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DRAFT

Environmental Profile

of

ZAMBIA

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An Introductory Note on Draft Environmental Profiles:

The attached draft environmental report has been prepared under a contract between the U.S. Agency for International Development (AID), Office of Forestry, Environment, and Natural Resources (ST/FNR) and the U.S. Man and the Biosphere (MAB) Program. It is a preliminary review of information available in the United States on the status of the environment and the natural resources of the identified country and is one of a series of similar studies now underway on countries which receive U.S. bilateral assistance.

This report is the first step in a process to develop better information for the AID Mission, for host country officials, and others on the environmental situation in specific countries and begins to identify the most critical areas of concern. A more comprehensive study may be undertaken in each country by Regional Bureaus and/or AID Missions. These would involve local scientists in a more detailed examination of the actual situations as well as a better definition of issues, problems and priorities. Such "Phase II" studies would provide substance for the Agency's Country Development Strategy Statements as well as justifications for program initiatives in the areas of environment and natural resources.

Comments on the attached draft report would be welcomed by USMAB and ST/FNR and should be addressed to either:

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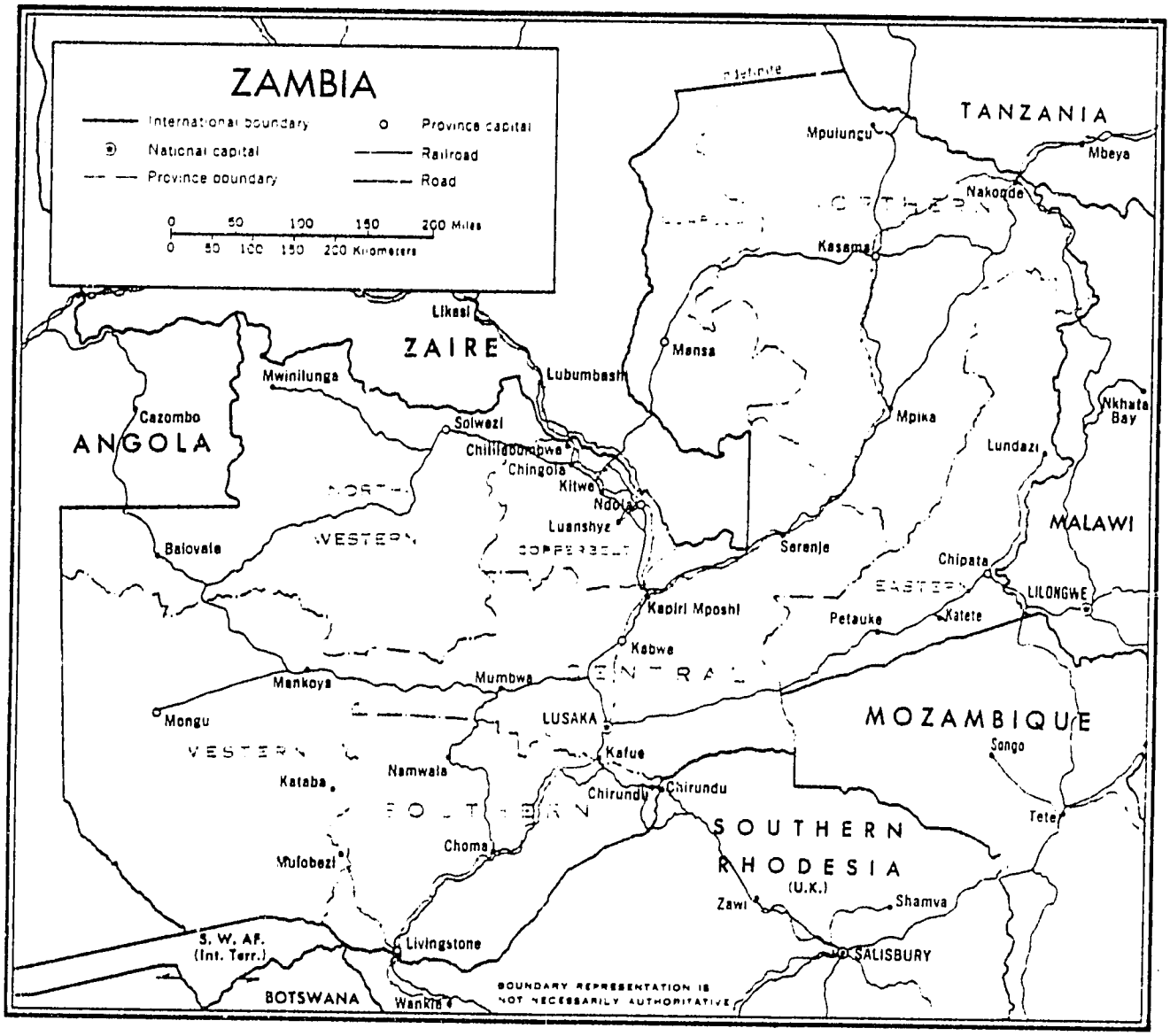
ZAMBIA
International boundary
National capital
Province boundary
Province capital
Railroad
Road
0 50 100 150 200 Miles
0 50 100 150 200 Kilometers
TANZANIA
Mpulungu
Mbeya
Nakonde
Kasama
Likasi
ZAIRE
Mansa
Mwinilunga
Lubumbashi
Cazombo
ANGOLA
Solwezi
Chililabombwe
Chingola
Kitwe
Ndola
Luanshya
Mpika
Nkhata Bay
Lundazi
MALAWI
Serenje
Chipata
Balovale
Kapiri Mposhi
Petauke
Katete
LILONGWE
Kabwe
Mankoya
Mumbwa
Mongu
LUSAKA
MOZAMBIQUE
Sango
Kafue
Namwala
Kataba
Chirundu
Tete
Choma
Mulobezi
SOUTHERN RHODESIA (U.K.)
Zawi
Shamva
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Wankie
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SUMMARY

The Republic of Zambia is a landlocked country in south central Africa, lying mostly on a high plateau. Climatic zones range from semiarid to humid (less than 700 mm to over 1,500 mm annually). Mining activity gives the country some financial base on which to build, but development is still largely in the beginning stages. Accordingly, most major environmental problems concern rural areas and agriculture.

The major environmental problems are summarized below.

Soil erosion is not well researched in Zambia, but some observers estimate that the country's 300,000 hectares of annually cropped land may lose up to three million tons of topsoil yearly. Some of Zambia's traditional agricultural systems require clearing large areas of forest, which leaves the soils more susceptible to erosion. Areas where cultivation takes place on relatively steep slopes are at great risk, such as the regions around Chipata, south of Lusaka, south of Mazabuku, near Mbala, or in the Copperbelt. The expansion of modern commercial agriculture, however, is probably a more significant factor. Vast areas are cleared and plowed, eliminating ground cover and leaving the land particularly susceptible to wind erosion. The most serious problems are along Zambia's central rail line.

Deforestation and rangeland degradation are serious throughout Zambia. The major factors behind deforestation are the traditional chitemene (slash and burn) agricultural system, firewood gathering, and charcoal production. Zambia loses at least 9,000 square km of woodland annually to the chitemene system, and another 2,000 square km to fuel needs. At the present rate of exploitation one observer has estimated that Zambia's woodlands could disappear within 25 years. Rangeland deterioration, mostly due to overgrazing, is also serious in the dryer portions of Zambia. The estimated average gross stocking rate in Zambia's rangelands is between 0.32 and 0.45 ha per livestock unit, which is 10 to 15 times greater than the recommended rate.

Environmental health problems are widespread. Water borne diseases include malaria and bilharzia. Development of irrigation systems and abandonment of open pit mines in mining and quarrying regions are likely to contribute to increased incidence of these kinds of diseases in the near future. A second issue is access to uncontaminated water supplies. Approximately one-fifth of the urban and nearly half of the rural population did not meet minimum required needs for an adequate water supply. Sanitation facilities are similarly inadequate or non-existent in many cases, particularly in rural areas. Occupational health hazards occur mostly in mining regions and include pneumonia among underground workers.

Industrial pollution is not a major national problem, but has become serious locally where mining activity occurs or industrialization has taken place. "Acid rain" and buildup of toxins in soils often accompanies smelter operations. The Kafue industrial center and Lusaka are the main

areas of industrial pollution aside from mine-connected operations, but little data is available. Pollution from agrochemicals may become a major problem as commercial farming expands, but does not yet seem very serious.

Wildlife issues concern three areas: hunting and poaching, destruction of wildlife habitat, and overpopulation. Hunting and poaching do not seem to seriously threaten most species at present. Perhaps of more concern is the killing of animals in various "vermin" control and disease control programs, which sometimes aim at the complete elimination of wildlife from target areas. Habitat destruction is more serious and will get worse yet as Zambia develops. Surface water development, for example, often floods prime areas in river valleys, disrupting life cycles of animals such as the lechwe, as well as reducing carrying capacity of the land. Overpopulation has also become a problem with a few animals which received very good protection. The Kafue lechwe population recovered from only 26,000 a few decades ago to 100,000 by the early 1970s. However, the area they were allotted was not sufficient to support these numbers, and the population has since dropped by about half. Elephant overpopulation is also serious in the Luanga valley, and too many elephants are rapidly destroying their own habitat.

1.0 Introduction

This draft environmental profile summarizes information available in the United States on the natural resources and environment of of Zambia. The report reviews the major environmental problems of Zambia and the impact of the development process upon resources and the environment. This draft report represents the first step in developing an environmental profile for use by the U.S. Agency for International Development (U.S. AID) and Zambian government officials. The next step in this process should be a field study to evaluate the information presented here, obtain additional information, and define the issues, problems, and priorities in greater detail. This entire process should help provide direction in future efforts to deal with the management, conservation, and rehabilitation of the environment and natural resources.

The information and interpretations in this report are preliminary and are not intended to attain the detail and accuracy required for development planning. The report represents a cooperative effort by the Man and the Biosphere (MAB) project staff of the Arid Lands Information Center (ALIC). The primary research, writing, and analysis were done by Mark Speece, through the resources of ALIC and the University of Arizona Library. The cooperation of James Carson, AID/MAB Project Coordinator, and other AID personnel is gratefully acknowledged.

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2.0 General Description

2.1 Geography and Climate [1/]

The Republic of Zambia covers an area of 752,972 sq km (290,724 sq mi) in south central Africa. Zambia is a land-locked country, surrounded by (clockwise from the north) Zaire, Tanzania, Malawi, Mozambique, Zimbabwe, Botswana, Namibia, and Angola. The country is situated on a high plateau, and elevations generally range from 900 to 1530 m above sea level. In the context of Africa, Zambia is generally classified in the savanna vegetation zone (e.g. O'Connor 1978). On a local level three climatic zones are distinguished. The dry zone (P/Etp <1.0) covers the southern part of Zambia (Fig. 2.1) and is considered to be part of the subhumid zone in UNESCO's survey of world aridity (UNESCO 1977). The hypermoist subhumid zone (P/Etp > 1.4) covers the northern tip of western Zambia and the highlands of the northeast. The remaining broad belt is considered moist. Rainy seasons vary from about 5 months in the dry zone to 7 months in the hypermoist.

The highest parts of the country are in the northeast, with the plateau gradually sloping to the southwest. Small areas along the northeast border with Tanzania, the mountains north of Lake Bangweulu, and mountains in the chain along the Luangwa River reach elevations over 1500 m. Most of the western portion of the country, in contrast, lies between 1000 and 1200 m, while the rift valleys contain extensive areas below 600 m. This topographic variation does not correspond exactly to the moisture zones and this fosters a greater ecological diversity than might be expected. Five major ecological zones can be distinguished:

Western semi-arid plains. These plains range in elevation from 900 to 1200 m. and cover all of Western Province and major portions of Northwestern, Central, and Southern Provinces (Fig. 2.2). Aridity is primarily due to high rates of evapotranspiration rather than lack of precipitation, but drought occasionally becomes a major problem. Rainfall in the southernmost portions may be under 700 mm, but gradually increases toward the north to about 100 mm annually. Rains generally begin in late November and last from 120 to 160 days, increasing in duration toward the north. Winter temperatures in the semi-arid plains are among the lowest in Zambia ($< 10^{o}$ C mean daily maximum in October). More detailed climatic data for this and other regions in Zambia are presented in Appendix I.

[1/] Chidumayo. 1979.
Davies. 1971
Kaplan. 1979.
Schultz. 1976.
U.S. AID. 1981.
U.S. Dept. of State. 1979.

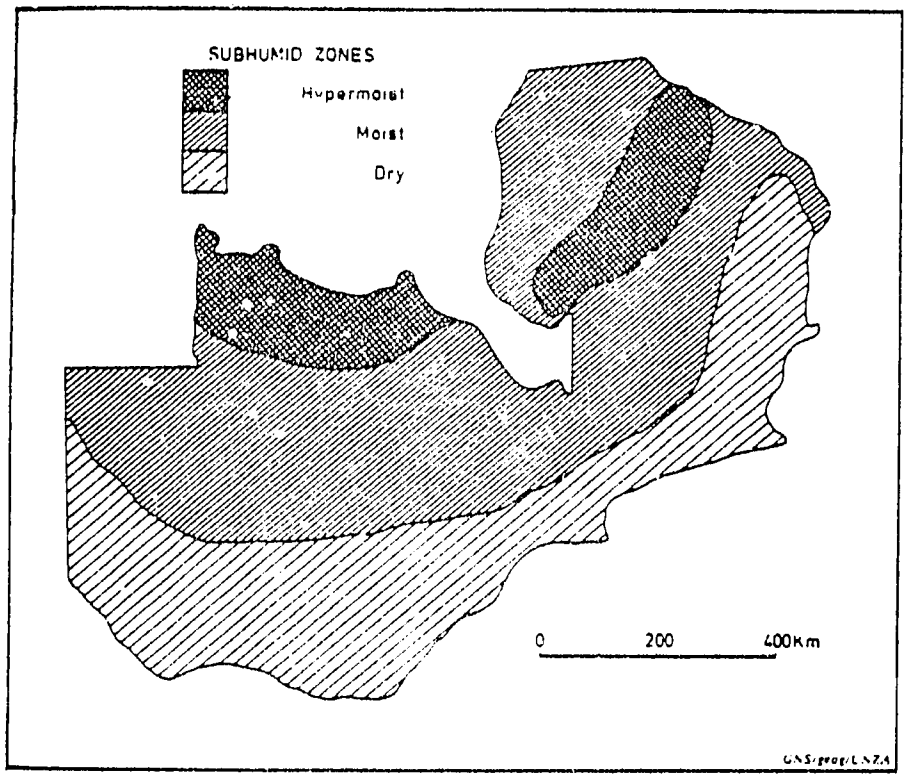

Figure 2.1. Subhumid Zones

Source: Chidumayo. 1979.

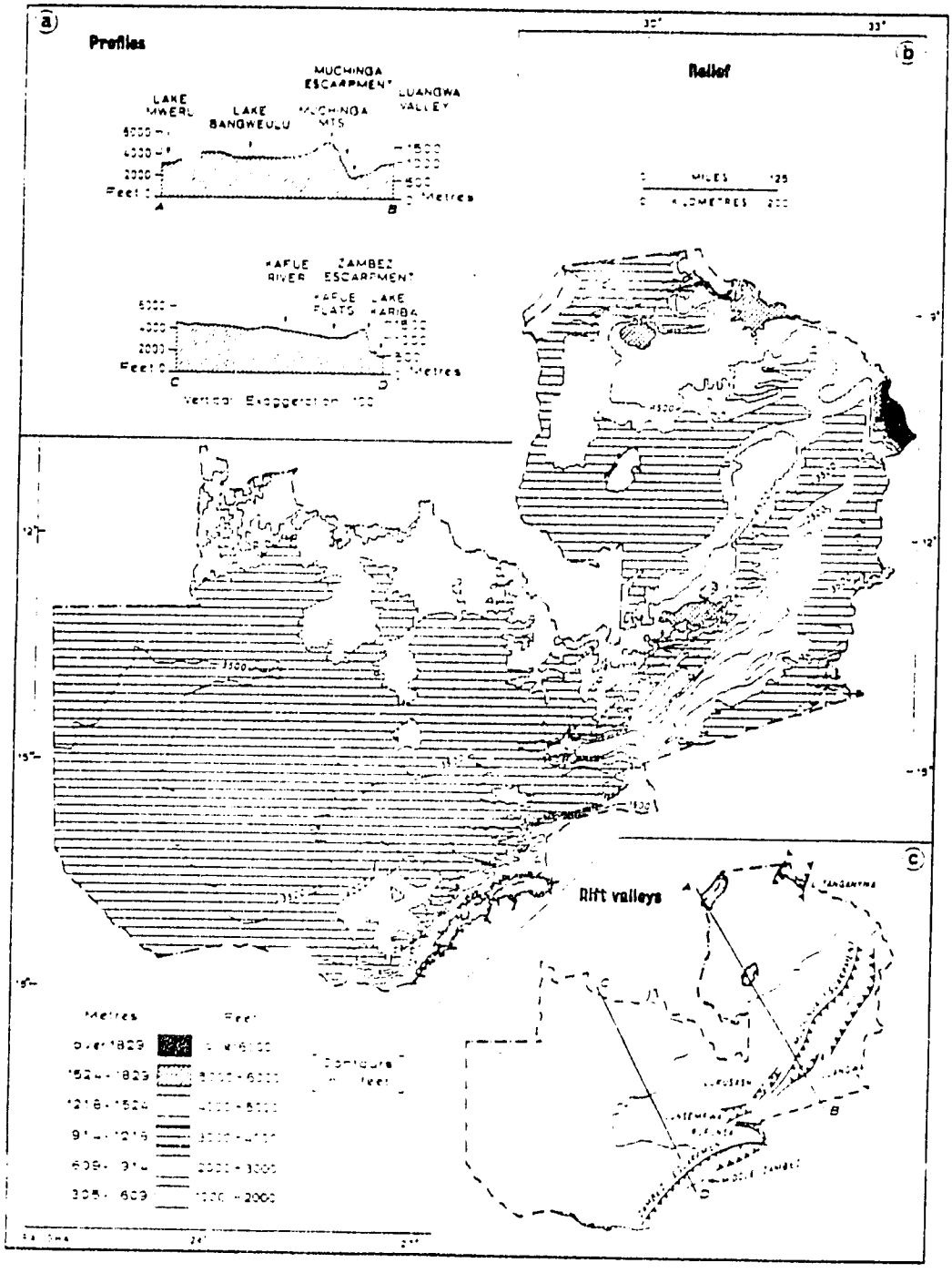

Figure 1.1. Relief

Source: Davies, 1971.

Much of the semi-arid plains region consists of Barotse Sands (also called Kalahari sands), which are generally poor as agricultural soils and retain very little moisture. As a result, vast areas are unsuited to cultivation, and in the remaining areas drought resistant crops such as sorghum and bullrush millet predominate. The major exception to this general observation is the floodplain of the upper Zambezi River, where better soils and more secure water supplies are available.

Plateau Region includes the Tonga Plateau (Southern Province), the Kafue Flats (Southern and Central Provinces), and the Lukanga Swamp (Central Province). Average annual rainfall in this zone is generally under 1000 mm, but soils are among the most fertile in Zambia. Agriculture is therefore the predominant occupation and population densities are fairly high. Crop diversity is much higher than in the semiarid plains, although sorghum and bullrush millet remain important

Southeastern Plateau Zone is roughly defined by the boundaries of the Eastern Province. Characteristics are similar to those of the Plateau Region. The zone is sometimes viewed as an extention of the Plateau Region interrupted by the Rift Valleys.

Rift Valleys of the Luangwa and Zambezi Rivers generally have an average annual rainfall of less than 900 mm. Soils of the Rift Valleys are also usually poor, which limits agriculture in this zone. As in the semiarid plains, sorghum and bullrush millet tend to predominate where agriculture is practiced. Population densities throughout most of the Rift Valleys are quite low.

Northern High Rainfall Zones are roughly equal to that portion of Zambia north of the 1000 mm rainfall isohyet (App. I, Fig. 2). Heavier rainfall leaches the soils of nutrients in most of this zone, making agriculture difficult. Shifting cultivation is predominant, with local communities moving to new areas as soils become exhausted. Population densities are low. Only in the area of the Bangweulu Swamps and the northern Luapula Valley does the availability of better soils and abundant fish permit higher population densities.

2.2 Population 2/

World Bank estimates (World Bank 1981), which agree fairly well with most other figures, placed Zambia's populalation at approximately

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2/ Davies. 1971.
Kaplan. 1979.
U.S. AID. 1981a.
U.S. AID. 1981b.
World Bank. 1981.
Zambia, Central Statistical Office. 1975.

5,650,000 in mid-1979. The annual growth rate from 1970 to 1979 was about 3.0 percent (a few sources give as high as 3.3%, e.g. U.S. AID 1981a). Projections indicate that by the year 2000 Zambia will have a population of around 11 million if current trends continue.

2.2.1 Distribution

Just over 40 percent of Zambia's population is considered urban by the World Bank (U.S. AID 1981b), compared with 23 percent two decades ago. Urban growth rates from 1974 to 1980 were 6.5 percent, down slightly from the previous five years. Table 2.1 summarizes figures for the major urban areas. Nearly two-thirds of the total urban population live in the Copperbelt cities, and virtually all urban areas are found either in the Copperbelt or along Zambia's central north-south rail line (Fig. 2.3).

Table 2.1 Urban Population

Large Urban Areas	1969 Census	1974 Sample Census	Mid-1979 Estimates	Growth Rates p.a. (%) 1969-74	1974-79
Chililabombwe	44,862	56,000	74,000	4.7	5.7
Chingola	103,292	134,000	183,000	5.3	6.4
Kabwe	65,974	99,000	139,000	8.4	7.0
Kalulushi	32,272	41,000	57,000	4.7	6.8
Kitwe	199,798	251,000	325,000	4.6	5.3
Livingstone	45,243	58,000	80,000	5.0	6.5
Luanshya	96,282	121,000	156,000	4.6	5.2
Lusaka	262,425	401,000	599,000	9.9	8.3
Mufulira	107,802	136,000	178,000	4.7	5.5
Ndola	159,786	229,000	307,000	7.4	6.0
Total Urban (incl. small urban areas)	1,192,116	1,663,000	2,280,000	6.9	6.5
Total Rural Areas	2,864,879	3,014,000	3,369,000	1.0	2.2
Percentage Urban	29.4	35.6	40.4		
Percentage Rural	70.6	64.4	59.6		

Source: U.S. AID. 1981.

Average population density is estimated at 7 persons per square km, but about 15 persons per square km of arable land (U.S. AID 1981a). Average rural densities are only about 4 persons per square km, but can vary widely. High densities occur in the Copperbelt, in the agricultural zone along the rail line, in the fertile southeastern corner of the country, in the west along the upper Zambezi floodplain, and scattered

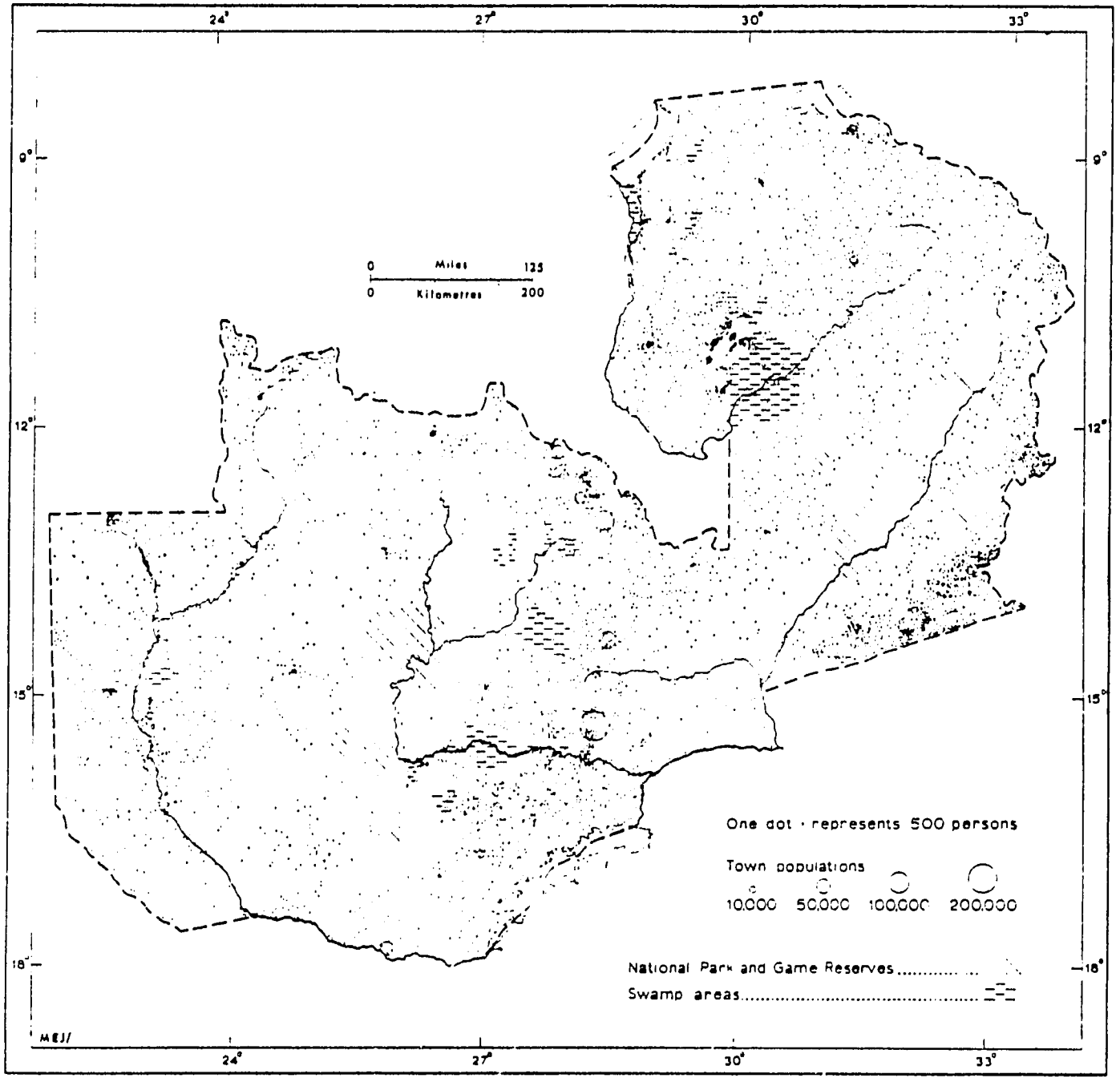

Figure 2.3 Population Distribution

Source: Davies, 1971.

throughout the northeast (App. II, Fig. 2). The entire central portion of western Zambia is very sparsely populated, as is the Luangwa Valley in the east.

2.2.2 Composition 3/

At least 73 ethnic groups are officially recognized in Zambia and over 80 different languages have been identified. These languages fall into 16 broader language groups, mostly variations of the Bantu family. At the level of maternal language (spoken at home), language is roughly related to the ethnic group, but nationally certain languages have become vernacular lingua francas.

Although no single ethnic group is politically or economically predominent, several do play more prominent roles in Zambia than most groups. The Bemba constitute probably the largest single group (about 19% of the population). They were originally slash-and-burn agriculturalists of the northeast, and have now become the major labor source in the Copperbelt. As a result, Bemba has become a lingua franca throughout most of northcentral and northeast Zambia. Because of high rates of labor migration, rural Bemba areas have been facing labor shortages for several decades, and agricultural production has suffered greatly.

The Nyanja, who actually constitute several closey related groups, are originally from far eastern Zambia (and Malawi, where they are called Chewa). Early access to education in missionary schools and recruitment in Nyanja areas by the British colonial government and army resulted in heavy representation of Nyanja in administrative posts and the military, a pattern which continues today. As a result, the Nyanja language has become a lingua franca in Lusaka and throughout the bureaucracy and army.

The Tonga are traditionally sedentary farmers located in south-central Zambia along the rail line. Relatively good agricultural soils and early adaptation to more modern farming methods have made the Tonga one of the primary forces in Zambian agriculture. Unlike the other major groups, the Tonga have shown little inclination to migrate, and their prominent position is still rurally based.

The Lozi are a group of various groups in western Zambia. Traditionally the economy was based upon cultivations of the upper Zambezi floodplain, but in colonial times a major source of income was obtained through labor migration to

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3/ Davies. 1971.
Kaplan. 1979.
U.S. AID. 1981b.

areas south of Zambia. After independence in 1964, Zambia discouraged economic contacts with white minority regimes to the south, causing a decline in the economy of the main Lozi urban area, Livingstone. Lozi prominence in Zambia has also declined because of these policies.

Small minorities of Europeans and South Asians play a major role in economic affairs. The former colonial language, English, has become one of the major languages of Zambia. Aside from its use by Europeans and Asians, English is a politically neutral language for use in administrations, broadcasting, and education. A survey in the early 1970's showed that 26 percent of Zambians claimed to be able to speak English (as opposed to 56% for Bemba; 42% for Nyanja).

2.2.3 Migration and Urbanization 4/

Figures in Tables 2.1 and 2.2 clearly indicate that rural-urban migration is an important demographic characteristic in Zambia. The overall urban growth rate of 6.5 percent is nearly three times greater than the rural growth rate, while Lusaka shows a growth rate of 8.3 percent. The Central and Copperbelt provinces already show the greatest urbanization and growth rates (cf. App. II, Table 2). The greatest migration rates tend to be from areas in the eastern part of the country. Agricultural production and the fishing industry have suffered greatly in some regions due to lack of labor. Northern and Luapula provinces have been particularly hard hit in these respects, and Eastern and Southern provinces have also had fairly high migration rates.

2.2.4 Public Health 5/

Although Zambia has made good progress in health care in the last few decades, a number of serious public health problems remain. The crude death rate was estimated at about 17 per 1,000 in 1977, an improvement from the 24 per 1,000 in 1960. Death rates among children 1 to 4 years of age were about 23 per 1,000 in 1977, also down from 36 per 1,000 in 1960. The infant mortality rate in the late 1970s was around 127 per

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4/ Davies. 1971.
Kaplan. 1979.
U.S. AID. 1981b.
World Bank. 1977.

5/ Davies. 1971.
Family Health Care and AFRICARE. 1978.
Kaplan. 1979.
Marks. 1979.
U.S. AID. 1981a.
U.S. AID. 1981b.

Table 2.2. Regional Population and Net Migration, 1963-74 (in thousands)

Province	Population 1963	Population 1969	Population 1974	Net Increase in Population 1963-69	Net Increase in Population 1969-74	Net Migration 1963-69	Net Migration 1969-74	Net Migration as a % of 1963 Population 1963-69	Net Migration as a % of 1963 Population 1969-74
Luapula	357.0	335.6	321.0	-21.4	- 14.6	-79.4	- 67.3	-22.2	-18.9
Northern	564.0	545.1	580.0	-18.9	+ 34.9	-110.6	- 50.7	-19.6	- 9.0
Eastern	479.9	509.5	568.0	+29.6	+ 58.5	- 48.4	- 21.5	-10.1	- 4.5
Northwestern	211.2	231.7	256.0	+20.5	+ 24.3	- 13.8	- 12.1	- 6.5	- 5.7
Western	362.5	410.1	463.0	+47.6	+ 52.9	- 11.3	- 11.5	- 3.1	- 3.2
Southern	466.3	496.0	540.0	+29.7	+ 44.0	- 46.1	- 33.9	- 9.9	- 7.3
Subtotal	2440.9	2528.0	2728.0	+87.1	+200.0	-309.8	-197.0	-12.7	- 8.1
Central	505.2	712.6	920.0	+207.4	+207.4	+125.3	+ 95.5	+24.8	+18.9
Copperbelt	543.5	816.3	1046.0	+272.8	+229.7	+184.5	+101.5	+33.9	+18.7
Subtotal	1048.7	1528.9	1966.0	+480.2	+437.1	+309.8	+197.0	+29.5	+18.8
Total	3489.6	4056.9	4694.0	567.3	+637.1	0	0		

Source: World Bank, 1977.

1,000 and life expectancy at birth was just over 48 years. Poor health conditions, particularly outside the major urban areas, may be partially attributed to malnutrition, lack of sanitation facilities, and absence of knowledge about personal hygiene or preventive health measures. Shortages of medical personnel and facilities further exacerbate public health problems.

Diseases. Malaria, probably the most common debilitating disease, is endemic in rural areas. Efforts to control the anopheles mosquito have had only limited success, chiefly in urban areas along the major rail line. Transmission is highest between November and May during the rainy season. Current figures on incidence of malaria (or other diseases) are not readily available, but figures from the late 1960s indicated that over 25 percent of the children had malarial parasites present. In 1975, malaria was third after diarrhea and injuries as a cause for treatment at health institutions in Zambia (Table 2.3).

Schistosomiasis (bilharzia) is another fairly common debilitating disease, particularly in regions where irrigated agriculture is practiced. Treatment of schistosomiasis in recent decades has proven relatively successful, but eradication of the snail vector has not met with any notable success. Trypanosomiasis (sleeping sickness) also occurs in Zambia, both varieties affecting humans and those attacking cattle. The major areas of tsetse fly infestation occur in the central portion of western Zambia and in the Luangwa Valley (cf. App. II, Fig. 7a). This infestation is undoubtly a major reason for the very low population densities in these same areas.

Various respiratory diseases, such as pneumonia, bronchitis, and influenza, still accounted for the largest number of hospital admissions in the late 1970s (U.S. AID 1981b, although figures are not given). Accidents and injuries and gastroenteric diseases also remained important causes of admission. Not many cases of bacillary and amoebic dysentery are actually reported, but it is likely that these two diseases are responsible for a large number of infant illnesses and deaths. Measles do seem to be more often reported, and in 1975 14,000 cases were recorded with over 1,100 deaths. Other diseases include typhoid, paratyphoid, poliomyelitis, cholera, leprosy, tuberculosis, and hookworm.

Diet and Nutrition. About 80 percent of the average Zambian's caloric intake comes from cereal and root crops. Maize is generally the main staple, except in a few areas where millet and sorghum or cassava predominate (cf. App. II, Table 7). Malnutrition seems

Table 2.3. Incidences of Major Morbidity (New Cases) in All Health Institutions in Zambia, Total and by Province (per 100,000 Population), 1975

	Total Zambia	Central	Copperbelt	Eastern	Luapula	Northern	North-Western	Southern	Western
Upper Respiratory Tract Infections	27,073	29,050	35,873	22,830	19,376	15,591	33,341	32,697	17,638
Diarrhea	19,142	19,462	25,982	11,197	18,157	14,287	22,218	20,635	13,189
Injuries	18,315	20,070	25,407	12,215	14,441	13,781	17,321	21,660	10,816
Malaria	11,940	5,865	5,357	13,825	16,599	13,438	19,195	17,082	22,211
Diseases of the Skin	9,342	8,578	10,083	12,552	7,023	7,653	13,829	8,396	7,654
Diseases of the Eyes	8,999	6,976	8,500	7,585	8,934	9,159	10,732	11,222	12,365
Diseases of the Ear	3,834	3,475	4,687	3,735	2,277	2,268	4,634	4,894	4,116
Worm Infestations	3,411	2,468	3,966	5,107	3,248	2,624	6,166	2,414	2,709
Diseases of the Teeth	2,609	1,905	3,055	2,496	2,036	1,740	2,776	4,263	2,647
Genitourinary Diseases	2,549	2,907	4,499	1,087	1,777	1,534	2,585	2,285	1,176
Venereal Diseases	2,259	3,403	2,899	1,392	1,573	1,389	2,033	2,425	998
Malnutrition & Anaemias	1,699	1,254	1,443	1,591	3,942	2,122	2,027	1,165	1,626
Pneumonia	1,376	1,036	955	2,051	1,152	1,264	2,584	1,462	1,758
Measles	1,310	1,818	1,687	781	981	897	856	1,498	827
TOTAL MAJOR CAUSES*	113,859	108,26866	134,391	100,444	101,515	87,748	140,297	132,098	99,730
TOTAL ALL CAUSES	178,186	169,796	214,476	150,893	166,393	140,933	225,216	198,258	150,147
Estimated Population	4,981,000	994,000	1,127,000	594,000	351,000	602,000	267,000	561,000	485,000

* Excluding diseases given under the heading "other", e.g., other abdominal cases, other fevers, etc. or unknown causes

Source: Family Health Care and AFRICARE. 1978.

to be declining in incidence but still represents a major health problem (Table 2.4). There was an estimated 13 percent calorie deficit in the mid-1970s (U.S. AID 1981a), and marasmus (calorie deficiency) seems to be somewhat more prevalent than kwashiorkor (protein deficiency). Avitaminosis and iron-deficiency anemia are also common. The levels of malnutrition indicate that malnutrition in Zambia tends to be debilitating rather than life threatening, and may exacerbate health problems due to other diseases. Severe malnutrition is rare and starvation almost unknown.

Table 2.4. Reported Malnutrition Cases

Hospitals

	1972	1973	1974	1975	1976
Inpatient Admissions	7,390	7,640	7,920	8,150	9,520
Inpatient Deaths	1,040	1,190	1,170	1,090	1,450
Case-Fatality (Deaths per 100 Admissions)	14.0%	15.6%	14.8%	13.4%	15.2%
Outpatient First Attendances	15,500	11,200	12,600	11,800	9,500

Health Centers

	1972	1973	1974	1975	1976
Inpatient Admissions	3,360	2,560	2,690	2,930	3,110
Inpatient Deaths	118	104	113	102	147
Case-Fatality (Deaths per 100 Admissions)	3.5%	4.1%	4.2%	3.5%	4.7%
Outpatient First Attendances	50,200	35,800	33,600	35,500	30,400

Source: Family Healthcare and AFRICARE. 1979.

2.3 Economic Characteristics 6/

Zambia began its independence in 1964 with relatively good economic prospects, primarily due to its copper mining industry. Until about 1970 the GDP increased at an annual rate of around 13 percent. However, this growth reflected increased copper output and rising copper prices on the world market, with little significant growth in other sectors of Zambia's economy. Since the early 1970s instability and ultimate declines in copper prices have contributed to the stagnation of the economy. In the last five years of the 1970s the GDP had declined in real terms by 8 to 10 percent annually. The per capita GDP of around US $500 , in 1978 was lower than at any time since independence.

Mining and quarrying has remained the single most important sector of the economy despite the decline in its contribution to the GDP from 56 percent in the late 1960s to 32.7 percent in 1978 (Table 2.5; cf. also App. III, Table 1). An even more striking indication of the mining sector's role in the economy is the fact that in 1977 minerals were the primary means of earning foreign exchange. Copper alone accounted for 91.1 percent of all exports by value in 1977, while the addition of zinc, lead, and cobalt brings the contribution to 96.7 percent (Table 2.6)

Table 2.5 Real GDP by Type of Economic Activity 1974-78
(in 1970 kwacha millions)*

	1974	1975	1976	1977	1978	Average Annual %Change 74-78	% of GDP in 1978
Gross domestic product	1,464	1,434	1,549	1,485	1,480	0.3	
Agriculture, forestry and fishing	150	157	167	168	172	3.5	11.6
Mining and quarrying	474	430	503	474	484	0.5	32.7
Manufacturing	178	158	152	141	150	-4.4	10.1
Construction	114	140	158	154	133	3.9	9.0
Transport, communication and storage	54	60	67	62	60	2.7	4.1
Services and other	493	492	502	485	482	-0.6	32.6

*Prior to February 1973, K1 = US $1.40

Source: U.S. AID. 1981b.

6/ Europa. 1980.
Kaplan. 1979.
Legum. 1981.
U.S. AID. 1981b.
World Bank. 1977.
World Bank. 1980.

Table 2.6 Foreign Trade

EXTERNAL TRADE
(K'000)

	1971	1972	1973	1974	1975	1976*	1977*
Imports f.o.b.	393,282	402,471	346,867	506,636	597,611	468,589	529,405
Exports f.o.b.	485,177	541,564	741,955	903,091	521,049	751,908	708,028

* Provisional

PRINCIPAL COMMODITIES
(K'000)

Imports	1975	1976*	1977*
Food	35,747	24,409	28,671
Beverages and Tobacco	1,018	884	879
Crude Materials, inedible	9,894	7,104	8,800
Mineral Fuels, Lubricants and Electricity	81,115	72,016	81,005
Animal and Vegetable Oils and Fats	9,087	10,684	9,108
Chemicals	77,293	68,341	58,927
Basic Manufactures	140,211	96,790	117,477
Machinery and Transport	211,300	167,930	204,924
Miscellaneous Manufactured Articles	28,698	18,996	19,102
Others	3,250	783	345
TOTAL	597,611	468,589	529,405

Exports	1975	1976*	1977*
Copper	472,000	688,600	644,000
Zinc	20,340	20,552	17,920
Lead	5,665	4,421	5,705
Cobalt	7,066	15,930	10,220
Tobacco	4,909	5,005	5,783
Maize	1,434	513	3,517
TOTAL (incl. others)	521,049	751,908	708,028

* Provisional

Source: Europa. 1980.

Agriculture contributed only 11.6 percent to the GDP in 1978, but its importance may perhaps be better gauged by noting that nearly 68 percent of the economically active population was engaged in agriculture in 1978 (cf. App. III, Table 3). Less than 14 percent of Zambian households do not engage in some agricultural activity (Table 2.7). The annual growth of the agricultural sector through the 1970s was around 1.5 percent, which most observers consider to be far below the sector's potential. Maize is Zambia's most important crop in both subsistence and cash cropping. (Maize accounts for about two-thirds of the value of all marketed crops.) Cassava (mainly in northeast Zambia), sorghum and millets, peanuts, and beans are other important staples, while cotton and tobacco are also important cash crops. Sugarcane is an important crop in terms of total production, but nearly the entire crop is concentrated on one estate at Mazabuka in Southern Province. Infrastructure difficulties (particularly in seed and fertilizer distribution) combined with drought in 1979-1980 caused production declines in many crops during these years. Maize was especially hard hit, and Zambia, although normally self-sufficient in maize, was forced to rely on massive imports.

Table 2.7. Distribution of Households According to Agricultural Activity, 1977-78

PROVINCE	HOUSEHOLDS RAISING							OTHERS	TOTAL NUMBER OF HOUSE-HOLDS
	CROPS ONLY	L/STOCK ONLY	POULTRY ONLY	CROPS AND L/STOCK	CROPS AND POULTRY	L/STOCK AND POULTRY	CROPS, L/STOCK AND POULTRY		
CENTRAL	10,000	600	4,100	2,000	36,400	1,100	20,300	6,400	80,800
COPPERBELT AND NORTH-WESTERN	28,500	500	2,000	5,000	24,900	300	5,200	14,400	81,300
EASTERN	31,500	600	2,800	14,600	36,900	800	51,300	9,700	148,300
LUAPULA	22,000	-	3,400	600	44,700	100	5,600	7,500	84,000
NORTHERN	19,200	100	6,300	700	80,300	300	10,000	17,400	134,300
SOUTHERN	4,200	500	5,100	1,800	14,900	1,700	32,300	25,100	85,700
WESTERN	34,300	600	3,900	4,000	32,500	1,000	16,.00	15,700	108,000
TOTAL ZAMBIA	149,700	3,000	27,400	28,800	270,500	5,300	141,200	96,300	722,200

Source: Zambia. Central Statistical Office. 1980.

3.0 Environmental Resources

3.1 Geology and Mineral Resources

3.1.1 Geology 7/

The majority of the country lies on the Zambezi Plateau between the Upembe Rift in the northwest and the Zambezi-Luangwa Rift system in the southeast. The northeastern portion of this plateau is similarly defined by the East African Rift, and only in the southwest is no tectonic boundary evident (Fig. 3.1). The eastern part of the plateau generally contains the oldest exposed rocks, while to the west successively younger sedimentary rocks predominate.

The Basement Complex in Zambia is represented by the lower layers (sometimes called the Lufubu system). Lower basement rock has undergone a high degree of metamorphism, with extensive faulting and folding. Main rock types include gneisses, mica, hornblende, kyanite schists, and micaceous quartzites. This Lower Basement complex is exposed in large areas of central and eastern Zambia, and appears locally in isolated domelike outcrops in many other areas (Fig. 3.2). The Upper Basement complex is represented in Zambia only by small outcrops bordering the Lower Basement formations. This Upper Basement, usually called the Muva group, consists primarily of quartzites, schists, and conglomerates.

Granite intrusions are very common in these basement formations. Granite formations are exposed in large areas of the northeast, as well as in local areas elsewhere. Mineralization of the Basement complex is limited, although small quantities of some minerals have been mined from these formations.

Katanga sediments were deposited during the Pre-Cambrian upon the irregular surface left after considerable erosion of the Basement complex. Three subdivisions of Katanga sediments have been distinguished, although it is not always clear how these divisions relate to each other on a country-wide basis. These sediments are usually highly mineralized, with copper occuring in many shales, sandstones, dolomites, and quartzites. Lead and zinc occur in many Katanga dolomites and argillites. Katanga limestone is widely used for metallurgical processing, cement, agricultural lime, and road stone. They predominate throughout the northern half of western Zambia and the central and northernmost portions of the eastern part of the country.

7/ Davies. 1971.
Trurnit. 1979.

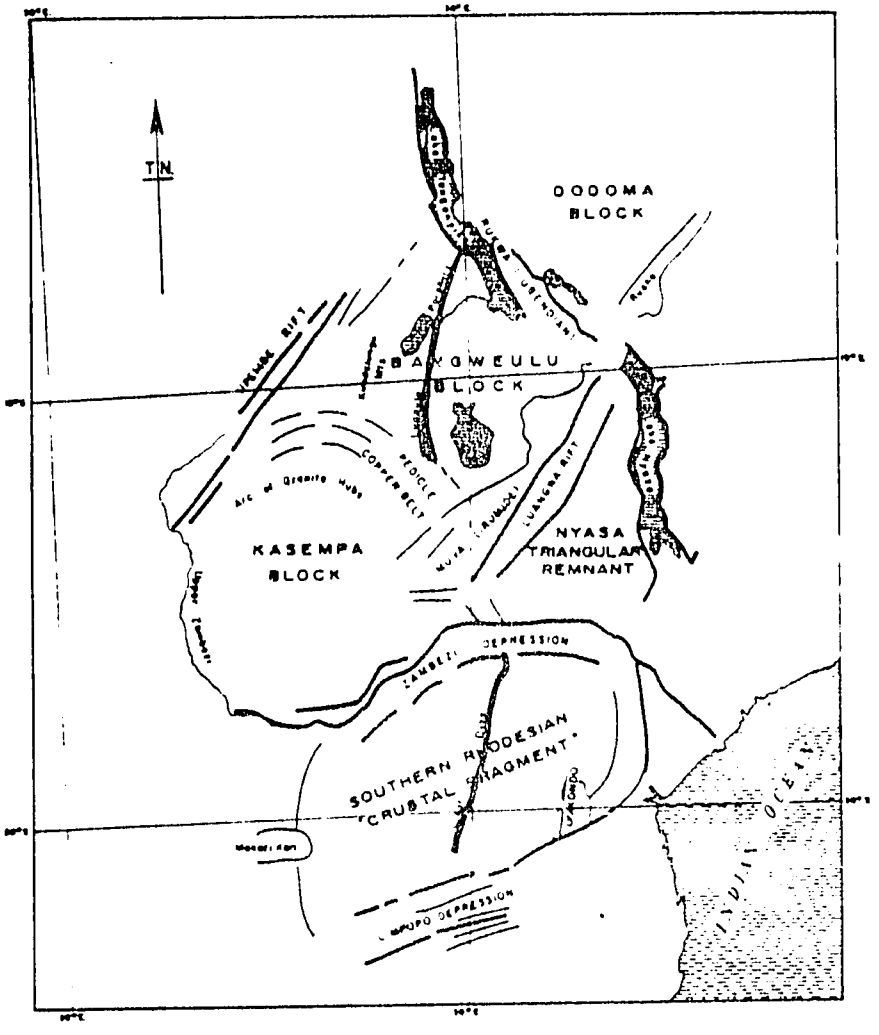

Figure 3.1. Structural Features in the Zambia Region

Source: Trurnit. 1979.

