Tanzania side)	R.T.C. Kajiado	R.T.C. and indi-viduals imple-mented by MOWD	2000 people & 1000 cattle	Completed
KAJIADO TOWNSHIP	Ngong Springs & 3 Bore-Holes PROBLEMS: The springs produce very little water during dry sea-sons. The pipeline bursts frequently due to soil cracking. A stand-by pipeline from Kisenan to Kajiado is needed	MOWD	MOWD	Area 3000	Completed and in operation

APPENDIX I - EXISTING WATER SUPPLY (Cont'd)

LOCATION/SITE OF FACILITY	TYPE OF FACILITY (PROBLEMS & REMENDS)	SPONSORING AGENCY	MAINTAINING AGENCY	PEOPLE OR AREA SERVED	LEVEL OF COMPLE-TION AND OPERATIC
MILE 46 No. 1	Bore-hole	County Council	County Council	400	
MILE 46 No. 2	Bore-hole	County Council	County Council	400	
MUTULUKJI 1	Bore-hole	County Council	County Council	400	
MUTULUKJI 2	Bore-hole	County Council	County Council	400	
LENGESIM	Bore-hole	County Council	County Council	400	
LOSINGELAU	Bore-hole	County Council	County Council	400	
MASHURI	Bore-hole	County Council	County Council	400	
MATULING	Bore-hole	County Council	County Council	400	
KIU	Bore-hole	County Council	County Council	400	
ELANALAU	Bore-hole	County Council	County Council	400	
KAREI	Bore-hole	County Council	County Council	400	
EMUGUL	Bore-hole	County Council	County Council	400	
MELUESHI	Bore-hole	County Council	County Council	400	
OLKATETAMAI	Bore-hole	County Council	County Council	400	
SAIKELI	Bore-hole	County Council	County Council	400	
ENKORIKA	Bore-hole	County Council	County Council	400	
BULATI	Bore-hole - Draw pipes sunk. Hope to drill another.	County Council	County Council	400	
KILALAPON	River intake	County Council	County Council	400	
LOLONGOSWA	Bore-hole	County Council	County Council	400	
SAILONI	Bore-hole	County Council	County Council	350	
ISENYA	Bore-hole	County Council	County Council	400	

Source: Ministry of Water Develcpment.

APPENDIX II

Area in Each Ecological Zone

Kajiado District (ha)[1]

UNIT	ZONE II	ZONE III	ZONE IV	ZONE V	TOTAL
West	15800	13900	337800	518600	886100
North	0	0	289100	252200	541300
South	6250	0	156172	619778	782200
DISTRICT	22050	13900	783072	1,390578	2,209600

[1]Areas from Atlas of Kenya p. 29 amended according to Pratt and Gwynne 1977, Map 1.