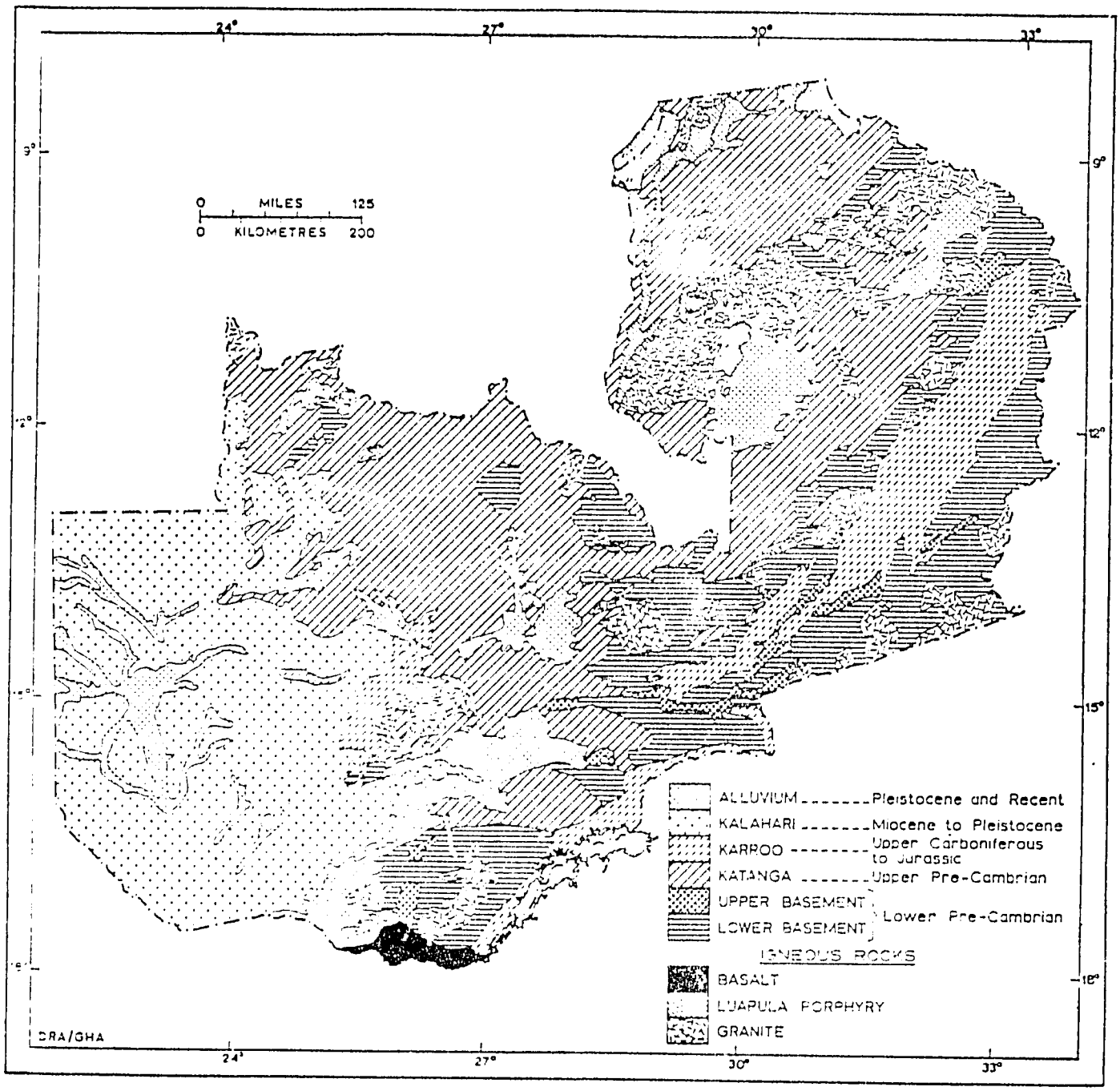

Figure 3.2. Geology

Source: Davies, 1971.

The Karroo system represents the next youngest rocks, ranging in age from the Upper Carboniferous to the Jurassic period. Karroo sediments are confined primarily to the Zambezi-Luangwa Rift system, and consist of (possibly) tillite followed by sandstone and coal formations. Upper layers include mudstones, grit, and more sandstone. Basaltic lava of Jurassic age, represented in the southernmost tip of Zambia, is also often included in the Karroo system.

The Kalahari system consists of poorly consolidated sandstones and unconsolidated windblown sands. These sands originated during the later Tertiary and Pleistocene periods and were deposited during an arid phase when the Kalahari Desert's limits extended much farther north. Such sands cover much of the westernmost portion of the country. Recent alluvial deposits are fairly extensive in the regions of the upper Zambezi and its tributaries, the Kafue Flats, the Lukanga and Bangweulu Swamps, and along the upper Chambeshi Rivers. Table 3.1 summarizes these Zambian formations.

3.1.2 Mineral Resources 8/

In addition to minor deposits of a wide range of minerals, Zambia contains major deposits of several important metals, in particular, copper. Until the late 1970s, metal mining had been the single most important economic activity, and as recently as 1974 it contributed 34 percent of the GDP and 97 percent of Zambia's export earnings. The declining importance of mining may be attributed to the sharp drop in copper prices in 1975 combined with rising production costs. Continued fluctuations in copper prices have not provided the copper industry with the long term stability needed for recovery. As a result, mining contributed only 12.6 percent to the GDP in 1977, although the proportion of export earnings from mining remained constant.

Figure 3.3 shows the location of major mineral deposits, while Appendix IV presents more detailed data on mineral resources in Zambia. The most significant minerals are as follows:

Copper. Zambia possesses approximately 6 percent of the world's proven reserves of copper ore. Reserves are

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8/ Europa. 1980.
Kaplan. 1979.
Legum. 1981.
Trurnit. 1979.
U.S. Bureau of Mines. 1976.
World Bank. 1977.

Table 3.1 Stratigraphic Series in Zambia

Characteristic Rock-types	Member	Series/Formation	System/Group		Local Equivalents		Igneous Intrusions
Alluvium, soils, laterite, stream gravels.							
Wind blown sand, sandstone, silcrete, thin limestone.	KALAHARI BEDS		KALAHARI				
Unconformity							
Clastic sediments	PEBBLE BEDS (In places, undifferentiated from Karroo)		? CRETACEOUS				CARBONATITE DOLERITE
Unconformity							
Basic lavas (with intercalated sandstones)	BATOKA BASALT	STORMBERG	KARROO				
Sandstone and marl	SANDSTONE BEDS (Informal nomenclature)						
Grit and sandstone	ESCARPMENT GRIT						
Unconformity							
Mudstone, calcareous or carbonaceous (with reptilian remains)	MADUMABISA MUDSTONE	BEAUFORT (? LOWER)					
Carbonaceous mudstone, with coal seams.	GWEMBE COAL FORMATION	ECCA					
Conglomerate, sandstone, mudstone, tillite (associated with varved clays).	LOWER WANKIE SANDSTONE — Non-glacial beds; Glacial beds	DWYKA					DOLERITE GABBRO SYENITE GRANITE (YOUNGER)
Unconformity							
Sandstone, quartzite and shale ...	ARENACEOUS	(UPPER)	KUNDELUNGU	KATANGA SUPERGROUP	*Kakontwe Limestone* — *Chafugoma Carbonate Formation (Solwezi area)*	KUNDELUNGU GROUP (Includes Lultikila Beds and Luapula Beds)	
Dolomite, carbonaceous shale and tillite; in west, limestone and dolomite.	CARBONATE	(LOWER)					
Fluvio glacial beds (? tillite), carbonaceous shales, conglomerate, oolite and chert; dolomite and ironstone.			MWASHIA		≡*Upper Bwana Mkubwa (Broken Hill Series)*		
Dolomite, dolomitic shale, feldspathic sandstone, schist.		(UPPER)	ROAN		≡*Middle Bwana Mkubwa (Lusaka Series)*	PLATEAU "SERIES" (GROUP)	In Northern and Luapula Provinces only
Quartzite, arkose, shale ("ore-shale") feldspathic sandstone, dolomite and conglomerate.		(LOWER)			≡*Lower Bwana Mkubwa*		
Unconformity							
Quartzite, schist, phyllite, conglomerate.	QUARTZITE SCHIST		MUVA		≡UPPER	≡MUVA SCHISTS	Luapula Volcanics
Epidotised metavolcanics, porphyry, and rhyolite.	KAFUE AND RUFUNSA VOLCANICS						BASIC INTRUSIVES GRANITE (OLDER)
Unconformity					BASEMENT COMPLEX (Guernsey)		BASEMENT COMPLEX (Gray)
Gneiss, schist, migmatite, with lenticular crystalline limestones and amphibolites, and some metavolcanics.			BASEMENT COMPLEX		≡LOWER	≡LUFUBU SCHISTS	

Source: Trurnit. 1979.

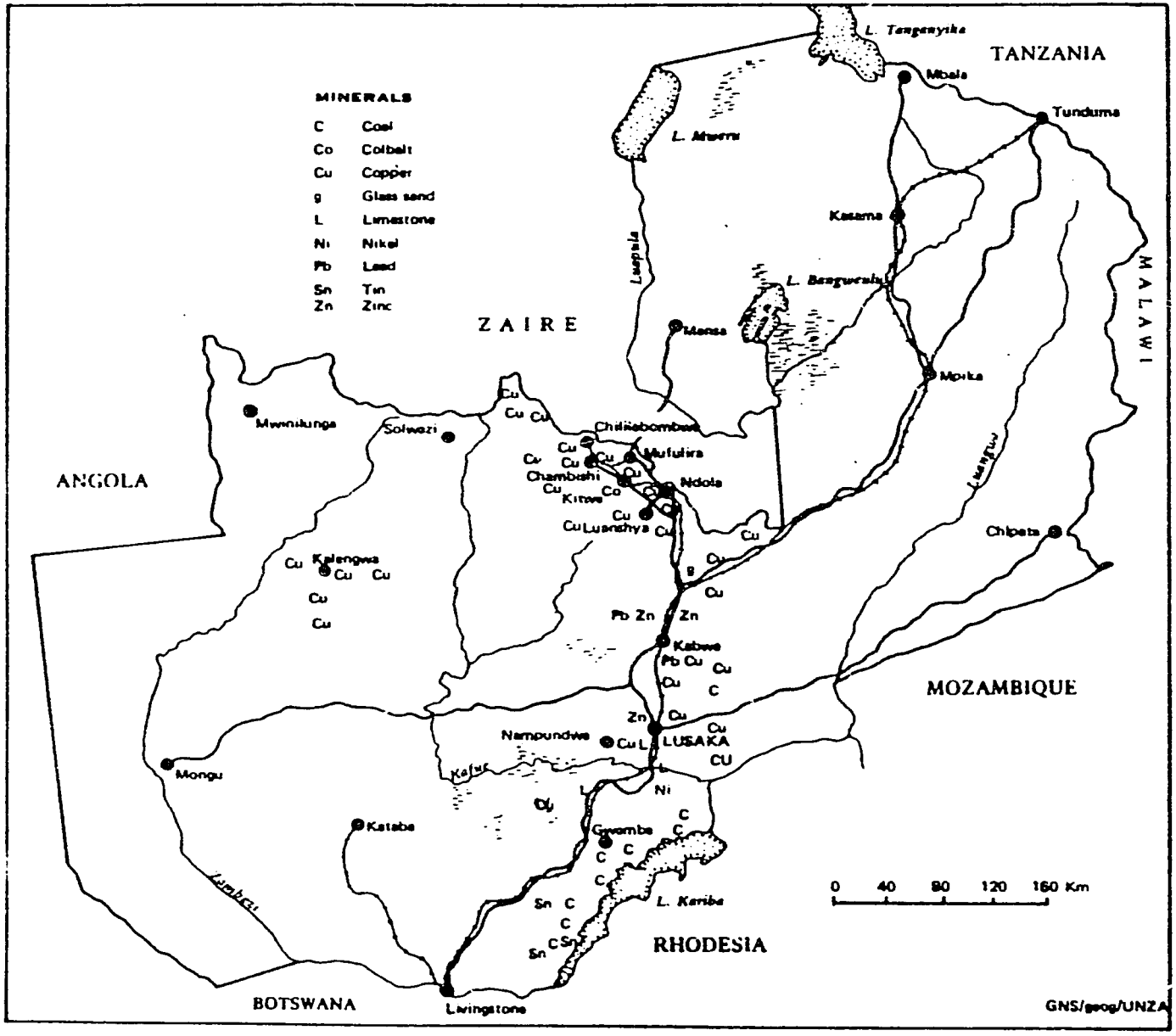

Figure 3.3. Mineral Deposits in Zambia

Source: Perera. 1979.

estimated at about 846 million tons, averaging near 3 percent copper. In 1978 Zambia produced 587,000 tons of copper, which was down considerably from production fluctuations of around 700,000 tons throughout the 1970s. Nearly all major producing mines are in the Copperbelt area (cf. App. IV, Fig. 2), although deposits are scattered throughout central Zambia.

Cobalt. Zambia is the world's third largest producer of cobalt, with an estimated 3,000 tons of production in 1979. In 1978 cobalt surpassed copper for the first time as the country's largest export earner. Reserves were estimated at 113,600 tons in 1977, when they represented 7.6 percent of the world's total reserves (Trurnit 1979), but a more recent claim gives Zambia about 15 percent of global reserves (Legum 1981). Cobalt is recovered as a by-product of copper mining in the currently operated copper mines.

Lead and Zinc. Zambia is a minor producer of these metals. Currently operating mines, as well as most known deposits, are found in the central portion of the country near the town of Kabwe. In most deposits, the two metals are found together.

Other Metals. Gold and silver are produced to a small extent, silver primarily in conjunction with copper and lead/zinc mines. Zambia also currently produces small quantities of a wide variety of other metals, including selenium, cadmium, manganese, tin. Iron ore and uranium are present and Zambia plans to begin exploitation of these metals soon. Small deposits of nickel, wolfram, vanadium, titanium, bismuth, and rare earths are also known, but it is not yet clear whether quantities are economically exploitable.

Coal. Although coal production has declined somewhat in recent years from 958,636 tons in 1972, coal remains important and provides a major energy source. The main operating mines are in the southern area near Lake Kariba, although deposits are also known throughout the Zambezi-Luangwa Rift area.

Other Non-metalic Minerals. Limestone and dolomite are quarried for the local building industry, and several other minerals are produced in smaller quantities (cf. Table 3.2). Graphite, sulpher, phosphate, and asbestos are also present, but possibilities of economic exploitation are not yet certain. Hope remains that major deposits will be discovered. Minor natural gas deposits have been discovered, but the search for oil has thus far been unsuccessful.

Table 3.2. Mineral Production
(in t)

	1975	1976	1977[1]
Copper	647,240	711,681	650,000
Cobalt	1,837	1,620	1,850
Zinc	46,922	36,327	44,000
Lead	18,832	13,583	17,600
Selenium	36.489	N.a.	N.a.
Cadmium	6.15	6.75	7.00
Silver	60.458	33.125	30.00
Gold	0.150	0.341	0.310
Amethyst	32.00	26.00	N.a.
Coal	898,154	772,513	750,000
Gypsum[2]	7,536	4,650	N.a.
Limestone, Dolomite	755,007	708,900	N.a.
Phyllite	21,880	N.a.	N.a.
Talc	164	N.a.	N.a.
Pyrite	19,046	9,118	N.a.
Feldspar	1,174	1,027	N.a.

1) estimate
2) not including production from the NCCM cobalt mine, Rokana, Kitwe

Source: Trurnit. 1979.

3.1.3 Minerals Policy 9/

There are two major mining companies active in zambia, Roan Consolidated Mines, Ltd. (RCM) and Nchanga Consolidated Copper Mines, Ltd. (NCCM). Controlling interest in each (51% and 60%, respectively) is owned by the government through the Zambia Industrial and Mining Corporation, Ltd. (ZIMCO). The structure of ownership in RCM and NCCM is represented in Appendix IV, Figure 5. This controlling interest allows the government to determine the nature and location of new mining projects as well as capital investment policies in all

9/ Europa. 1980.
Fry. 1980
Kaplan. 1979.
Legum. 1981.
Perera. 1979.
Simwinga. 1980.
Trurnit. 1979.
World Bank. 1977.

operations. Many new projects are sited in outlying areas, which results in high operational costs while local infrastructure is built up. Government revenue also depends heavily upon mining. Their share of mining profits averaged around 50 percent during the first half of the 1970s, but reached as high as 73 percent in 1973 (Table 3.3).

Table 3.3. Government Revenues and Company Retentions From Mining Company Profits, 1970-75
(K millions)

	1970	1971	1972	1973	1974	1975
Profits (Losses), /a	289.9	154.1	178.9	499.0	179.0	(63.3)
of which:						
Taxes	121.7	42.8	51.2	308.0	87.9	-
Dividends	62.8	56.5	67.0	111.3	23.5	-
Government Revenues						
(Taxes + 0.51 x Dividends)	153.8	71.6	85.3	364.8	99.9	-
(As a % of Gross Profits)	53.1%	46.5%	47.7%	73.1%	55.8%	-
Retention of Profits (before depreciation)	105.4	54.8	60.7	79.7	67.6	-

/a Before deducting depreciation.

Source: World Bank. 1977.

3.1.4 Energy 10/

In 1980, the major sources of energy were water (hydro-electric), which accounted for about 29 percent of total energy consumption; imported oil (36% of total consumption), coal, and wood. The mining and manufacturing industries are the major consumers of electricity, oil, and coal, while wood (and charcoal) is the energy source of about 90 percent of Zambia's population. Zambian policy seeks to eventually increase the use of electricity and coal; reduce oil consumption; and achieve more efficient use of wood and charcoal through improved technology. Tables 3.4 to 3.8 give an overview of Zambia's energy situation.

10/ Trurnit. 1979.
U.N. 1981.
U.S. AID. 1981b.
Univ. of Zambia. 1978.

Table 3.4. Production of Energy 1973-78

	1973	1974	1975	1976	1977	1978
Electricity million Kwh	3275.2	5972.7	6196.3	7046.2	8682.7	7883.2
Coal ('000 tons)	940.1	809.5	813.9	762.0	708.1	615.1
Oil ('000 barrels)	6458.0	6178.6	6937.8	6854.6	6200.9	6023.0
('000 metric tons)	852.1	809.0	852.1	907.6	777.0	780.2
Fuelwood (min. cubic meters)	4.6	4.6	3.5	3.7	n.a.	n.a.

Source: U.S. AID. 1981b.

Table 3.5. Estimated Energy Demand 1974-78

(percentages)

	1974	1975	1976	1977	1978
Agriculture	0.9	0.9	0.8	0.8	1.4
Mining	61.6	61.4.	61.3	62.1	59.4
Manufacturing and Commerce	16.7,	16.7	16.4	16.4	12.2
Transport	3.5	3.6	3.8	3.4	3.3
Commerce and Services	17.3	17.7	17.7	17.6	23.7

Source: U.S. AID. 1981b.

Table 3.6. Zambia's Fuel Import Bill 1974-78

	1974	1975	1976	1977	1978
Volume*	6,178.6	6,937.8	6,854.6	6,200.9	6,023.0
Value (f.o.b.) (K'000)	45,998	49,228	63,540	67,388	58,101
Unit Value Index	291	277	362	425	442

* In 1,000 barrels.

Source: U.S. AID. 1981b.

Table 3.7. Coal Usage (in Thousand Tons)

Consumer	1977	1983	% Annual Growth Rate
Mining	426	440	15
Manufacturing	171	494	19.3
Transport	5	11	14.0
Services	6	12	12.2
Domestic	5	16	21.4
Export	20	33	8.7

Source: U.N. 1981.

Table 3.8. Wood Consumption in 1978

Sector	Population size (million)	Firewood	Charcoal (FE)	Firewood & Charcoal	Total wood Used $10^6 m^3$	Area of Land Required (km^2)
Rural	3.21	2.43	0.72	3.15	7.8	911
Urban	2.27	0.50	1.68	2.18	4.95	446

FE: Firewood equivalent assuming $1 m^3$ of firewood weighing 3 tonnes and producing 300 kg of charcoal.

Source: U.N. 1981.

Renewable Energy Sources. The Kafue Gorge (near Lusaka), Kariba North (at the Kariba Dam on the Zambezi), and the Victoria Falls power stations are Zambia's three major hydroelectric plants. Together they are capable of providing about 1600 MW, which should be adequate for Zambian needs until 1990 at the presently projected rates of electricity consumption. Another six small plants together provide 58 MW. It is estimated that the total 1658 MW is about 36 percent of Zambia's total hydroelectric potential.

An estimated 500,000 tons of charcoal were consumed in 1978, which is equivalent to about 5.0 millions tons of raw wood (Table 3.8). In addition another 464,000 tons of wood were consumed directly. Zambia is currently involved in research to improve efficiencies, which are now only around 5 and 10 percent for wood and charcoal, respectively. Improved efficiency in charcoal manufacture is also a major research concern, and several steel kilns are used in demonstrations in rural areas.

Pilot projects are also researching the use of cow dung, grass, and agricultural wastes to produce biogas; crop production for alcohol; the use of wind powered water pumps; and solar powered cookers.

3.2 Water Resources

Zambia has quite extensive water resources, including several major rivers, large lakes, and swamps, as well as numerous aquifers. Zambia's water use is dependent fairly evenly upon both surface and groundwater sources.

3.2.1 Surface Water [11/]

Rainfall over the northern portion of Zambia and adjacent regions in bordering countries range from 1000 mm to as much as 1500 mm (cf. App. I, Section 2.1). Potential evapotranspiration is generally high; pan evaporation was measured at 2492 mm at Samfiyia in the Bangweulu Swamps in 1957-58 (Balek 1977), and between 1500 and 1750 in the Copperbelt (Table 3.9). Nevertheless, a water surplus remains throughout most of the country (Fig 3.4c), giving rise to an extensive network of streams and rivers (Fig. 3.4b).

Rivers. Nearly the entire area of the country falls within either the Zambezi or the Congo watersheds. The Zambezi River rises in the northwestern corner of the country and after swinging into Angola for approximately 200 km, flows southward across western Zambia. In this region, its

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11/ Balek. 1977.
Davies. 1971.
Mhango et al. 1977.

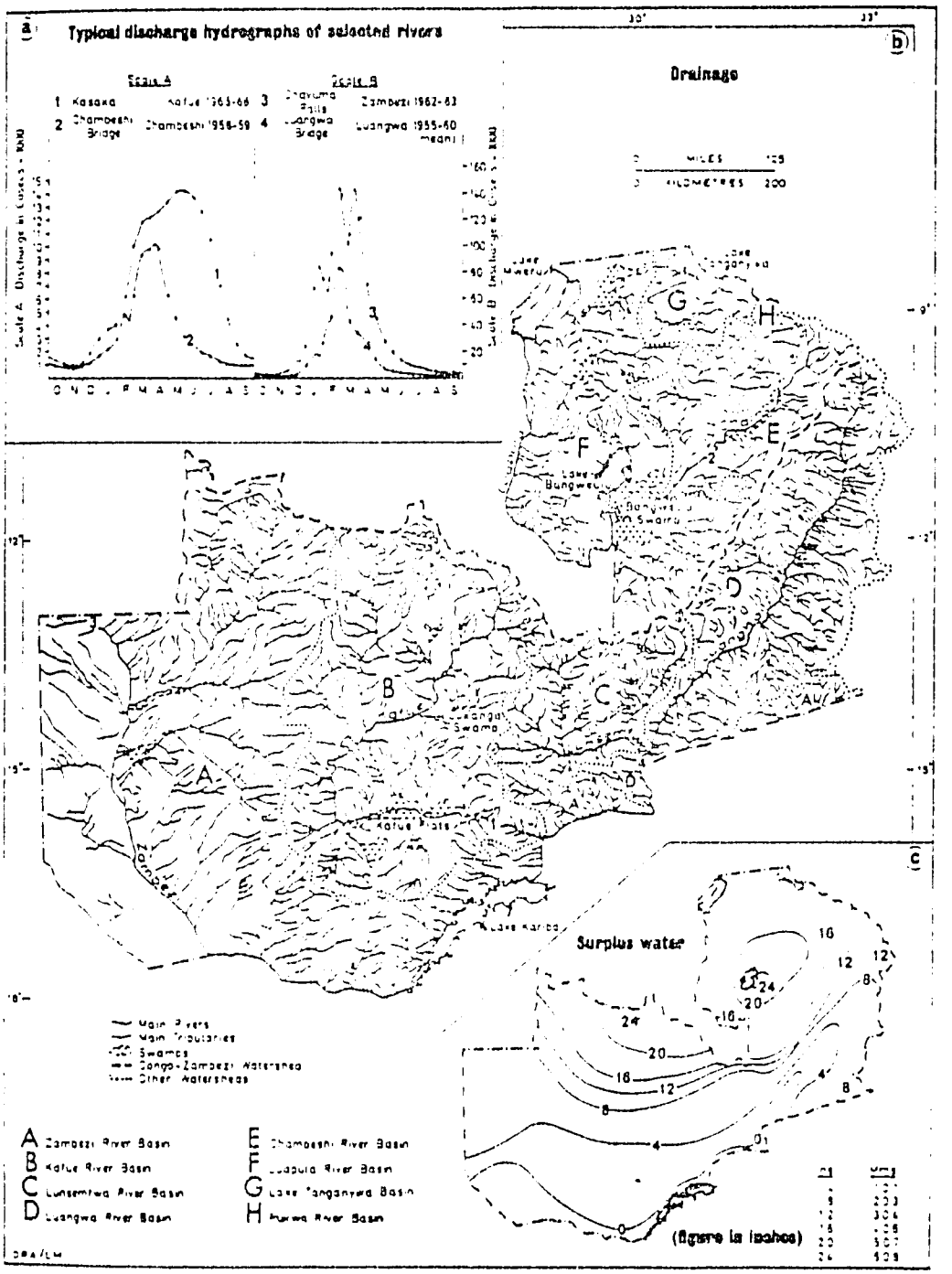

Figure 2.4. Surface Water in Zambia

Source: Davies, 1971.

Table 3.9. Observed evaporation from galvanized and fibreglass pans at the Luano catchments (12°34' S, 28°01'E)

Month	Evaporation from galvanized Class A pan (mm)	Evaporation from fibreglass pan (mm)
October	227.48	170.43
November	135.94	120.20
December	129.89	106.44
January	111.14	99.34
February	127.85	103.18
March	127.40	115.14
April	136.68	127.68
May	138.45	122.62
June	119.96	102.28
July	135.06	116.99
August	173.45	155.03
September	193.65	162.77
Total 1967/68	1756.95	1502.15

Source: Balek. 1977.

gradient is low and extensive floodplains and swamps occur. The middle Zambezi below the Victoria Falls flows through deeper valleys and gorges, finally opening into a wide plain just before the Mozambique border. The Kariba Dam was built just above one of these gorges, and Lake Kariba now occupies a substantial portion of the middle Zambezi Valley. Flow characteristics of the Zambezi may be seen in Figure 3.5 and Table 3.10, and characteristics of the entire Zambezi River Basin are presented in Table 3.11.

The Kafue River drains most of central Zambia and is one of the Zambezi's major tributaries. It rises in the Copperbelt region, and like the upper Zambezi, flows southward through a region of low gradients. Extensive swamps occur all along the Kafue and its tributaries, the Lukanga and the Busanga Swamps being the most notable. Further south are the Kafue Flats, another vast floodplain zone with adjacent areas of poorly drained soils. The final 32 km of the Kafue's course before joining the Zambezi are through a gorge with a steep gradient.

The Luangwa River and its main tributary, the Lunsemfwa, drain much of eastern Zambia. The Luangwa follows a fairly direct course from northeast to south-west along a rifted zone and the main tributaries also follow the lines of rift block valleys. The Luangwa has on average a steeper gradient than the other Zambian rivers and has few swamps along its course. Tributaries fall steeply from the Muchinga Escarpment and from the high plateau on the Malawi border. The Congo drainage in Zambia comprises the basins of the

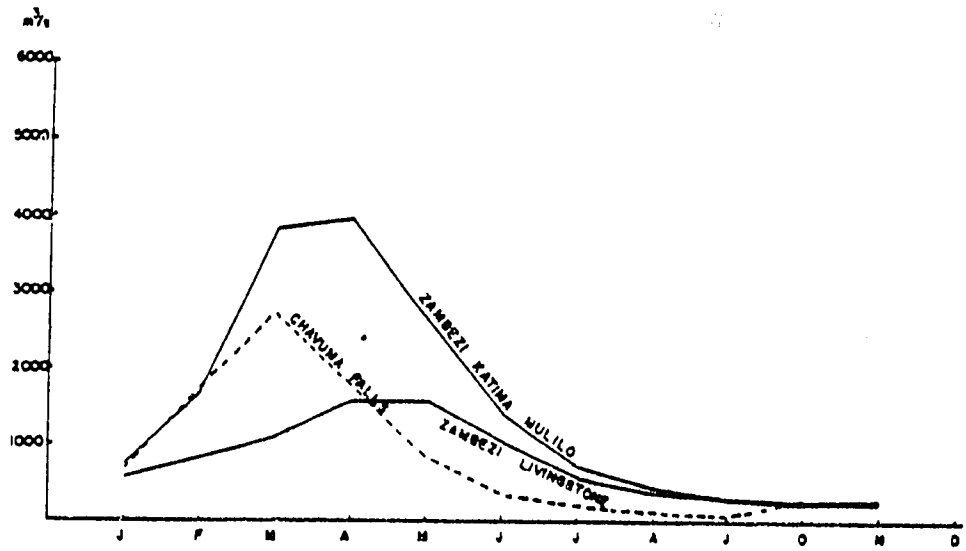

Figure 3.5. Flood Regime of the Zambezi

Source: Balek. 1977.

Table 3.10. Monthly Discharges of Zambezi

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year	Unit
Zambezi, Chavuma Falls, 1956—65	687	1757	2727	1818	863	368	219	158	96	73	98	226	755	m^3/s
Zambezi, Livingstone, 1908—65	240	244	342	576	840	1633	1600	1585	1025	580	377	278	730	m^3/s

Source: Balek. 1977.

Table 3.11. Water Balance of Zambezi Basin

River	Location	Dr. area	Precipi-tation	Runoff	Evapo-transpi-ration	Runoff coef.	Water yield	Mean annual discharge
Unit		km^2	mm	mm	mm	%	$l/s/km^2$	m^3/s
Zambezi	Chavuma Falls	75,967	1288	231	1057	0.18	7.3	555
Interbasin	Chavuma Falls-Chobe	284,538	1030	61	969	0.16	1.9	541
Zambezi	above Chobe	360,505	1085	95	990	0.09	3.0	1096
Chobe	mouth	870,758[1])	625[2])	3	622	0.01	0.1	135
Zambezi	below Chobe	1231,263	760	30	730	0.05	1.0	1231
Interbasin	Chobe-Vict. Falls	5,317	605	21	584	0.03	1.1	6
Zambezi	Victoria Falls	1236,580	759	30	729	0.04	1.0	1237
Interbasin	Victoria F.-Kafue	163,380	718	54	664	0.08	1.6	261
Zambezi	above Kafue	1399,960	754	34	720	0.05	1.1	1498
Kafue	mouth to Zambezi	154,856	1023	85	938	0.08	2.7	417
Zambezi	below Kafue	1554,816	782	38	744	0.05	1.2	1915
Interbasin	Kafue-Luangwa	19,091	1198	25	1173	0.02	0.8	151
Zambezi	above mouth Luangwa	1573,907	787	41	746	0.05	1.3	2066
Luangwa	mouth	148,326	925	91	834	0.10	2.9	436
Zambezi	below Luangwa	1722,233	799	44	755	0.06	1.4	2501

[1]) with Northern Kalahari
[2]) Chobe basin only, 798mm

Source: Balek. 1977.

Chambeshi, the Luapula and Lake Tanganyika. The Luapula River is a continuation of the Chambeshi, but they are separated by Bangweulu Lake and Swamps, and are usually considered separately.

The Chambeshi River follows a northeast to southwest course. It has a gentle gradient and extensive swamps, but it progresses through a series of shallow rapids as it approaches the Bangweulu Swamps. These swamps consist of two basic units: an outer belt of 40 km, which is flooded annually during the rains, and the main swamp, permanently flooded and covered by floating vegetation. The Chambeshi waters are distributed in an intricate system of channels across the swamps, some finding their way to Lake Bengweulu but most being discharged directly into the Luapula River. Characteristics of the upper Chambeshi are presented in Table 3.12, and in Table 3.13, for the entire Zambian portion of the Congo basin.

The Luapula River has a gently sloping profile in its upper course, but as it swings northward it becomes incised and flows over a series of falls. The valley widens again into a broad swampy zone before flowing into Lake Mweru.

The drainage into Lake Tanganyika consists of one main river, the Lufubu, and some short streams steepy incised into the surrounding scarps, with many rapids and water falls, including the Kalambo Falls, 216 m high. One tiny area of northeast Zambia forms part of the internal drainage system of Lake Rukwa in Tanzania (H on Fig. 3.4b).

Lakes. Zambia contains portions of two major African lakes, Tanganyika and Mweru, as well as part of one of the world's largest man-made lakes, Kariba. In addition several other lakes lie entirely within Zambia's borders, notably Bangweulu and Mweru Wantipa.

Lake Tanganyika, which lies on Zambia's northeast border, is the second largest natural lake in Africa. It has a total area of about 34,000 square km, its surface is 773 m above sea level, and its average depth is 570 m (maximum 1130 m). Considerable upwelling, turbulence, and internal waves characterize the lake, particularly at the Zambian end, which help make the waters quite rich in nutrients and very productive for fishing (Huckabay 1979).

Lake Mweru, on the northwestern corner of Luapula Province, has a total area of about 4,580 square km. Its depth ranges from three to 15 m in most places, with a maximum of 37 m at the north end. The southern end of the lake merges with the swamps at the mouth of the Luapula River, and smaller swampy areas may be found at other points along the eastern shore (Huckabay 1979).

Table 3.12. Water Balance of Some Parts of the Upper Chambeshi Basin, Congo Headwaters

Upper Chambeshi Water Balance	Drainage area	Mean annual rainfall	Mean annual runoff	Mean annual loss	Runoff coeff.	Water yield	Mean annual disch.	Discharge likely to be exceeded				
								20	40	60	80	95
								% of a year				
Unit	m^2	in	in	in	%	cfs/m^2	cfs	cfs				
Chambeshi CG8	1580	46.0	10.70	36.30	23.3	0.789	1245	2855	1370	560	162	31
Interbasin Chambeshi GG8 — Wiwa Kalungu	673	42.0	8.33	33.67	19.8	0.613	413	965	455	190	53	10
Chambeshi above Wiwa Kalungu	2253	44.8	10.00	37.80	22.3	0.756	1658	3820	1825	740	215	41
Chozi CG7	849	43.1	8.70	34.40	20.2	0.640	544	1250	600	245	70	14
Interbasin CG7 — Wiwa Kalungu	1215	39.9	7.00	32.90	17.5	0.515	626	1440	690	255	80	15
Chozi mouth — Wiwa Kalungu	2064	41.2	7.70	33.50	18.7	0.566	1170	2690	1290	500	150	29
Wiwa Kalungu CG12	1121	40.0	5.40	34.60	13.5	0.397	446	865	245	105	30	5

Rem.: The observed and gauged cross sections are underlined.

Source: Balek. 1977.

Table 3.13. Water Balance of the Congo Basin in Zambia

River	Location	Dr. area	Precipitation	Runoff	Evapotranspiration	Runoff coef.	Water yield	Mean annual discharge
Unit		km^2	mm	mm	mm	%	$l/s/km^2$	m^3/s
Chambeshi	above Bangweulu Swamps	43,830	1143	241	902	0.21	7.7	337
Interbasin	Bangweulu Swamps	57,664	1229	59	1170	0.05	1.9	110
Luapula	Below Bangweulu Swamps	101,494	1191	138	1053	0.12	4.4	441
Interbasin	Bangweulu S.-Mweru L.	71,372	1165	136	1029	0.12	4.3	307
Luapula	at Mweru L.	172,866	1181	138	1319	0.12	4.4	754
Kalungwishi	Mweru (mouth to)	26,696	1143	164	929	0.14	5.2	139

Source: Balek. 1977.

Little data is readily available on the smaller natural lakes falling partially or entirely within Zambia's borders.

Lake Kariba was created after the completion of the Kariba Dam in 1958, and now covers some 5360 square km. The mean depth is nearly 30 m, with a maximum of about 120 m. Lake Kariba was initially quite productive for fishing, because new conditions caused by a buildup of nutrients. After conditions stabilized, however, nutrient levels, aquatic weeds and fish production dropped off (Balon 1978; Symoens, Burgis & Gaudet 1981).

There are also numerous smaller man-made lakes in Zambia, usually constructed for the purpose of irrigation development or resulting from dams built to harness hydroelectric power. A representative sample of irrigation schemes is presented in Section 3.2.4, and the major hydroelectric dams are noted in Table 3.14.

Table 3.14

Location	Capacity	
Kafue Gorge	900 MW	(1350 projected by 1983)
Kariba North	600 MW	
Victoria Falls	108 MW	
Six small stations	50 MW	

Sources: U.S. AID. 1980b.
Europa. 1980.
U.N. 1981.

Swamps. Extensive areas in Zambia are covered by swamps or dambos, which are usually defined as seasonally waterlogged areas. Water balance figures for three major Zambian swamps and a typical small damboo in the Copperbelt region are presented in Table 3.15.

Table 3.15. Water balance calculations for Zambian swamps and dambos

Parameter	Unit	Bangweulu swamps	Kafue Flats	Lukanga	Dambo
Drainage area	km^2	102,000	58,290	19,490	1.43
Area of swamp	km^2	15,875	2,600	2,600	0.15
Rainfall on the area in a year	mm	1,190	1,090	1,250	1,330
Rainfall on the swamp in a year	mm	1,210	1,110	970	1,330
Evaporation from free water surface, yearly	mm	2,340	2,070	2,070	1,710
Evapotranspiration outside the swamps, yearly	mm	890	785	908	1,320
Additionally evaporated from the swamps, yearly	mm	1120—1260	196	252	—
Total evapotranspiration in the swamps, yearly	mm	2000—2180	1,000	1,120	1,075
Lost in % of inflow	%	60	4	7.8	—

Source: Balek. 1977.

3.2.2 Groundwater 12/

Zambia generally enjoys better groundwater conditions than most surrounding countries in several aspects, including depth, storage capacity, available yields, and exploitation potential. Figure 3.6 gives a rough idea of the location of major Zambian aquifers, and Table 3.16 summarizes data on some aquifers. In general, the limestones and dolomites of the Katanga system form the best aquifers (category 4 on Fig. 3.6; compare Fig. 3.2).

Extensive data is available on groundwater in several local areas. Mhango et al (1977) contains detailed data on the Luangwa River Basin, which has a total groundwater storage of approximately 221 billion cubic m. (Table 3.17). Additional data is presented in Figures 3.7 and 3.8 and Tables 3.18 and 3.19.

12/ Burgman et al. 1979.
Mhango et al. 1977.
Reeve. 1969.
U.N. Dept. of Economic and Social Affairs. 1973.

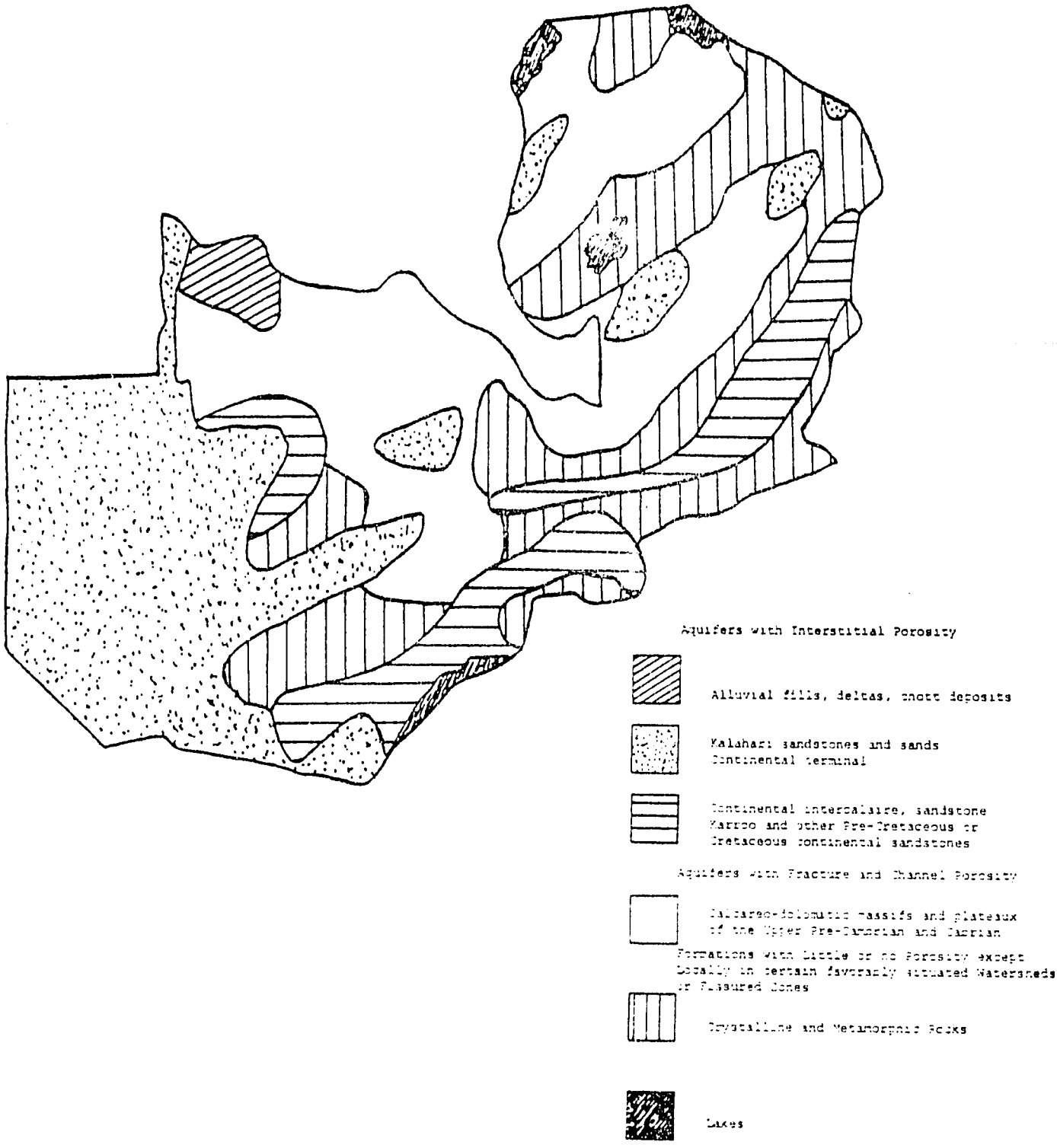

Figure 3.6. Sketchmap of Zambian Aquifers

Source: U.N. Dept. of Economic and Social Affairs. 1973.

Table 3.16. Summary of Zambian Groundwater Data

Localities and Districts	Formations	Comments
Southern Province:		
Livingstone	Basalts, Kalahari sands	Low yields, water sometimes salty
Kalomo-Choma	Weathered granite-gneiss zone, quartz viens and pegmatites	Depth of wells: 35 m; yield: 0.9 to 1.5 litres/s (for 6-inch boreholes); in the quartz veins the water is under a slight head (yield: up to 2-3 litres/s)
Mazabuka	Lower Katanga: sandstone and shale	Depth of wells: 35 m; yield: 1 litre/s (0.4 litre/s in phyllites)
"	Middle Katanga: limestones, dolomitic shaly limestones, argillites	Low yield in argillites, 1 to 3 litres/s in dolomites, 12 litres/s at the Mazabuka fault
"	Upper Katanga: calcareo-siliceous rocks	
Munali Pass	Biotite schists	0.3 litre/s
Kafue	Shaly sandstones	1 litre/s
"	Upper Karroo sandstone	1 to 2 litres/s (depth: 45 to 50 m)
Gwembe Valley	Karroo in a rift valley: shales, sandstones	0.2 to 0.5 litress
"	Sandstones	1 litre/s (water sometimes contains fluorides)
Central Province	Synclines of the Katanga system isolated in depressions of the basement:	
	Dolomites	1 to 5 litres/s (at 45 m)
	Fractured dolomites at Lusaka [a]	2,000 m^3/d through 10-inch tubes
	Quartiose veins in the basement schists	1 to 2 litres/s
	Granite gneisses north of Broken Hill	Negligible yields
Western Province (Copperbelt)	Katanga dolomites and limestones (pumping for the copper mines)	Large yields (see below)
	Basement schists	0.5 litre/s (35 to 45 m holes)
Northern and Luapula Provinces	Plateau sandstones (Karroo): water supply to towns (Karama, Abercorn); sometimes overlain by fairly thick shales	0.5 to 22 litres/s (average: 1 litre/s); low yields in the shales or where the sandstones are not thick
	Basement zone	Low yields
North-Western Province	Katanga system (limestones and dolomites with sterile argillaceaous schists)	No holes drilled
Barotseland (South-West)	Kalahari sands often overlying the Karroo	Little is known about the region; a few isolated bore-holes in the exceptionally favorable areas (1 to 2 litres/s)
Eastern Province	Basement formations: granite gneisses and schists	Yields are sometimes substantial or adequate

[a] In 1968, yields of up to 20 litres/s per metre of drawdown were obtained for the drilled wells of Lusaka (diameter 8 inches).

Source: U.N. Dept. of Economic and Social Affairs, 1973.

Table 3.17. Storage in the Groundwater Reservoir of the Luangwa River Basin

No.	Aquifer (geological age)	Area A ($10^6 m^2$)	Average Thickness of saturated Rock H (m)	Average Specific Yield μ	Storage of Ground-water reservoir ($10^6 m^3$)
1.	Sands, gravel, clayey sands and gravels (Quaternary)	16000	24	0.09	34600
2.	Sandstones, quartzites and shales (Kundulungu)	1100	34	0.10	3740
3.	Limestones and dolomites (Kundulungu)	1400	38	0.20	10650
4.	Schists and quartzites (Muva System)	8600	40	0.07	24100
5.	Gneisses, Schists, granulites and Mignaffites (basement) complex	57000	31	0.068	12000
6.	Granites (Igneous rocks)	13400	28	0.076	28500
	TOTAL	97500			221590

Source: Mhango et al. 1977.

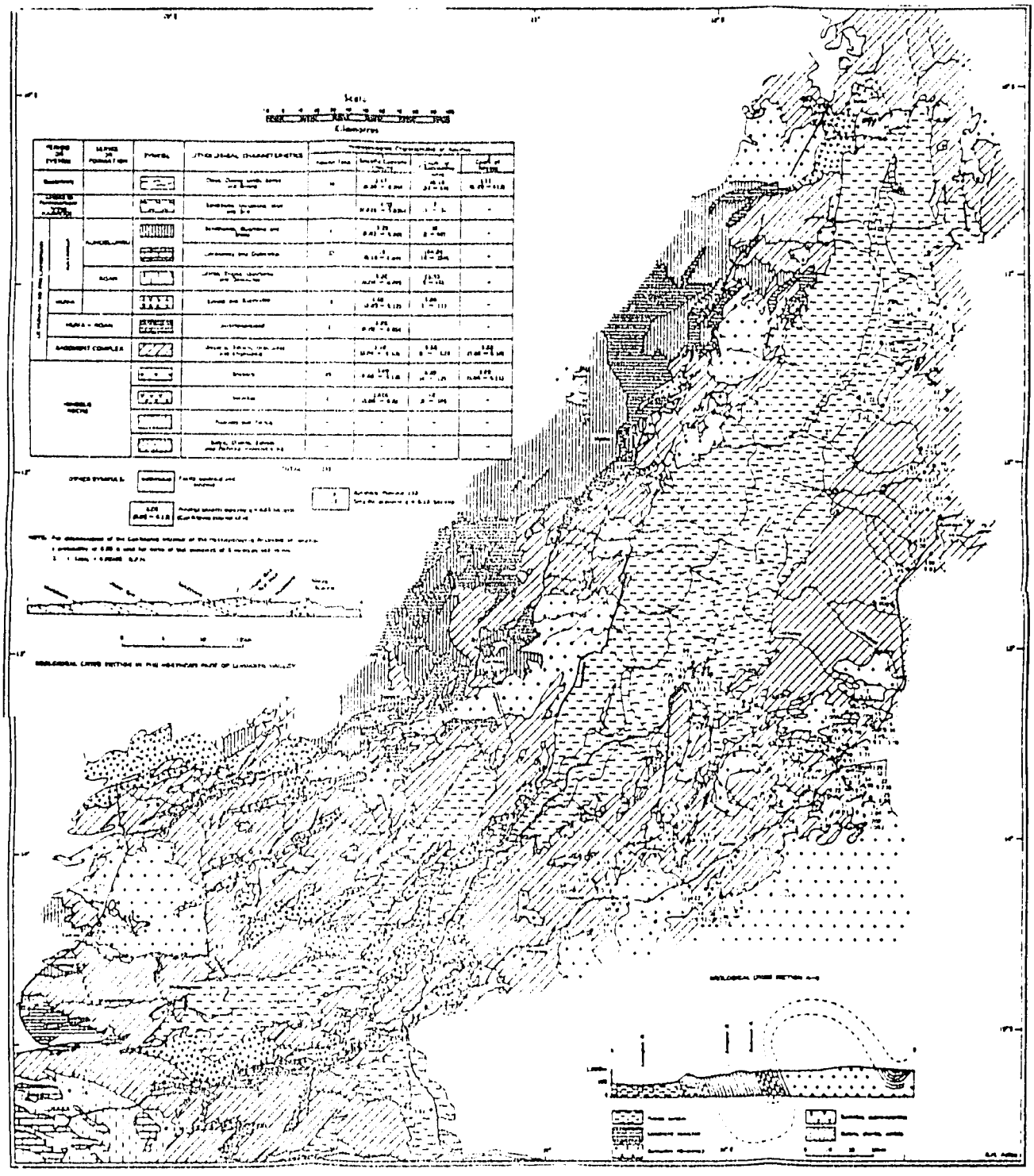

Figure 3.7. Geology and groundwater of the Limpopo Valley

Source: Manuel et al. 1977.

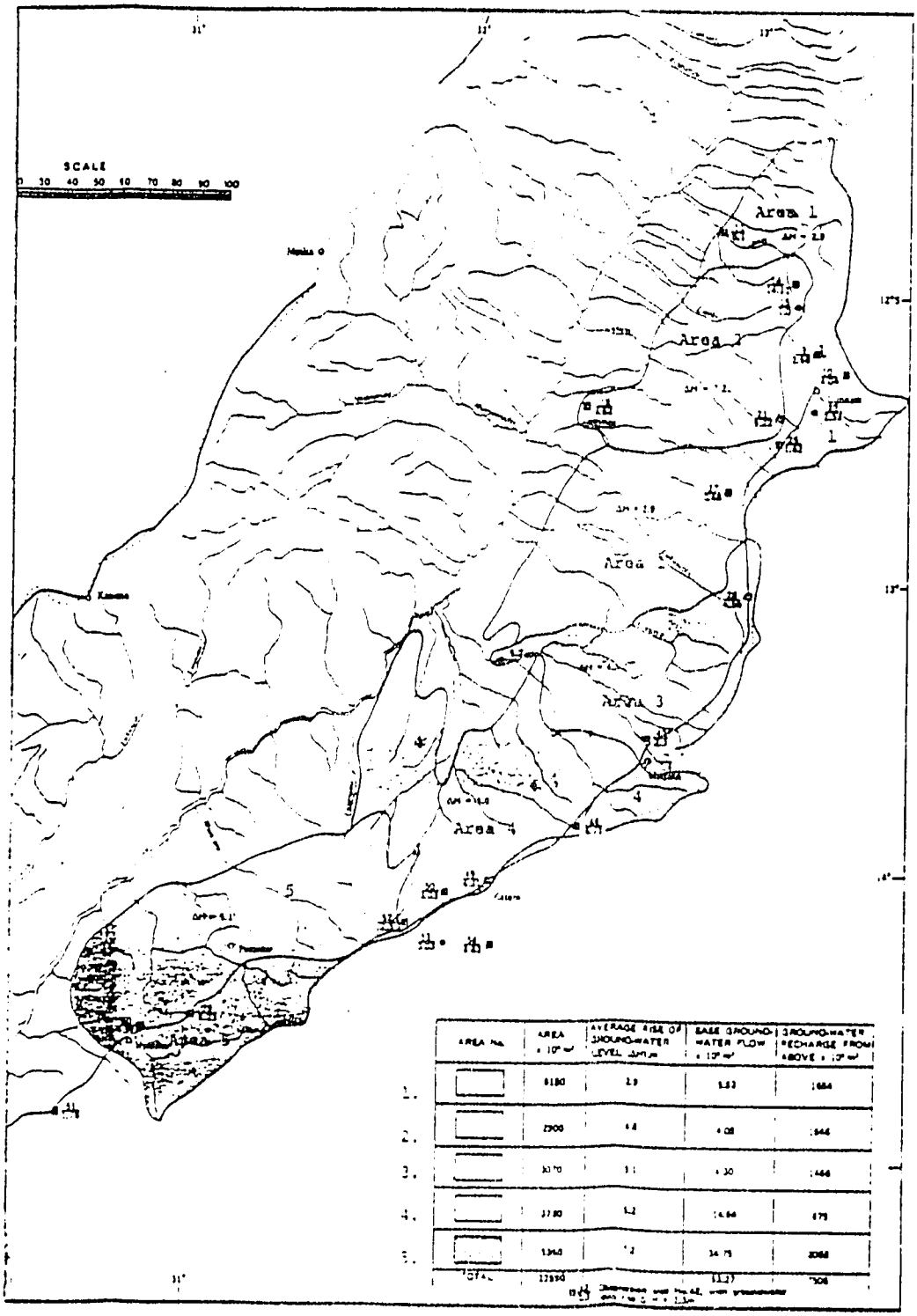

Figure 3.3. Groundwater Level Rise, Luangwa Basin

Source: Mhango et al. 1977.

Table 3.18. Recharge of Groundwater from above, Luangwa Basin, 1975-1976

No. of Area *	Area	Average specific yield	Average rise of ground water level	Change of ground-water storage	Twice the length of the rivers	Average flow thick-ness	Average coefficient of perm-ability	Average hydraulic gradient	Base flow Y_b		Recharge from above
										Total for 140 days	
		μ	ΔH	$A\mu\Delta H$	L	H	k	I			$WA\Delta t = A\mu\Delta H + Y_b$
	$(10^6 m^2)$	-	(m)	$(10^6 m^3)$	$(10^6 m)$	(m)	(m/d)		$(10^6 m^3/d)$	$(10^6 m^3)$	$(10^6 m^3)$
1.	8150	0.07	2.9	1654.00	1.44	23.7	0.127	0.0091	0.0394	5.60	1659.60
2.	2900	0.07	7.2	1461.60	0.66	21.2	0.23	0.0091	0.0249	4.20	1465.80
3.	5070	0.07	6.2	1332.38	0.60	27.1	0.33	0.0057	0.0306	4.20	1336.58
4.	3120	0.04	4.5	599.04	0.80	26.3	0.62	0.0080	0.1045	14.00	613.04
5.	5350	0.07	5.10	1909.95	1.08	36.3	1.11	0.0057	0.248	35.00	1944.95
Total	28590			6956.97						63.00	7019.97

*cf Fig. 3.8 for areas

Source: Mhango et al. 1977.

Table 3.19. Rate of Groundwater Flow in Luangwa River Basin

No.	Main rivers and tributaries	Aquifer	Twice the length of rivers L $(10^6 m)$	Average flow thickness H (m)	Average coefficient of permeability k (m/d)	Average Hydraulic gradient I	Rate of ground-water flow $Q = LHKI$ $(10^6 m^3/d)$
1.	Luangwa River	alluvium, left bank	0.62	26.3	2.90	0.0061	0.288
		alluvium, right bank	0.62	25.0	1.41	0.0080	0.175
2.	Left tributaries of Luangwa river	alluvial deposits	2.30	26.3	2.90	0.0060	1.052
		gneisses and granites	5.00	29.5	0.58	0.0075	0.644
	Right tributaries of Luangwa river	alluvial deposits	0.94	25.0	1.41	0.0080	0.265
3.		gneisses and granites	10.16	29.5	0.45	0.0090	1.210
4.	Lunsemfwa river	alluvium, Left and right-banks, schists and granites (left and right banks)	0.42	1.0	3.90	0.0060	0.099
			0.61	35.5	0.33	0.0090	0.065
5.	Left tributaries of Lunsemfwa river	alluvial deposits	0.11	10.0	3.90	0.0060	0.026
		schists and granites	2.46	35.5	0.33	0.0090	0.260
6.	Right tributaries of Lunsemfwa river	alluvial deposits	0.15	10.0	3.90	0.0060	0.036
		schists and granites	3.29	35.5	0.33	0.0090	0.350
7.	Lukusashi river	alluvium, left and right	0.32	10.0	3.90	0.0067	0.083
		schists and granites (left and right)	0.22	20.0	0.45	0.0075	0.015
8.	Left tributaries of Lukusashi river	alluvial deposits	0.20	10.0	3.90	0.0060	0.047
		schists and granites	0.09	20.0	0.45	0.0080	0.007
9.	Right tributaries of Lukusashi river	alluvial deposits	0.17	10.0	3.90	0.0060	0.040
		schists and granites	1.90	20.0	0.45	0.0080	0.137
	TOTAL						4.476 or $0.164 \times 10^{10} m^3$ per year

Source: Mhango et al. 1977.

3.2.3 Water Quality 13/

Except for the Luangwa Valley, extensive data on water quality is not readily available. Tables 3.20 and 3.21 give data for a number of small tributaries to the Luangwa River, while Table 3.22 covers tests from three other areas in Zambia. Groundwater quality tests for 153 boreholes and wells are listed in Mhango et al (1977), some of which are reproduced in Table 3.23.

Table 3.20. Water Quality Data from the Luangwa Basin

Parameters mg/litre	*Mubalashi River*	*Mulungushi River*	*Lunsemfwa River*	*Mkushi River*	*Chiwefwe River*	*Musofu River*
pH	7.2	7.3	7.0	6.5	6.3	7.4
Conductivity UMHOCM	56	110	46	9	11	165
Alkalinity	64	96	58	28	26	126
Total Hardness	30	60	22	4	6	158
Chloride	5	5	6	4	4	16
Sulphate	N/A	N/A	N/A	N/A	N/A	0.88
ammonia - N	N/A	N/A	N/A	N/A	N/A	N/D
Nitrate - N	N/A	N/A	N/A	N/A	N/A	N/D
Phosphorus	2.24	4.32	4.80	3.76	N/D	N/D
Ca	2.42	14.74	0.98	0.12	0.15	N/A
Mg	N/D	N/D	0.02	0.12	0.03	N/A
Pb	N/D	N/D	0.01	0.01	N/D	N/D
Zn	0.06	0.40	0.09	0.03	0.01	
Fe	0.19	0.14	0.48	0.64	0.34	0.076
Calcium Hardness	N/A	N/A	N/A	N/A	N/A	130
TDS	N/A	N/A	N/A	N/A	N/A	158
Na	N/A	N/A	N/A	N/A	N/A	2.150
Mn	N/A	N/A	N/A	N/A	N/A	N/D
f	N/A	N/A	N/A	N/A	N/A	0.014

Note:- N/D Means not detected
N/A Means not analysed
TDS Means Total Dissolved Solids

Source: Mhango et al. 1977.

13/ Mhango et al. 1977.
UNDP-FAO. 1978.

Table 3.21. Micro-Biological Analysis of Some Lunsemfwa Tributaries, Luangwa Basin

Name of River	Bacteria Counts	
	*Coli form/100 ml	Total Count/litre
Mulungushi at G. N. R. Bridge	140	4200
Lunsemfwa at G. N. R. Bridge	67	415
Mubalashi at G. N. R. Bridge	79	2400
Mkushi River at G. N. R. Bridge	26	840
Chiwefwe at Mkushi Boma	0	250

*This was made up of: (i) Escherichia Coli
(ii) Arebactor Gerogenes
There was no salmonella.

Source: Mhango et al. 1977.

Table 3.22. Water Quality Data at Scattered Points in Zambia (mg/l)

	pH	Ca	Mg	Na	K	HCO_3	CO_3	NO_3-N	NH_4-N	Fe	P_2O_5	Mn	Zn
Shishamba River (Kaome Dist., Western Prov.)	6.9	3.34	0.81	0.46	3.10	36	Tr	1.4	0.2	Tr	Tr	*	*
Mwekera Reservoir (Copperbelt)	8.1	3.34	2.83	15.63	1.57	-	Tr	-	-	Tr	Tr	*	*
Lundazi Reservoir (Eastern Prov.)	7.8	18.0	15.0	51.5	11.7	402.7	-	2.2	3.3	-	Tr	0.47	7.0

Tr = trace
* = not determined

Source: UNDP-FAO. 1978.

Table 3.23. Ground-Water Chemical Analysis, Luangwa Basin
(Results in milligrammes per litre)

Sample No.*	Locality	pH	EC mmNO	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	Fe	Date
1.	St Monica Sec School BH 188	8.5	260	18	1	8	2.5	105.0	86.6	26	-	-	10-7-75
2.	Kabombo Village BH 183	8.7	300	31	-	24	8.0	70.8	61.0	56	-	-	10-7-75
3.	Tigone Settlement BH 186	8.2	520	42	2	48	9.0	90.6	80.0	79	-	-	10-7-75
5.	Lumezi Store BH 197	7.4	560	110	7	14	4.0	225.6	230.0	28	-	-	14-7-75
7.	Chizombo Camp BH 205	7.9	640	48	5	84	2.0	176.4	179.0	61	-	-	14-7-75
10.	Chindwe Village BH 195	8.4	500	60	6	44	8.0	205.2	208.0	620	-	- not plotted	
15.	Katete Hospital BH 174/74	7.2	480	71	19	25	8.0	186.0	-	8	-	-	11-1-72
18.	Katete Boma BH 165	8.0	350	38	17	20	2.0	120.0	-	4	-	-	18-9-71
22.	Chama BH No. 92 and pump	8.2	325	30	9	40	3.0	120.0	-	2	-	-	3-9-70
26.	Mwape H.Q. Well 23/70	7.6	455	47	12	48	4.0	126.0	-	12	30	-	22-7 70
34.	Luambe Camp Well 8/N	7.2	185	23	12	10	4	76	-	4	-	-	22-7-70
49.	Kacele Township (51) BH3/71	7.4	470	26	25	60	2	150	-	8	40	-	21-9-71
72.	Chifunda BH No. 1 3/70	8.0	900	38	16	214	1	372	-	6	-	-	25-11-70
80.	Petauke No. 4 BH ws-	7.2	610	104	5	35	3	170	-	8	64	-	21 9-71
89.	Mkushi Farm 3080	7.0	276	27	14	14	3	93	-	2	-	-	4-6-63
114.	Nyachiza Village, BH 42, 1430 d2	7.8	550	105	2	30	7	163	-	4	65	-	9-4-73
137.	Kakumbi Village va 712520/5D36-6) Chipata	7.4	105	80	26	177	3	184	-	100	240	-	31-8-73
140.	Kwame Nkruma T.T.C. Kabwe	8.4	700	376	28	44	1.7	147.0	-	-	-	-	8-3-76
147.	Chilonga Mission, Mpika	5.5	35	-	0.5	1.2	1.5	21.6	-	-	-	-	14-2-75
148.	Kanona Project	7.0	10	4.8	1.4	2	0.8	14.4	-	42	-	-	10-2-76
149.	Chief Serenje	7.4	770	8.8	3	9	100	60.6	-	40	-	-	29-12-75
150.	Jancire School, Feira	8.4	585	24	21	80	4	150.0	-	60	-	-	16-9-70
151.	Mpanshya Hospital BH Rufunsa	7.4	560	83	5	19	-	228.0	-	-	-	-	29-2-64

*cf. Figure 3.9 for location of sample.

Source: Mhango et al. 1977.

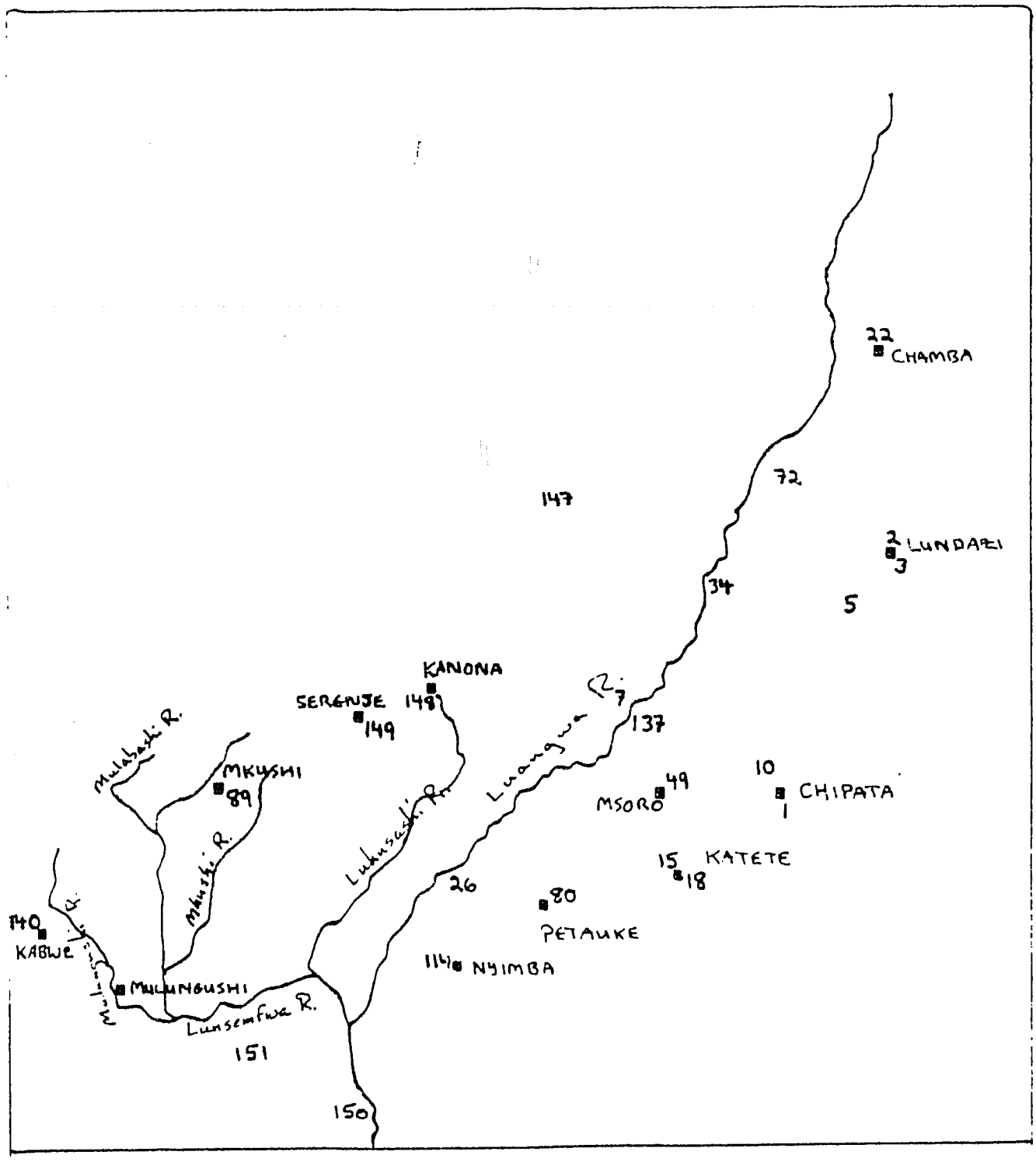

Figure 3.9. Sketch Map of Luangwa Basin Water Quality Test Locations for Table 3.23.

Source: Based on Mhango et al. 1977.

3.2.4 Water Use and Management [14/]

In the early 1970s Zambia depended almost equally upon surface and ground water for its water needs. Major groundwater users were Lusaka, other towns along the central rail line, and Copperbelt towns and mines. Outside of these areas many villages may have a few wells, but total groundwater extraction is nevertheless comparatively low. Countrywide figures on groundwater extraction are not readily available, but figures for the Luangwa Basin from the mid-1970s give an idea of groundwater usage (Table 3.24).

Table 3.24. Ground-water abstraction from the Luangwa Basin

No.	*District*	*Number of Boreholes*	*Total amount of ground-water discharge (m^3/d)*
1.	Chadiza	23	1375.06
2.	Chama	15	1683.68
3.	Lundazi	23	1156.65
4.	Katete	25	1875.58
5.	Petauke	22	1624.05
6.	Chipata	68	8790.80
7.	Rufunsa	7	1087.73
8.	Feira	6	1243.29
9.	Mkushi	9	598.74
10.	Serenje	8	845.85
11.	Kabwe	8	1623.45
12.	Mpika	2	240.96
13.	Lusaka*	1	54.43
	TOTAL	217	22194.43 m^3/d

*Note that this is one borehole in the Luangwa Basin portion of Lusaka District. It is not a figure for Lusaka city, which is in the Kafue Basin.

Source: Mhango et al. 1977.

Surface water has usually been the main supply source for most rural areas and many towns. Within the last decade, surface water has also served as the main source for expansion of water supplies even in the Copperbelt and along the central rail line (Fig. 3.10). In 1975, approximately 86 percent of the urban and 16 percent of the rural population (42% of total population) was considered to have access to safe water (U.S. AID 1981a). Data on piped water and type of water service in 1973 are presented in Table 3.25.

[14/] Davies. 1971.
Mhango et al. 1977.
Sedjo. 1977.

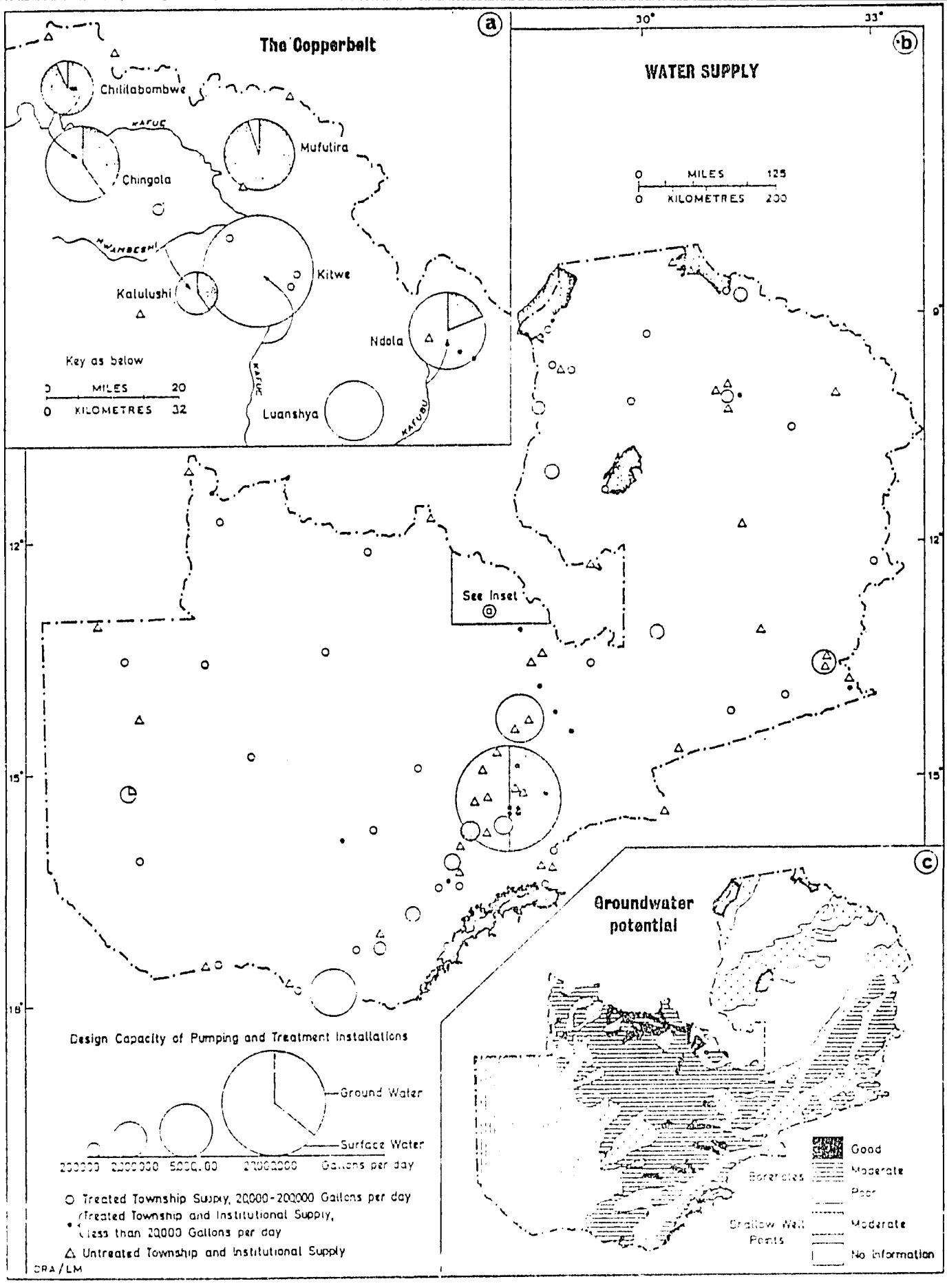

Figure 1.10. Water Supply

Source: Davies, D.T.L.

Table 3.25. Domestic Water Supply, 1973

Distribution and water services

Population		Served with piped water		(Mm³/y) Total		Per capita (m³/day)	
Urban	1,208,000 (30 percent)	906,000	(75 percent)	134	234	0.4	0.7
Rural	2,852,000 (70 percent)	285,000	(10 percent)	42	73	0.4	0.7
Total	4,060,000 (100 percent)	1,191,000	(30 percent)	176	307		

Urban water service with central water supply (60 percent by house connections, 40 percent by standpipes)

Cities (3)	Municipalities (5)	Townships (11)	
Lusaka	Chingola	Choma	Kasame
Ndola	Kabwe	Kalomo	Mbala
Kitwe	Livingstone	Mazabuka	Mansa
	Luanshya	Monze	Chipata
	Mufulira	Pemba	Kafue
		Mongu	

Rural water service

Type	Dwellings (thousands)	Population (thousands)		Water use Total (Mm³/y)	Water use Per capita (m³/day)
Private taps	17	70	(2.5 percent)	5.0	0.2
Shared taps	56	229	(8.0 percent)	8.3	0.1
Wells or boreholes	300	1,240	(43.5 percent)	22.7	0.05
River or stream	270	1,113	(39.0 percent)	4.2	0.01
Other	48	200	(7.0 percent)	0.8	0.01
Total	691	2,852	(100.0 percent)	41.0	

Forecast 1986

Population		Served		Water use Total (Mm³/y)	Water use Per capita (m³/day)
Urban	3,500,000	with piped water	3,200,000 (90 percent)	467	0.4
Rural	3,400,000	with piped water	880,000	128	0.1
		with wells or boreholes	1,700,000 (74 percent)	31	0.05
Total	6,900,000		5,780,000 (83 percent)	626	

Source: Sedjo, 1977.

In a sense, hydropower is actually Zambia's major use of water resources. Although water is not actually consumed, power stations are often allocated water which potentially could be used upstream. Traditional farmers view irrigation largely as supplementary, and use it to grow a second crop, or to protect against drought. Most irrigation development has been commercial, and approximately 9,000 ha were probably irrigated under such conditions in 1974 (Table 3.26). The potential for irrigation is quite large, particularly in areas such as the Kafue Flats or the Chambezi Flats. However, current policies of maximizing power generation would conflict with irrigation development in the Kafue Flats, as they already inhibit irrigation development in the Kariba Dam region.

3.2.5 Water Law 15/

Ownership and Water Rights. Theoretically ownership of all waters in Zambia reverted to the state upon independence, which reflected traditional African law prior to the colonial period. However, subsequent Zambian legislation has clarified water as both public and private. Public water includes all water courses (rivers, streams) where water flows (perennially or seasonally), as well as all lakes, swamps, or marshes which are sources for these public streams. Swamps, marshes, or springs situated entirely on private land, and which are not a source for a public stream, are classed as private. Also classed as private are groundwater brought to the surface of private land, and floodwaters impounded on private land. Theoretically, these classifications distinguish differing water rights rather than separate ownership categories.

For any purpose other than domestic use, rights over public waters must be granted by administrative authorities, which in most cases is the Water Board. Rights may be revoked for failure to beneficially use the water for three consecutive years or for breach of the conditions under which the rights were obtained.

Legislation (cf. Appendix VII). The basis for most Zambian water law seems to be the Water Ordinance No. 34 of 1948, which has subsequently been amended a number of times. In addition to defining the various categories of water and water rights, the ordinance sets out conditions for granting rights. Regulations are generally strict, and rights may be revoked for non-compliance. In particular, Zambia seems to have ample legal authority to enforce legislation regarding harmful effects of water and water pollution, which is set forth in additional legislation. The Natural Resources and Conservation Act empowers the government to require land

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15/ Caponera. 1979.

Table 3.26. Existing Irrigation Schemes by Province, 1974

Province	District	Scheme	Area (ha)	Crop
Southern	Gwembe	Buleya Mulima	100	Fruit, vegetables
	"	Siatwinda	80	"
	"	Bishop of Monze	40	Bananas
	Mazabuka	Zambia Sugar Cy.	6,500	Sugar cane
	"	National Irrigation Research Station (NIRS)	30	Wheat, various
Central	Kafue	Chiawa	20	Bananas
	Chilanga	Liempe farm	30	Wheat
	Chisamba	Grobler farm[a]	130	Onions, maize
	Feira	Feira pilot irrigation	20	Vegetables
	Central	Dean farm[a]	30	Citrus, vegetables
Copperbelt	Ndola rural	Chapula	60	Vegetables
	" "	Ipafu	40	"
	" "	Kafubu	60	"
North Western	Kwinilunga	Kwinilunga	50	Pineapple, vegetables
	Zambezi	Training settlement	30	Vegetables
Western	Kongu	Kabompo	2	Rice
	"	Pilot irrigation	5	Vegetables
Eastern	Lundazi	Lundazi scheme	6	"
	Chadiza	Rukizye	4	"
	Chipata	Makungwa	4	"
	Petauke	Lusowe	2	"
Northern	Kasama	Ngoli	80	Coffee
	Kporokoso	Kapatu	40	Fruit, vegetables
	Kasama	Kasama scheme	2	Vegetables
	Mbala	Mbala "	2	"
	Chinsali	Chinsali "	20	Rice
	Mpika	Kalashi	4	Citrus
Luapula	Mwanse	Mununshi	80	Bananas
	Kawambwa	Mushota	20	Vegetables
	Mansa	Pawambwa Scheme	240	Tea
	"	Research station	2	Rice Trials
		Grand total:	7,693	

[a] These are indicative only. There are more than 30 commercial farms with more than 20 hectares under irrigation, mainly for fruit, vegetables, sugar, and wheat.

Source: Sedjo, 1977.

owners to take measures for flood control, control of soil erosion, and protection of water courses. These measures include the authority to restrict land use.

Legislation also exists to prevent water wastage, empowering the government to enforce punishment if needed. Both surface and groundwater are covered. Extensive legislation covers the control and prevention of pollution. Pollution control or prevention may be among the terms under which water rights are granted.

Organizations (cf. Appendix VIII). Water resources administration is basically the responsibility of the central government, although some steps toward decentralization have taken place. Authority over water is primarily vested in the Ministries of Lands and Natural Resources; Rural Development; Power, Transport, and Works; and Health. The Water Board, the Natural Resources Advisory Board, and the Chief Conservator of Forests are also all closely connected with water resources policy and legislation on the national level. Committees may be set up on the Provincial or District level to assist or assume duties. These intermediate level committees are under fairly direct government control, and committee members are usually appointed by the national minister. Local committees also exist, over which the government has only indirect control. These usually are responsible for local water supplies, local irrigation or drainage projects, and for attempting to coordinate local needs with national policy and projects.

3.3 Soils and Agricultural Land Use

3.3.1 Soils

The following discussion of soils is taken from Davies (1971), who distinguishes eight general soil categories in Zambia (Fig. 3.11).

Fersiallitic soils occur mainly on parent rock materials rich in ferromagnesian minerals (dolomite, calcareous schist, etc), but may even cover old alluvium--'Kafue basin aluvium'. They have a moderate base status (pH five to seven). Topsoil texture ranges from clay to sandy loams or sandy loams, while solum thickness varies from 50 to over 300 cm. Colour changes with drainage: red clays and reddish brown to yellowish red loams occur in well-drained environment, while grey brown or greyish soils indicate poor drainage. Fersiallitic soils are formed on uplands in Central Province (Lusaka, Mumbwa, Kabwe), in the Monze-Mazabuka Districts, and in Eastern Province (Petauke-Chipata), usually on nearly level to gently undulating topography, with slopes ranging from under one to over five percent. Here average annual rainfall is under 1000 mm. The relatively wide soil variation is attributed to the proximity of parent materials. Fersiallitic

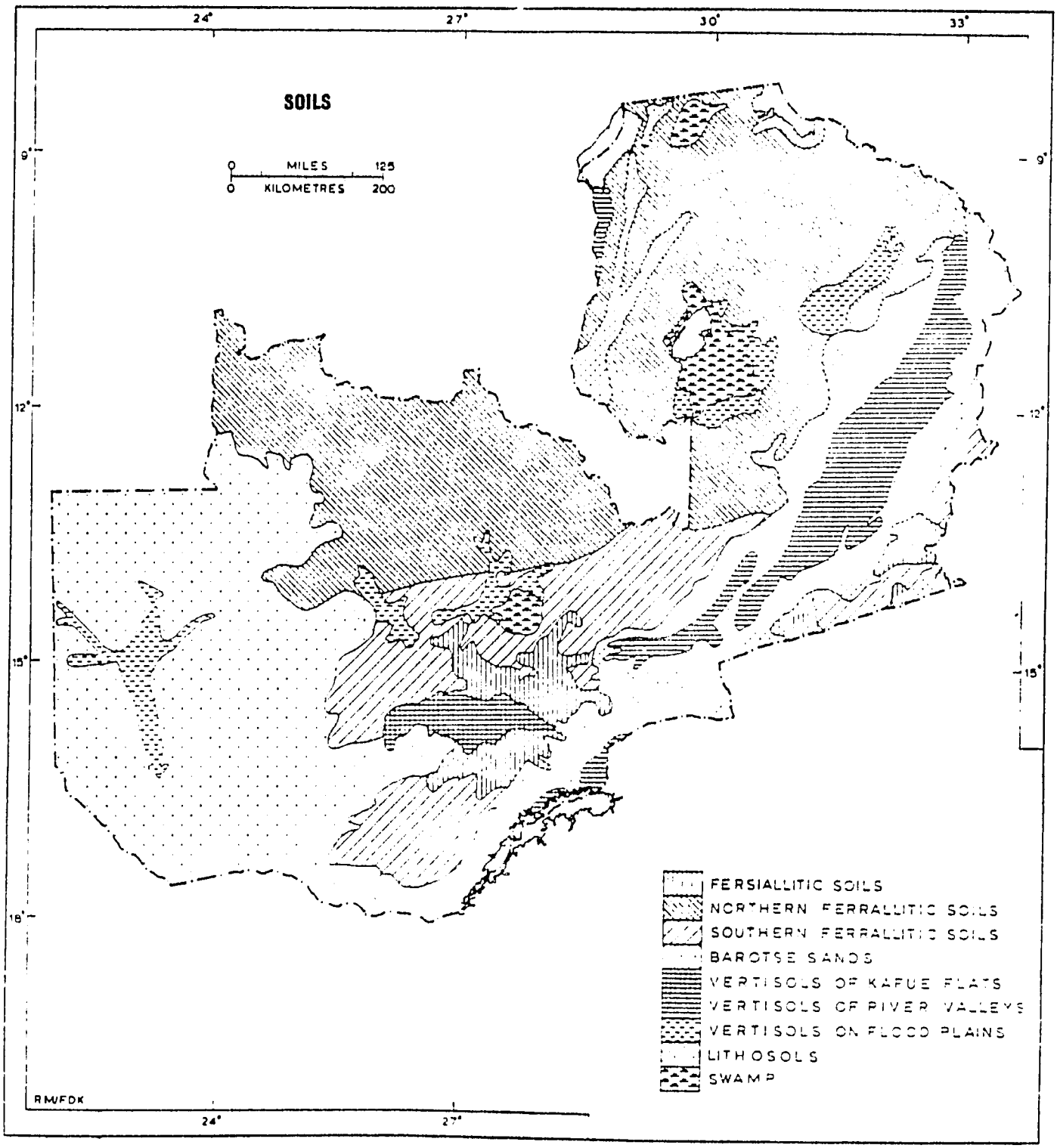

Figure 3.11. Soils

Source: Davies. 1971.

soils are suitable for cultivation of a wide range of climatically adapted crops. They include the most fertile Zambian soils, now widely cultivated.

Ferrallitic soils derive from various parent rocks, including granite, gneiss, sandstone and schist. Covering half Zambia, they occur mainly on gently undulating uplands with slopes of up to three per cent or more. They fall into two groups: the northern ferrallitic soils of the higher rainfall area (over 1000 mm per annum) and the southern ferrallitic soils. The latter vary from sandy loams to loamy sands. Usually clay content increases with depth: a sandy surface horizon occurs on loamy sand or sandy loam, underlain by sandy clay loam. Soil colour changes from yellowish red to yellowish brown in well drained areas, to greyish brown where poorly drained. The solum thickness extends to over 180 cm, but shallow soils, often with rock outcrops, are common associates. These soils, found in Southern, Eastern and Central Provinces are partly suitable for cultivation. However sandy soils particularly require careful management, while vast areas are best suited to permanent vegetative cover utilized through timber production, grazing, or wildlife. In contrast, the northern ferrallitic soils are more leached because of higher rainfall with lower base saturation (pH four to five). The clay content is generally higher: soil textures change from clays to sandy clays or sandy clay loams, showing gradually increasing clay content from the coarse-grained surface soil to the subsoils. These deep friable soils, 180 cm deep, show a colour range from dark reddish brown through red to yellowish red. They occur in Northwestern, Western, Northern and Luapula Provinces, and are widely used for chitimene cultivation. They may be used for local crops under good soil management and for timber production or pasture grasses.

Barotse sands are deep, loose, structureless sands. They comprise wind and water-sorted quartzitic sands with very low clay and silt content throughout the soil profile, usually under five per cent clay plus silt. The solum thickness is generally over 180 cm. Normally whitish or grey where the surface is discoloured with organic matter or ash, they pass to golden or reddish colours where stained with iron oxide (most frequently on the Zambezi scarps). Their origin is controversial. One view is that they were transported by wind from the Kalahari Desert during late Tertiary times: another, that they are developed from underlying Karroo sandstone by a process of water transport and subsequent wind action. Vast areas of western Zambia are covered by Barotse sands, which extend as shallower lobes into Mwinilunga, Kasempa and Namwala Districts. They are best suited to permanent vegetation cover (woodland, grassland), utilizable through grazing, timber production or wildlife habitat.

Vertisols of the Kafue Flats consist of deep, calcareous cracking clays. They change in colour from black in the upper

horizons to grey at depth. The surface pH ranges from 5.7 to 7.3, increasing to 8.5 in the subsoil. A characteristic calcium carbonate horizon generally occurs within 120 cm of the surface. The Kafue vertisols are formed on the nearly level flood plains of the Kafue Flats. Of alluvial (lacustrine) origin they experience seasonal flooding. An estimated 1.7 million acres (7000 sq km) are covered by these soils between Iteshi Teshi and the Kafue Gorge, which may also be found as small bodies along other rivers and swamps. They may be utilized for grazing cattle and wildlife and, particularly in border zones, may produce crops adapted to wet habitats after adequate drainage management.

Vertisols of the river valleys cover the Luangwa and its tributary valleys, the Luapala, and parts of the Zambezi valley. They are believed to derive from Karroo sediments, largely by colluvial and alluvial processes. They comprise a mixed group of soils. The fluvial deposits have been variously sorted during transport: they may range from lighter coloured, freshly deposited sands of river beds and local older beds or darker sands, through dark brown sandy loams, to lighter greyish and darker grey-brown clay loams of more cloddy tendency, and finally to dark grey clays similar to Kafue vertisols. In parts of the Luangwa valley, especially where drainage is poor, soils tend to be halomorphic due to salt accumulation. These are known as solonetzic grey clays to sandy loams.

Vertisols of flood plains are hydromorphic soils derived from siliceous parent material. They generally have a peaty organic horizon, ranging from 25 to over 180 cm thickness. The usually black topsoil horizon is underlain by quartz sands ranging in colour from dark greyish brown to pale grey. The peat horizon usually has a pH of 3.5 to 4.5, if not drained and cultivated. These soils are found in the flooded areas of the Zambezi and tributary rivers in Western Province, around major swamps (Lukanga, Bangweulu, Busanga) and in depressions of dambos. Parts may be used for grasslands or locally adapted crops if protected from flooding and adequately drained.

Lithosols are shallow to very shallow escarpment soils, often intermixed with outcrops and surface rocks ('rock and rubble'). They are frequently underlain by laterite crusts and/or quartz gravels or weathering rocks. Texture ranges from sand through loamy sand to sandy clay loam, rock material increasing with depth. The colour of the well-drained soils usually ranges from dark greyish brown to reddish brown. Lithosols are developed from granite, gneiss, schist or sandstone. They are best suited to a permanent vegetation cover utilizable for wildlife or a few woodland products (charcoal).

3.3.2 Agriculture [16]

Nearly 142,000 square km, or just under 19 percent of Zambia's surface area is clasified as cropland (Fig. 3.12; compare Fig. 3.13; App. V, Tab. 1). In actual practice, most of this land is fallow, and only about 10 to 15 percent of the area classified as cropland is actually cropped at any one time.

The major crop in Zambia in terms of total production is maize, followed by sorghum and then cassava (cf. App. III, Tab. 2). However, the vast majority of farms are traditional, and most farming is subsistence (Tables 3.27, 3.28). In terms of quantity of marketed production, groundnuts are the most important crop, followed by maize, with no other crop even coming close (cf. App. III, Tab. 3; note that the USDA and World Bank figures are not consistent with each other).

There are major regional variations in cropping patterns. While maize is widely grown throughout the country, cassava is not found in the southern areas, and sorghum is normally grown only along the southern border, between about 14 and 15 degrees latitude (Fig. 3.14; compare data in App. V).

Schultz (1976) has worked extensively on traditional farming systems, and distinguishes five broad categories in addition to the modern commercial sector (Figures 3.15 and 3.16). The most widespread system in terms of area is identified as shifting axe and hoe cultivation, which is generally associated with areas of over 1000 mm annual rainfall and heavily leached soils. In this system, often called chitemene or slash and burn, cultivation is restricted to a few patches within a larger clearing. In these patches, branches and trunks are collected and burnt, providing a thick layer of ash which is worked into the ground as fertilizer. No particular long-term land rights are held on these small fields, and they are abandoned after a few growing seasons for new ones. Five sub-categories of the chitimene system are distinguished by the proportion of cropped area in the larger clearing, periods between shifting fields, and cropping patterns.

A second type of farming system is identified by Schultz as semi-permanent hoe cultivation, which predominates in the Luangwa basin. Burning is used only as a means of clearing land, but not for the purpose of enriching the soil.

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[16] Schultz. 1976.
Sedjo. 1977.
Tuthill et al. 1978.
World Bank. 1977.

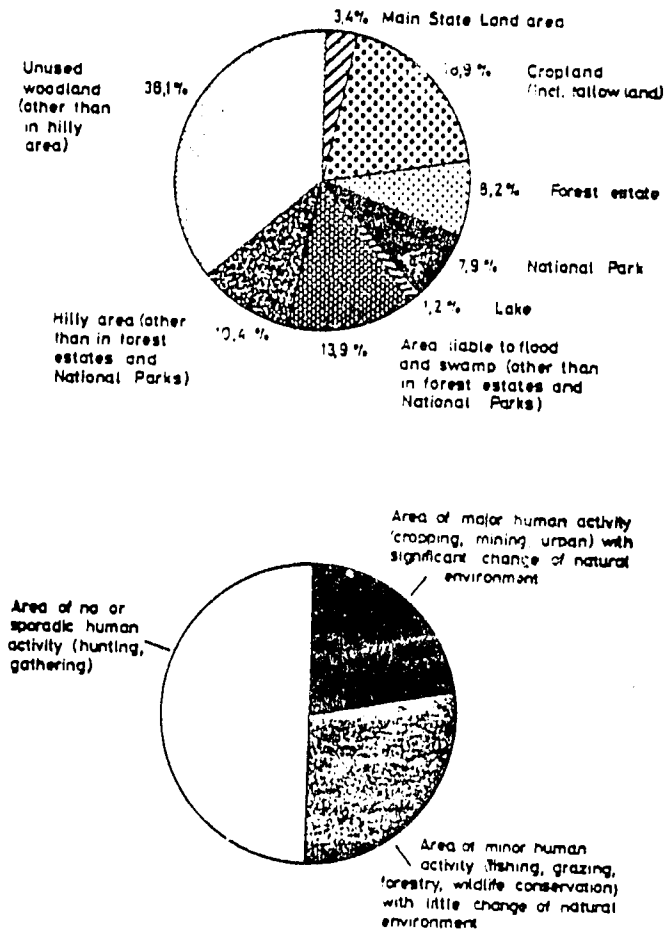

Figure 3.12. Area of Main Land Categories and Intensity of Human Activities

Source: Schultz. 1976.

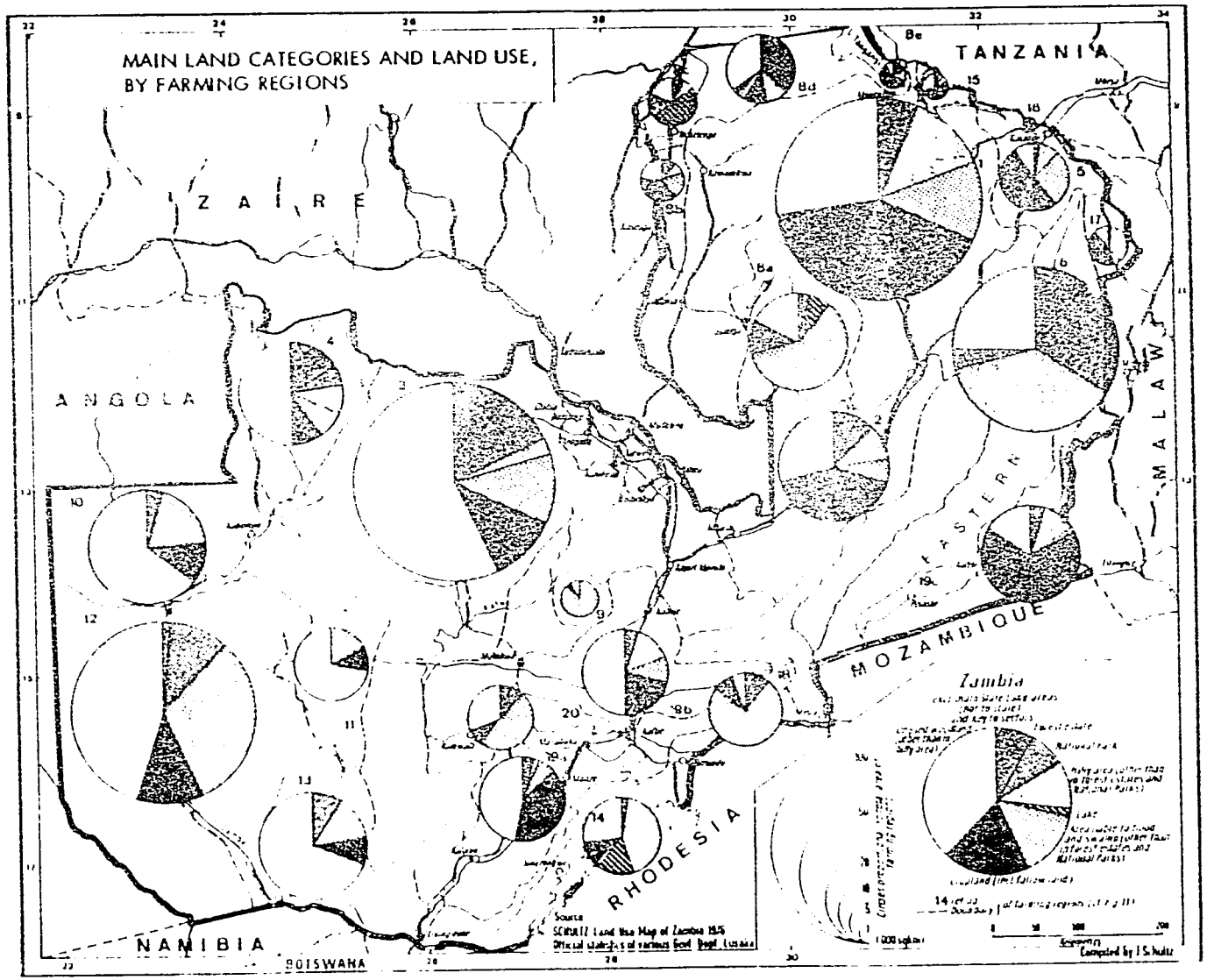

Figure 3.13. Main Land Categories and Land Use, by Farming Regions
Source: Schultz. 1976.

Table 3.27. Types of Farms, 1970

Type	Number
Commercial expatriate	550
Emergent	20,000
Traditional	309,000
Cooperatives	800
State farms	50

Source: Sedjo, 1977.

Table 3.28. Commercial Contribution to Agriculture Value Added (Millions of Kwacha)

Year	Commercial sector	Percent of total	Subsistence sector	Total
1970	27.5	25.0	82.0	109.5
1971	29.6	26.4	82.4	112.0
1972	35.2	29.8	83.0	118.2
1973	30.5	26.6	84.0	114.5
1974	32.9	27.9	85.0	117.9
1975	32.4	27.5	85.6	118.0

Source: Sedjo, 1977.

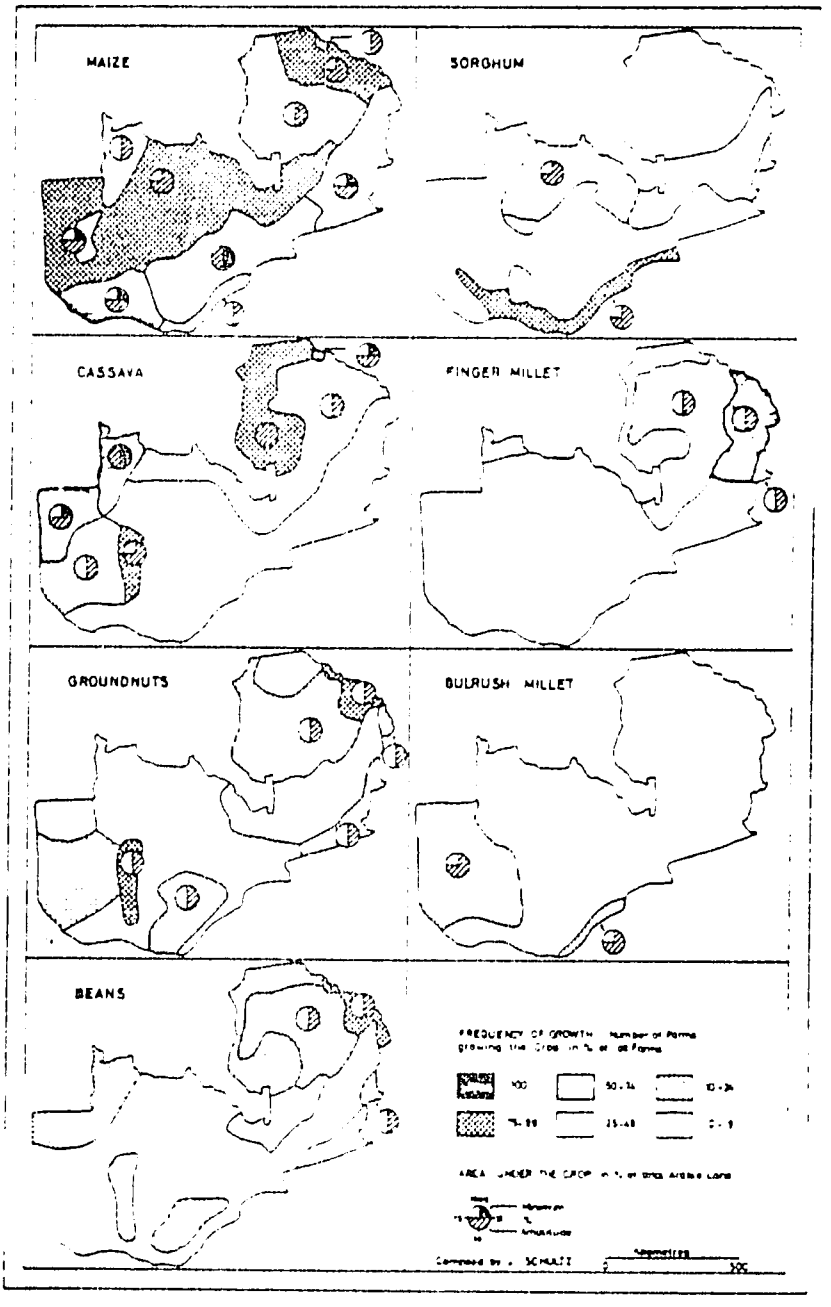

Figure 3.14. Distribution of Staple Crops

Source: Davies. 1976.

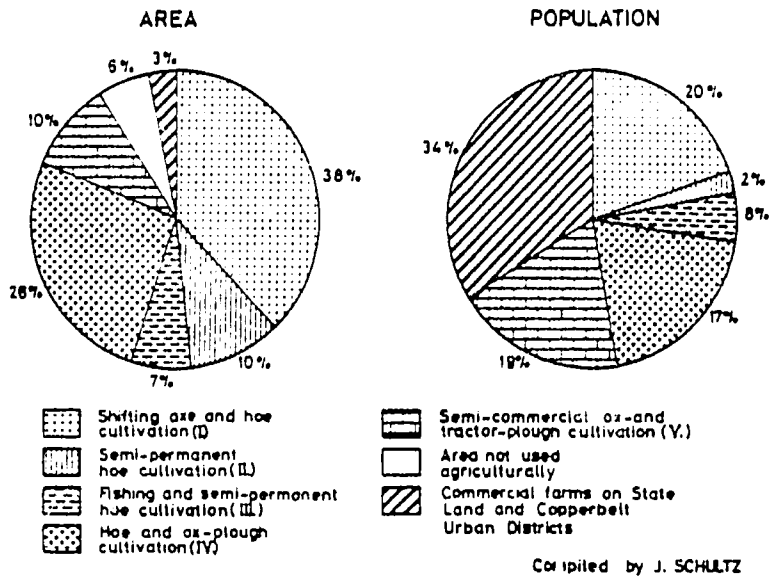

Figure 3.15. Area and Population under the Main Land Use Categories

Source: Schultz. 1976.

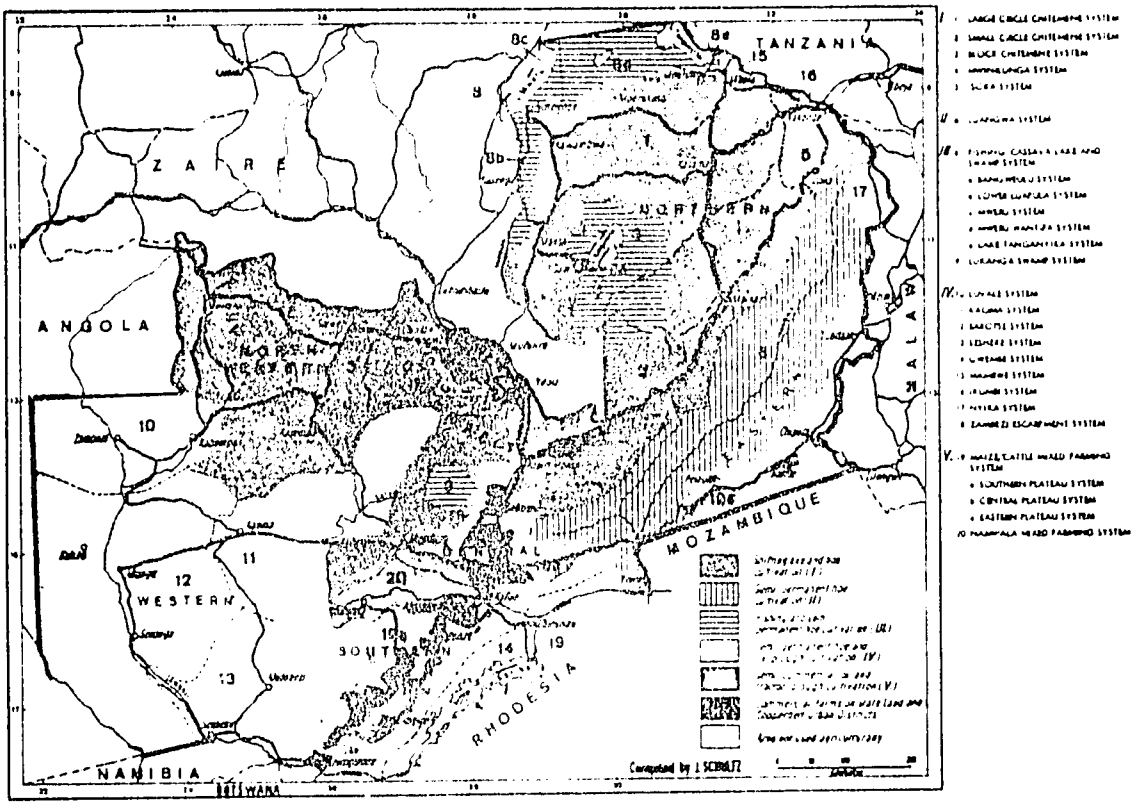

Figure 3.16. Farming Regions

Source: Schultz. 1976.

Vegetative matter is therefore not piled for burning, and cultivation is not restricted to burnt patches. The basin's alluvial soils are generally productive enough that continuous cultivation may last up to ten years, and fallow periods are short.

Fishing and semi-permanent hoe cultivation is the third classification, which is found in swampy areas such as the Lukanga, Bangweulu, Luapulu, Mweru, and Lake Tanganyika regions. Fishing is the primary economic activity, and agriculture is practiced to supplement food supply. Cassava is a particularly favored crop under these circumstances, except in the Lukanga Swamp, because it requires little attention, gives relatively high yields, and places relatively little pressure on the scarce soils in swampy regions. Sub-categories are distinguished on the basis of permanency of villages or cultivated fields, cropping patterns, fishing methods, and cultivation methods.

Semi-permanent hoe and ox plough cultivation is found primarily along the Zambezi Valley and in the western part of the country, although patches are distinguished along the eastern borders. Cattle-raising is a key element in the system, and the use of animal power offers opportunities for expansion and commercialization of agriculture which are not generally available in the systems discussed previously. Dung may be used for fertilizer, and cultivation is semi-permanent to permanent. Subdivisions of the system are based on the relative importance of cattle and variations in rainfall which necessitate varied cropping patterns.

Semi-commercial ox and tractor plough cultivation is the final traditional farming system distinguished by Schultz, but it is actually more or less an intermediate between traditional and modern, commercial agriculture. Holdings are generally larger than under previous systems, fertilizer usage (both industrial and manure) is widespread, crop specialization is common, and a large proportion of crops are grown for the market. One important reason that these farms are classified with traditional systems is that no formal titles to the land have yet developed.

Farms classified as commercial are generally on state land or in urban districts, principally along the central rail line or in the Copperbelt, respectively. Most of these areas were European held prior to independence, and about 65 percent of the farms are still run by expatriates (World Bank 1977).

3.4 Vegetation

3.4.1 Native Flora [17]

Zambia lies entirely within the broad Sudano-Zambezian phytochorological region (Fig. 3.17). The region is very rich floristically, with a large number of species having a wide range of distribution throughout Africa. Typical vegetation consists of woodlands and savannas (Werger 1978a).

Within the broad Sudana-Zambezian region, a number of categories can be distinguished. Sources differ on detail, but generally the ten zones discussed here (from Davis 1971) can be recognized in other discussions as various combinations of zones and sub-zones.

Zambia's vegetation can broadly be divided into 'forest', 'woodland' and 'grassland'. In the forests the upper tree layer is mostly closed and the middle layer often characterized by a dense thicket understorey. There is at best a discontinuous grass cover. Woodlands show a dense tree cover with more or less closed canopy. The middle layer, however, is open and there is only a sparse grass cover. True woodlands often merge into open grassy woodlands, in which the canopy is not closed, and there may be a complete grass cover ('woodland savanna'). Grasslands encompass areas with scattered trees and/or shrubs and treeless plains.

Together with climatic (precipitation, flooding) and edaphic (soils) factors, man has influenced the natural vegetation and helped to degrade forests and woodlands by burning and cultivation. Fire is undoubtedly the dominant single factor in maintaining a fairly open vegetation.

Livunda Forest (cf. Fig. 3.18) covers parts of north-western Zambia. It is a dry evergreen low forest characterized by Chryptosepalum pseudotaxus ('Livunda'), with lianes forming a fairly dense understorey. Southward it merges into Mushibe Woodland, while other dry evergreen forests in northern Zambia have degraded to fire-hardy Chipya Woodland under the influences of drier climate, fire and cultivation. Mutemwa Forest is a dry deciduous forest confined to areas of Kalahari sand, occurring widely in southern Western Province and as relics in Balovale, Kabompo and Sesheke Districts. It is dominated by Baikiaea plurijuga ('Zambian Teak') and Pterocarpus antunesii. A similar forest, with a poorly

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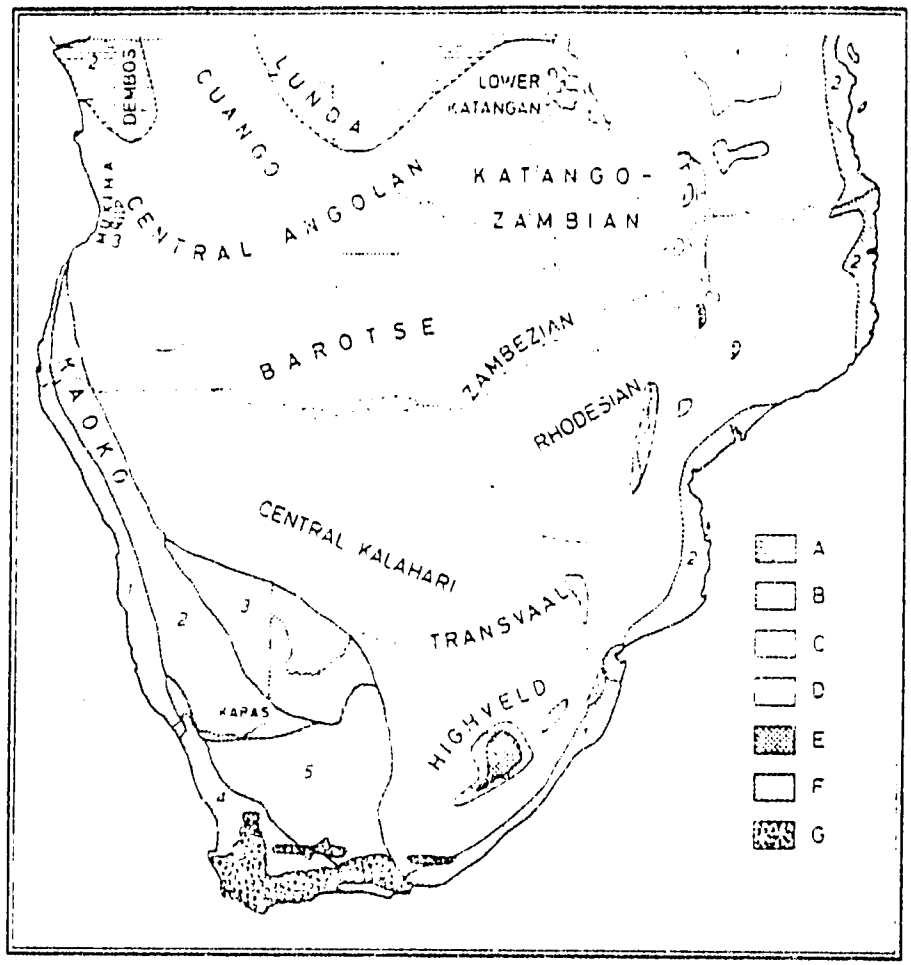
[17] Davies. 1971.
Ernst. 1971.
de Vos. 1975.
Werger. 1978a.
Werger and Coetzee. 1978.



A. Guineo–Congolian Region
   A1. Congolian Domain
   A2. Nigerian–Cameroonian Domain (including Littoral South Atlantic Domain)
   A3. Amboim Section of A2
B. Indian Ocean Coastal Belt
   B1. Tongaland–Pondoland Regional Mosaic
   B2. Zanzibar–Inhambane Regional Mosaic
C. Sudano–Zambezian Region (Zambezian Domain)
   C1. Oriental Domain
D. Afromontane Region
E. Afro-alpine Region (Austral Domain)
F. Karoo–Namib Region
   F1. Namib Domain
   F2. Namaqualand Domain
   F3. Southern Kalahari Subdomain
   F4. Western Cape Domain
   F5. Karoo Domain
G. Capensis

Figure 3.17. Phytochorological Regions of Southern Africa

Source: Werger, 1978a.

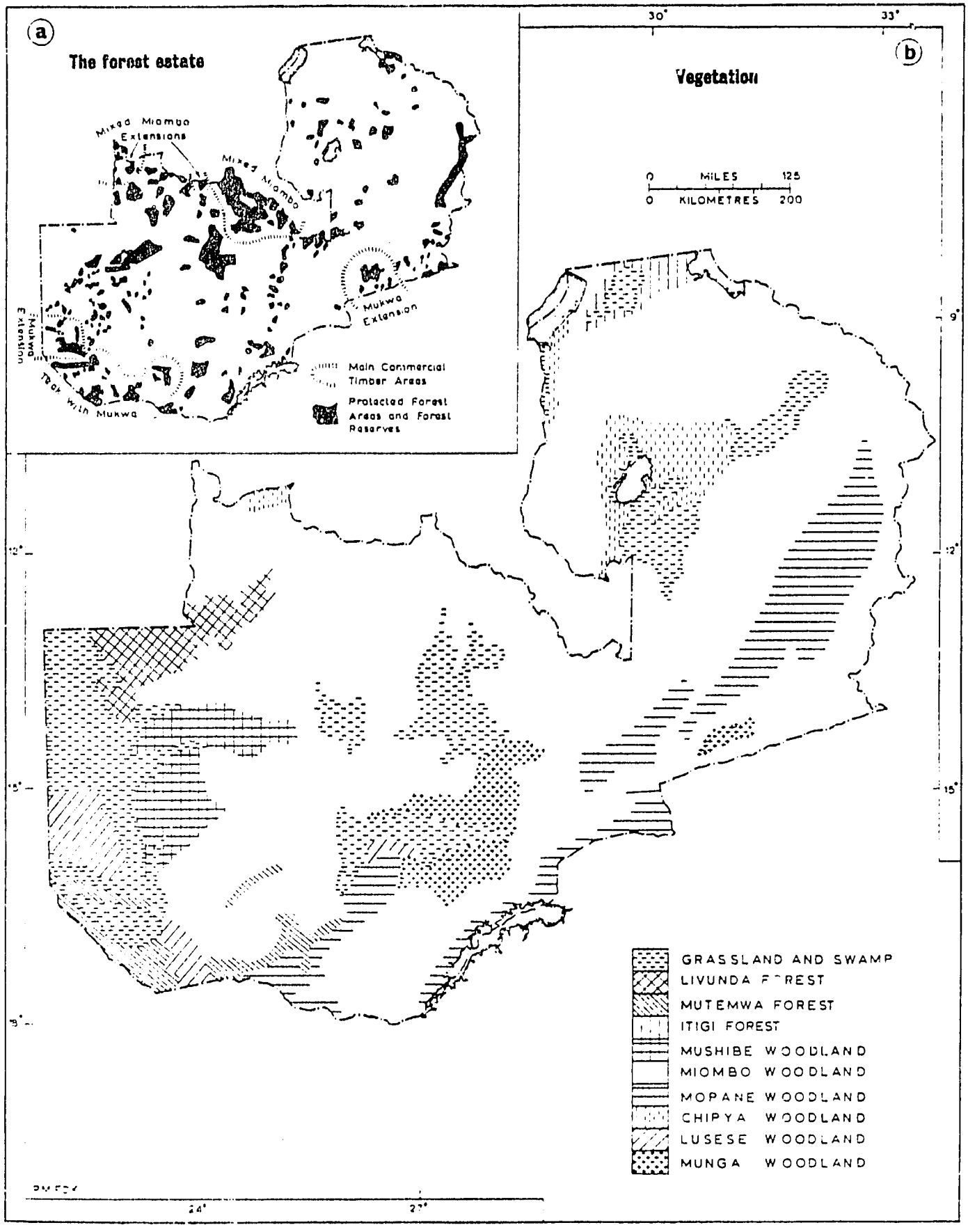


Figure 3.18. Vegetation Zones in Zambia

Source: Davies. 1971.

developed upper storey and a dense thicket layer, is found in the Mweru-Chishi-Tanganyika lowlands of Northern Province as Itigi Forest, closely related to the great Itigi Thicket of Tanzania. Characteristic species are Bussea massaiensis, Baphia massaiensis and Combretum ssp.

Woodland of various types covers four-fifths of Zambia. Mushibe Woodland occurs widely on Kalahari sand in Western Province, with evergreen species increasing northward. Typical species are Guibourtia coleosperma ('Mushibe'), Burkea africana and Erythrophleum africanum. Miombo Woodland covers over half of Zambia, mainly on plateau and escarpment country, and is characterized by Brachystegia, Jubelnardia and Isoberlinia species. In the west, Miombo species, especially Brachystegia spiciformis, have invaded Mushibe Woodland. Munga Woodland, dominated by Acacia, Combretum and Terminalia species among tall grass, occurs in Central Province, Mazabuka-Monze Districts and in Petauke District. Mopane Woodland covers much of the hot, dry southern valleys of the Zambezi and Luangwa. Dominated by Colophospermum mopane, it is almost monotypic, but may be mixed with Kirkia accuminata, Sterculia africana and other species and have significant stands of baobab.

Chipya Woodland occurs particularly around Lake Bangweulu and also around Lake Mweru, in the Luapula valley and north-east of Mwinilunga. It reveals mixed tree growth of Pterocarpus angolensis, Erthrophleum africanum, Parinari curatellifolia and others, with small trees (Terminalia, Combretum, etc.) standing in very tall grass and herbs. Another open grassy woodland is Lusese Woodland in Western Province and Namwala District, dominated by Burkea africana, Dialium engleanum and species of Baikiaea and Colophospermum. In Western Province this shades into Diplorhynchus shrub savanna or into Loudetia grassland in flooded areas of the Zambezi and tributary valleys.

Grassland and swamp. Larger grasslands occupy seasonally flooded Kalahari sands (Loudetia grassland) and great swampy depressions such as Lukanga, Bangweulu and Kafue (Hyparrhenia grassland). Smaller grasslands line dambos, streams and rivers. Virtually permanently flooded areas of Hyparrhenia grassland are occupied by swamp and papyrus sudd.

3.4.2 Range Use and Livestock 18/

Livestock figures are noted in Table 3.29. Cattle are the most important animals, and approximately 90 percent of the cattle are owned by traditional herders. Offtake from the traditional herds for the commercial sector is estimated to be only about four percent annually, compared to 15-17 percent offtake from the commercial herd. Cattle are occassionally slaughtered for domestic consumption in the traditional sector, usually for feasts and other notable events. Otherwise, cattle are usually regarded as a source of wealth by those groups which have herding traditions, and are only rarely sold. Dairy products are widely consumed by cattle herding groups, and cattle further contribute greatly to cultivation by providing manure and animal power.

Table 3.29. Livestock and Livestock Products

LIVESTOCK
(FAO estimates, '000 head, year ending September)

	1976	1977	1978
Cattle	1,815	1,900	1,800
Sheep	50	51	51
Goats	183	500	500
Pigs	190	500	150
Poultry	15,000	14,000*	14,000

* Unofficial estimate.

LIVESTOCK PRODUCTS
(FAO estimates—metric tons)

	1976	1977	1978
Cows' milk	51,000	50,000	45,000
Beef and veal	20,000	25,000	25,000
Pig meat	9,000	10,000	11,000
Poultry meat	11,000	12,000	12,000
Other meat	20,000	20,000	21,000
Hen eggs	10,200	13,870	10,404
Cattle hides	3,031	3,075	1,745

Source: Europa. 1980.

Only relatively restricted areas of the country are currently utilized as rangeland. Cattle distribution is restricted by the availability of extended grassy areas and by the prevalence of tsetse flys in some areas. Only in the upper Zambezi Western Province, the area of the Kafue River west of Kafue (city), and Eastern Province along the border of Mozambique is there any appreciable density of cattle (Fig. 3.19.) Sheep and goats have an even more limited distribution, and are numerous only in the Luapula and Gwembe/Luangwa Valleys. Tables 3.30 through 3.33 give an indication of the major grazing or fodder plants in Zambia.

18/ Europa. 1980.
Kalapula. 1979.
Kaplan. 1979.
Schultz. 1976.

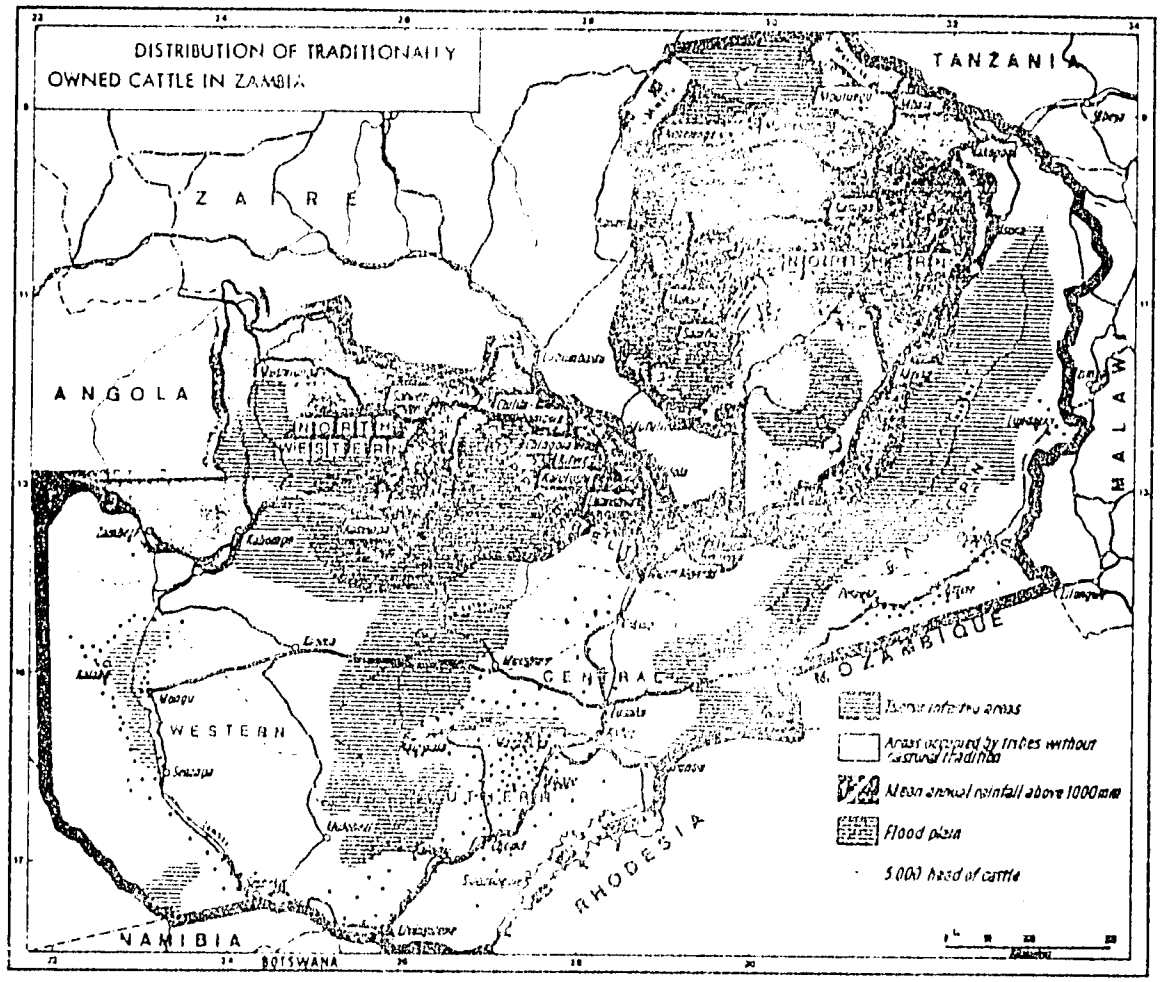


Figure 3.19. Distribution of Traditionally Owned Cattle in Zambia (after Harekma 1971)

Source: Schultz. 1976.

Table 3.30. Zambian Grass and Legume Species: Tolerance to Environmental Conditions

Tolerance: P = Poor, F = Fair, G = Good, VG = Very Good

Common name	Rainfall (1) range (mm)	Tolerance to:				Winter (2) growth
		Frost	Drought	Waterlogging	Low-fertility soils	
A. GRASSES						
Buffel grass	300-900	F	VG	P	F	P
Bushman Mine Panic	600+	F	G	G	F	P
Guinea grass:						
cv Gatton	750+	F	G	F	P	F
Hamil	1000+	F	F	F	P	F
Petrie (green Panic)	750+	G	F	F	P	F
Kikuyu grass	1000+	VG	G	F	P	F
Maize	600+	F	P	P	F	G
Napier grass	1000+	F	G	F	F	F
Pangola grass	1000+	F	F	G	G	P
Para grass	1000+	P	F	VG	P	P
Rhodes grass	600-1000	F	G	F	F	F
Sorghum	400-750	G	G	P	F	F
Star grass	800+	F	G	F	F	P
Torpedo grass	1000+	F	G	VG	F	P

Common name	Rainfall (1) range (mm)	Tolerance to:				Winter (2) growth
		Frost	Drought	Waterlogging	Low-fertility soils	
B. LEGUMES						
Archer dolichos	1000+	F	G	P	F	P
Centro	1200+	F	F	G	F	P
Cowpea	500-	P	F	F	F	P
Desmodium greenleaf	800+	F	G	G	F	F
Desmodium silverleaf	1000+	F	F	F	F	F
Glycine	800+	F	G	P	P	P
Jack bean	500+	G	G	P	G	P
Lablab bean	500+	F	G	F	G	F
Leucaena	700+	F	VG	F	F	F
Lotononis	900+	VG	F	G	G	F
Lucerne	500+ (3)	G	G	P	F	VG
Rhynchosia	700+	F	G	F	G	G
Siratro	700+	F	G	F	G	F
Soybean	700+	F	F	P	F	F
Stylo	700+	F	G	F	G	F
Townsville stylo	500+	P	VG	P	G	P
Velvet bean	700+	F	G	F	G	F

1. Without irrigation
2. May to August, with irrigation
3. In pure pasture, recommended under irrigation only
4. October and November growth, without irrigation

Source: FAO. 1979.

Table 3.31. Nutritive Value of Some Pasture and Fodder Crops

young = one month growth; mature = flowering stage

		CP (%)	CF (%)	DM Digestibility (%)
A. GRASSES				
Veld	young	10	31	65
	mature	3	40	50
Improved, fertilized grasses				
Buffel	young	10	30	
	mature	6	40	
Guinea	young	11	31	
	mature	6	41	
Maize	silage (whole plant)	7		60
	grain	9		
	bran	10	13	83
Napier	young	11	31	
	mature	6	47	
	silage	10		
Rhodes	young	11	25	60
	mature	6	40	45
Sorghum	silage (whole plant)	7	25	60
	grain	12	2	53
Star	young	11		
	mature	6		
B. LEGUMES				
Archer				
Dolichos	green fodder	17		
Centro	green fodder	15	30	
Cowpea	hay	20	23	
	meal (whole plant)	19		
	silage	15	27	
	green fodder	20	28	
	grain only	24	4	
	pods with grain	23		
Desmodium greenleaf	green fodder	18	31	
Desmodium silverleaf	green fodder	20	28	
Glycine	green fodder	19		
	hay	14		
Guar	grain	33		
Jack bean	green fodder	15	31	57
Jack bean	grain	24	5	
Lablab (dolichos) bean	green fodder	24		
	hay	20		
	grain	25	2	
Leucaena	green fodder (leaves and stems)	21	30	
	hay (leaves only)	28	14	
	stems	8		
Lotononis	green fodder	20	27	60
Lucerne (early flowering)	green fodder	22	26	
	hay	17	31	
	meal	19	26	
Siratro	green fodder	18		
Stylo	green fodder	20		
Soybean	green fodder	16		
	hay	13		
	grain	45	5	
	haulm	7		
Townsville stylo	green fodder	15		
Velvet bean	green fodder	18		
	grain	24		

Source: FAO. 1979.

Table 3.32. Browse Trees in Zambia

a. The Distribution, Habitat and Nature of Browse of Indigenous Leguminous Browse Trees

Name of Tree	Distribution	Habitat	Nature of Browse
Acacia albida	Throughout Zambia except in the north-west of the Republic	River banks and alluvial flood plains	Ripe pods, leaves
Acacia giraffae	West, Southern and Eastern Provinces	Dambo margins especially in the Barotse sand country or deep alluvium	Pods
Acacia sieberiana	Throughout Zambia except in Mwinilunga District	Alluvial flats and also among mopane, chipya and riparian woodland	Pod, leaves
Baphia massaiensis spp. obovata	North-Western, Western, Central and Copperbelt Provinces and parts of Northern and Eastern Provinces	Forest and woodland among Baikiaea forests thickets, plateau, Miombo and Kalahari woodland	Pods and occasionally leaves
Colophospermum mopane	The lower Zambesi, Kafue and Luangwa Valleys and in patches in valleys	Alkaline clay soils and basalt around the Victoria Falls	Pods, fresh leaves and fodder
Dichrostachys glomerata	Throughout Zambia	A component of mopane, miombo and chipya woodlands	Pods
Lonchocarpus [illegible]	Throughout Zambia	On termitaria, in mange and lake basin chipya woodlands	Leaves
Piliostigma thonningii	Throughout Zambia	In all types of woodland and on termitaria but absent from evergreen forests	Leaves, pods
Swartzia madagascariensis	Throughout Zambia	Miombo woodlands, chipya and savanna woodlands	Pods
Xeroderris stuhlmannii	Western, Southern, Eastern and Central Provinces and Mpika District	Typically savanna woodlands though it also extends westwards in the fringes of the Barotse sand woodlands and Mukusi forest	Pods, leaves

b. Non-Leguminous Browse Trees

Afromomum angolensis
Afzelia quanzensis
Combretum molle
Grewia bicolor
Cannea discolor
Monotes glaber
Parinari curatellifolia
Pterocarpus angolensis
Tipaca kirkiana
Ziziphus abyssinica

Source: FAO. 1979.

Table 3.33. An Index of Local Names of Browse Trees

Scientific Name	Kaonda	Lozi	Nyanja	Tonga	Bemba
Acacia albida	mviba	munga	nsangu	musangu	-
Acacia giraffae	mviba	muhoto	-	-	-
Acacia sieberiana	mviba	mutubatuba	mzizi	mumpangala	munganunshi
Afromorsia angolensis	mubanga	mubanga	mubanga	-	mubanga
Afzelia quanzensis	musambamfwa	mwande	mkolando	mupap	mupapa
Albizia amara	mvikalan-kanga	mukangala	mjelenjete	mukanga	mukala
Baphia massaiensis spp. obovata	-	isunde	-	-	-
Brachystegia:					
boehmii	mubombo	mibombo	muombo	mupombo	ngansa
floribunda	musobo	-	msamba	-	musampa
glabberima	mubombo	-	-	-	muombo
longifolia	mibombo	-	mbovu	-	mumbo
spiciformis	mungu	mutuya	mkuti	museve	muputu
utilis	lwenshe	-	kasumbuti	-	musaka
Burkea africana	kapanga	museshe	kavizi	museshe	mukoso
Colophospermum mopane	-	mupane	tsanya	mupani	-
Combretum molle	mulama	mulama	mufula	mulama	mulama
Dichrostachys glomerata	-	-	-	myeeye	-
Grewia bicolor	mukomba	muwana	msipana	musongongo	ndyabatemi
Isoberlinia angolensis	mutobo	-	kapane	-	mutobo
Julbernardia paniculata	mutondo	mutondo	mtondo	-	mutondo
Kigelia pinnata	kifungula	muzungula	mwunguti	muzungula	mufungufungu
Lannea discolor	-	mubumbu	kabumbu	mugongya	kamumbu
Lonchocarpus capassa	-	mupanda	chimpakasa	mukololn	chiya
Monotes glaber	kipampa	mutembo	mzaza	mutembo	chimpampa
Parinari curatellifolia	mupundu	mubala	mbula	mula	mupundu
Piliostigma thonningii	kifumbe	mubala	msekese	musekese	mufumbe
Pterocarpus angolensis	mukulakula	muhwa	mulombwa	mukula	mulombwa
Swartzia madagascariensis	ndale	mushakush-ela	mchelekete	lulundu	ndale
Uapaca kirkiana	mukusu	mukusu	mauku	mukusu	mukusu
Ziziphus abyssinica	kankona	mukalu	kankande	mwichachete	kangwa

Source: FAO. 1979.

3.4.3 Forestry and Fuelwood 19/

In the late 1970s the Zambian Forestry Department classified nearly 55 percent of the country as forested, although the majority of this was actually one of the woodland types described in Section 3.4.1. About 67,000 square km (9%) of this area falls within the two types of state forest reserves (cf. Fig. 3.18a). The main function of protection reserves is to protect hill ranges and headwaters through prevention of soil erosion. Exploitation is either entirely prohibited or limited to harvesting in such a way so as to improve the forest stand and growth. Production reserves, about two-thirds of the state reserve area, are managed to produce wood on a sustained yield basis. The Forestry Department also classifies National Parks and Wildlife sanctuaries as Conservation Forests, which are managed to maintain or improve wildlife habitat (Musokotwane 1979). Because of potential export value certain trees are protected both in and out of reserves, including Entandrophragma candatum (Mupumena), Khaya nyasica (Mululu), Petrocarpus angolensis (Mukwa), Afzelia quanzensis (Mupapa), Faurea saligna (Saninga) and Baikiaea plurijuga (Makushi or 'Zambian Teak') (Davies 1971).

Utilization of indigenous forests is patchily distributed. In the south-west, 'Zambian Teak' and Mukwa are extensively logged. A little quality timber is also produced in the north. Larger quantities of wood, mostly from Copperbelt Province, are used for mining construction and pit props. The rather limited and scattered useful trees and archaic production methods force Zambia to import much timber.

Inadequate local production, particularly for the mines during wartime (when outside supplies were disrupted) led to extensive development of exotic softwood plantations in reserves in the Copperbelt, especially around Ndola and near Kalulushi. After much experimentation, most planting has been of Eucalyptus and tropical pines. Older plantations have now begun to produce timber. Manufacturing developments led to further planting under the First National Development Plan, especially in Northwestern Province and along the line of rail (Davies 1971).

The World Bank has assisted since 1969 in a number of projects to establish plantations of fast growing pine and eucalyptus. One of the latest projects (1978-1982) is to plant 17,500 ha in the Copperbelt. By 1982 the total area of industrial forest should have reached 40,000 ha. Zambia plans an additional 40,000 ha during the next two decades.

19/ Cheatle and Cheatle. 1979.
Davies. 1971.
Kaplan. 1979.
Musokotwane. 1979.

Fuelwood. About 90 percent of the estimated 5.7 million cubic m of wood used annually is produced locally and nearly all of this is for fuelwood or making charcoal (cf. Section 3.1.4 for some data on wood and charcoal as energy sources). Preferred species in fuelwood exploitation are Brachystegia spp., Julbernadia spp., and Pericopsis angolensis. Fuelwood cutting can be a serious problem locally, particularly near large urban areas (thus primarily along the rail line and in the Copperbelt). On a national scale, however, the estimated annual clearance of 2,000 square km for fuelwood usage is not an overwhelming problem. Over four times as much area (8,720 sq km) is probably cleared yearly for chitemene cultivation (Cheatle and Cheatle 1979). Additional data on fuelwood and charcoal usage are presented in Tables 3.34 and 3.35.

Table 3.34. Estimates of Total Charcoal and Firewood Consumption, 1970-80

Amounts expressed in (a) tonnes of dry wood equivalent; (b) woodland (km^2) required for tonnage in (a)

Year	Domestic Charcoal		Industrial Charcoal		Total Charcoal		Total Charcoal and Firewood	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
1970	187,960 FAO (p)	37.6	60,000 FAO (p)	12.2				
1971	187,960 F (p)	37.6	50,800 F (p)	10.2	162,560-182,880 M (p)	32.5 36.6		
1974							1,500,000 B (p)	300.0
1975	193,040 F (f)	38.6	264,160 F (f)	52.8	203,200 M (f)	40.6		
1978	3,424,000 C (p)	684.8	100,000 B (p)	20.0	2,500,000 B (p)	500.0	10,000,000 C (p)	2000.0
	2,400,000 B (p)	480.0						
1980					304,800 M (f)	61.0		

(p) estimate for past or present
(f) estimate for future

Data Conversions: Column (a) values calculated from m^3 fuelwood, tonnes of charcoal to equivalent tonnes of dry wood using the following assumptions.
3 m^3 fuelwood = 1 cord = 1 tonne dry wood
1 tonne charcoal is derived from 10 tonnes dry wood
Column (b) values calculated as described for Columns 4 and 8, Table 2.

Source: Cheatle and Cheatle. 1979.

Table 3.35. Estimates for Fuelwood Cut and Corresponding Clear-Felled Areas, 1945 - 1978

Year	Amount of Wood cut (in t dry wt) for			Woodland (km^2) needed for t in column		Charcoal Burners		
	Firewood (1)	Charcoal (2)	Fuelwood (3)	2 (4)	3 (5)	Number (6)	Amount of wood cut (t, dry wt) (7)	Woodland (km^2) needed for t in col. 7 (8)
1945	61,000				12.2			
1946	91,000				18.2			
1947	154,000				30.8			
1948	381,884				76.4			
1949	526,040				105.2			
1950			523,967		104.8			
1951			654,000		130.8			
1952-3		No Data available						
1954						459	44,064	8.8
1955-6		No Data available						
1957		> 50,000		> 10.0				
1958*		60,000		12.0		> 900	> 86,400	> 17.3
1959*		46,045		9.2		1200	115,200	23.0
1960*		43,029		8.6		1200-1400	115,200-134,400	23.0-26.9
1961*		43,298		8.7		1600-1800	153,600-172,800	30.7-34.6
1962*		52,713		10.5		1800-2000	172,800-192,000	34.6-38.4
1963		No Data available						
1964	52,964	77,914	130,878	15.6	26.2			
1965	51,078	87,632	138,710	17.5	27.7			
1966		No Data available						
1967		76,553		15.3				
1968	64,644	91,034	155,878	18.2	31.2			
1969	49,868	91,418	141,286	18.3	28.3			
1970	47,912	107,630	155,542	21.5	31.1			
1971		160,471		32.1		2200 full-time 5000 part-time (M)	451,200	90.2
1972		155,813 200,000 (M)		31.2 40.0				
1973		161,881		32.4		2000 full-time 3000 part-time	336,000	67.2
1974-6		No Data available						
1977**						7070 (C)	678,720	135.7
1978						12208 full-time 36639 part-time (C)	2,930,640	586.1

* Data for Copperbelt Province only

** Data for Copperbelt and Central Provinces only

Data Conversions

Columns 1, 2, 3 calculated from cordwood values assuming 1 cord = 1 tonne (dry weight)

Columns 4, 8 calculated from cord values assuming an average yield of 50 cords/hectare

Column 7 calculated by assuming an average of 8 cords wood cut/month/full-time burner and 4 cords wood cut/month/part-time burner

Source: Cheatle and Cheatle. 1978.

3.5 Fauna

3.5.1 Mammals 20/

Well over 100 species of mammals occur in Zambia. The partial listing presented in Appendix VI, Table 1, is based on Hanks (1972, who lists 74 mammals) and Mitchell and Ansell (1965, who lists 69). This list should be regarded as representative rather than exhaustive, as the smaller mammals are usually neglected. Sheppe (1973), for example, discusses 30 species of rodents and shrews although Hanks (1972) listed only seven. Bigalke (1978) considers that 407 species occur in the southern Africa area, in which he includes Zambia (Table 3.36).

Table 3.36. Orders, families and approximate numbers of species of mammals--Africa and southern Africa

	No. of species in	
	Africa	southern Africa
LIPOTYPHLA		
Potamogalidae (Otter Shrews)	3	1
Chrysochloridae (Golden Moles)	16	14
Erinaceidae (Hedgehogs)	6	1
Soricidae (Shrews)	56	?15
MENOTYPHLA		
Macroscelididae (Elephant Shrews)	13	8
CHIROPTERA		
Pteropodidae (Fruit Bats)	26	17
Rhinopomatidae (Mouse-tailed Bats)	2	0
Emballonuridae (Sheath-tailed Bats)	7	4
Nycteridae (Slit-faced Bats)	11	7
Megadermatidae (Big-eared Bats)	2	1
Rhinolophidae (Horseshoe Bats)	17	10
Hipposideridae (Leaf-nosed Bats)	14	4
Vespertilionidae (Simple-nosed Bats)	64	34
Molossidae (Mastiff Bats)	31	16
PRIMATES		
Lorisidae (Pottos)	2	2
Galagidae (Galagos)	5	2
Cercopithecidae (Monkeys)	47	10
Pongidae (Apes)	3	2
PHOLIDOTA		
Manidae (Scaly Anteaters)	4	4
LAGOMORPHA		
Leporidae (Hares)	10	9

cont.

20/ Haltenorth and Diller. 1977.
Hanks. 1972.
Mitchell and Ansell. 1965.
Zambia, National Parks and Wildlife Service. 1977.
Zambia, National Parks and Wildlife Service. 1979.

Table 3.36, cont.

	No. of species in Africa	No. of species in southern Africa
RODENTIA		
Sciuridae (Squirrels)	31	14
Anomaluridae (Scaly Tails)	7	2
Pedetidae (Springhare)	1	1
Muridae		
Murinae	79	40
Cricetidae	70	35
Dendromurinae	14	8
Otomyinae	12	10
Cricetinae	1	1
Gerbillinae	33	10
Lophiomyinae	1	0
Cricetomyinae	5	4
Petromyscinae	3	2
Microtinae	1	0
Rhizomyidae (Bamboo Rats)	2	0
Muscardinidae (Dormice)	7	4
Dipodidae (Jerboas)	3	0
Hystricidae (Porcupines)	5	1
Thryonomyidae (Cane Rats)	2	2
Petromyidae (Dassie Rat)	1	1
Bathyergidae (Mole Rats)	13	10
Ctenodactylidae (Gundis)	5	0
Spalacidae (Blind Mole Rat)	1	0
CARNIVORA		
Canidae (Jackals, etc.)	11	5
Mustelidae (Weasels, etc.)	7	5
Viverridae (Genets, etc.)	37	22
Hyaenidae (Hyaenas)	3	2
Protelidae (Aardwolf)	1	1
Felidae (Cats)	10	7
TUBULIDENTATA		
Orycteropodidae (Aardvark)	1	1
PROBOSCIDEA		
Elephantidae (Elephant)	1	1
HYRACOIDEA		
Procaviidae (Dassies)	11	6
SIRENIA		
Trichechidae (Manatee)	1	1
Dugongidae (Dugong)	1	1
PERISSODACTYLA		
Equidae (Zebras)	5	3
Rhinocerotidae (Rhinos)	2	2
ARTIODACTYLA		
Suidae (Pigs)	3	2
Hippopotamidae (Hippos)	2	1
Tragulidae (Chevrotain)	1	1
Giraffidae (Giraffe and Okapi)	2	1
Bovidae (Antelopes)	78	39

Source: Bigalke, 1973.

Some of the most distinctive mammals include the giraffe (Giraffa camelopardalis thornicrofti in the Luangwa Valley, G.c. infiumata in the Western Province); the hippopotamus (Hippopotamus amphibius) along rivers; and the black rhinoceros (Diceros bicornis). In the Musi-oa-Tunya National Park near Livingston, the white rhino (Ceratotherium simum) has been introduced, but is not native to Zambia. Elephants (Loxodonta africana) and zebra (Equus burchelli) are fairly common, and a large number of antelope species of all sizes occur, including three subspecies of the vulneralbe lechwe (Kobus leche). Large carnivore include the lion (Panthera leo), cheetah (Acinonyx jubatus), and leopard (Panthera pardus). Rough ideas on the distribution of larger mammals can be obtained by noting their occurrence in the national parks (App. VI, Table 5).

The following brief description of faunal adaptation to one Zambian environment is from Sheppe and Osborne (1971), who studied the animal populations in the Kafue Flats (west of Lusaka).

Every year the Kafue River floods the Kafue Flats, to a depth of up to 5 m for several months. Animal life of the flats is conditioned primarily by the alternating rainy and dry seasons and by the floods. The Kafue rises slowly during the winter rains, is highest in May, and falls during the latter part of the dry season. Vegetation is composed primarily of grasses, especially Oryza barthii. Because of the abundant water the primary productivity of the flats is much greater than that of the surrounding woodlands. Every year there is an alternation of aquatic and terrestrial faunas. During the floods fish move onto the flats from the Kafue, and most spawning takes place there. Terrestrial species are driven off, but as the floods recede they reoccupy the flood plain to use the best grazing in the region.

Large mammals find shelter in tall stands of grass, small mammals in the thick mat of vegetation that covers much of the ground or in the deeply cracked soil. Some species (hippopotamus, otter) always stay near the river at low water, others (lechwe, zebra, wildebeest) go for varying distances onto the floodplain and more than half of the mammals (kudu, squirrel, vervet, aardvark) enter only slightly if at all. Failure to use the flood plain seems to be due to absence of suitable habitats or food, rather than exclusion by the floods. The most abundant large mammal on the flood plain is the lechwe, the only terrestrial ungulate that sometimes feeds in the floodwaters.

Several shrews and mice, especially Mastomys natalensis, are common on the flood plain and breed there during the rains. During the floods they leave the flood plain or take refuge on natural levees along the Kafue. Large populations of water birds are common. Crocodile and monitor live near the

Table 3.37. Ungulates Known to Occur in the Vicinity of the Kafue Flats Now or in the Recent Past

Scientific name	Common name
Order Proboscidea, Family Elephantidae	
Loxodonta africana Blumenbach	Elephant
Order Perissodactyla, Family Equidae	
Equus gurchelli Gray	Zebra
Order Artiodactyla	
Family Suidae	
Potamochoerus porcus L.	Bush pig
Phacochoerus aethiopicus Pallas	Wart hog
Family Hippopotamidae	
Hippopotamus amphibius L.	Hippopotamus
Family Bovidae	
Sylvicapra grimmia L.	Common duiker
Raphicerus sharpei Thomas	Grysbok
Ourebia ourebi Zimmermann	Oribi
Redunca arundinum Boddaert	Reedbuck
Kobus ellipsiprymnus Ogilby	Waterbuck
K. leche Gray	Lechwe
K. vardoni Livingstone	Puku
Aepyceros melampus Lichtenstein	Impala
Hippotragus equinus Desmarest	Roan
H. niger Harris	Sable
Alcelaphus lichtensteini Peters	Hartebeest
Connochaetes taurinus Burchell	Wildebeest
Tragelaphus scriptus Pallas	Bushbuck
T. spekei Sclater	Sitatunga
T. strepsiceros Pallas	Kudu
Taurotragus oryx Pallas	Eland
Syncerus caffer Sparrman	Buffalo

Source: Sheppe and Osborne. 1971.

Table 3.38. Use of the Flood Plain by Ungulates

Flood-plain use	Lochinvar	Blue Lagoon
Amphibious	Hippopotamus	Hippopotamus
Terrestrial		
Use flood plain extensively		
Feeding in water	Lechwe	Lechwe
Not feeding in water	Zebra	Zebra
	Wildebeest	Buffalo
	Eland	Roan
		Reedbuck
		Bush pig
Use flood plain marginally	Oribi	Oribi
In woods and termite zone	Duiker	Duiker
	Grysbok	Grysbok
	Bushbuck	Bushbuck
	Kudu	Kudu
	Bush pig	
	Reedbuck	
	Impala	

Source: Sheppe and Osborne. 1971.

Table 3.39. Use of the Flood lain by Members of the Order Car ra

Scientific name	Common name	Family
Amphibious, largely confined to the vicinity of water		
Lutra maculicollis Lichtenstein	Spotted-necked otter	Mustelidae
Aonyx capensis Schinz	Clawless otter	Mustelidae
Atilax paludinosus G. Cuvier	Marsh mongoose	Viverridae
Terrestrial, but living primarily on the flood plain at low water		
Lycaon pictus Temminck	Wild dog	Canidae
Living on the flood plain or on surrounding higher ground		
Canis adustus Sundevall	Sidestriped jackal	Canidae
Viverra civetta Schreber	Civet	Viverridae
Crocuta crocuta Erxleben	Spotted hyaena	Hyaenidae
Panthera leo L.	Lion	Felidae
Acinonyx jubatus Schreber	Cheetah	Felidae
Living primarily on higher ground, but ranging onto the outer margins of the flood plain		
Herpestes ichneumon L.	Large gray mongoose	Viverridae
Genetta angolensis Bocage	Small-spotted genet	Viverridae
G. rubignosa Pucheran	Large-spotted genet	Viverridae
Felis lybica Forster	Wild cat	Felidae
F. serval Schreber	Serval	Felidae
Ictonyx striatus Perry	Cape polecat	Mustelidae
Not known to go onto the flood plain		
Herpestes sanguineus Rueppell	Slender mongoose	Viverridae
Helogale parvula Sundevall	Dwarf mongoose	Viverridae
Mungos mungo Gmelin	Banded mongoose	Viverridae
Ichneumia albicauda	Whitetailed mongoose	Viverridae
Mellivora capensis Schreber	Ratel	Mustelidae
Felis caracal Shreber	Caracal	Felidae
Panthera pardus L.	Leopard	Felidae
Proteles cristatus Sparrman	Aard wolf	Protelidae

Source: Sheppe and Osborne. 1971.

Table 3.40. Use of the Flood Plain by Rodents (Order Rodentia) and Shrews (Order Insectivora)

Scientific name	Common name	Family
Found primarily on the wetter parts of the flood plain		
Crocidura mariquensis (Smith)	Shrew	Soricidae
C. occidentalis Pucheran	Shrew	Soricidae
C. bicolor Bocage	Shrew	Soricidae
C. nigricans Bocage	Shrew	Soricidae
Dasymys incomtus Sundevall	Slingly at	Muridae
Pelomys fallax Peters	Creek rat	Muridae
Found in various habitats, but most abundant on the flood plain		
Mastomys natalensis A. Smith	Multimammate rat	Muridae
?*Mus minutoides* A. Smith	Pygmy mouse	Muridae
?*M. triton* Thomas		Muridae
Have been found on flood plain, but probably live primarily on higher ground		
Crocidura hirta Peters	Shrew	Soricidae
Arvicanthis niloticus Desmarest		Muridae
Lemniscomys griselda Thomas	Grass rat	Muridae
Hystrix africae-australis Peters	Porcupine	Hystricidae
Rarley if ever go onto flood plain		
Crocidura cyanea Duvernoy	Shrew	Soricidae
Paraxerus cepapi A. Smith	Bush squirrel	Sciuridae
Graphiurus murinus Desmarest	Dormouse	Gliridae
Steatomys pratensis Peters	Fat mouse	Muridae
Aethomys chrysophilus de Winton		Muridae
Thallomys paedulcus Sundevall	Tree rat	Muridae
Acomys spinosissimus Peters	Spiny mouse	Muridae
Cricetomys gambianus Waterhouse	Giant rat	Muridae
Saccostomus campestris Peters	Pouched mouse	Muridae
Dendromus mystacalis Heuglin	Climbing mouse	Muridae
Otomys angoniensis Wroughton	Swamp rat	Muridae
Pedetes capensis Forster	Cape hare	Pedetidae
Cryptomys hottentotus Lesson	Mole rat	Bathyergidae
Tatera leucogaster Peters	Gerbil	Cricetidae
T. valida Bocage	Gerbil	Cricetidae
Thryonomys swinderianus Temminck	Cane rat	Thryonomyidae
T. gregorianus Thomas	Cane rat	Thryonomyidae

Source: Sheppe and Osborne. 1971.

Table 3.41. Representatives of Other Orders living in the Vicinity of the Kafue Flats (None Inhabit the Flood Plain)

Scientific name	Common name
Order Primates	
Family Lorisidae	
Galago senegalensis E. Geoffroy	Night ape
G. crassicaudatus E. Geoffroy	Bush baby
Family Cercopithecidae	
Cercopithecus aethiops L.	Vervet monkey
Papio ursinus Kerr	Chacma baboon
Order Lagomorpha, Family Leporidae	
Lepus whitei Thomas	Hare
Order Hyracoidea, Family Procaviidae	
Dendrohyrax brucei Gray	Yellow-spotted dassie
Order Macroscelidea, Family Macroscelididae	
Petrodromus tetradactylus Peters	Four-toed elephant shrew
Order Pholidota, Family Manidae	
Manis temminckii Smuts	Pangolin
Order Tubulidentata, Family Orycteropodidae	
Orycteropus afer Pallas	Aardvark

Source: Sheppe and Osborne. 1971.

water's edge and move in and out with the floods like the hippopotamus. Some snakes are common on the flats, but turtles and frogs are not. Although ants and termites are abundant in the surrounding region, they are largely excluded from the flats by the floods. Tables 3.37-3.41 indicate in more detail the animals utilizing the flats and cycles of use.

Hydroelectric development on Kafue River since the early 1970s has resulted in disruption of the natural flooding cycle, which may result in pressure on the animals utilizing the floodplain habitat. Schuster (1980) has shown that this is certainly the case for the Kafue lechwe (Korbus lechwe kafuensis) which is considered vulnerable by the IUCN (1978). The lechwe mating cycle was closely alligned with the flooding cycle, and once disrupted, lechwe populations may not be able to keep pace with such factors as poaching (cf. also Sections 3.5.5 and 4.5).

3.5.2 Avifauna [21]

Nearly the entire country falls within the broad classification of south central highlands in the context of ecological habitats for birds in southern Africa (Winterbottom 1978). A wide variety of birds occur throughout this zone, and Benson et al. (1971) lists 699 species for Zambia, which fall within the broad south central highlands classification. Appendix VI, Table 2 presents an abridgment of their discussion of avifauna in these habitats.

3.5.3 Herpetofauna and Invertebrates [22]

Poynton and Broadley (1978), discuss southern African herpetofauna, without usually distinguishing Zambia separately. Broadley (1971), has compiled a checklist of Zambian herpetofauna, which is summarized in Appendix VI, Table 3.

Werger (1978b), contains extensive discussions of the invertebrate fauna of the southern African region as a whole. In most cases Zambia is not addressed separately, and in fact knowledge of most Zambian invertebrate fauna is far less extensive than for other areas of southern Africa, particularly South Africa.

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[21] Benson et al. 1971.
Winterbottom. 1978.

[22] Broadley. 1971.
Poynton and Broadley. 1978
Werger. 1978b.

3.5.4 Ichthyofauna and Fishing 23/

A wide range of aquatic habitats occur in Zambia, some of which are schematically portrayed in Figure 3.20. Five major river and lake systems are identified for the purposes of distinguishing Zambia's ichthyofauna (Bell-Cross 1965). The Lake Mweru system, which includes Lakes Mweru, Mweru Wantipa, and Chishi, and the Luapula River downstream of Johnston Falls, sustains the highest species diversity, with 98 noted by Bell-Cross (cf. App. VI, Table 4). Kafue River, Middle Zambezi River, Upper Zambezi River, and Lake Bangweula consitute the remaining four systems, and a total of 161 species are listed covering all the systems.

The occurrance of several large lakes and major river systems in Zambia, combined with the wide diversity of habitat and species, help make fishing a fairly important industry. Fishing employs approximately 50,000 Zambians, about half of whom are regular commercial fishermen. About a quarter are subsistence fishers, and the remainder fish commercially part-time. The most important fisheries are in the northeastern part of the country. The fisheries of Bangweulu, Mweru/Luapula, Mweru Wantipa, and Tanganyika supplied about 62 percent of the total domestic catch in 1976 (70% of the commercial catch). Zambia at one time imported about one-third of its total fish consumption, largly from Tanzanian fisheries on Lakes Tanganyika and Rukwa. During the 1970s, total consumption began declining while domestic catch has slowly risen, so that only small amounts of fish are now imported. Production patterns in 1968 are presented in Figure 3.21, while figures for 1971-1976 appear in Table 3.42. Estimates of Zambia's potential suggest that total production could probably be doubled (Huckabay 1979).

3.5.5 Endangered Species

The IUCN lists six endangered mammals and two crocodiles (IUCN 1975) in Zambia (Table 3.43). Summaries of the status and distribution of these eight endangered animals are presented in Appendix VI, Table 5. Mammals occuring in Zambia and listed by the Federal Register (USFWS 1981) in addition to those in the IUCN list are also noted in Table 3.43.

23/ Bell-Cross. 1965.
Bowmaker et al. 1978.
Davies. 1971.
Huckabay. 1979.
Kaplan et al. 1979.
UNDP - FAO. 1978.

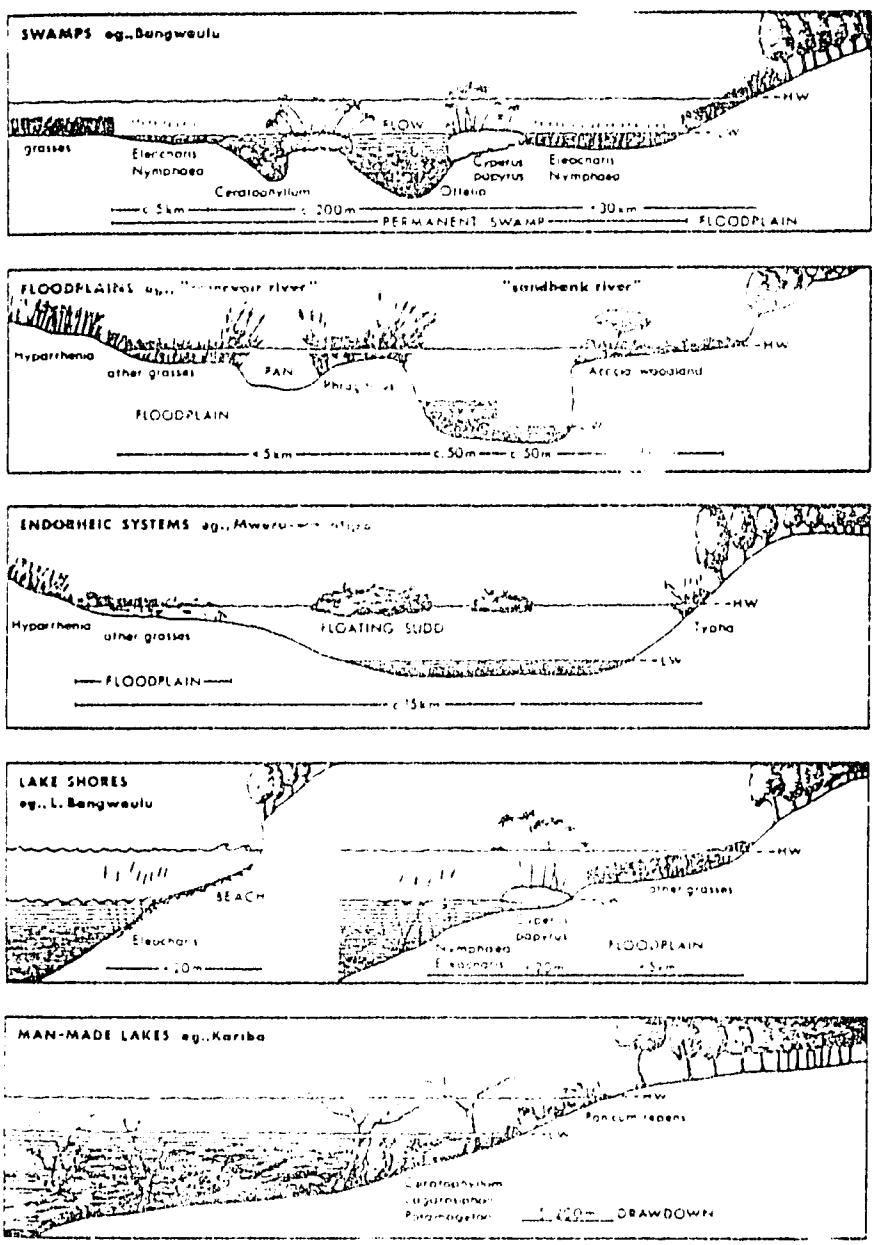

Figure 4.2.1. Zambian Aquatic Habitats

Source: Bowmaker et al. 1974.

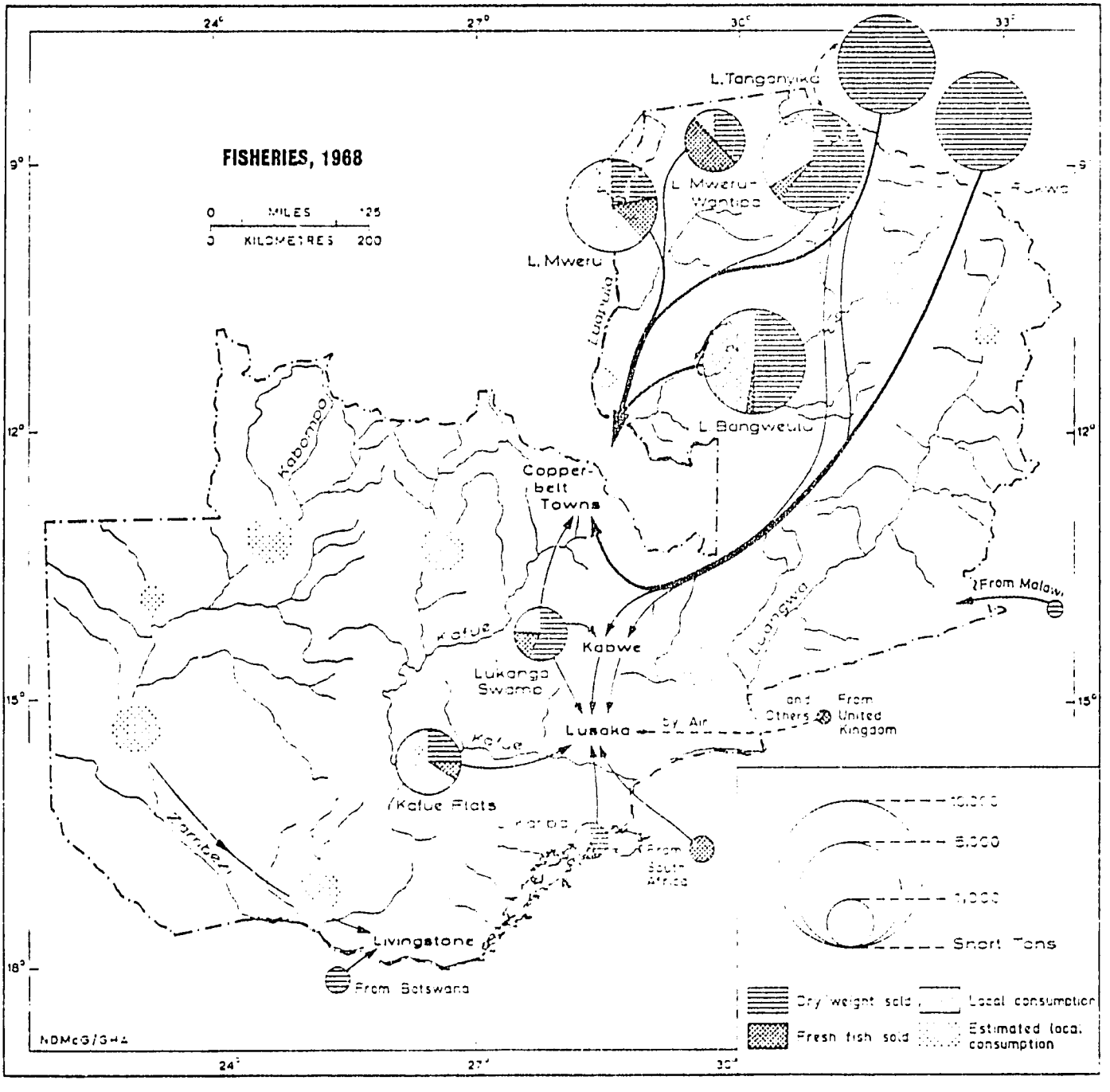

Figure 3.21. Fisheries, 1968

Source: Davies, 1971.

Table 3.42. Supply and Consumption of Fish 1971-76 (tons)

Source	1971	1972	1973	1974	1975	1976
Bangweulu	11,782	13,034	14,032	15,713	9,881	7,598
Mweru/Luapula	8,342	9,068	8,031	8,135	9,881	7,598
Mweru Wantipa	3,825	5,812	8,113	5,992	16,765	13,330
Tanganyika	6,988	6,281	5,488	4,522	7,440	6,510
Kafue	8,247	7,874	6,289	5,177	7,226	9,306
Kariba	2,311	1,955	3,093	2,181	(600)	(600)
Lukanga	1,900	2,370	1,801	1,707	1,802	856
Upper Zambezi	3,500	3,500	3,500	3,500	5,827	5,995
Major Fisheries[1]	46,841	49,894	50,352	46,929	58,026	54,867
Minor Fisheries[2]	1,000	1,000	1,000	1,000	1,000	1,000
Fish Culture[3]	500	500	500	500	500	500
Domestic Supply	48,341	51,394	51,852	48,429	59,526	56,367
Net Imports	21,906	21,354	11,408	12,932	7,950	5,000
Total Consumption	70,247	72,748	63 260	61,361	67,476	61,367
Per Capital Consumption (kg)	16.5	16.7	14.1	13.1	13.5	12.3

[1]1971-74 figures adjusted from old official data for consistency with the new system begun in 1975.

[2]Minor fisheries (dams, small streams, rivers) are not covered by official statistics; a nominal figure is supplied.

[3]Refers to artificial water areas constructed for the purpose of raising fish; not covered by official figures; a nominal figure is supplied.

Source: UNDP-FAO. 1978.

Table 3.43. Endangered Species

a. IUCN List

Mammals

Lycaon pictus	African wild dog
Panthera pardus	Leopard
Acinonyx jubatus	Cheetah
Loxodonta africana	African elephant
Diceros bicornis	Black rhinoceros
Kobus leche	Lechwe

Reptiles

Crocodylus cataphractus	African slender-snouted crocodile
Crocodylus niloticus	Nile crocodile

b. Mammals in Federal Register but not IUCN

Hippopotamus amphibius	Hippopotamus
Tragelaphus spekei	Sititunga
Hippotragus equinus	Roan Antelope
H. niger variani	Sable Antelope
Damaliscus lunatus	Tsessebe
RHINOCEROTIDAE (all species) (Cerathotherium simum)	(White Rhino)
Orycteropus ater	Aardvark
Mellivora capensis	Honey Badger
Viverra civetta	African Civit
Proteles cristatus	Aardwolf

3.5.6 Hunting

Marks (1976) has studied in detail the role of hunting in the area between the South and North Luangwa National Parks. The total amount of time spent in hunting by villagers is relatively small (Fig. 3.22); nevertheless, hunting contributes substantially to the villagers diet. Approximately 200 pounds of meat per adult per year is supplied to villagers, about 60 percent through the efforts of village hunters; the rest by game guards. (Zambian policy is to distribute meat from animals killed by licensed trophy safaris, animal population control programs, etc.) Hunters prefer to shoot warthog, impala, or buffalo, but about 90 percent of all meat consumed consists of buffalo or elephant. Although elephants are not usually hunted, it is not uncommon to kill them in protecting cultivated fields, in which case the meat is utilized. Marks believes that the level of hunting in his study area did not significantly affect animal

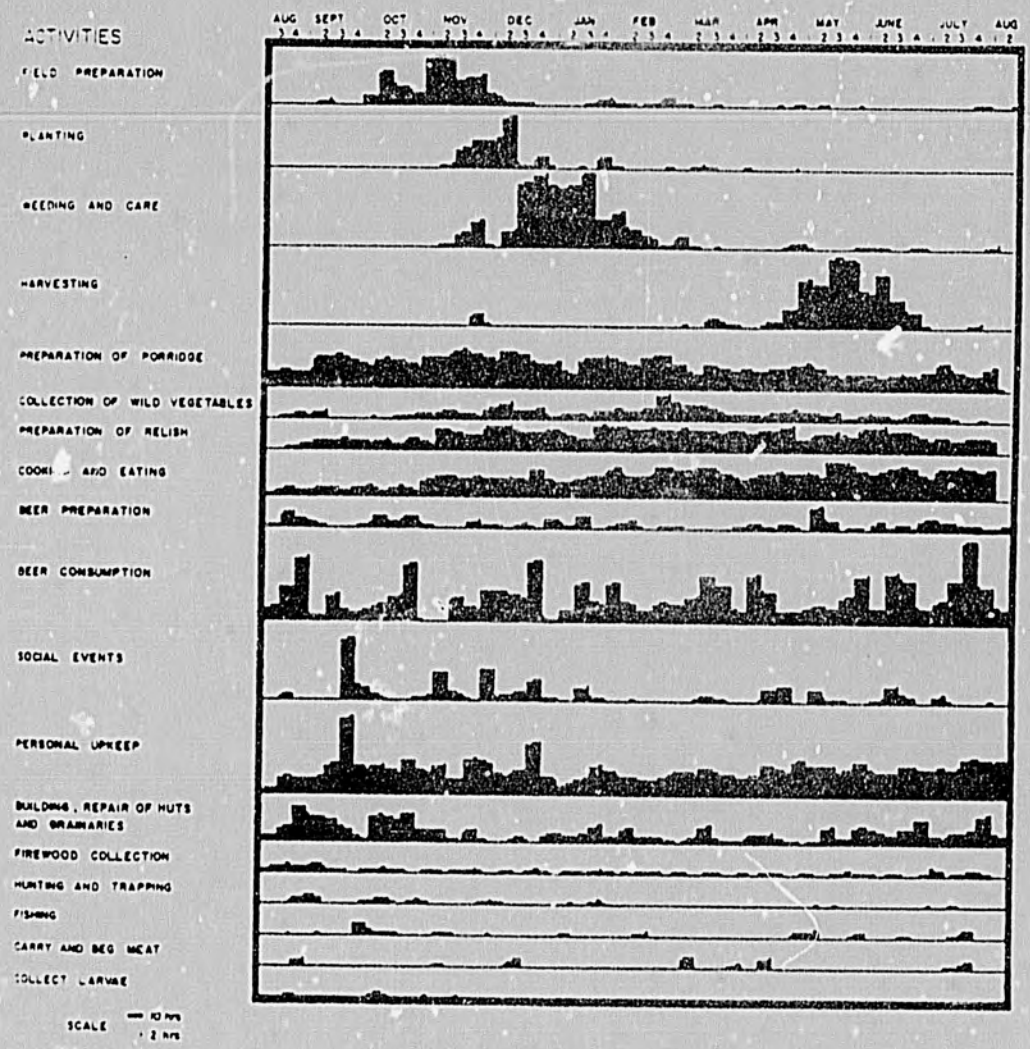

Figure 3.22. Histogram of Time Spent by Adults in Various Activities in Mukupa village, Luangwa Valley

Source: Marks, 1974.

populations, although he notes that a longer term study than he was able to conduct is needed to confirm this.

Banage (1978) notes that a substantial proportion of poaching is actually traditional subsistence hunting which became illegal with the passage of new laws. There is no reliable way to estimate the actual magnitude of illegal hunting (poaching and overshooting by hunters with permits), although it is likely that overall these illegal activities are not a significant danger to animal populations. A more significant factor has been killing of animals through various disease control programs or for protection of fields and crops (Table 3.44). In recent years this kind of activity has declined, and the major legal means of shooting has become safari hunting, which is carefully regulated. In fact, it is in the best interests of the licensed safari companies to maintain animal populations, and these companies contribute substantially to the reduction of illegal hunting in areas where they operate. Further data on hunting and animal control is presented in Appendix VI.

3.5.7 Protected areas 24/

Zambia originally set up a system of protected areas while still controlled by Britain, though some observers note that Britain did little to develop the administrative structure needed to oversee the system. Upon independence, Zambia retained the various categories of protected areas (cf. Table 3.45) until 1971. In that year, vast areas were added to the National Park System (Kafue had been the only previously) by upgrading the status of many protected or restricted areas. In addition, a new category of Game Management Areas (GMA) was created which incorporated many other restricted areas, and the old categories of Game Reserve, Controlled Hunting Area, and Private Game Area were abolished. The reorganization left 225,273 square km under some form of wildlife management (30% of the country), including 59,420 square km in National Parks (8.12% of total surface area; cf. Fig. 3.23). The 18 National Parks and 32 GMA are noted in Appendix VI, Tables 6 and 7.

24/ Banage. 1978.
Zambia, National Parks and Wildlife Service. 1977.
Zambia, National Parks and Wildlife Service. 1979.

Table 3.44. Number of Animals Killed in Control and Utilization Schemes

Year	Tsetse Control	Rinderpest Control	Safari Hunting	Protection Control	Cropping Schemes
1943		2466			
1944	1244*	1922		3590	
1945	2370	1605		5134	
1946	2648	762		7432	
1947	2466	504		5457	
1948	1629*	602		9353	
1949	6606	576		8332	
1950	1026	463		12042	
1951	2045	435		6464	
1952	1949	252		11,324	
1953	365	100		13,274	
1954	N.A.			7883	
1955	215			9950	1367
1956	135			10806	2379
1957	2367		120	13605	1993
1958	160		N.A.	9191	
1959	627		124	9681	
1960	N.A.		104	2615	
1961	N.A.		46	2320	1
1962	2369		45	1709	334
1963	2129		197 (16)	267(4)	1124
1964	N.A.		N.A.	238(1)	93(3)
1965			N.A.	N.A.	62(3)
1966	1847		N.A.	N.A.	522(3)
1967	1639		N.A.	410(4)	657(3)
1968	1643		1338 (30)	475(6)	571(5)
1969	N.A.		N.A.	406(4)	844(5)
1970	N.A.		2587 (6)	472(6)	379(1)
1971	1686		1609 (34)	656(8)	
1972	1860		1504 (30)	507(7)	
1973	N.A.		1521 (35)	433(6)	
1974	1202		1809 (34)	339(6)	
1975			1447 (33)	306(7)	
1976			1332 (34)	525(5)	
1977			1605 (36)	291(5)	

Source: Bandje, 1978.

Table 3.45. Changes in the Wildlife Estate

Year:	1943	1948	1953	1958	1963	1968	1973	1978
National Parks								
Number	-	-	1	1	1	1	1s	18
Area (km^2)	-	-	22,403	22,403	22,403	22,403	59,420	59,420
Game Management Areas								
Number	-	-	-	-	-	-	32	32
Area (km^2)	-	-	-	-	-	-	165,853	165,853
Game Reserves								
Number	13	12	12	11	11	11	-	-
Area (km^2)	40,378	37,589	28,122	26,107	26,107	26,107	-	-
Controlled Hunting Areas								
1st Class (No.)	-	-	-	16	16	16	-	-
Area (km^2)	-	-	-	56,617	61,797	61,797	-	-
2nd Class (No.)	-	-	-	23	23	23	-	-
Area (km^2)	-	-	-	210,705	216,705	216,705	-	-
Total Number	9	23	39	39	39	39	-	-
Total Area (km^2)	?	?	278,502	273,322	278,502	278,502	-	-
Private Game Areas								
Number	-	-	-	95	114	?	-	-
Area (km^2)	-	-	-	?	?	?	-	-
Total Public Area (km^2)	?	?	329,027	321,832	327,012	327,012	225,273	225,273

Source: Banage. 1978.

1 South Luangwa (9050)
2 North Luangwa (4636)
3 Lukusuzi (2720)
4 Luambe (254)
5 Mweru Wantipa (3134)
6 Sumbu (2020)
7 Lusenga Plain (880)
8 Isangano (840)
9 Lavushi Manda (1500)
10 Kasanka (390)
11 Kafue (22400)
12 Blue Lagoon (420)
13 Lochinvar (410)
14 West Lunga (1684)
15 Liuwa Plain (3660)
16 Sioma Ngwezi (5276)
17 Mosi-oa-Tunya (66)
18 Nyika (80)

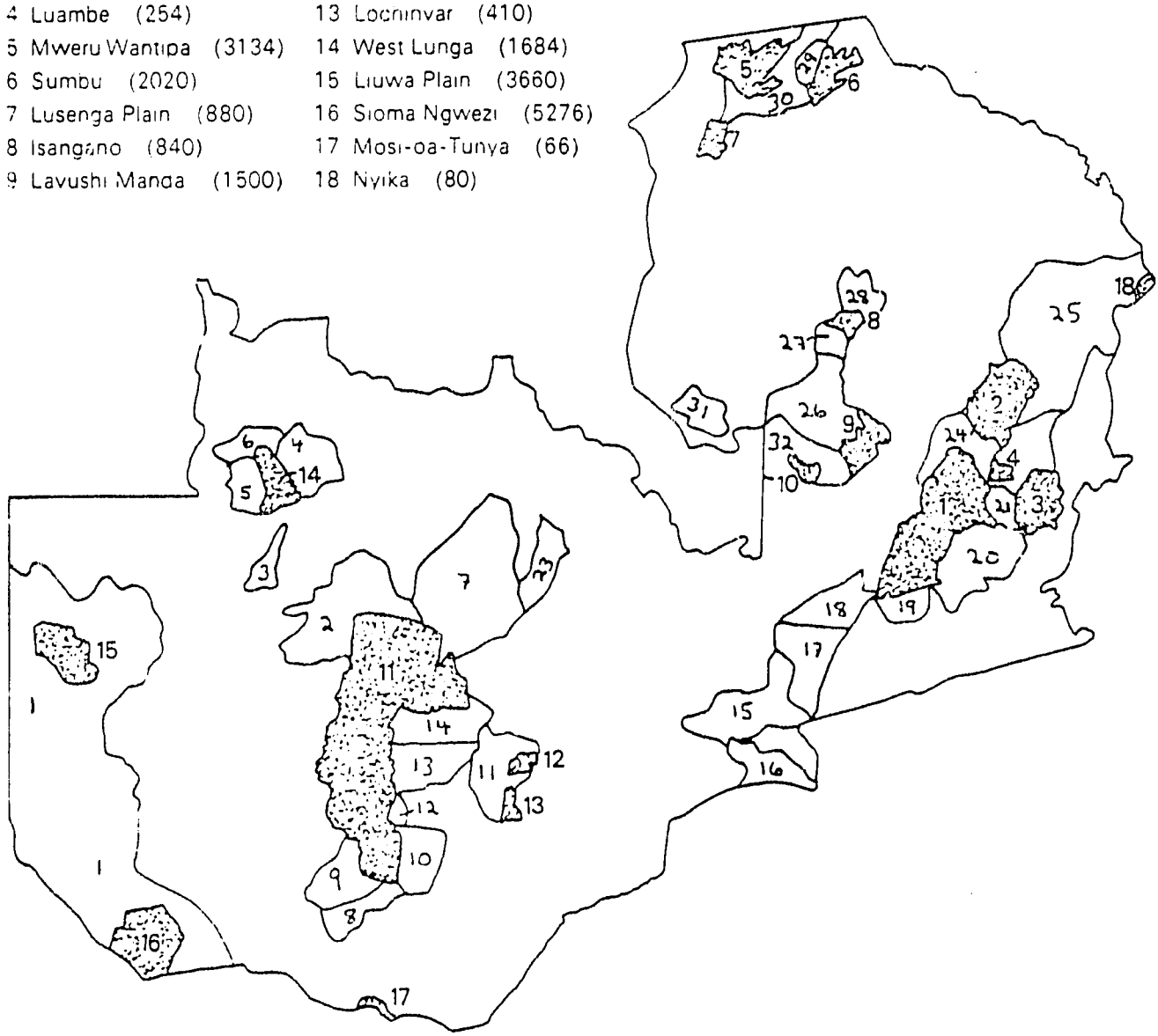

Figure 3.23 National Parks and Game Management Areas

(Parks are shaded. Game Management Areas are listed in Appendix VI, Table 7.)

Source: Hanks, 1972.

4.0 Major Environmental Problems

4.1 Soil Erosion 25/

Soil erosion problems in Zambia nave not been quantified. Research in central Africa under conditions similar to those in Zambia show that losses of topsoil from cropland could reach up to 50 tons of soil per hectare annually. In Zambia, topsoil losses from only the 300,000 hectares of annually cropped lands could reach an estimated three million tons annually.

The potential for soil erosion is determined partially by rainfall intensities and runoff characteristics. In Zambia, rainfall intensities are greatest in the northern portions of the country (Fig. 4.1). However, vegetation cover in the northern regions is usually higher, so that the erosive potential of raindrop impact and runoff is reduced. Some research has indicated that the dryer southern portion of the country has actually suffered more erosion than the north (Chidumayo 1979).

Runoff is generally greater on clay soils, while sandy and silty soils have higher infiltration rates and are subject to erosive runoff less often. Zambia's clay rich soils therefore tend to suffer the most severe erosion, particularly red clays, leached red clays, and many dambo soils.

Dambo soils are particularly subject to piping as well as surface erosion. Water which infiltrates the soil moves downslope and can attain velocities sufficient to erode and transport disaggregated soil particles. This results in the development of pipes (tunnels) oriented downslope within the soil body. Eventually the pipes become enlarged until the roof collapses. These exposed pipes then gradually coalesce into gullies which function as if they were originally caused by surface erosion.

Slope is yet another factor influencing erosion, and fortunately much of Zambia is flat or gently sloping. Most areas with good agricultural potential are in these relatively flat areas. The extended areas of steeply sloping land, such as the Zambezi and Muchinga Escarpments, are generally covered by poor agricultural soils. Only in a few restricted areas do good soils occur in conjunction with steep slopes having high erosion potential. Such areas occur around Chipata (Eastern Province), south of Lusaka, south and southeast of Mazabuka (Southern Province), around Mbala (Northern Province), and scattered local areas in Copperbelt and elsewhere.

Wind erosion is even less researched than water erosion. Winds are generally light in Zambia (Table 4.1), but thunderstorms or "dust

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25/ Beaumont. 1979.
Chidumayo. 1979.
Robinson. 1978.

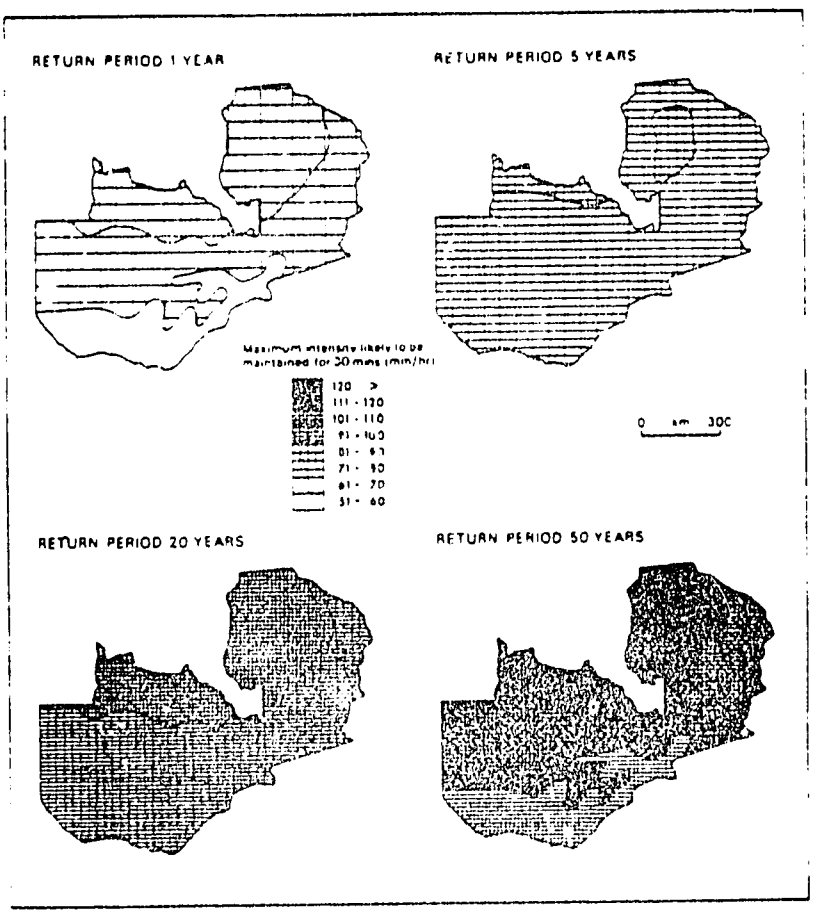

Figure 4.1. Maximum Rainfall Intensities Likely to be Encountered Over Zambia Within Particular Return Periods

Source: Robinson. 1978.

devils" occur commonly, bringing occasional gusts of high velocity winds. The flat areas of the country which are relatively immune to water erosion are most susceptable, because wind speed is not broken by obstructions. Wind erosion is particularly damaging on lands which have been cleared and plowed for cultivation, because all plant cover has been removed and soil particles broken down. The problem seems to be most serious in the commercial farming areas along the rail lines.

Table 4.1. Wind Speed Records in Zambia

	% Daytime with winds in excess of 10 mph	Maximum Wind Speed Recorded (mph)
Chipata	12.8	-
Kabwe	38.2	75
Kasama	24.8	77
Kasempa	2.2	-
Livingstone	14.8	60
Lundazi	8.5	-
Lusaka	47.0	70
Mbala	34.3	-
Mongu	44.0	81
Mpika	26.5	-
Mwinilunga	5.8	-
Ndola	24.0	67
Petauke	9.5	-
Samfya	9.8	-
Sesheke	3.8	-
Zambezi	3.5	-

Source: Robinson, 1978.

Agriculture is one of the activities which contribute most to making soil susceptable to erosion. Deforestation and devegetation are also primary contributing factors, and will be discussed in Section 4.2. Another cause is often road construction. Vegetation is removed from the road right of way, the road is compacted or paved, greatly increasing surface runoff.

Low levels of organic content in cultivated soils exacerbate erosion problems. Increasing pressure on agricultural lands has often necessitated the abandonment of fallow periods, which help maintain organic content levels. In a survey carried out in 1975 in Chipata district (Eastern Province) the surface layers of soils which had been cultivated for five years continuously contained some 50 to 80 percent less organic matter than soils in the surrounding woodlands. Organic carbon content was as low as 0.3 to 0.4 percent in some

cases. The aggregate stability of the cultivated soils was some 25 to 50 percent lower than that of the woodland soils (Robinson 1979).

4.1.1 Soil Conservation Methods in Zambia

Robinson (1979) has examined Zambia's soil conservation policies in some detail, and the following discussion is taken from him.

Conservation farming based on sound land-use principles has been impossible in Zambia for much of the present century because of the inheritance of outdated agricultural practices and the arbitrary division of the country by land apportionment. In Native Reserves, the unfair apportionment of land frequently resulted in the cultivation of areas that were totally unsuited to crop cultivation because of their high erosion potential. Since Independence, the restrictions imposed by land apportionment have largely been removed but the persistence of traditional cultivation methods, frequently incapable of supporting the rural population levels that have been attained during the latter half of the present century, remains a problem.

Soil conservation in Zambia has concentrated on the protection of arable land, some of which is unsuitable for cultivation. It is the arable land which is periodically exposed to the full erosive impact of rainfall during the planting and early growing season, and where detrimental changes can be most markedly induced by inadequate farming techniques. Conservation has had three main aims:

i) To develop systems of cropping and land-use that minimise structural and nutrient deterioration of the soils so as to keep soil erosion and loss of fertility to a minimum.

ii) To reduce run-off from cultivated land to a minimum and avoid the passage of erosive water over extensive areas of susceptible soil.

iii) To safely dispose of any unavoidable run-off water along defined and protected channels with gentle gradients.

The soil erosion problem began to receive attention as early as the 1930s, when Zambia was still under colonial administration. Methods such as contour plowing and/or channelling excess runoff into grassed strips were utilized. By 1956 the agricultural officer reported that serious erosion from arable land had been contained in Zambia except in restricted areas. However, the problems were actually far from solved, since the program had been carried out in such a

way that most Zambians viewed it as simply another method by which Europeans could exploit them.

Zambians had conservation measures and taxes imposed upon them by law, while conservation on European held lands was voluntary. Contour ridges and grassed strips were often viewed as a means to take land out of production and eventually force farmers off the land. Many Zambians resisted the measures. In addition, many projects were not well planned technically. Often for example, the techniques worked well enough on the protected area but the excess water was channelled into an unprotected area which then suffered severe erosion.

Since independence the Zambian government has worked to overcome these negative impressions of conservation measures. In recognition of the fact that long-term success depends upon local cooperation, policies have shifted from imposed measures to local education. Results have been mixed. In some areas, comprehensive soil conservation plans have been implemented, and soil loss has been minimized. In other regions, the expansion of large scale farming has brought new land into production much faster than counter-erosion measures have been implemented. Many new commercial farms are particularly prone to erosion. Overall, Zambia does not seem to have made much progress in controlling erosion.

4.2 Deforestation and Rangeland Degradation 26/

The major factors behind deforestation are the chitemene (slash and burn) agricultural system (cf. Section 3.3.2), firewood gathering and charcoal production (cf. Section 3.4.3). Zambia is losing at least 9000 sq km of woodland to the chitemene system annually, and another 2000 sq km to fuel needs. Chidumayo (1979) estimates that at the present exploitation rate Zambia's woodlands could disappear within 25 years. While the estimate does not seem to account for regeneration, it nevertheless clearly demonstrates the magnitude of the problem.

According to Kalapula and Roder (1979), farmers do not generally recognize the destructive impact of indiscriminate clearing of woodlands. For example, rather than viewing forest cover as an aid in combatting soil erosion, they see it as an obstacle to farming or as a fuelwood resource. In most areas deforestation is not yet so widespread that rural inhabitants have had to turn to other fuels.

26/ Beaumont. 1979.
Cheatle and Cheatle. 1979.
Chidumayo. 1979.
Kalapula and Roder. 1979.

Local deforestation problems actually seem most serious around urban centers, where fuelwood needs are greatly concentrated. Estimates indicate that over 20 sq km of woodland are being clear-felled each year around the Lusaka area. There were no exploitable woodlands left within 70 km of the city by 1978, and estimates at that time indicated that this radius would extend to 120 km within five years.

Rangeland degradation is similarly a serious problem in the dryer portions of the country where livestock raising is common. In these dry regions, the estimated average gross stocking rate ranges between 0.32 to 0.45 ha per livestock unit (LU). The recommended rate, according to Chidumayo (1979) should be around 5 ha/LU. Overgrazing is common, although figures on the magnitude of the problem are not readily available. Severe cover depletion has already contributed to erosion in widespread areas, particularly near natural waterways and dambos.

Some surveys show that overgrazing and its potential for degradation of range and soil is not generally perceived to be a problem by rural inhabitants. The lack of adequate quality grazing lands may be noticed, but the concept of limiting stocking rates to carrying capacity is not widely adhered to. Generally, the condition of cattle deteriorates to some extent during the dry season, and improves during the wet season. This largely masks any longer-term deterioration of livestock due to deteriorating range (Kalapula and Roder 1979).

4.3 Environmental Health Issues

Health issues in Zambia may be divided for convenience into several categories. Development of surface water resources may cause the spread of certain diseases such as malaria and bilharzia. Rural areas, and occassionally sections of urban areas as well, often lack elementary water or sewage treatment facilities. Chemical pollution of air, water, and soil has become serious in mining and industrial centers. The major problems include:

Water borne disease. According to Family Healthcare and AFRICARE (1978) Zambia can expect increasing incidences of malaria in coming years. Among the contributing factors are: shortages and occasionally a total lack of chloroquine, the principal drug used for suppression and treatment of malaria; shortages of insecticides used in controlling the mosquito vector; a reported increase in the incidence of malnutrition, which increases vulnerability to malaria; and cessation of organized, country-wide malaria control activities. Reduction of endemicity in urban areas, which reduces the acquired immunity to malaria of large parts of the urban population has also made them more susceptible to malaria. The problem is enhanced when it is noted that the most lethal strain of malaria, plasmodium falciparum, is the most common form in Zambia.

Chidumayo (1979) notes that in mining and quarrying areas, open pits are often abandoned. These become standing pools after rains and breeding grounds for mosquitoes. Traditional building materials in rural areas (particularly thatched roofing) may also provide breeding areas for malarial mosquitos (U.S. AID 1979).

Surface water development also carries the risk of increasing incidence of malaria, as well as other diseases. Eskilsson and Miti (1974) warned that the creation of large reservoirs in hydroelectric or irrigation schemes could increase bilharzia. The snail vector was documented in the Kafue Flats, for example, before much of the development of the Kafue River was begun and likely has spread since. Concentration of workers for construction of major works also facilitates the spread. Lack of adequate water treatment compounds problems with bilharzia and other parasitic infections (U.S. AID 1979).

Water. The availability of an adequate supply of uncontaminated water is vital to the health of any population. In 1973 approximately 79 percent of the urban and 10 percent of the rural population had access to piped water systems. The estimated number of wells in rural Zambia in 1977 is between 2,500 and 3,000. In addition, there are between 1,400 and 1,700 boreholes in rural areas. The 1974 ILO advisory commission calculated that about 19 percent of the urban households (about 12,000) and about 44 percent of the rural households did not meet the minimum required need for an adequate water supply.

As already noted, the lack of adequate treatment of water from lakes and slow-moving streams contributes to the high prevalence of bilharzia and other parasitic infections. Many wells and boreholes need occasional chlorine treatments, boreholes need a pump maintenance program and most wells are uncovered (Family Health Care and AFRICARE 1978).

Sanitation. According to Family Health Care and AFRICARE (1978) there were 15 sewage systems in Zambia in 1978. The largest are found in Lusaka, Ndola, and Kitwe. Slightly more than half of Zambia's urban population is served by one of these sewage systems. Tables 4.2a and 4.2b summarize data on sanitation from 1969 and 1975. (Discrepancies should probably be attributed to unreliable data. There is no evidence that Zambia is regressing in its attempts to provide sanitation services to its citizens.)

Table 4.2a. Waste Disposal Methods and Facilities 1969

Type Facility	% of Urban Population	% of Rural Population
Flush Toilet	57.5	3.5
Septic Tank/Aqua Privy	7.0	0.5
Pit Latrine	26.5	33.5
Bucket Service	2.0	-
None	7.0	62.5
	100.00	100.00

Source: Family Health Care and AFRICARE. 1978.

Table 4.2b. Access to Waste Disposal and Safe Water 1975

	% of Total Population	% of Urban Population	% of Rural Population
Access to Waste Disposal Systems[1]	42.0	87.0	16.0
Access to Safe Water	42.0	86.0	16.0

[1]Water-borne sewage systems or pit latrines

Source: U.S. AID. 1981a.

Assuming that a good pit latrine is a minimal standard for sanitation, a 1974 ILO commission calculated that 28,000 urban households and 430,000 rural households did not meet this minimum level. In addition, in view of the large growth rate of urban areas, the government must continue to rapidly expand services just to maintain the current level of sewerage and sanitation facilities.

Lusaka sewerage is treated by two conventional treatment plants and three stabilization ponds. The quality of treatment is good. About 180,000 people are served by these facilities and one is being enlarged. However, much of Lusaka is not served by the sewage system and is dependent on either pit latrines or the collection of fecal material by municipal trucks. Sewerage systems in Ndola and Kitwe cover only parts of the cities but are rapidly being expanded.

Pit latrines are the most common type of facility in rural areas, and efforts are being made to increase the numbers and explain their utilization and importance. The program, however, has had difficulty because the required behavioral changes, in addition to cost and labor factors, sometimes conflict with local customs and beliefs. Even after construction, many latrines are underutilized and inadequately maintained.

Rat infestations present another environmental health hazard that in some densely populated areas is increasing in severity (Family Health Care and AFRICARE).

Fungal Toxins. Zambia's climate promotes growth of a wide variety of fungi which can grow on food crops in the field and on food stored in traditional manners. A survey to detect aflatoxins was carried out in the mid 1970s in the Eastern Province. Table 4.3a gives the results of the survey. While fungal contamination did prove to be a health hazard in the sample area, Table 4.3b shows that the problem is of much smaller magnitude than in sample areas of neighboring countries (Lovelace and Salter 1979; Bayley 1979).

Occupational Health. The major occupational health issues are those related to work in the mines. The mines run their own hospitals and medical services, and provide relatively thorough coverage and detailed reports. Mine-related accidents are one of the principal causes of hospital admissions in the Copperbelt (between 800 and 1,000 in 1977) and were cited as the direct cause of 22 fatilities. The incidence of pneumonia among underground employees (13.83/1000) is more than twice the rate for those working on the surface (6.55/1000). Fungal infections and chronic bursitis (Dunlow foot) are foot problems encountered among underground workers and viewed as serious problems by local health authorities. Additional occupational health issues

Table 4.3a. Aflatoxin Analysis by Food Type

Food Type	No. Samples	Samples w/ Aflatoxin	Aflatoxin Concentrat. in pos. snls.	
			Range	Mean
Maize-based	95	0		
Other grains and beverages	12	0		
Sweet potato	6	0		
Groundnuts	12	1		0.6
Beans (cooked and dried)	8	1		2.1
Meat	3	0		
Green vegetables (cooked and dried)	66	4	1.7-43.9	14.3
TOTAL SAMPLES	202	6	0.6-43.9	10.0

Source: Lovelace and Salter. 1979.

Table 4.3b. Aflatoxin Concentration in Total Food Samples, by Country

	Uganda	Swaziland	Mozambique	Kenya	Zambia
% positive	29.6	40	31.6	7.0	3.0
Range (µg/kg)	1 - >1000	1-50	-	1-21	1-44
Mean of pos. samples	-	-	3.4	3.2	10.0
Foods	stored or market samples	ground-nuts	Total diet	Total diet	Total diet

Source: Lovelace and Salter. 1978.

include industrial deafness, dental erosion caused by acid fumes, and localized high concentrations of lead and sulphur dioxide (Family Health Care and AFRICARE 1978).

4.4 Industrial Pollution

While industrial pollution has not yet become a country-wide problem, it has become serious locally where mining activities or industrialization are taking place. The Copperbelt, in particular, is prone to pollution. The mining companies have, by most accounts, taken seriously the responsibility for keeping pollution to a minimum. Nevertheless, Zambia is hampered by lack of legislation and the absence of an independent monitoring body for controlling pollution.

There is a problem with sulphur dioxide emissions oxidizing into sulphates and precipitating out of the atmosphere as "acid rain." A monitoring survey carried out near Kabwe determined the annual average of sulphur dioxide in the air (Table 4.4a). Changes in operation of the RCCM smelter resulted in the improvement of sulphur dioxide levels. Similar surveys were carried out near Kitwe (Table 4.4b), Luanshya (Table 4.4c) and Mufulira (Table 4.4d; Kaoma and Salter 1979).

Buildup of toxins in the soil near many smelters has also been a problem. Table 4.5a presents results from one survey which determined cadmium, lead, and zinc levels in a polluted area near Kabwe and a control area near Lusaka. Preliminary surveys also suggest that these toxins are finding their way into food crops grown in the area (Nwankwo and Elinder 1979).

Table 4.4a. Atmospheric Levels of Sulphur Dioxide and Lead Near NCCM's Broken Hill Smelter in Kabwe

Area	Approximate Mean Distance from Smelter	Relation to Smelter
1	2 km	north-west
2	1 km	due east
3	3 km	due north

Area	Year	Sulphur Dioxide mg m^{-3}	Lead-in-Air $\mu g\ m^{-3}$
1	1975	0.32	12
	1976	0.18	9
	1977	0.14	12
	1978 (anticipated)	0.11	11
2	1974/75	0.02	7
3	1978	0.02	0.5

Source: Kaoma and Salter. 1979.

Table 4.4b. Sulphur Dioxide Level at NCCM's Rokana Division Near Kitwe

Site	Distance from Smelter (km)	Relation to Smelter (bearing degrees)
1	1.00	52
2	2.50	24
3	3.50	200
4	0.75	148

Quarterly Mean Values of Ground-Level Concentration of Sulphur Dioxide $\mu g\ m^{-3}$

Period in 1977	Site 1	Site 2	Site 3	Site 4
Jan/Mar	23	18	76	33
Apr/June	10	13	20	12
July/Sept	9	10	44	25
Oct/Dec	21	9	7	41

Source: Kaoma and Salter. 1979.

Table 4.4c. Sulphur Dioxide Levels at RCM's Smelter in Luanshya

Site	Distance from Smelter (m)	Relation to Smelter (bearing degree)	Mean and Standard Deviation Values for Concentrations of Sulphur Dioxide u gm -3			
			May/June mean	σ	Dec/Jan mean	σ
1	1000	30	22	26	93	48
2	1000	270	146	259	97	64
3	1700	210	147	140	106	64
4	750	105	97	140	107	91

Source: Kaoma and Salter. 1979.

Table 4.4d. Sulphur Dioxide Levels at RCM's Smelter in Mufulira

Site	Distance from Smelter (m)	Relation to Smelter (bearing degree)	Mean and Standard Deviation Values for Concentrations of Sulphur Dioxide u gm -3			
			July mean	σ	Aug. mean	σ
1	2075	122	14	6	12	7
2	1650	147	6	4	9	4
3	375	229	25	24	-	-
4	600	337	172	179	307	205

Source: Kaoma and Salter. 1979.

Table 4.5a. Cadmium, Lead and Zinc Concentrations (ug/g dry weight) in Soils Taken from within 5km of the Kabwe Plant, and from Lusaka and Its Vicinity

	Number of samples	Range	Average
Kabwe			
Total cadmium	11	0.55-46.4	9.0
Total lead	11	92-2580	862
Total zinc	11	180-3500	1050
Acid extractable cadmium	11	0.16-8.4	1.9
Acid extractable lead	11	2.9-492	153
Acid extractable zinc	11	51-2150	529
Lusaka			
Total cadmium	17	0.08-0.31	0.16
Total lead	17	1.1-40	16.1
Total zinc	17	10.0-97.5	35.0
Acid extractable cadmium	17	0.007-0.24	0.025
Acid extractable lead	17	0.01-3.18	1.14
Acid extractable zinc	17	1.2-43.4	10.3

Source: Nwankwo and Elinder. 1979.

Table 4.5b. Cadmium and Lead Concentrations in Food near Kabwe

		Cadium concentration (g/g)		Lead concentration (g/g)	
Kabwe samples					
7 maize samples within 3 km of smelter	range ave	0.028 0.064	- 0.116	0.57 0.90	- 1.36
3 samples of fresh washed vegetables west side of smelter		2.1	- 6.4	47.5	- 322
3 samples of fresh washed vegetables north side of smelter		0.08	- 0.12	20.5	- 29.4
6 samples of food (misc.) from Kabwe market		0.02	- 1.5	2.4	- 66.4
Lusaka control samples					
16 samples maize	range ave	0.002 0.025	- 0.088	not measured	
4 samples vegetables		0.003	- 0.053	not measures	

Source: Nwankwo and Elinder. 1979.

The mining industries are not considered major water polluters; nevertheless, most mines are situated within the drainage basin of the upper Kafue, so that any pollution is concentrated in the Kafue River system. Many smaller streams have been adversely affected by effluent discharge, although the impact upon the majority of the river system has been slight. The mines themselves have been fairly dilligent at monitoring water pollution, and have usually taken the necessary steps to clean up waters. Table 4.6 shows a general improvement in many respects since the early 1970s.

Table 4.6. Effluent Levels Monitored in Chingola Stream; Downstream of Effluents

EFFLUENT LEVELS MONITORED IN CHINGOLA STREAM; DOWNSTREAM OF EFFLUENTS

	Dissolved Solids ppm	Cu ppm		Fe ppm		Mn ppm		Co ppm	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
July	1318	45	0.6	10	0.5	46	47	1.5	0.8
August	1675	23	0.8	15	0.5	44	36	1.3	1.1
September	1873	17	1.0	7.0	0.8	30	32	1.4	1.2
1971[1]									
October	2343	84	47	19	5.2	46	43	1.5	0.4
November	1021	76	62	44	23	61	52	-	-
December	1520	62	2.5	22	5.7	20	16	2.9	2.1
January	910	49.2	2.2	13.1	1.2	16.1	12.5	2.6	1.3
February	1418	28.6	4.0	126.7	1.8	31.8	16.6	4.2	2.2
March	1485	23.1	1.1	4.5	0.8	28.0	24.7	3.3	2.5
1972[2]									
April	1484	23.0	1.1	15.0	0.9	26.9	25.4	3.3	2.5
May	2361	73.0	25.0	88.9	46.6	53.2	47.7	3.3	3.1
June	3135	115.6	19.1	75.1	6.0	60.0	47.7	6.5	5.0
July	672	63.3	0.6	41.4	<0.1	4.4	1.3	1.3	0.2
August	1292	79.6	0.5	95.7	<0.1	9.0	0.7	2.7	0.2
September	996	55.3	0.5	50.6	<0.1	12.2	4.2	2.6	0.6
1973[3]									
October	1419	93.5	13.8	48.6	0.9	17.6	6.6	4.1	1.6
November	974	122.5	0.2	87.5	<0.1	11.9	3.1	2.8	0.4
December	671	75.7	<0.1	75.2	<0.1	17.6	1.5	1.8	0.2
January	1248	99.7	0.8	180.0	<0.1	12.6	2.8	3.9	0.6
February	711	121.0	0.1	125.5	0.1	8.9	1.4	2.5	0.2
March	494	19.4	0.3	40.2	<0.1	4.5	1.2	1.4	0.3
1974[4]									
April	444	16.8	0.5	99.9	0.1	7.6	1.2	1.0	0.6
May	896	181.7	13.5	99.7	1.2	15.5	5.6	1.0	0.9
June	1156	130.3	4.6	109.0	<0.1	18.0	7.4	1.9	0.8

[illegible]

Source: Kaoma and Salter. 1979.

There is also some concern that other industries may contribute to air or water pollution, particularly in the Kafue industrial center area or around Lusaka, however, data is not currently available. Agrochemicals are also a source of worry, although it has not yet become serious. Kaoma and Salter (1979) have identified areas where potential problems may occur:

Copperbelt. Industrial and urban pollution would mask agricultural pollution, as the few commercial farms in the Copperbelt are fairly scattered. The Misundu area near Ndola may be a danger point as there are a large citrus orchard, dairy and vegetable farms upstream of the Ndola water supply.

Mkushi. Commercial farmers growing maize and tobacco, and holding limited livestock may have some effect on the

agrochemical content of drainage water into the Mita Hills and Mulungushi Dams.

Kabwe. Commercial farmers in this area are on several catchments - Mulungushi and Kafue through the Lukanga Swamp, hence the effects would be reduced by substantial volume dilution.

Lusaka, Chisamba. Crop and stock farms around Lusaka drain into the Chongwe, Chalimbana, Ngwerere and Kafue Rivers. With an increase in dry season irrigated crops (mainly wheat) there will probably be an increase of fertilizer application.

Mazabuka. This is an area of concentrated agricultural activity with both rainy and dry season crops being grown. High fertilizer, pesticide, and herbicide applications are used on maize, sugar and other crops. Together with the presence of relatively large numbers of cattle and the fact that the farms are drained by a series of parallel rivers running into the Kafue Flats, a possible polluting effect is indicated.

Choma, Kalomo, Zimba, Livingstone. These are areas of minor risk, with the Maramba River being of interest due to the cropping and dairy farming taking place there.

Mount Makulu Research Station. Two potential pollutants may persist in the environment for months or years rather than weeks:

a) Picloram. A constituent of Tordon 101 and Tordon 155 which have been widely used in Zambia for bush and tree clearing by the tsetse control people and by individual farmers.

b) Atrazine. One of the main herbicides used in the country's maize production.

4.5 Wildlife Issues 27/

Zambia's problems in the sphere of wildlife conservation can be roughly divided into three categories. Hunting and poaching are clearly problems in some local areas. In protected areas, however,

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27/ Balon. 1978.
Banage. 1979.
Chidumayo. 1979.
Eskilsson and Miti. 1974.
Kalapula. 1979.
Lumbe. 1979.
Marks. 1976.
Schuster. 1980.

the government seems to have fairly good enforcement and local cooperation in combatting unauthorized killing of wildlife. A second more serious threat to wildlife populations is destruction of habitat through the expansion of industrial and especially agricultural activities. The third category concerns local overpopulation of some species, particularly elephants, which also leads to destruction of habitat.

Hunting and Poaching (cf. Section 3.5.6; App. VI). The majority of illegal poaching is actually subsistence hunting which became illegal when new laws were passed regarding hunting. The level of subsistence hunting does not seem to pose any threat to animal populations in most cases. Some observers do see poaching as a threat to particular species. Schuster (1980), for example, cites poaching as a threat to the Kafue lechwe, although their populations increased rapidly during the 1960s despite poaching. Schuster believes that the new surface water development in the Kafue Flats will so disrupt the lechwe's habitat that poaching could become a critical factor.

Legal hunting activities are strictly regulated. It is in the best interests of Zambia's legal hunting organizations to maintain animal populations. Licensed safari companies have cooperated in severely restricting illegal hunting activities in areas where they operate.

The various "vermin" control and disease control programs have posed a much more serious threat to animal populations. Vast numbers of elephants, buffalos, and various carnivors were killed in the human and crop protection campaigns of the 1940s and 1950s. More recently these programs have reduced the numbers of animals killed. Similarly, disease control (particularly tsetse control) programs often aimed at the elimination of wildlife from target areas so that there would be no hosts. The scale of these programs has also been restricted since the 1960s. Nevertheless, a considerable number of animals are still killed in the interests of tsetse control, and the issue is still sensitive and controversial both within Zambia and internationally. One major criticism of the tsetse control programs is that they have ignored data about host preferences of Glossina morsitans (Banage 1979).

Destruction of Habitat. Lumbe (1979) cites encroachment of human settlement and industry, particularly agro-industry, as a major conservation problem. Resulting destruction of wildlife habitats in non- or semi-protected areas is undoubtly the major threat to Zambian wildlife. Although the process is commonly cited, little data is available which would allow assessment of the magnitude of the problem.

Habitat destruction has also occurred through the development of surface water resources. Usually this is through dam construction, and occasionally through swamp drainage or similar measures. Development of the Kafue River has disrupted the flooding cycle of the Kafue Flats. Not only does this reduce the suitable lechwe habitat, but disrupts their social behavior, particularly mating.

Lechwe feed on the vegetation which grows on seasonally flooded areas, and mating is tied to these seasonal cycles (Schuster 1980; Eskilsson and Miti 1974). Similar observations have been made regarding the much older Kariba Dam. Balon (1978) estimates that the carrying capacity of the region around Kariba Lake has been greatly reduced since the lake was created.

Overpopulation. In some cases, wildlife protection measures have been so successful in local areas that populations have rapidly increased, exceeding the carrying capacity of the region. Since the 1930s, the Kafue lechwe has received stringent protection in the Lochinvar and Blue Lagoon Game Management Areas (both of which became National Parks in the early 1970s). Populations recovered from a low of about 26,000 to nearly 100,000 by the early 1970s. However, within the protected areas this population greatly exceeded carrying capacity. Serious overgrazing has occurred, and the close confinement of the lechwe has led to increased incidence of disease, particularly tuberculosis. Since the peak, populations have declined to around 50,000 in the late 1970s (Schuster 1980).

Probably the most serious overpopulation problem has been among elephants. The central Luangwa Valley, for example, contained approximately 86,000 elephants in 1975 (2.17 elephants/square km), with a continuing rise in density. Elephants destroy trees faster than they can regenerate, resulting in changing habitats. Some observers fear the long term result will be desertification in many areas of the Luangwa Valley (Lumbe 1979).

If animal populations are restored in areas where progress has been made in tsetse control, the tsetse flys usually return in force. This process occurred in the Luangwa Valley under colonial government and in early independent years (Marks 1979), but recent data is not available on the success of tsetse control.

Present Status of Wildlife. Wildlife populations suffered greatest declines during the colonial administration. Woodland species apparently suffered the greatest reductions, both in numbers and in range. No species has become extinct in Zambia in modern times, and the country has carried out several very successful conservation programs to save threatened species. The black lechwe of the Bangweulu Swamps, for example, declined from an estimated 150,000 in 1934 to 17,000 in 1964, and was put on the IUCN Red List in 1967. Populations have now stabilized at around 20,000, with every indication that this number should increase under proper management. Similarly, Kafue lechwe populations dropped from 250,000 in 1934 to 26,000 in 1954. By the early 1970s they had recovered to nearly 100,000 and overpopulation in the lechwe habitat actually has been the major cause of declines to about 50,000 by the late 1970s (Banage 1979; Schuster 1980).

These accomplishments have taken place mostly within the Game Management Areas and the National Parks. Elsewhere wildlife is under severe pressure and often larger species can no longer be found in non-protected areas.

4.6 Economic Development 28/

Zambia launched its Third National Development Plan in October 1979, covering the period until 1983. The main objectives of the plan for individual sectors were:

(i) The adoption of a more labor-intensive technology to generate fuller employment.

(ii) To give the highest priority to rural development, emphasizing the expansion of the production base of agriculture, the promotion of village and small-scale industries, and the creation of infrastructural and extension facilities to benefit subsistence producers and small-scale farmers.

(iii) To promote industrial production based on local raw materials.

(iv) To reduce the disparities in the levels of income between rural and urban sectors;

(v) To expand education and training facilities both in quality and quantity; while

(vi) obtaining, with reasonable price stability, target growth of 6 percent per annum in real GDP.

It is envisaged that total investment expenditure during the plan will be K3,354 million, of which about one-third will come from foreign lenders and 42 percent will be government-financed (Europa 1980).

Precise breakdowns of the plan's budget are not readily available. Figures would only be approximate in any case, given the fact that government revenues are highly dependent on the world prices of copper, cobalt and other minerals.

Development in Zambia will likely have direct impact upon environmental problems in the fields of agriculture, industry, mining, and public health. In agriculture, a trend toward commercialization of farming already seems evident, which will greatly exacerbate soil erosion problems unless soil protection measures are explicitly incorporated into agricultural programs.

28/ Africa Research Bulletin. 1980.
Africa Research Bulletin. 1981.
Boulton. 1973.
Europa. 1980.
Legum. 1980.
U.S. AID. 1981c.
World Bank. 1977.

The expansion of irrigation must also be carefully planned to avoid salinization problems, particularly in the semiarid portions of Zambia. Throughout the country, surface water development has also led to increased incidence of water borne diseases.

Zambia's reliance on the mining industry is likely to continue, which translates into a progression of smelter pollution problems. As new industries develop, they will also add to industrial pollution. Zambian companies have been fairly conscientious in restricting pollution, but, as Kaoma and Salter (1979) note, the country nevertheless needs to develop the legal structure to deal with pollution before it becomes a widespread problem.

Despite the fact that health problems remain severe, Zambia has made advances in health care which compare favorably with the progress continent wide. The incidence of most environmentally related diseases should decline as the country extends health care and upgrades sanitation standards. Water borne disease may be the exception to this trend, as surface water development and irrigation schemes proceed faster than improvements in health and sanitation.

Zambia already has a comprehensive educational program to teach wildlife conservation at all levels in the school system. Other environmental issues could gradually be incorporated into the program without much difficulty. Wildlife conservation has received fairly enthusiastic public support in most cases once the needs and goals of the program have been explained. Indications are that Zambians would generally support similar programs aimed at other aspects of environment, providing the approach is carefully thought out.

Literature Cited

Africa Research Bulletin. 1980. Zambia: Budget (1980). Africa Research Bulletin January 15-February 14, 1980:5404-5407.

Africa Research Bulletin. 1981. Zambia: Budget (1981). Africa Research Bulletin January 15-February 14, 1981:5813-5814.

Balek, J. 1977. Hydrology and Water Resources in Tropical Africa. Amsterdam: Elsevier. 208 pp.

Balon, E.K. 1978. Kariba: The Dubious Benefits of Large Dams. Ambio 7(2):40-48.

Banage, W.B. 1979. Wildlife Conservation and its Problems in Zambia. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 77-110.

Bayley, A. 1979. The Aetiology and Prevention of Hepatocelluar Carcinoma. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 243-251.

Beaumont, A.N. 1979. Agricultural Land-use in the Southern Province and its Effects on the Natural Resources. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 19-26.

Bell-Cross, G. 1965. Additions and Amendments to the Check List of the Fishes of Zambia. The Puku, Occassional Papers of the Department of Game and Fisheries, Zambia. No. 3:29-43.

Benson, C.W., R.K. Brooke, R.J. Dowsett and M.P.S. Irwin. 1971. The Birds of Zambia. London: Collins. 414 pp.

Bigalke, R.C. 1978. Mammals. In: Biogeography and Ecology of Southern Africa (M.J.A. Werger, ed.). The Hague: Dr. W. Junk bv Publishers, pp. 981-1048. (=Monographiae Biologicae vol. 31)

Boulton, M.N. 1973. Luangwa Valley Conservation and Development Project, Zambia. Conservation Education in Zambia. Rome: FAO. vi + 83 pp. (FO:DP/ZAM/68/510 Working Document No. 5; order no. 44531-73-WS)

Bowmaker, A.P., P.B.N. Jackson and R.A. Judd. 1978. Freshwater Fishes. In: Biogeography and Ecology of Southern Africa (M.J.A. Werger, ed.). The Hague: Dr. W. Junk bv Publishers, pp. 1181-1230. (=Monographiae Biologicae vol. 31)

Broadley, D.G. 1971. The Reptiles and Ampnibians of Zambia. The Puku, Occasional Papers of the Department of Wildlife, Fisheries, and National Parks, Zambia, No. 6:1-143.

Caponera, D.A., ed. 1979. Water Law in Selected African Countries. Rome: FAO. vi + 267 pp.

Cheatle, R.J. and M.E. Cheatle. 1979. Fuelwood Utilization in Zambia: A Review. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Associates, pp. 157-179.

Chidumayo, E.N. 1979. Environment and Development in Zambia: An Overview. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Associates, pp. 9-18.

Davies, D.H., ed. 1971. Zambia in Maps. London: University of London Press. 128 pp.

Ernst, W. 1971. Zur Ökologie der Miombo-Wälder. Flora Bd. 160:317-331.

Eskilsson, E. and R.G. Miti. 1974. Kafue River Development and its Effect on the Ecology of the Kafue Flats. Transactions of the Ninth World Energy Conference, Detroit, Sept. 23-27, 1974. Vol. III, Division 2, Technical Papers: Environment and the Energy Supply, pp. 910-929.

Europa Publications Ltd. 1980. Africa South of the Sahara, 1980-81. 10th edition. London: Europa, pp. 1159-1188.

FAO. 1979. A Zambian Handbook of Pasture and Fodder Crops. Rome: FAO. ix + 139 pp.

Family Health Care, Inc. and AFRICARE. 1978. Health and Development in Southern Africa, Vol. 2: A Review of Health Care in Zambia. Washington, D.C.: Family Health Care, Inc. vi + 140 pp.

Fry, J. 1980. The Zambian Economy. In: Administration in Zambia (W. Tordoff, ed.). Manchester: Manchester University Press, pp. 43-67.

Haltenorth, T. and H. Diller. 1977. A Field Guide to the Mammals of Africa, including Madagascar. London: Collins. 400 pp.

Hanks, J. 1972. Mammals of Zambia. Zambia: National Tourist Bureau. 84 pp.

Huckabay, J.D. 1979. Trends in Zambian Fisheries: The Tanganyika and Mweru/Luapula Fisheries as Examples. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Associates, pp. 115-143.

IUCN. 1975. Red Data Book. Vol. 3. Amphibia and Retilia. Morges, Switzerland: IUCN.

-----. 1977. World Directory of National Parks and Other Protected Areas. Morges, Switzerland: IUCN.

-----. 1978. Red Data Book. Vol. 1: Mammalia. Morges, Switzerland: IUCN.

Jackson, P.B.N. 1961. The Fishes of Northern Rhodesia. Lusaka, Zambia: Government Printer.

Johnson, H. and J. Johnson. 1977. Environmental Policies in Developing Countries. Beiträge Zur Umweltgestaltung, Heft A 27. Berlin: Erich Schmidt Verlag.

Kalapula, E.S. 1979. Effects of the Itezhi-tezhi Dam on the Cattle Industry in the Namwala Area: Some Preliminary Findings for the Period 1976-1979. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 47-68.

Kalapula, E.S. and W. Roder. 1979. Environmental Problems: The Villagers Views. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 253.

Kaoma, C. and L.F. Salter. 1979. Environmental Pollution in Zambia. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 181-214.

Kaplan, I., ed. 1979. Zambia: A Country Study. Washington, D.C.: U.S. Government Printing Office. (DA pam 550-75) xxv + 308 pp.

Legum, C., ed. 1980. Africa Contemporary Record. New York: Africana Publishing Company, pp. B 940-B 963.

Lovelace, C.E.A. and L.F. Salter. 1979. Environmental Factors which may Contribute to the Causation of Hepatocellular Carcinoma in Zambia: Analysis of Fungal Toxins in Village Food Samples. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 235-242.

Lumbe, R. 1979. Wildlife Aspects of Environment and Development. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 111-114.

Marks, S.A. 1976. Large Mammals and a Brave People: Subsistence Hunters in Zambia. Seattle: University of Washington Press. xx+ 254 pp.

-----. 1979. An Integrated Social-Environmental Analysis of the Luangwa Valley in Zambia. Washington, D.C.: U.S. AID. ii + 58 pp + App. (mimeographed copy)

Mhango, K.H.M., C.R.W. Kayombo, G. Kienitz and C.D. Chenov. 1977. The Water Resources Inventory of Zambia, Volume 1: The Luangwa River Basin. Lusaka: National Council for Scientific Research. vii + 94 pp + App.

Mitchell, B.L. and W.F.H. Ansell. 1965. Wildlife of Kafue and Luangwa: A Tourist Field Guide. 65 pp.

Moore, G. and L. Christy. 1978. Legislation for Control of Aquatic Pollution Part II: National Aspects. Sixth FAO/SIDA Workshop on Aquatic Pollution in Relation to Protection of Living Resources. Scientific and Administrative Basis for Management Measures. Nairobi and Mombasa, Kenya, 12 June - 22 July 1978. Rome: FAO. 8 pp.

Musokotwane, I.E.O. 1979. Management of Forest Resources for Eco-Development. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 145-155.

Nwankwo, J.N. and C.-G. Elinder. 1979. Cadmium, Lead and Zinc Concentrations in Soils and in Food Grown near a Zinc and Lead Smelter in Zambia. Bulletin of Environmental Contamination and Toxicology 22:625-631.

O'Connor, A.M. 1978. The Geography of Tropical African Development. 2nd Ed. Oxford, England: Pergamon Press. xviii + 229 pp.

Perera, N.P. 1979. Derelict Land in Zambia. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 217-233.

Poynton, J.C. and D.G. Broadley. 1978. The Herpetofauna. In: Biogeography and Ecology of Southern Africa (M.J.A. Werger, ed.). The Hague: Dr. W.Junk bv Publishers, pp. 925-948.

Robinson, D.A. 1978. Soil Erosion and Soil Conservation in Zambia: A Geographical Appraisal, Lusaka: Zambia Geographical Association. 49 pp. (Zambia Geographical Association Occasional Study No. 9)

Schultz, J. 1976. Land Use in Zambia. Pt. I: The Basically Traditional Land Use Systems and their Regions. München: Weltforum Verlag. viii + 209 pp + App.

Schuster, R. 1980. Will the Kafue Lechwe Survive the Kafue Dams? Oryx 15(5):476-489.

Sedjo, R.A. 1977. A Framework for U.S. Assistance in Southern Africa, Country Resource Paper: Zambia. Washington, D.C.: Robert R. Nathan Associates. (AID/afr-C-1134 GTS)

Sheppe, W.A. 1973. Notes on Zambian Rodents and Shrews. The Puku: Occassional Papers of the Department of Wildlife, Fisheries, and National Parks, Zambia. No. 7:147-190.

Sheppe, W. and T. Osborne. 1971. Patterns of use of a Flood Plain by Zambian Mammals. Ecological Monographs 41(3):179-205.

Simwinga, G.K. 1980. Corporate autonomy and government control of State enterprises. In: Administration in Zambia (W. Tordoff ed.). Manchester: Manchester University Press, pp. 130-138.

Trurnit, P. 1979. Sambia. (=Rohstoff-wirtschaftliche Länderberichte xxi). Hannover: Bundesanstalt für Geowissenschaften und Rohstoffe. ix + 167 pp.

Trzyna T.C. and E.V. Coan. 1976. World Directory of Environmental Organizations, 2nd ed. Claremont, CA: Public Affairs Clearinghouse. xxx + 258 pp.

United Nations. 1981. United Nations Conference on New and Renewal Sources of Energy, Nairobi, Kenya, 10-21 August 1981. National Report Submitted by Zambia. 8 pp. (A/CONF.100/NR/64)

United Nations, Department of Economic and Social Affairs. 1973. Groundwater in Africa. New York: U.N. ST/ECA/147. iv + 170 pp.

United Nations Development Programme--Food and Agriculture Organization (UNDP-FAO). 1978. Agriculture Development and Coordination Programme: Aquaculture Development in Zambia, Report of a Mission to Study the Feasibility of Commercial Fish Farming. Rome: FAO. ii + 68 pp.

U.N. Economic Commission for Africa. 1972. Directory of Intergovernmental Cooperation Organizations in Africa. New York: U.N. ECA. 97 pp.

UNESCO. 1977. Map of the World Distribution of Arid Regions. (MAB Technical Notes 7). Paris: UNESCO. 54 pp. + map.

United Nations Environment Program. 1979. Directory of Institutions and Individuals Active in Environmentally-Sound and Appropriate Technologies. Oxford: Pergamon Press. xviii + 152 pp.

U.S. AID. 1979. Development Needs and Opportunities for Cooperation in Southern Africa, Annex A: Zambia. Washington, D.C.: U.S. AID. 138 pp.

-----. 1981a. All Data Currently Available on Zambia. Washington D.C.: U.S. AID, DS/DIU/ESDS.02/25/81. (Computer Data Base, in House Access)

-----. 1981b. Zambia: A Country Profile. Washington, D.C.: U.S. AID, Office of Foreign Disaster Assistance. 36 pp. (preliminary draft)

U.S. AID. 1981c. Zambia: Country Development Strategy Statement, FY 83. Washington D.C.: U.S. AID. iv + 41 pp + annex.

U.S. Bureau of Mines. 1976. Mineral Industries of Africa. Washington, D.C.: U.S. Dept. of the Interior. 115 pp.

U.S. Department of Agriculture. 1980. Indices of Agricultural Production in Africa and the Near East, 1970-79. Washington, D.C.: USDA Economics, Statistics, and Cooperatives Service. Statistical Bulletin No. 637. i + 54 pp.

U.S. Department of State. 1979. Background Notes: Zambia. Washington, D.C.: U.S. GPO. 5 pp.

U.S. Environmental Protection Agency. 1976. Environmental Reports Summaries, vol. 1: Africa, Asia, Australia, Sept. 1972-June 1976. Washington D.C.: National Technical Information Service No. PB-259 891.

U.S. Fish and Wildlife Service (USFWS). 1981. Amendments to Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Federal Register 46(172):44660-444674.

University of Zambia Alternative Energy Group. 1978. Alternative Energy Resources in Zambia. In: Proceedings of the National Seminar on Environment and Development. A Review of Some Environmental Problems in Zambia (D.S. Johnson and W. Roder, eds.). Lusaka: Zambia Geographical Association, pp. 267-272.

de Vos, A. 1975. Africa, the Devastated Continent? Man's Impact on the Ecology of Africa. The Hague: Dr. W. Junk bv Publishers. 236 pp. (=Monographie Biologicae Vol. 26)

Werger, M.J.A. 1978a. Biogeographical Division of Southern Africa. In: Biogeography and Ecology of Southern Africa (M.J.A. Werger, ed.) The Hague: Dr. W. Junk bv Publishers. pp. 145-170.

Werger, M.J.A., ed. 1978b. Biogeography and Ecology of Southern Africa. The Hague: Dr. W. Junk bv Publishers. xv + 1439 pp. (=Monographie Biologicae vol. 31)

Werger, M.J.A. and B.J. Coetzee. 1978. The Sudano-Zambezian Region. In: Biogeography and Ecology of Southern Africa. The Hague: Dr. W. Junk bv Publishers, pp. 301-462.

Winterbottom, J.M. 1978. Birds. In: Biogeography and Ecology on Southern Africa. The Hague: Dr. W. Junk bv Publishers, pp. 949-979. (=Monographiae Biologicae vol. 31)

World Bank. 1977. Zambia: A Basic Economic Report. Main Report xix + 228 pp. Annex 1: Mining Sector Review. ii + 45 pp. Annex 2: The Parastatal Sector. iii + 83 pp. Annex 3: Education and Training. 38 pp. Annex 4: A Long-Run Projection Model. 43 pp. Washington D.C.: World Bank.

-----. 1980. World Tables, 2nd ed. Baltimore: The Johns Hopkins University Press. 474 pp.

-----. 1981. World Development Report 1981. Washington, D.C.: World Bank. viii + 192 pp.

Zambia, Central Statistical Office. 1975. Population Projections for Zambia, 1969-1999. Lusaka: Central Statistical Office. 454 pp.

-----. 1980. Agricultural and Pastoral Production (Non-Commercial Sector) 1977-78. Lusaka: Central Statistical Office. 26 pp.

Zambia, National Parks and Wildlife Service. 1977. Annual Report. i + 35 pp.

-----. 1979. Annual Report. i + 22 pp.

Appendix I

Geograpny and Climate

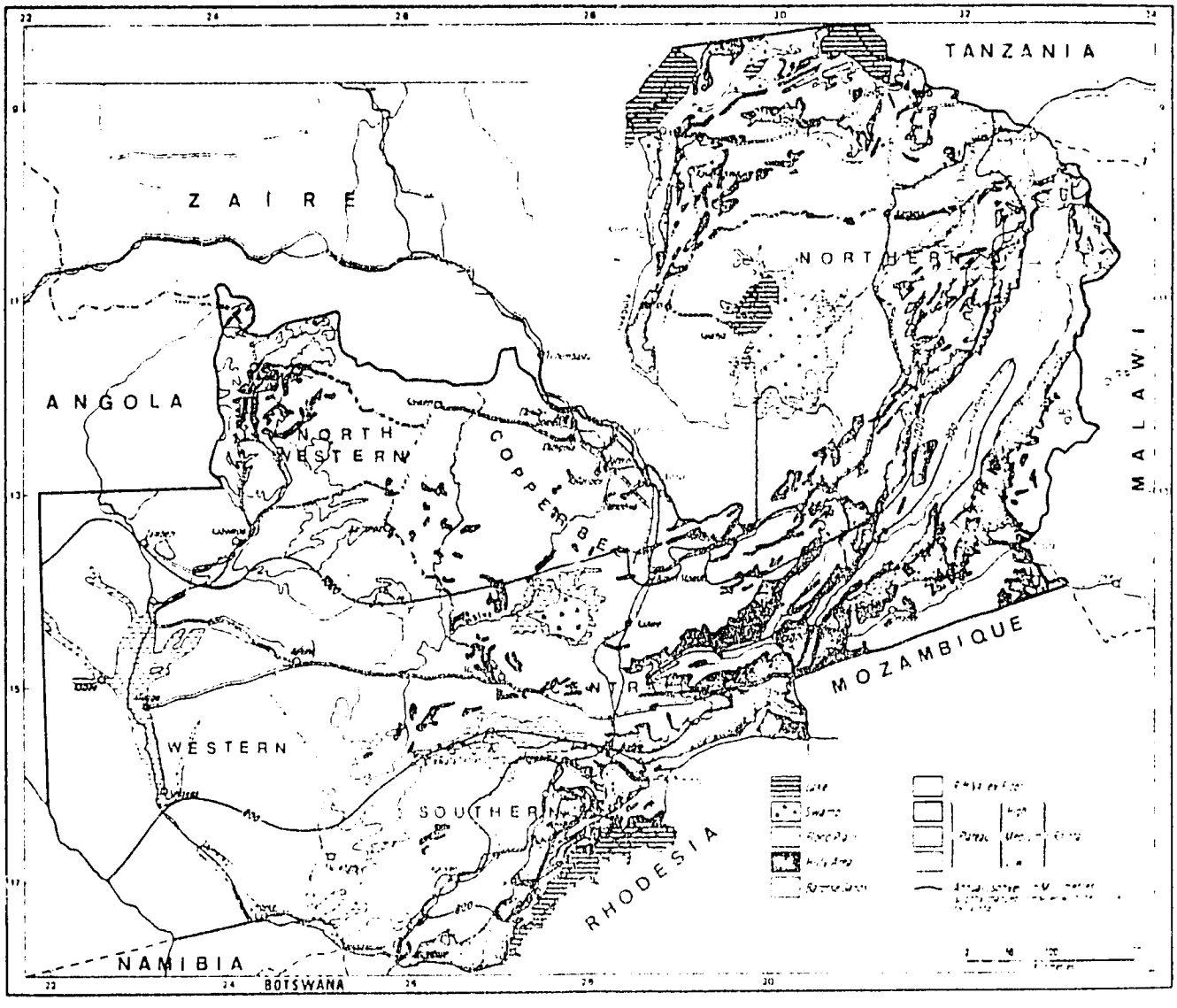


Figure 1. Main Physical Features

Source: Schultz. 1976.

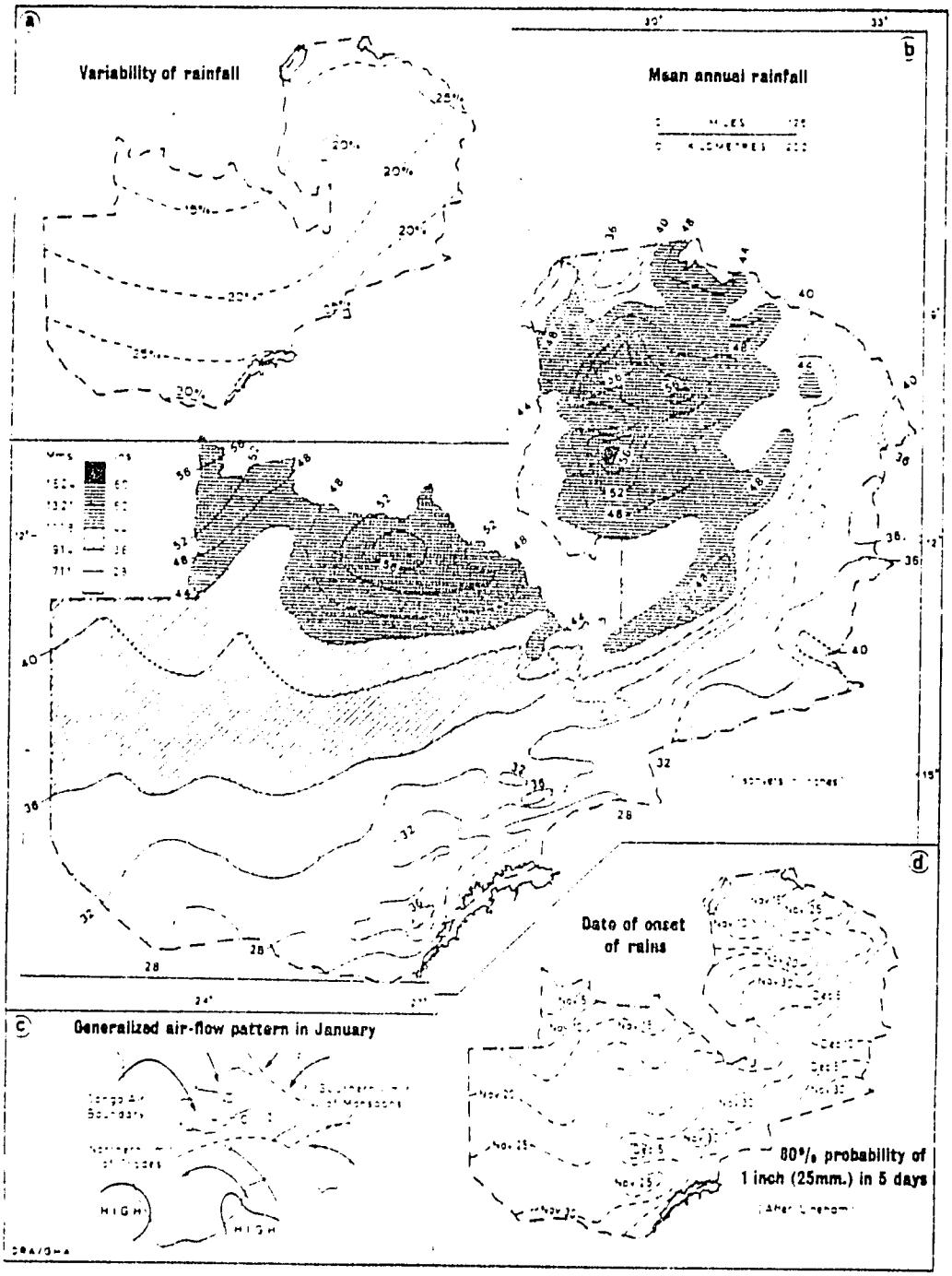


Figure 2. Rainfall Maps

Source: Davies, 1971.

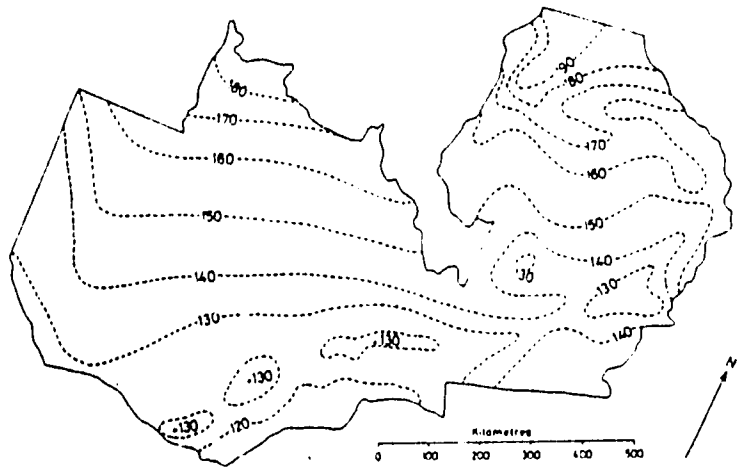
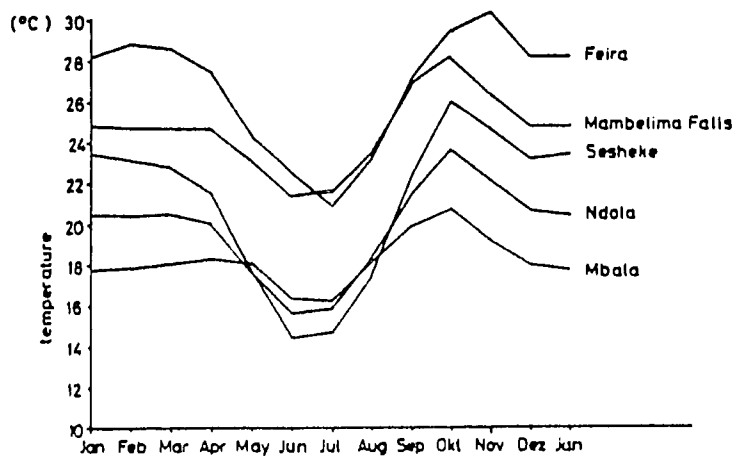


Figure 3. Duration of Rainy Season

Source: Schultz. 1976.



Details of stations:

Name	Latitude (south)	Longitude (east)	Altitude (metres)	Temperature (C°) Mean annual	Mean annual minimum	Classification
Feira	15° 36'	30° 23'	329	26.6	19.7	hot tropical
Mambelima Falls	10° 35'	28° 40'	991	24.6	15.8	hot tropical
Sesheke	17° 29'	24° 10'	951	20.9	12.7	moderate tropical
Ndola	13° 00'	28° 39'	1270	19.7	13.1	moderate tropical
Mbala	08° 51'	31° 20'	1673	18.2	13.6	moderate tropical

Figure 4. Monthly mean temperatures at five stations

Source: Schultz. 1976.

Table 1. Temperature and Precipitation at three Stations

A: Average Daily Temperature (°F)

	Jan		Apr		July		Oct		Extreme	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Balovale	82	65	84	61	81	47	91	64	108	38
Kasama	79	61	79	60	76	50	87	62	95	39
Lusaka	78	63	79	59	73	49	88	64	100	39

B: Average Precipitation (Inches)

Station	Elevation *	J	F	M	A	M	J	J	A	S	O	N	D	Year
Balovale	3,577	8.5	6.9	5.8	1.2	-	-	-	-	0.3	2.3	4.4	8.9	38.3
Kasama	4,544	10.7	9.9	10.9	2.8	0.5	-	-	-	-	0.8	6.4	9.5	51.5
Lusaka	4,191	9.1	7.5	5.6	0.7	0.1	-	-	-	-	0.4	3.6	5.9	32.9

* feet

Source: U.S. AID. 1981.

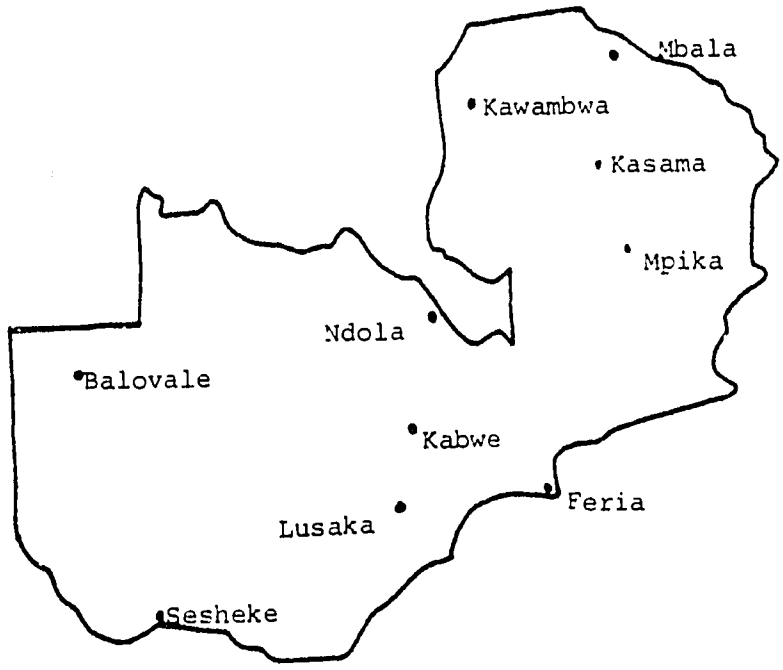


Figure 5. Location Sketch Map of Climatic Stations for Table 1; Figures 4 and 6

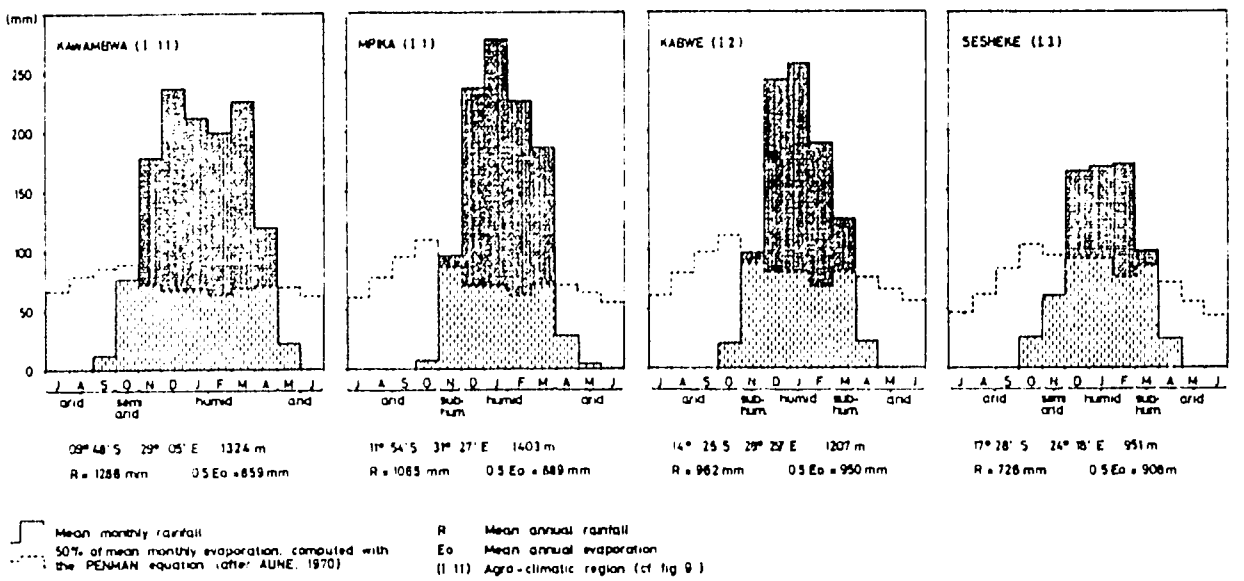


Figure 6. Climatic Diagrams of Four Stations

Source: Schultz. 1976.

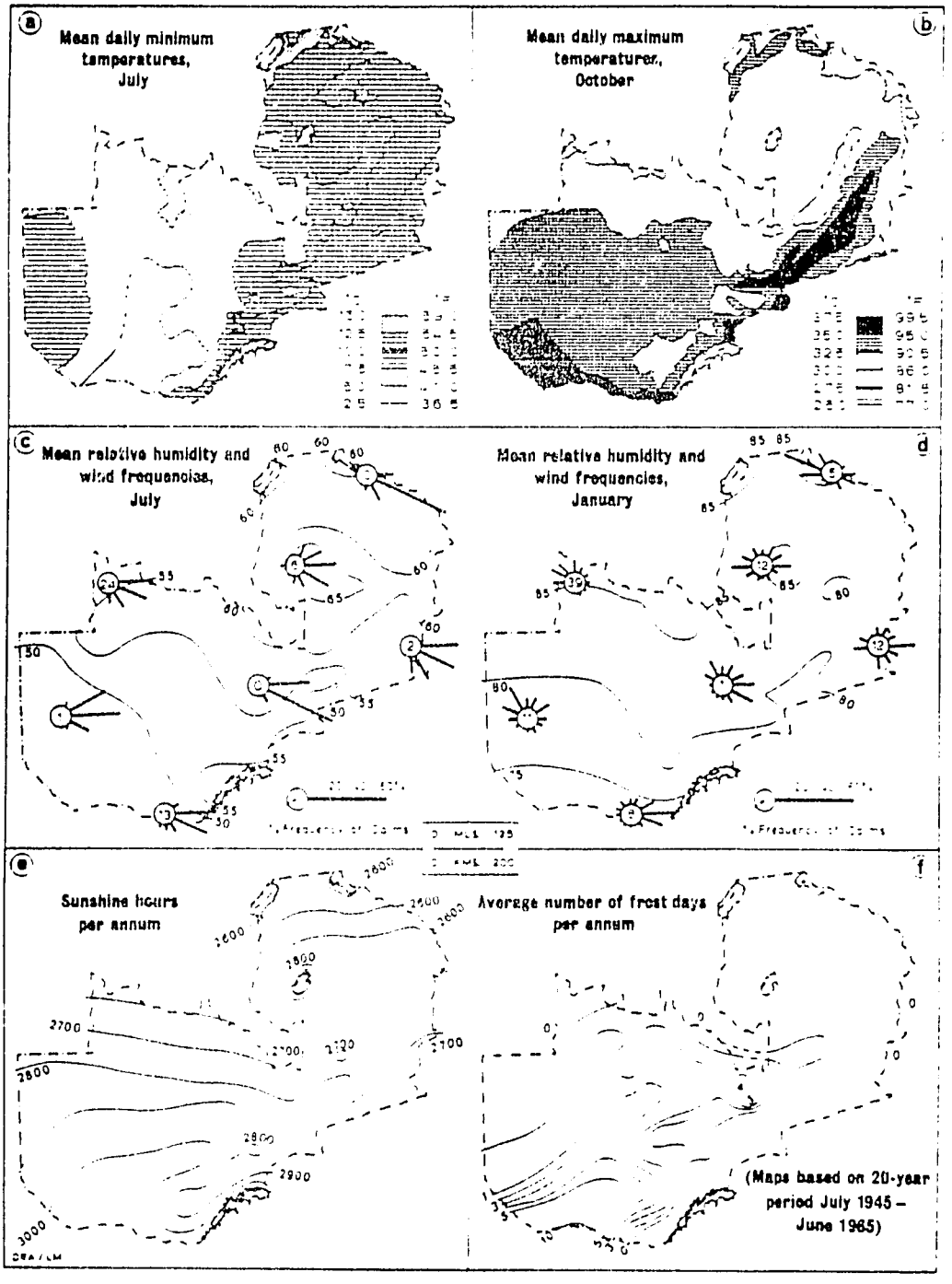


Figure 7. Miscellaneous Climatic Data

Source: Davies, 1971.

Appendix II

Population and Public Health

TABLE 1

Miscellaneous Demographic Features

			Year
Population	5,821,000		1980
Density per sq km	7		1977
Density per sq km arable land	15		1977
Growth rate (%)	3.2		1979
Crude birth rate (per 1,000)	49		1979
Crude death rate (per 1,000)	17		1977
Life expectancy at birth (years)	48.3		1978
Average daily caloric consumption (% of estimated requirement)	2,018	(87%)	1976
Population per practicing physician	10,191		1975
Percent literate	39		1975
Per capita GND (U.S. $)	480		1978
Total labor force (1,000)	1952		1978
% of women in labor force	32.5		1975
% of labor force in agriculture	68		1978

Source: U.S. AID. 1981a.

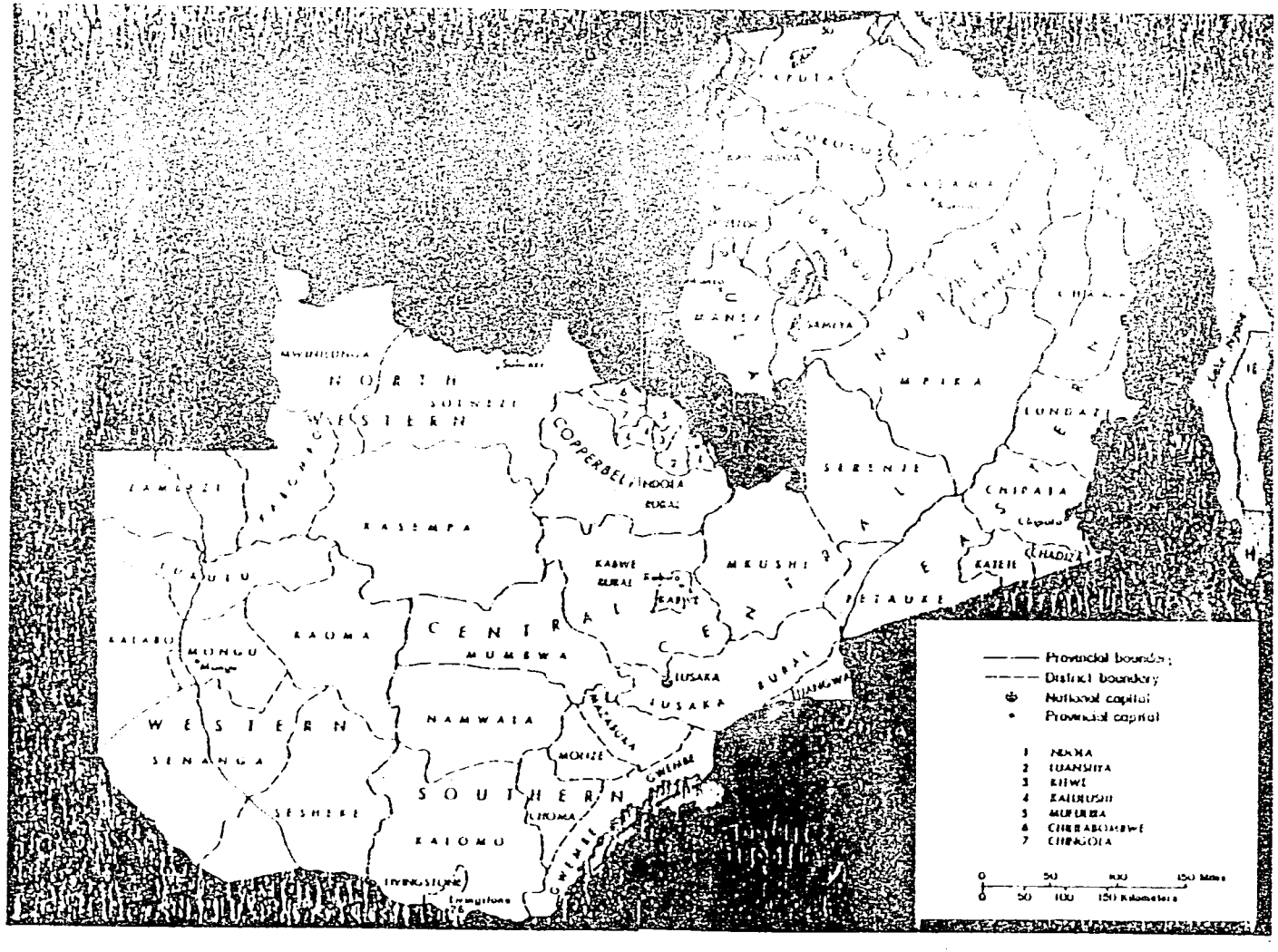


Figure 1. Major Administrative Divisions

Source: Kaplan. 1978.

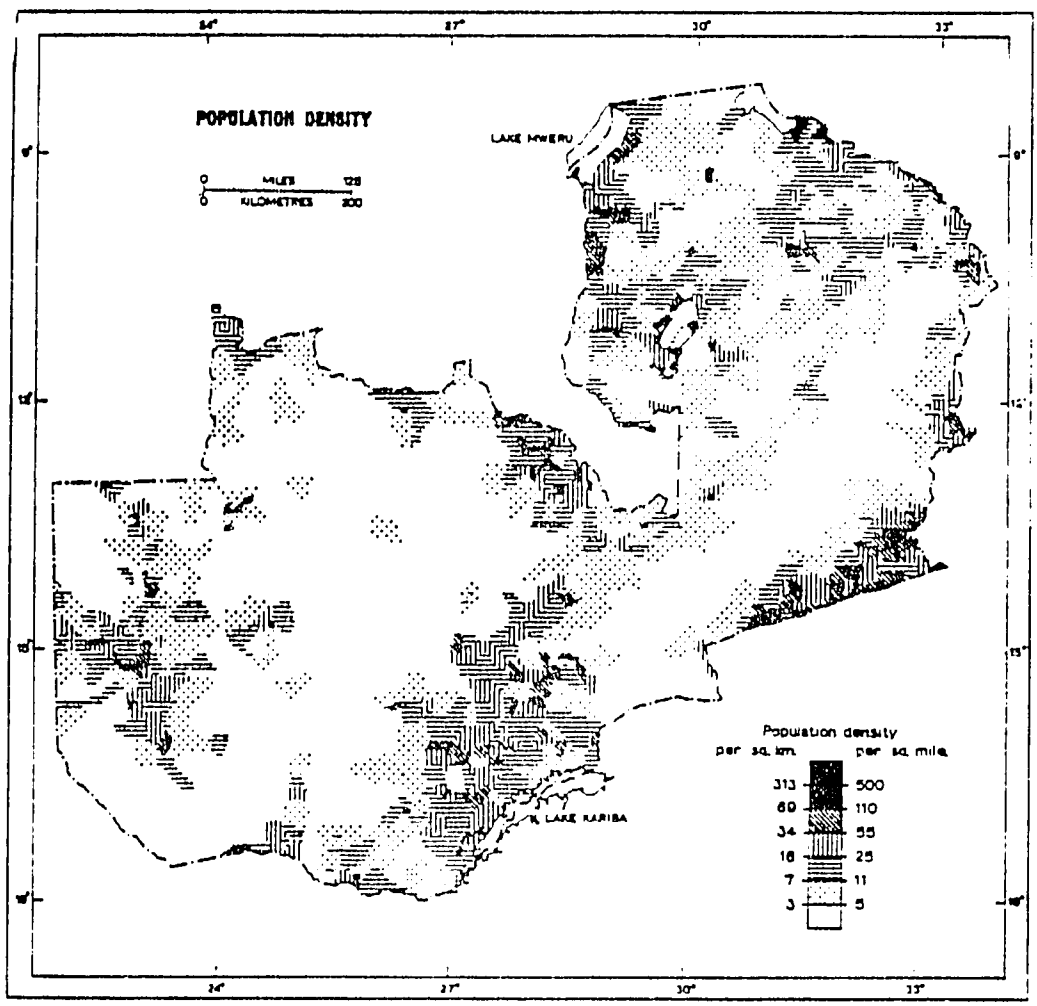


Figure 2. Population Density

Source: Davies. 1971.

Table 2. Population by Province

	1969 Census	1974 Sample Census	Mid-1979 estimates	Growth Rates p.a. (%) 1969-74	1974-79
Central (including Lusaka Province)	712,630	919,000	1,208,000	5.2	5.6
Copperbelt	816,309	1,046,000	1,367,000	5.1	5.5
Eastern	503,515	570,000	651,000	2.3	2.6
Luapula	335,504	321,000	358,000	-0.9	2.2
Northern	545,096	584,000	638,000	1.4	1.8
North-Western	231,733	242,000	291,000	0.8	3.8
Southern	496,041	534,000	602,000	1.5	2.4
Western	410,087	460,000	535,000	2.3	3.0
Total Zambia	4,056,915	4,676,000	5,650,000	2.9	3.8

Source: U.S. AID. 1981.

Table 3. Age and Sex Structure

Age	Urban Total	Rural Total	Total Male	Total Female	Total Zambia
0-4	362,973	626,704	485,942	503,735	989,677
5-14	497,168	946,822	717,098	726,892	1,443,990
15-49	785,462	1,272,287	966,352	1,091,397	2,057,749
60+	17,611	167,720	105,880	79,451	185,331
Total	1,663,214	3,013,533	2,275,272	2,401,475	4,676,747
			(in percentages)		
0-4	21.8	20.8	21.4	21.0	21.2
5-14	29.9	31.4	31.5	30.3	30.9
15.49	47.2	42.2	42.5	45.5	44.0
60+	1.1	5.6	4.7	3.3	.3.9

* Based on the 1974 sample census.

Source: U.S. AID. 1981.

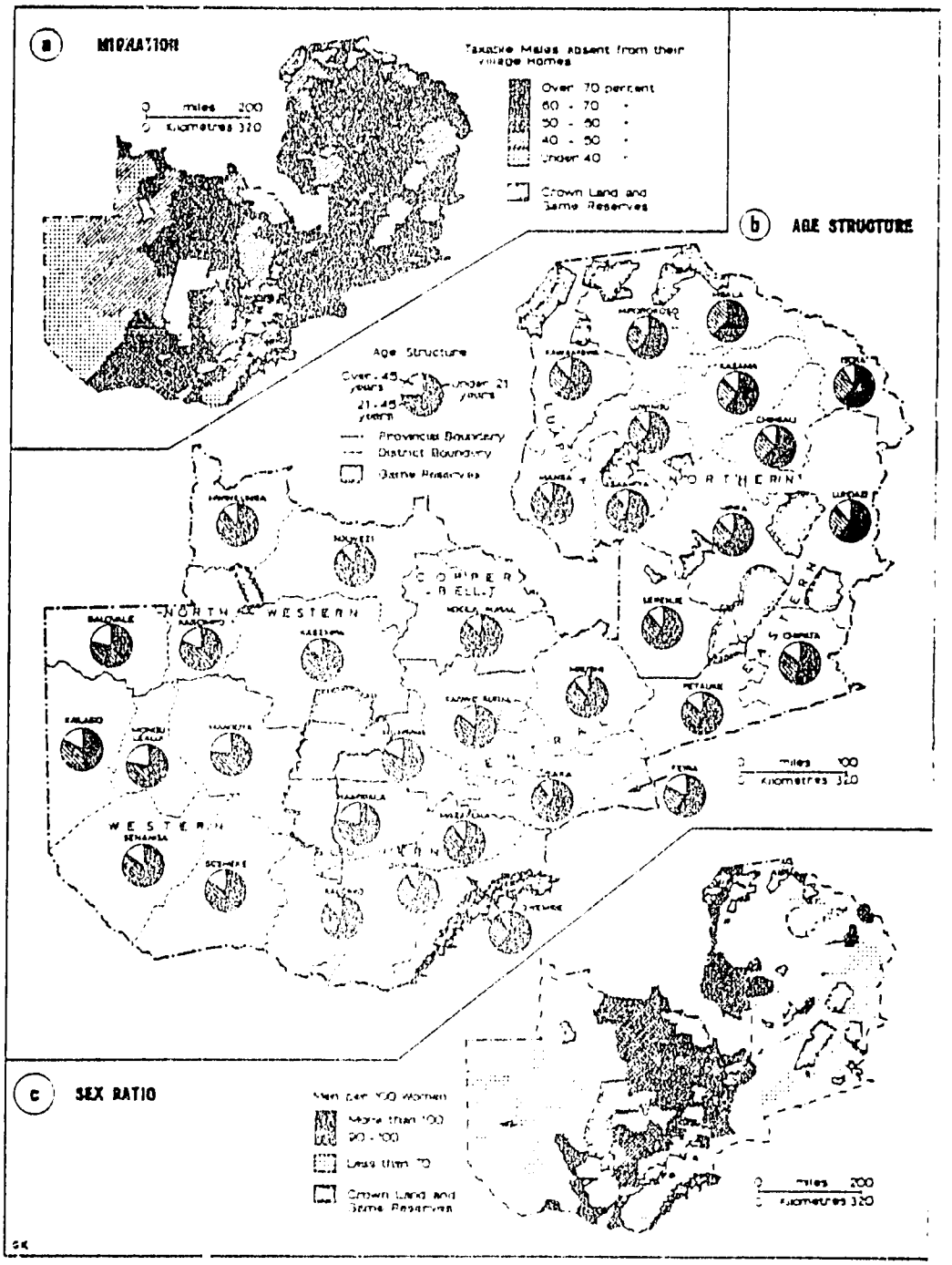


Figure 3. Migration, Age Structure, Sex Ratio

Source: Davies, 1971.

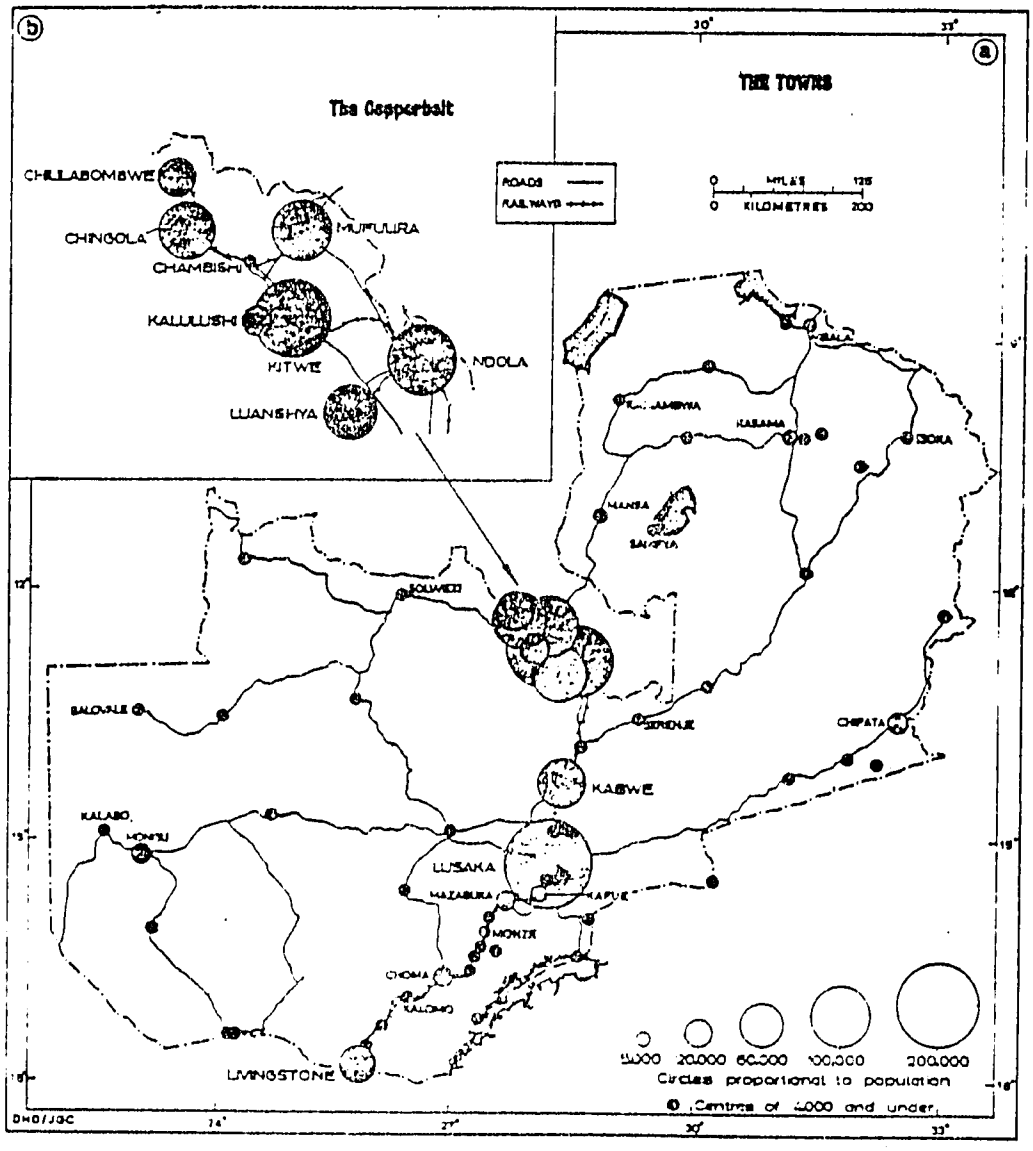


Figure 4. Main Towns

Source: Davies. 1971.

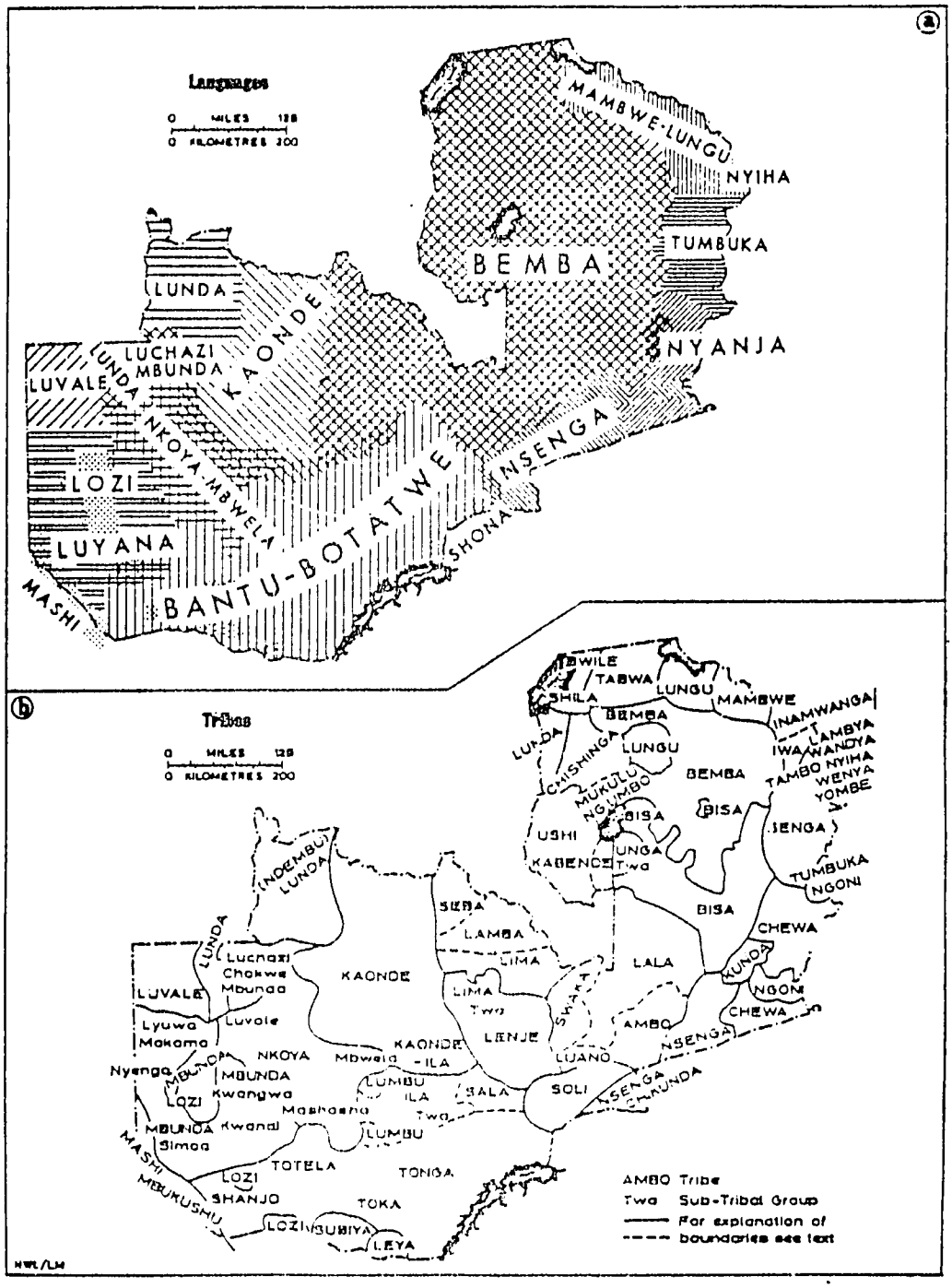


Figure 5. Major Languages and Tribes

Source: Davies, 1971.

Table 4a. Ten Leading Causes of Hospital Mortality, Annual Average, 1972-1975

Rank	Mortality Cause	Number of Deaths	% of Total
1	Disorders of newborn & perinatal period	2,110	15.4
2	Malnutrition & Anaemias	1,600	11.6
3	Pneumonia	1,470	10.7
4	Measles	1,190	8.7
5	Gastritis, Gastroenteritis & other diseases of the digestive system	790	5.7
6	Dysentery/Enteritis & other diarrhoeal diseases	680	4.9
7	Accidents & injuries	650	4.8
8	Diseases of heart	580	4.3
9	Malignant Neoplasms & Leukemia	520	3.8
10	Malaria	510	3.7
	TOTAL DEATHS	13,730	100.0

Table 4b. Ten Leading Causes of Health Center Mortality, Annual Average, 1972-1975

Rank	Mortality Cause	Number of Deaths	% of Total
1	Measles	450	20.0
2	Pneumonia	360	16.1
3	Diarrhea	255	11.3
4	Malnutrition & Anaemias	255	11.3
5	Malaria	230	10.2
6	Other abdominal cases (including Jaundice)	90	4.1
7	Other pulmonary cases (URIs)	45	2.1
8	Injuries	40	1.7
9	Whooping Cough	25	1.0
10	Tuberculosis	25	1.0
	Yearly Average, Ten Major Causes	1,775	78.8
	Yearly Average, Health Center Deaths	2,250	100.0

Source: Family Health Care and AFRICARE, 1978.

Table 5. Leading Morbidity Causes 1972 - 1975

Causes*	Relative Ranking		
	In-Patient		Out-Patient
	Hospital	H.Center	New Cases
Upper Respiratory Tract Infections	10	5	1
Diarrhea	9	2	2
Accidents & Injuries	1	6	3
Malaria	2	1	4
Diseases of the Skin	-	-	5
Diseases of the Eyes	-	-	6
Diseases of the Ears	-	-	7
Worm Infestations (Bilharzia, Hookworm, etc.)	-	-	8
Gastritis, Gastroentaritis & other diseases of digestive system	4	7	-
Diseases of the Teeth	-	-	9
Diseases of the Genitourinary system	7	-	10
Venereal Diseases	-	-	11
Malnutrition & Anaemias	5	10	12
Pneumonia	8	4	13
Measles	6	3	14
Disorders of Pregnancy/Delivery/ Puerperium	3	-	-
Other Pulmonary Cases (incl TB)	-	9	-
Other fevers (incl sleeping sickness)	-	8	-

* Lack of diagnostic expertise and laboratory facilities are partially responsible for variations in classification system.

Source: Family Health Care and AFRICARE. 1978.

Table 6. Regional Variations in Morbidity

(H = Highest incidence; L = Lowest incidence)

Cause	Provinces							
	Central	C.Belt	East	Luapula	N	NW	S	W
Upper Respiratory Infection	H	H	-	L	L	H	H	L
Diarrhea	H	H	L	H	-	-	-	L
Injuries	H	H	L	L	-	L	H	L
Malaria	L	L	H	H	H	-	-	H
Diseases of the Skin	-	L	H	L	-	H	L	-
Diseases of the Eyes	L	L	-	-	H	L	-	H
Diseases of the Ear	-	-	H	L	L	-	H	H
Worm Infestations	L	-	H	-	-	H	L	-
Diseases of the Teeth	L	-	-	L	L	L	H	-
Genitourinary Diseases	H	H	L	-	-	-	-	L
Venereal Diseases	H	H	L	L	-	L	H	L
Malnutrition & Anemia	L	L	-	H	-	-	L	-
Pneumonia	L	L	H	-	-	H	-	H
Measles	H	H	L	-	-	L	H	-

Source: Family Health Care and AFRICARE. 1978.

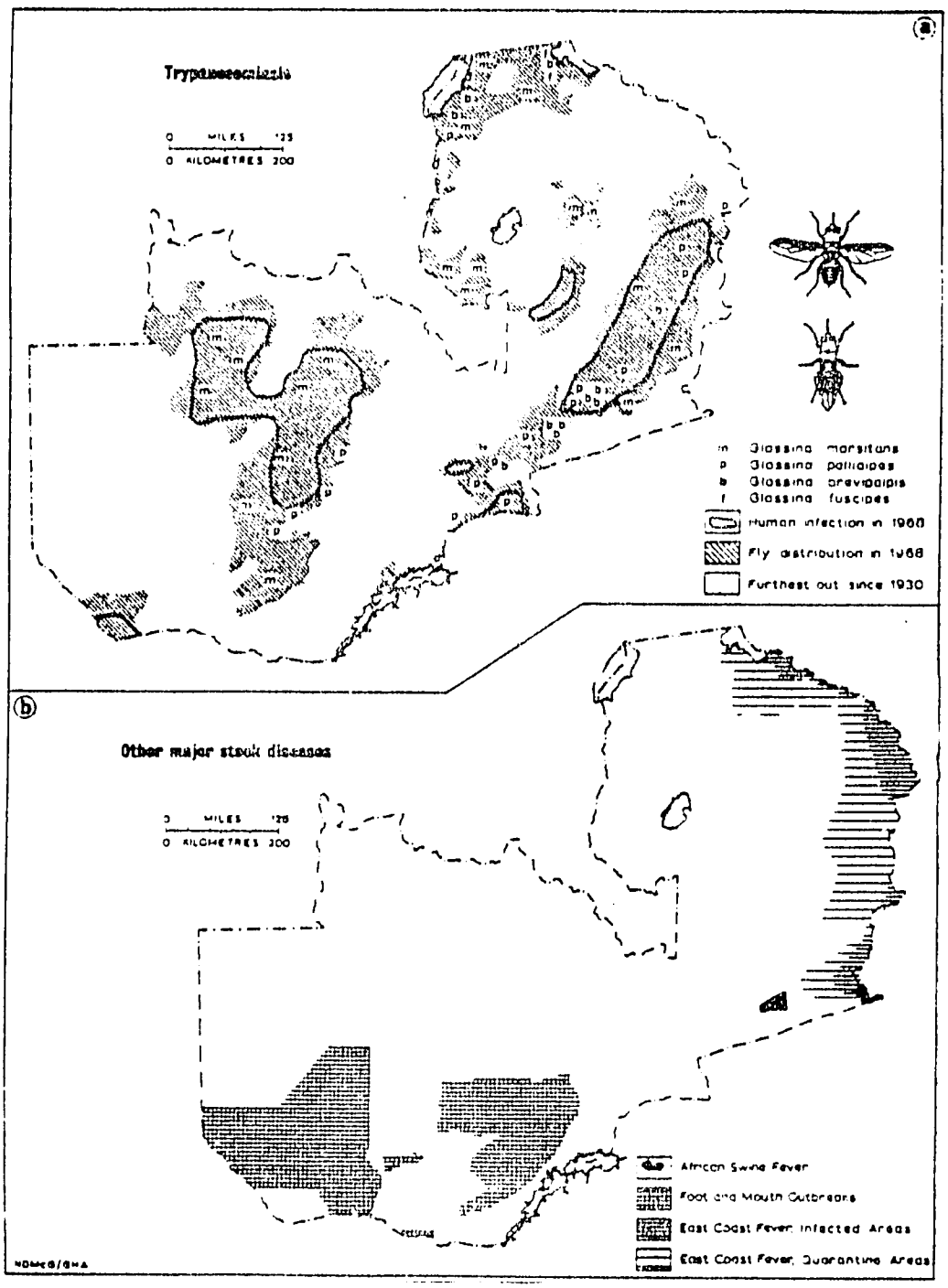


Figure 6. Trypanosomiasis and Stock Diseases Distribution

Source: Davies, 1971.

Table 7. Average Annual Food Intake Per Capita by Province (kg)

	Northern	Eastern	Central	Copperbelt	North-western	Western	Southern
Staples	176.5	126.4	169.6	138.6	209.0	210.9	151.6
Maize	25.6	121.7	143.9	92.0	53.1	107.9	137.0
Finger Millet	38.1	2.4	3.8	-	4.5	-	-
Sorghum	0.6	1.2	10.6	34.8	41.7	19.8	13.9
Rice	0.7	0.6	0.4	0.1	0.7	0.3	-
Cassava	111.5	0.5	10.9	11.6	109.9	82.9	0.8
Other Roots	3.9	-	1.9	0.8	17.4	8.5	3.2
Sugar	0.4	0.6	1.2	0.4	1.3	2.3	1.3
Pulses	7.2	1.2	1.5	0.5	3.7	0.5	0.8
Groundnuts	3.3	5.9	1.3	0.7	1.8	1.3	10.8
Vegetables	28.0	28.4	27.6	46.8	41.9	28.1	62.7
Fruits	2.0	35.4	4.0	2.8	3.9	10.3	6.1
Meat (fresh)	9.8	22.0	13.8	4.2	22.8	18.5	23.3
Domesticated	2.9	13.7	6.4	3.2	7.4	18.5	21.5
Other	6.9	8.3	7.4	1.0	15.4	-	1.7
Eggs	0.1	0.1	0.5	0.3	0.1	0.1	0.1
Milk	0.3	1.3	4.6	-	0.4	9.5	3.5
Fish (fresh)	34.3	11.4	36.0	32.4	21.3	50.3	9.4
Fats & Oils	0.4	0.5	0.8	3.1	0.6	0.1	0.1

Source: U.S. AID. 1981.

Table 8. Health Personnel in Zambia, 1975 and 1977

Category	Public and Private, 1975 Total	% Zambians	Government, Mission and Mine, 1977
Physicians	643*	10%	596
Dentists	28	11%	17
Pharmacists	126	7%	40
Nurse Educators	19	16%	32
Midwivery Tutors	-	-	10
Nurse Administrators	36	47%	40
Public Health Nurses	-	-	10
Registered Nurse/Midwives	905	48%	1,740
Enrolled Nurse/Midwives	1,330	100%	2,540
Medical Assistants	980	82%	1,030
Health Inspectors	91	80%	115
Health Assistants	219	100%	415
Physiotherapists	16	19%	23
Laboratory Technicians	70	29%	132
Laboratory Assistants	60	100%	83
Radiographers	40	50%	72
X-Ray Assistants	40*	-	58
Dental Technicians	45*	-	10
Dental Assistants	18	100%	25
Health Aides (Orassars)	380	100%	900**
Totals	5,746		7,389

* Figures for 1977 (includes estimate of 50 doctors in private practice)
** Estimate

Source: U.S. AID. 1981.

Appendix III

Economic Characteristics

Table 1. World Bank Economic Data Sheet

ZAMBIA

Economic Data Sheet 1 - Population, National Accounts, and Prices

GNP Per Capita - 1977 (US$) 460

	1964	1965	1966	1968	1969	1967	1968	1969	1970	1971
Population										
Total, midyear, thousands	2467.0	2768.0	3139.0	3595.0	3700.0	3808.0	3920.0	4034.0	4152.0	4276.0
GDP by industrial origin									At current factor cost	
Agriculture	..	37.3	54.0	102.3	112.2	115.5	119.9	124.5	136.1	154.0
Mining	..	244.5	255.5	306.6	399.7	399.9	433.7	671.9	467.7	503.7
Manufacturing	..	13.8	19.8	50.4	72.5	90.5	111.2	119.7	127.5	142.6
Construction	..	25.7	24.3	43.0	57.6	59.8	65.5	70.9	91.4	99.1
Electricity, gas, and water	..	3.3	9.8	5.7	7.8	9.8	13.2	14.9	15.5	18.2
Transport and communications	..	13.8	24.8	34.5	35.0	52.5	50.9	46.3	49.9	62.7
Trade and finance[a]	..	28.9	43.2	122.2	120.1	164.5	194.4	189.2	224.7	229.0
Public administration and defense	..	9.1	17.6	32.0	37.3	44.2	48.1	45.4	62.6	81.9
Other branches	..	27.0	43.1	50.7	49.1	70.2	79.3	97.7	103.6	112.5
GDP at factor cost[b]	146.3	401.4	492.1	747.4	891.5	1005.9	1116.2	1380.5	1279.0	1204.0
Net indirect taxes	0.6	5.0	18.6	102.6	138.5	141.5	195.0	268.4	184.9	92.4
GDP at market prices	146.3	401.4	492.1	747.4	891.5	1005.9	1116.2	1380.5	1279.0	1204.0
GDP by industrial origin (constant 1965 prices)									At constant factor cost	
Agriculture	..	..	..	102.3	107.5	106.6	107.3	109.7	115.7	118.2
Mining	..	..	..	306.6	262.8	248.1	239.6	275.2	232.6	202.7
Manufacturing	..	..	..	50.4	62.1	72.2	78.5	90.1	92.3	98.2
Construction	..	..	..	43.0	48.4	41.5	37.0	43.1	52.1	51.1
Electricity, gas, and water	..	..	..	5.7	7.9	9.1	11.2	15.8	16.0	19.8
Transport and communications	..	..	..	34.5	32.5	45.9	43.5	38.4	39.8	47.5
Trade and finance[a]	..	..	..	122.2	121.3	141.8	158.5	144.2	158.9	163.8
Public administration and defense	..	..	..	32.0	38.9	39.2	42.5	38.7	56.0	61.0
Other branches	..	..	..	50.7	54.9	70.2	75.3	73.6	91.9	92.5
GDP at factor cost[b]	..	..	..	747.4	736.5	773.6	793.6	818.8	845.3	842.8
Net indirect taxes	..	..	..	..	..	..	..	..	..	..
GDP at market prices	324.5	386.0	559.4	747.4	736.5	773.6	793.6	818.8	845.3	842.8
Resources and expenditures									At current market prices	
GNP	98.1	347.5	440.3	701.9	833.5	955.3	1064.1	1333.0	1245.6	1160.4
Factor payments to abroad (net)	-48.2	-53.9	-51.8	-45.5	-58.0	-50.6	-52.1	-47.5	-33.4	-43.6
GDP	146.3	401.4	492.1	747.4	891.5	1005.9	1116.2	1380.5	1279.0	1204.0
Imports of goods and N.F.S.	..	158.6	200.2	262.7	335.4	416.3	470.4	425.9	470.5	525.7
Exports of goods and N.F.S.	..	250.6	275.4	373.3	455.7	475.2	544.5	562.7	685.4	500.6
Total resources	113.7	309.4	416.9	636.8	771.2	947.0	1042.1	943.7	1064.1	1229.1
Private consumption	68.0	177.8	244.7	337.6	394.1	478.6	505.7	514.4	519.0	529.3
General government consumption	12.0	30.1	54.4	114.4	115.5	153.5	169.6	175.5	198.5	272.8
Gross domestic investment	33.7	101.7	117.8	184.8	261.6	314.9	366.8	253.8	346.6	427.2
Resources and expenditures (constant 1965 prices)									At constant market prices	
GNP	217.5	334.1	500.3	701.9	688.8	734.8	756.3	790.6	823.3	812.0
Factor payments to abroad (net)	-107.0	-51.9	-59.1	-45.5	-47.7	-38.8	-37.3	-28.2	-22.0	-30.5
GDP	324.5	386.0	559.4	747.4	736.5	773.6	793.6	818.8	845.3	842.8
Imports of goods and N.F.S.	..	159.8	226.9	262.7	227.0	291.5	420.0	390.0	394.7	418.2
Exports of goods and N.F.S.	..	197.4	323.9	373.3	319.0	322.5	348.0	434.5	400.0	360.0
Total resources	252.1	378.4	472.4	636.8	744.5	942.6	967.6	774.3	940.0	901.0
Private consumption	165.7	216.1	288.8	341.3	431.2	473.3	480.6	458.4	410.2	397.4
General government consumption	28.6	44.4	60.5	110.7	111.9	132.0	140.4	135.9	163.0	204.8
Gross domestic investment	59.8	117.9	123.1	184.8	201.4	237.3	246.6	180.0	266.9	299.0
Investment financing									At current market prices	
Gross domestic investment	33.7	101.7	117.8	184.8	261.6	314.9	366.8	253.8	346.6	427.2
Gross national savings (excluding net current transfers from abroad)	20.1	139.8	141.2	249.9	323.9	323.2	388.8	643.1	528.1	358.5
Net balance of goods and services	-15.6	38.1	23.4	65.1	62.3	9.3	22.0	389.3	181.5	-68.7
Gross national savings (including net current transfers from abroad)	..	..	..	..	..	334.6	383.0	630.2	483.0	318.4
Domestic price indexes (1970=100)										
Consumer price (or retail price) index	..	..	65.8	74.1	91.6	95.8	95.0	97.3	100.0	108.0
Wholesale price index	..	..	..	90.9	97.2	96.1	93.7	102.6	100.0	93.5
Implicit GDP deflator	29.8	98.7	98.2	96.1	90.0	95.9	93.0	111.4	100.0	94.4
										Kwacha per US dollar
Foreign exchange rate	0.714	0.714	0.714	0.714	0.714	0.714	0.714	0.714	0.714	0.714

a. 1966-68. b. 1965-70. c. 1970-72. d. From 1966 onwards includes ownership of dwellings. e. Included in other branches. f. GDP at market prices. g. 1971-72.

continued.

1972	1973	1974	1975	1976	1977	1960-60	1965-70	1970-77	
						Average annual growth rate (percent)			
4404.0	4535.0	4671.0	4810.0	4966.0	5126.0	2.4	2.6	3.0	Total, midyear, thousands
(millions of kwacha)						As percentage of GDP			
171.7	186.3	191.6	196.5	256.5	260.3	10.2[a]	11.1[a]	11.9[a]	Agriculture
326.1	544.7	611.0	206.6	335.2	241.5	56.0[a]	41.7[a]	30.2[a]	Mining
182.3	196.6	247.2	276.4	305.3	344.0	3.8[a]	5.9[a]	11.9[a]	Manufacturing
102.6	107.3	125.3	150.8	181.2	154.0	5.6[a]	8.0[a]	7.4[a]	Construction
25.7	27.0	35.0	36.0	39.0	38.0	1.5[a]	1.0[a]	1.6[a]	Electricity, gas, and water
63.4	70.4	76.1	86.6	95.5	92.0	4.3[a]	4.2[a]	4.5[a]	Transport and communications
249.5	279.9	357.0	371.5	403.5	466.0	7.8[a]	15.5[a]	18.1[a]	Trade and finance[d]
81.7	78.2	. .	. .	. .	. .	3.0[a]	4.2[a]	5.6[a]	Public administration and defense
131.7	125.4	244.0	286.2	300.0	325.5	7.8[a]	7.0[a]	9.7[a]	Other branches
1334.7	1616.0	1887.2	1612.8	1916.2	1921.3	100.0	100.0	100.0	GDP at factor cost[e]
103.7	239.8	300.0	74.0	165.0	. .	2.3	12.8	10.7	Net indirect taxes
1334.7	1616.0	1887.2	1612.8	1916.2	1921.3	100.0	100.0	100.0	GDP at market prices
(millions of kwacha)						Average annual growth rate (percent)			
129.2	131.4	119.9	128.5	135.9	137.0	. .	2.0[a]	2.1	Agriculture
217.6	227.2	222.5	204.5	227.6	207.0	. .	-3.6[a]	-0.5	Mining
101.0	106.0	118.5	112.5	107.9	102.0	. .	9.9[a]	3.7	Manufacturing
58.6	61.0	65.3	76.6	82.0	68.0	. .	1.4[a]	6.1	Construction
27.2	30.4	40.6	42.6	44.6	43.9	. .	24.1[a]	16.4	Electricity, gas, and water
43.9	45.1	43.9	45.0	42.6	33.4	. .	3.4[a]	-2.0	Transport and communications
163.7	178.0	232.8	226.9	218.4	220.1	. .	5.7[a]	6.1	Trade and finance[d]
81.0	52.2	. .	. .	. .	. .	. .	5.0[a]	. .	Public administration and defense
104.8	92.2	156.9	161.3	160.4	169.4	. .	12.1[a]	. .	Other branches
905.0	923.5	1000.4	997.9	1019.4	978.8	. .	5.0	2.8	GDP at factor cost[e]
. .	. .	. .	. .	. .	. .	. .	. .	. .	Net indirect taxes
905.0	923.5	1000.4	997.9	1019.4	978.8	5.6	5.0	2.8	GDP at market prices
(millions of kwacha)						As percentage of GDP			
1260.6	1538.7	1825.0	1585.8	1836.7	1844.3	85.2	93.6	96.1	GNP
-74.1	-77.3	-82.2	-47.0	-79.5	-77.0	-14.8	-6.2	-3.9	Factor payments to abroad (net)
1334.7	1616.0	1887.2	1612.8	1916.2	1921.3	100.0	100.0	100.0	GDP
564.7	529.0	732.2	539.2	781.2	848.0	40.2[a]	38.0	41.6	Imports of goods and N.F.S.
586.1	780.5	944.4	575.0	814.0	772.0	58.9[a]	53.8	44.3	Exports of goods and N.F.S.
1313.3	1384.5	1695.0	1597.0	1803.4	1997.3	81.3[a]	84.2	97.3	Total resources
554.9	574.2	662.0	543.0	593.7	912.0	47.3[a]	45.1	43.0	Private consumption
302.4	326.5	347.0	420.0	480.0	588.0	9.5[a]	14.2	23.0	General government consumption
456.0	483.6	686.0	634.0	489.7	497.3	24.6[a]	24.9	31.3	Gross domestic investment
(millions of kwacha)						Average annual growth rate (percent)			
554.6	879.3	967.7	968.9	977.0	939.5	8.7	6.0	2.8	GNP
-50.4	-44.2	-32.7	-29.0	-42.4	-39.3	. .	. .	. .	Factor payments to abroad (net)
905.0	923.5	1000.4	997.9	1019.4	978.8	5.6	5.0	2.8	GDP
425.0	353.0	385.5	366.9	249.6	224.2	. .	7.6	-7.9	Imports of goods and N.F.S.
410.0	386.5	414.4	419.4	446.3	420.9	. .	2.1	1.9	Exports of goods and N.F.S.
920.0	890.0	971.5	945.4	822.7	782.1	6.5	7.9	-0.9	Total resources
393.0	371.4	383.7	408.5	383.8	356.4	5.7	5.9	-1.2	Private consumption
220.0	214.0	212.5	228.1	238.6	251.3	8.6	11.0	5.0	General government consumption
307.0	304.6	375.0	308.8	202.3	164.4	7.5	10.6	-5.9	Gross domestic investment
(millions of kwacha)						As percentage of GDI			
456.0	483.6	686.0	634.0	489.7	497.3	100.0	100.0	100.0	Gross domestic investment
403.3	638.0	816.0	302.8	463.0	344.3	116.0	138.8	96.3	Gross national savings (excluding net current transfers from abroad)
-52.7	174.2	130.0	-331.2	-26.7	-153.0	16.0	38.8	-3.7	Net balance of goods and services
373.5	824.8	897.7	211.3	379.8	279.8			54.2	Gross national savings (including net current transfers from abroad)
						Average annual growth rate (percent)			
111.7	118.5	128.9	141.8	168.7	201.7		5.0	10.0	Consumer price (or retail price) index
98.9	121.0	138.7	128.2	153.2	152.1		4.5[a]	9.4	Wholesale price index
97.5	115.7	124.7	106.8	124.3	129.7	6.9	7.6	4.3	Implicit GDP deflator
(annual average)									
0.714	0.648	0.936	0.745	0.774	0.759				Foreign exchange rate

Source: World Bank. 1980.

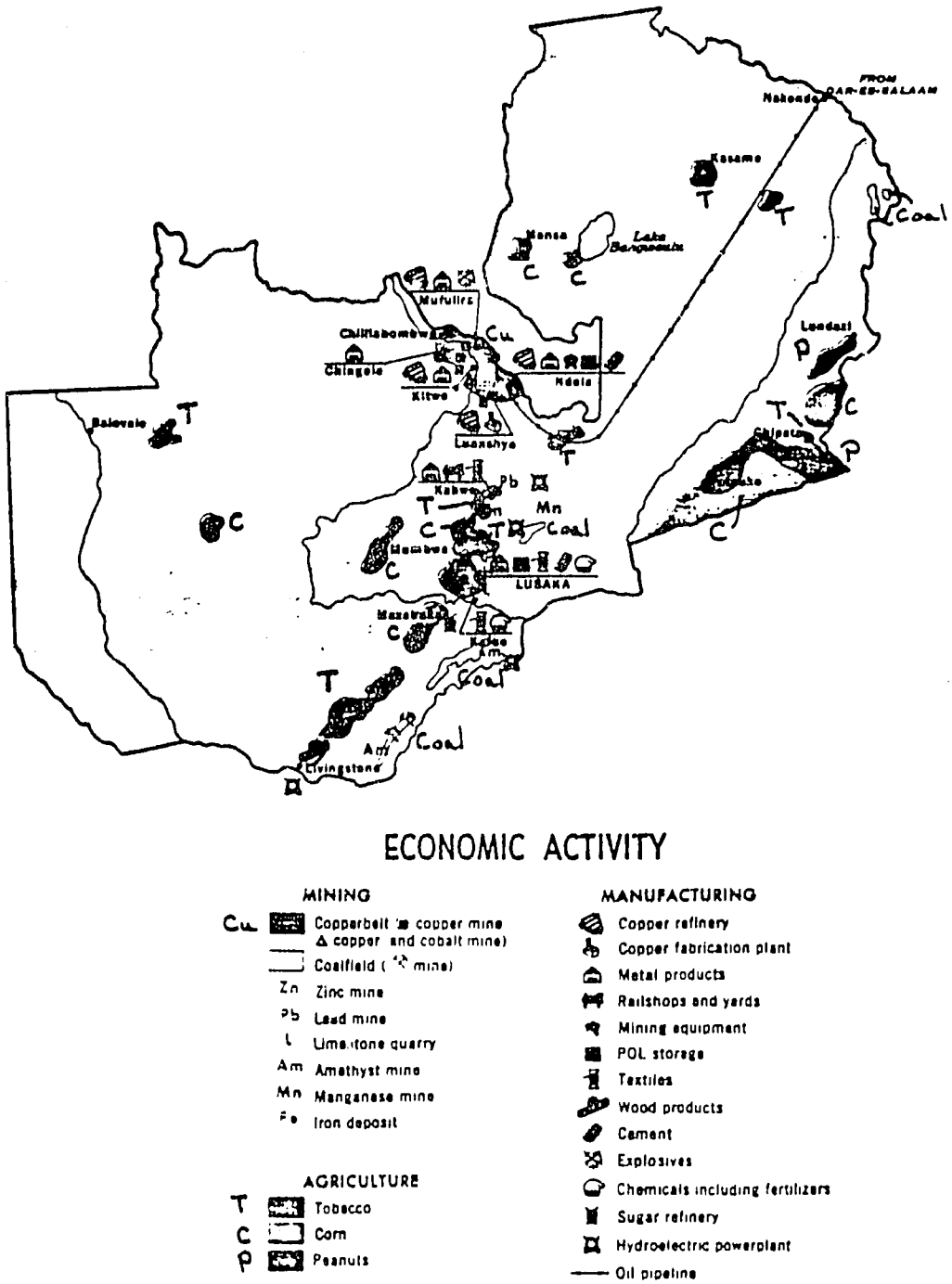


Figure 1. Map of Economic Activity

Source: Available from U.S. GPO Map 77374. 8-70.

Table 2. Agricultural Production

Production by Commodity, Value and Indices of Total Agricultural and Food Production, Average 1961-65, Annual 1970-79

Commodity	Average 1961-65	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	1,000 Metric Tons										
Corn	187	124	374	572	383	563	575	750	696	576	333
Sorghum	341	445	339	275	275	275	275	275	275	250	200
Potatoes	3	4	6	6	15	44	50	55	55	55	55
Cassava	145	143	145	175	174	173	172	170	170	173	180
Tobacco	9	5	6	6	7	7	7	7	6	4	5
Cotton	0	2	4	3	2	1	1	1	2	3	5
Cottonseed	1	4	8	5	4	2	2	2	4	6	9
Peanuts, in shell	15	15	33	32	30	31	30	30	31	39	59
Sugar, raw	0	40	42	51	58	65	80	90	85	90	95
Aggregates of Production	Million Dollars at Constant Prices										
Crops	35.4	37.1	47.2	53.4	47.3	57.7	60.7	68.1	65.1	59.5	52.2
Livestock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Agriculture	35.4	37.1	47.2	53.4	47.3	57.7	60.7	68.1	65.1	59.5	52.2
Total Food	27.4	32.0	40.5	47.1	40.5	51.3	54.3	61.7	59.2	54.9	46.0
Indices of Production	(1961-65 = 100)										
Crops	100	105	133	151	134	163	171	192	184	168	147
Total Agriculture	100	105	133	151	134	163	171	192	184	168	147
Total Food	100	117	148	172	148	187	198	225	216	200	168
Per Capita Agriculture	100	86	106	116	100	118	120	131	121	108	92
Per Capita Food	100	95	117	132	110	136	139	153	143	128	104
Index of Population 1961 65 Population = 3,464,000	100.0	122.4	126.1	128.9	133.9	138.1	142.5	147.0	151.6	156.3	161.1

Source: USDA. 1980.

Table 3. Quantities of Marketed Agricultural Production, 1964-1975

Commodity	Unit	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Maize	tons	204,270	263,000	348,720	383,080	233,830	273,990	133,200	399,950	616,554	460,480	495,000	558,376	746,426
Tobacco														
Flue Cured	tons	10,960	6,600	6,566	4,930	6,280	5,020	4,792	5,908	5,532	6,230	6,201	6,466	6,262
Burley	tons	1,703	1,993	855	275	285	240	255	388	385	471	430	502	211
Oriental	tons	297	526	213	131	114	75	8	4	---	---	---	---	---
Sugar Cane	tons	---	---	---	---	183,000	257,000	322,000	331,000	397,400	488,000	570,243	768,153	860,000
Groundnuts	tons	3,630	6,760	11,530	4,810	5,390	7,828	3,270	5,970	6,480	2,960	3,435	6,511	8,371
Sunflower Seed	tons	---	---	---	---	---	---	---	16	163	1,050	3,519	9,750	13,097
Soya Beans	tons	---	---	---	---	---	---	---	---	---	173	400	683	944
Ser - Cotton	tons	1,649	2,273	2,778	831	4,252	6,915	5,606	11,919	8,453	5,225	2,564	2,500	4,500
Sorghum	tons	---	---	24	727	3,543	1,181	545	90	212	34	350	57	23
Fruit	tons	2,600	2,400	2,500	2,600	2,200	3,100	4,800	5,600	5,900	5,500	5,700	6,500	6,850
Vegetables	tons	13,500	13,000	14,100	15,200	15,500	17,200	21,000	24,100	27,700	20,000	25,000	27,408	28,000
Cattle	head	71,000	69,000	63,000	55,000	47,000	49,000	68,000	68,000	72,443	90,000	80,654	84,000	77,000
Pigs	head	16,000	17,000	20,000	22,000	25,000	27,000	35,000	34,000	32,000	35,700	44,280	52,800	55,440
Chickens	1000 head	650	905	1,410	2,100	3,200	3,800	4,000	4,425	5,500	6,100	9,673	9,600	11,000
Turkeys and Ducks	1000 head	---	---	27	33	40	46	50	25	40	30	---	---	---
Eggs	millions	17	22	27	36	54	93	99	108	115	123	140	150	178
Milk	tons	20,500	19,770	19,020	18,330	18,430	16,260	15,610	16,000	16,586	16,700	n.a.	n.a.	n.a.
Day Old Chicks	1000 head	---	---	---	---	280	440	665	910	1,100	1,250	1,112	1,330	1,480

Source: World Bank. 1977.

Table 4. Labor Force

a.

ECONOMICALLY ACTIVE POPULATION
(ILO estimates, '000 persons at mid-year)

	1900			1970		
	Males	Females	Total	Males	Females	Total
Agriculture, etc.	679	354	1,033	833	382	1,215
Industry	78	13	92	118	29	146
Services	113	75	188	169	139	307
TOTAL	870	443	1,313	1,119	550	1,669

Mid-1978 (estimates in '000): Agriculture, etc. 1,377; Total 2,047

b.

EMPLOYMENT
('000 employees, average for June and December)

	1970	1971	1972	1973	1974	1975	1976	1977†
Agriculture, forestry and fishing	34.3	38.6	37.0	36.7	38.7	36.3	33.0	32.5
Mining and quarrying	37.1	58.1	57.9	62.0	64.4	65.8	65.6	68.1
Manufacturing	37.5	41.3	41.7	42.0	42.4	44.5	43.1	40.6
Electricity, gas and water	3.1	4.1	4.8	5.6	4.6	5.0	5.5	5.5
Construction	69.1	68.0	69.7	75.8	69.6	72.8	52.5	45.5
Trade, restaurants and hotels	33.1	35.9	37.0	36.2	34.6	34.6	35.2	35.8
Transport, storage and communications	22.8	22.4	16.2	25.8	23.4	22.2	21.0	21.3
Financing, insurance, real estate and business services	9.1	10.4	11.7	13.2	15.5	16.3	17.9	19.5
Community, social and personal services*	74.3	83.2	80.3	83.3	89.4	96.7	98.6	100.0
TOTAL	340.4	362.0	366.2	380.6	376.6	396.2	374.0	372.5

* Excluding domestic services † At June.

Source: Europa. 1980.

Table 5. Principal Trading Partners

a. DIRECTION OF EXPORTS (million US dollars)

	1976	1977	1978*
Japan	170.3	157.0	153.1
United Kingdom	141.6	143.6	116.8
United States	169.6	92.8	109.5
France	66.5	82.2	73.5
West Germany	145.3	129.6	66.6
Italy	98.1	94.3	65.3
China	27.0	29.0	31.9
Yugoslavia	22.8	15.3	28.5
Belgium	29.8	35.8	22.7
India	54.9	20.1	22.1
TOTAL (including others)	1,043.8	897.3	779.1

*Data partly extrapolated and/or derived from partner country.

b. DIRECTION OF IMPORTS (million US dollars)

	1976	1977	1978*
United Kingdom	158.0	154.0	134.1
Saudi Arabia	87.9	83.1	78.9
West Germany	46.5	79.5	62.3
South Africa	49.9	48.8	53.6
United States	70.9	73.0	44.3
Italy	38.2	22.6	30.9
Japan	31.8	32.2	26.0
Bahrain	..	..	24.1
Sweden	16.2	21.4	19.8
Yugoslavia	8.3	8.0	16.4
TOTAL (including others)	654.8	671.6	639.6

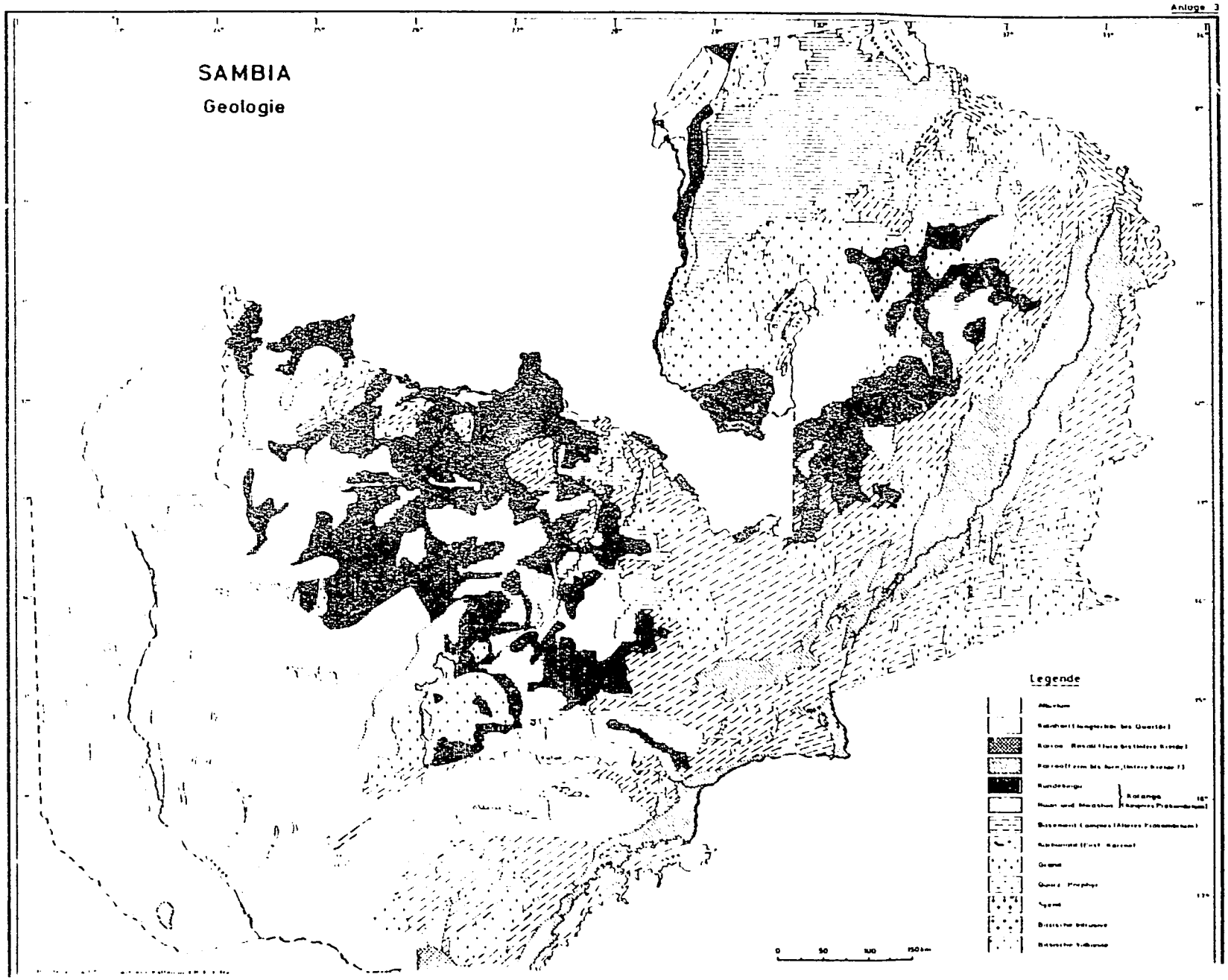
*Data partly extrapolated and/or derived from partner country.

Source: Legum. 1981.

Appendix IV

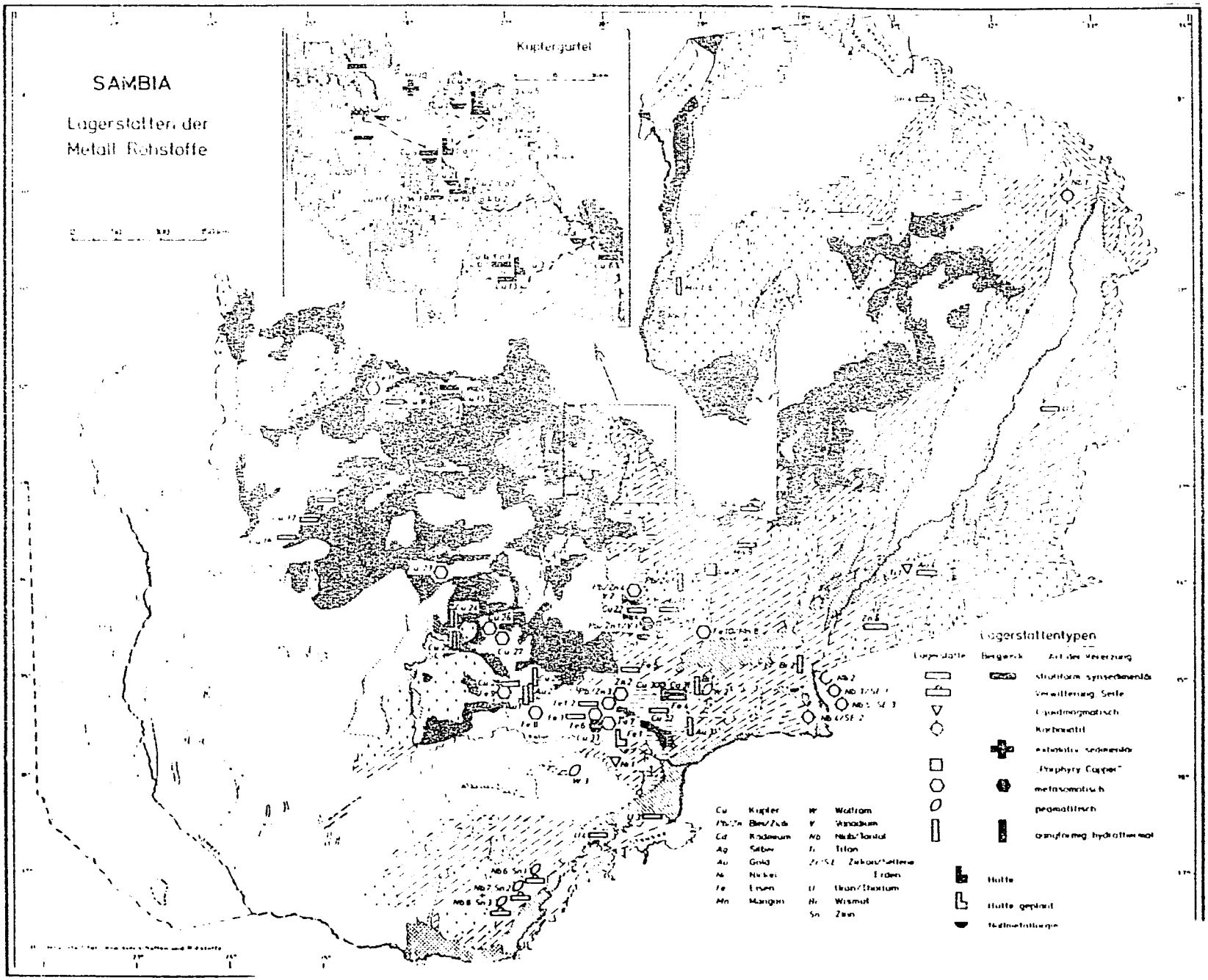
Geology and Mineral Resources

Figure 1. Geology (Base Map for Figures 2 - 4)



Source: Trurnit. 1979.

Figure 2. Deposits of Metals



Source: Trurnit, 1979.

Symbols on Figure 2

Kupfer

Cu 1 - Mufulira
Cu 2 - Luansobe
Cu 3 - Mutundu
Cu 4 - Ngala
Cu 5 - Mokambo
Cu 6 - Bwana Mkubwa
Cu 7 - Konkola-Kirila Bomwe
Cu 8 - Chingola
Cu 9 - Chambishi
Cu 10 - Nkana-Mindola
Cu 11 - Chibuluma
Cu 12 - Kalulushi-Ost
Cu 13 - Luanshya
Cu 14 - Baluba
Cu 15 - Kansanshi
Cu 16 - Lumwana
Cu 17 - Kalengwa
Cu 18 - Mufumbwe
Cu 19 - Chifue
Cu 20 - Samba
Cu 21 - Mtuga
Cu 22 - Sebembere
Cu 23 - Chifumpa
Cu 24 - Kasonso
Cu 25 - Hippo
Cu 26 - Silver King
Cu 27 - Sable Antelope
Cu 28 - Chanobie
Cu 29 - Lewis
Cu 30 - Allies
Cu 31 - Chongwe East
Cu 32 - Chalimbana
Cu 33 - Nampundwe

Blei/Zink

Pb/Zn 1 - Broken Hill (Kabwe)
Zn 2 - Star Zinc
Pb/Zn 3 - Excelsior
Pb/Zn 4 - Carmanor
Pb/Zn 5 - Millberg
Zn 6 - Nyimba

Gold

Au 1 - Dunrobin (Luiri)
Au 2 - Matala
Au 3 - Chumbwe (Nsofu)
Au 4 - Sasare

Kobalt

Co 1 - Nkana-Mindola
Co 2 - Chibuluma
Co 3 - Baluba
Co 4 - Chingola

Nickel

Ni 1 - Munali

Eisen

Fe 1 - Pamba Hills
Fe 2 - Mutombe
Fe 3 - Nagaibwa
Fe 4 - Chongwe
Fe 5 - Chisamba
Fe 6 - Chota
Fe 7 - Sanje
Fe 8 - Shimyoka (Namantombwa)
Fe 9 - Nambala-Sonkwe
Fe 10 - Kampumba
Fe 11 - Chisasa

Mangan

Mn 1 - Bahati
Mn 2 - Kitakwe
Mn 3 - Lukwina
Mn 4 - Chipuzi
Mn 5 - Mulozi
Mn 6 - Chemesi
Mn 7 - Luwama
Mn 8 - Kampumba
Mn 9 - Chiwefwe
Mn 10 - Luano
Mn 11 - Chowa

Wolfram

W 1 - Chibuluma
W 2 - "Pollards Scheelite"
W 3 - "Parke Scheelite Prospect"

Vanadium

V 1 - Broken Hill (Kabwe)
V 2 - Carmanor

Niob und Tantal

Nb 1 - Nkombwa Hill
Nb 2 - Kaluwe
Nb 3 - Nachomba
Nb 4 - Mwambuto
Nb 5 - Chaswela
Nb 6 - Masuku ("Buffalo Claims", Chisuki, Nkeni)
Nb 7 - Chimwami
Nb 8 - Kabanga

Titan

Ti 1 - Chinkombe

Seltene Erden

SE 1 - Nachomba
SE 2 - Mwambuto
SE 3 - Chaswela
SE 4 - Irumi Hills

Wismut

Bi 1 - "Bismuthia" (Darg, Cairn Dhu, Shapola, Devonshire)
Bi 2 - Nchoncho

Zinn

Sn 1 - Masuku (Chisuki, Terne, Muzuma)
Sn 2 - Chimwami
Sn 3 - Kabanga (Chitende, Chaboola, Machinga)
Sn 4 - Mbala-Chambeshi

Uran und Thorium

U 1 - Chingola
U 2 - Nkana-Mindola
U 3 - Bungua
U 4 - Kariba-See
U 5 - Njame, Mutanga, Dibwe

Hütten

Kupfer

Cu 1 - Mufulira
Cu 2 - Rokana (Kitwe)
Cu 3 - Luanshya

Kobalt

Co 1 - Chambishi
Co 2 - Rokana

Blei/Zink

Pb/Zn 1 - Broken Hill (Kabwe)

Stahl

Fe 1 - Kafue

Naßmetallurgie

Kupfer

Cu 1 - Chingola
Cu 2 - Chambishi

Zink

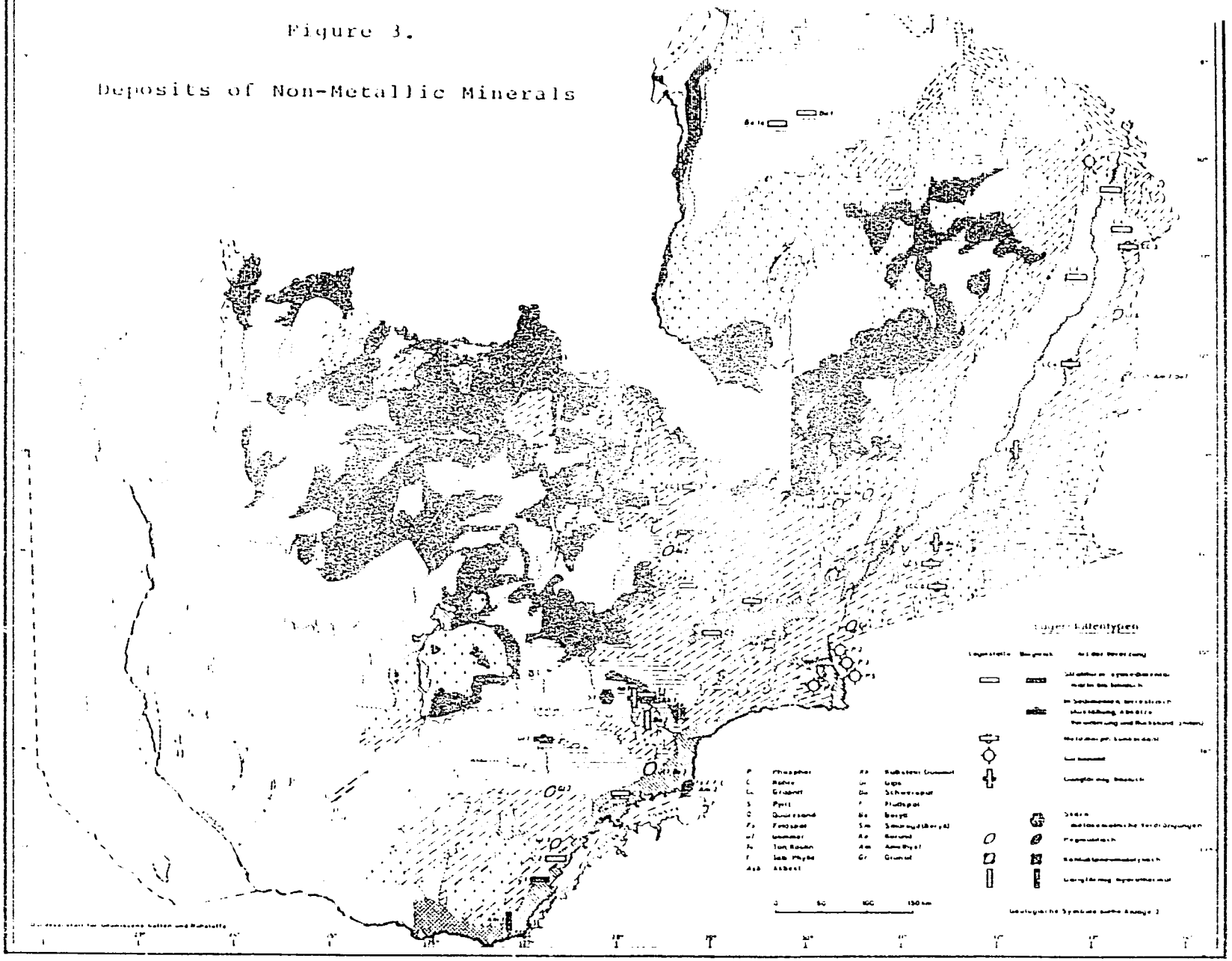
Zn 1 - Broken Hill (Kabwe)

Raffinerien

Cu 1 - Mufulira
Cu 2 - Rokana
Cu 3 - Ndola (Cu-und Edelmetalle)

Figure 3.

Deposits of Non-Metallic Minerals



Source Trurnit. 1979.

Symbols on Figure 3

Graphit

CC 1 - Mwalemba
CC 2 - Luano
CC 3 - Kajumba
CC 4 - Njoka
CC 5 - Mkonda
CC 6 - Mvuvyo

Pyrit

S 1 - Nampundwe

Phosphat

P 1 - Nkombwa Hill
P 2 - Kaluwe
P 3 - Nachomba
P 4 - Mwambuto
P 5 - Chaswela

Quarzsand

Q 1 - Kapiri Mposhi

Feldspat

Fs 1 - Serenje
Fs 2 - Slavonga

Flußspat

F 1 - Slavonga

Glimmer

Gl 1 - Sachenga, Matagula
Gl 2 - Pemba
Gl 3 - Phoenix
Gl 4 - N Feira ("Great East Road")
Gl 5 - Aries
Gl 6 - Libra
Gl 7 - S und SE Serenje

Talk

T 1 - Lusaka

Asbest

As 1 - SW Lusaka
As 2 - Chinkombe
As 3 - Chirulu

Kalkstein, Dolomit

Kk 1 - Lusaka
Kk 2 - Kabwe
Kk 3 - Ndola

Gips

Gi 1 - Lochnivar

Schwerspat

Ba 1 - SW Mporokoso
Ba 2 - E Kafue

Amethyst

Am 1 - Snamane (Simani)
Am 2 - Slavonga
Am 3 - Aries

Smaragd (Beryll)

Sm 1 - Miku

Beryll

Be 1 - Aries
Be 2 - SW Kapiri Mposhi
Be 3 - Sachenga, Siakalinda

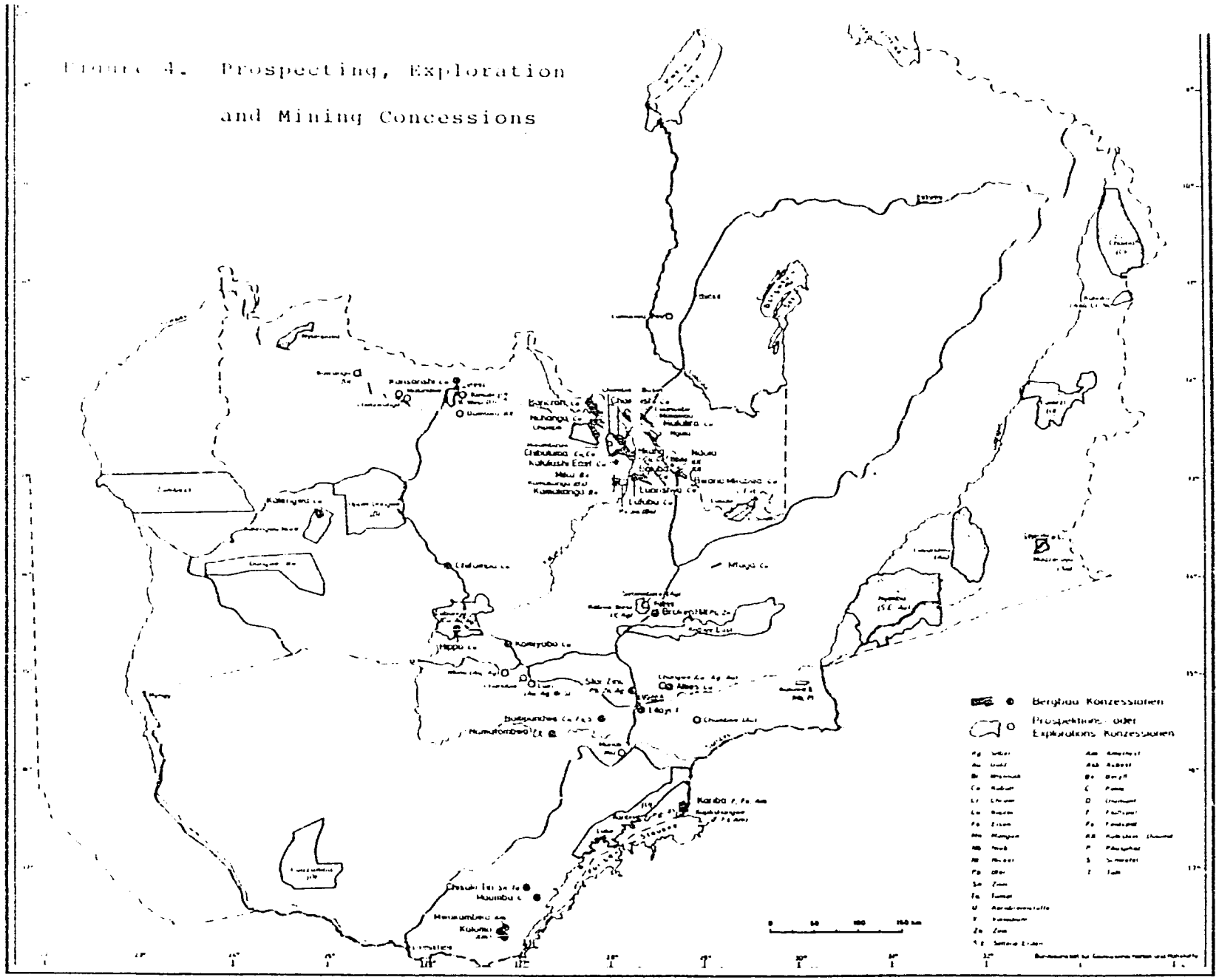
Korund

Ko 1 - N Rufunsa

Kohle

C 1 - Siankandobo (Maamba)
C 2 - Nkandabwe
C 3 - Gwembe
C 4 - Luangwa-Graben (NE)
C 5 - Luano-Graben

Figure 4. Prospecting, Exploration and Mining Concessions



Source: Trurnit. 1979.

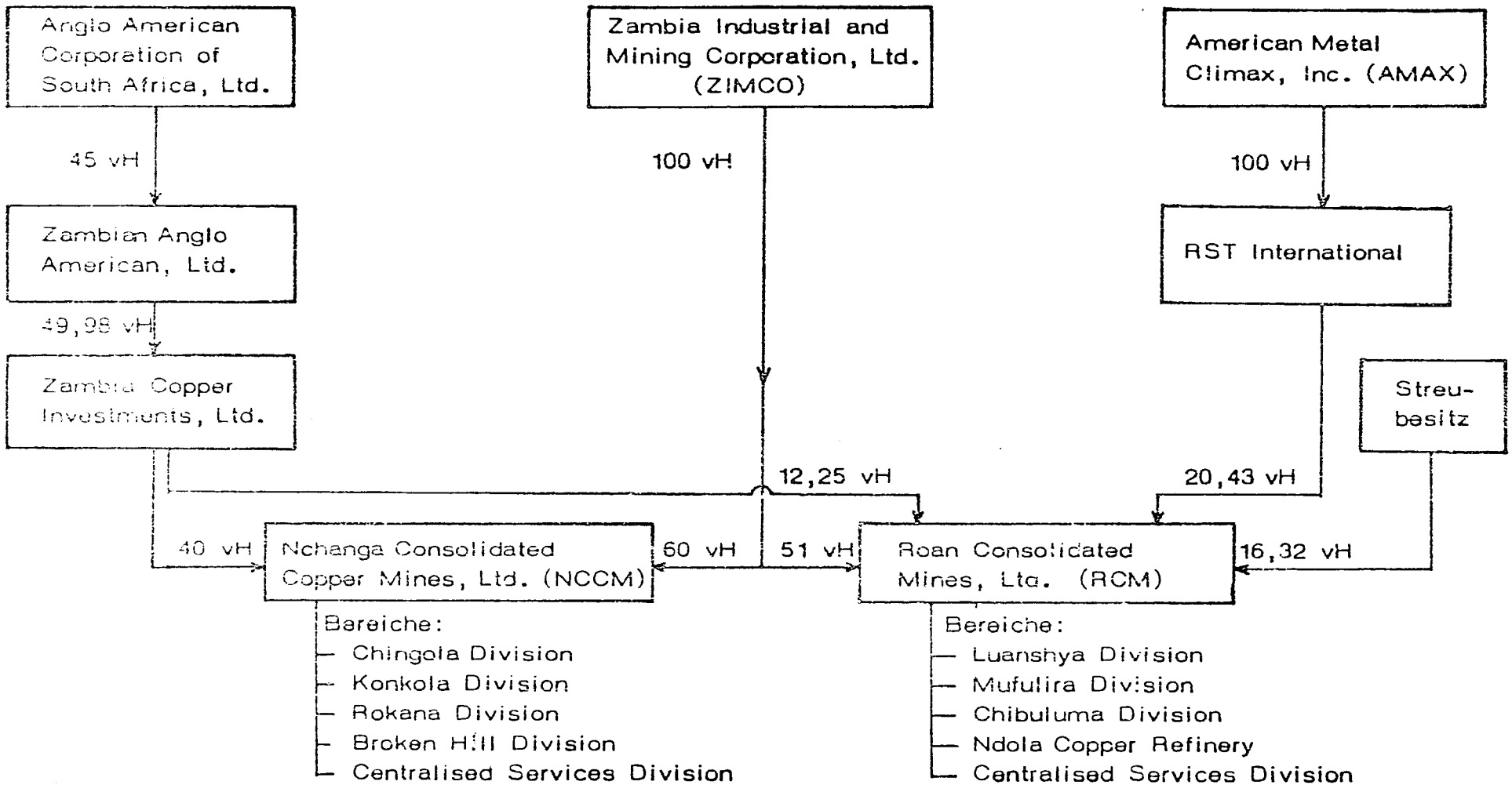


Figure 5. Structure of RCM, NCCM

Source: Trurnit. 1979.

Table 1. Direction of Copper Exports (in t)

Year:	1973	1974	1975	1976
Production: Concentrate	706.574	697.956	676.921	708.867
Raw Copper	683.000	709.500	659.028	705.906
Electrolytic copper	638.309	676.654	629.150	694.943
Export of Raw Copper (total)	42.683	31.946	19.022	21.105
West Germany	-	-	-	520
France	-	747	-	-
Great Britain	10.893	9.816	11.612	11.612
Italy	750	-	-	159
Greece	86	-	2.427	-
Spain	-	2.192	1.021	346
Portugal	1.137	1.496	1.271	286
Austria	2.893	-	-	-
Yugoslavia	5.511	11.716	2.492	15.698
Japan	21.413	3.488	199	1.203
Others	-	2.491	-	1.006
Electrolytic Copper	627.153	649.774	616.058	712.346
West Germany	68.811	95.379	100.550	106.857
France	56.137	65.745	63.558	50.061
Great Britain	124.061	143.036	132.752	96.335
Belgium	4.925	8.916	13.701	17.778
Netherlands	7.697	4.916	5.815	1.275
Denmark	3.302	1.649	2.579	502
Italy	77.366	79.431	79.320	73.314
Greece	6.577	4.027	5.462	8.943
Spain	9.585	6.104	3.246	1.651
Austria	4.249	3.646	3.676	3.728
Switzerland	10.078	11.324	10.525	14.350
Sweden	6.335	8.007	14.712	16.847
Finland	1.102	1.500	1.379	2.020
Yugoslavia	4.510	8.967	18.036	183
USA	4.800	729	5	125.773
Brazil	33.847	29.184	16.434	-
Egypt	851	296	2.948	1.800
India	29.905	20.514	7.575	39.538
Japan	160.811	137.931	113.644	124.316
Peoples Republic China	10.000	7.997	17.479	23.000
Others	2.564	476	2.662	7.075

Source: Trurnit, 1979.

Appendix V

Agriculture

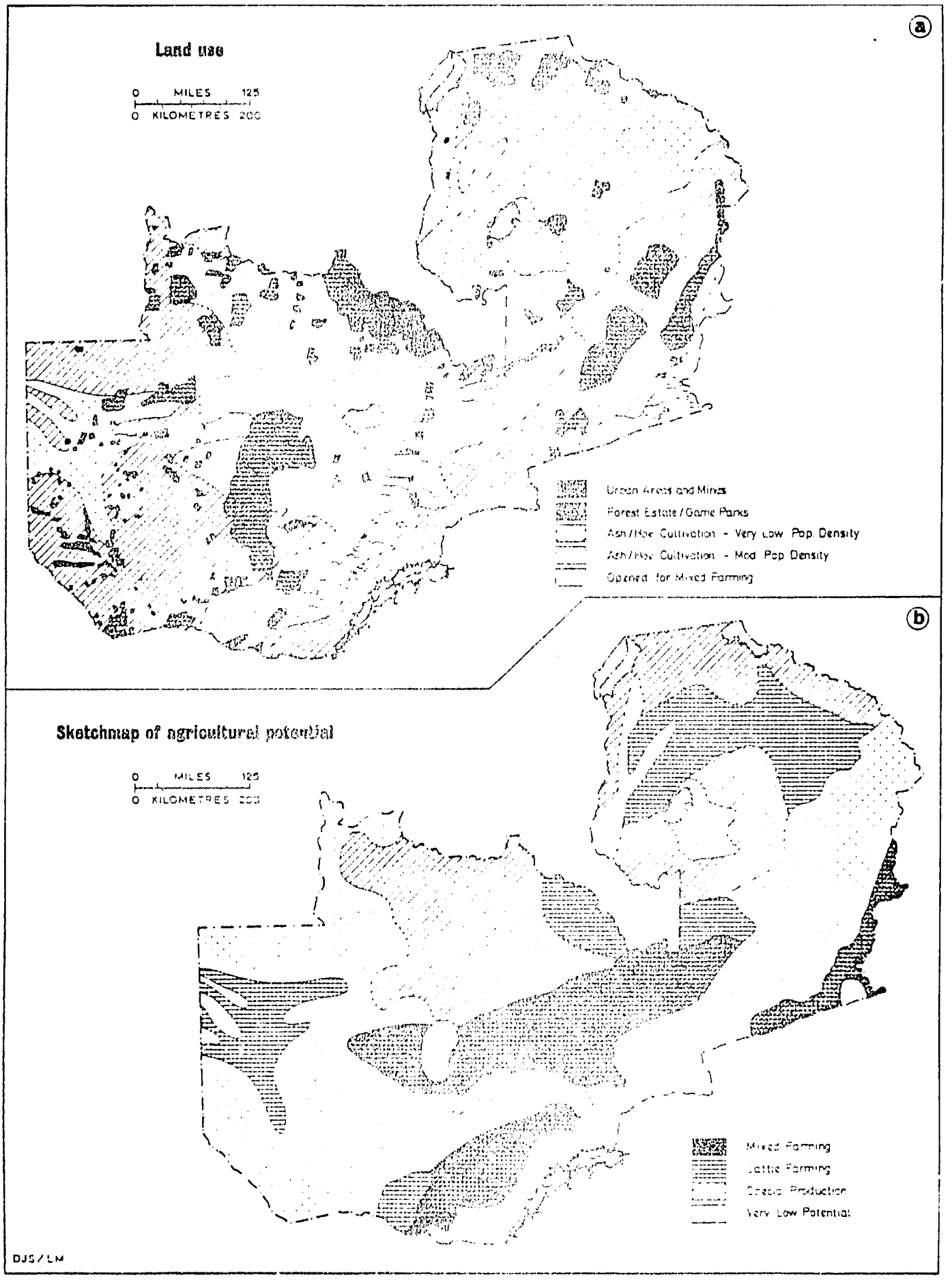


Figure 1. Land Use and Agricultural Potential

Source: Davies, 1971.

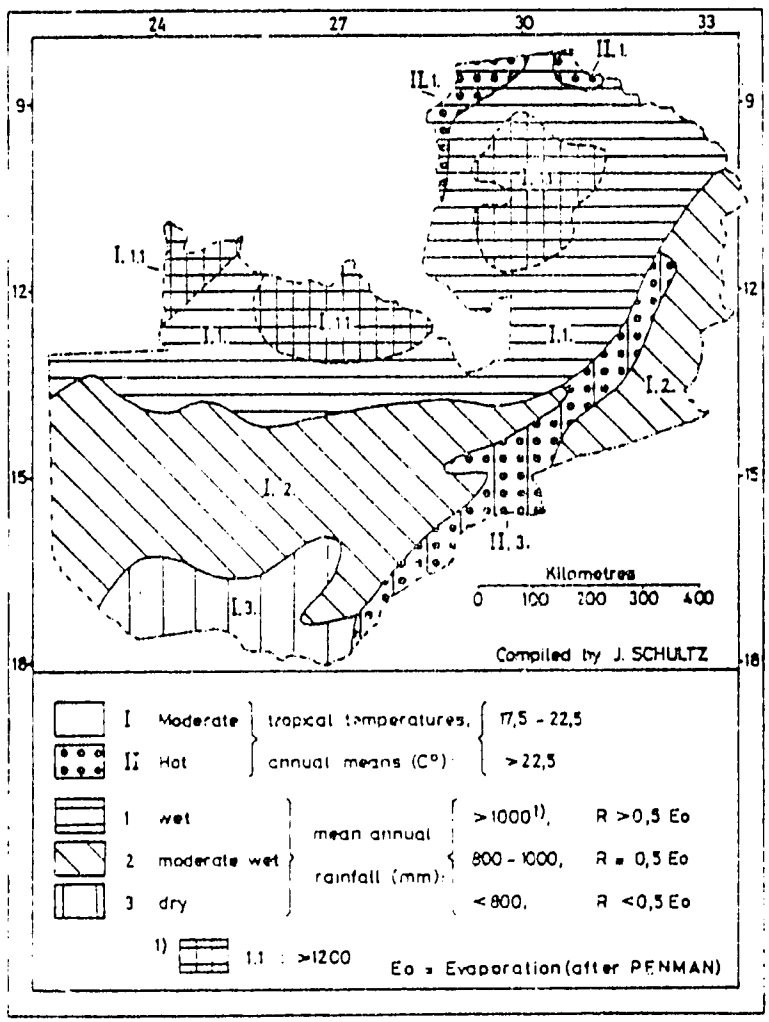


Figure 2. Main Agroclimatic Regions

Source: Schultz. 1976.

Table 1. Land Use and Population Distribution, by Provinces

(Unit: sq. km.)

Province	Total area	Main State Land areas		Forest estates (other than under 3)1)		National Parks (other than under 3)		Hilly areas (other than under 5 and 7)		Lake		Area liable to flood and swamp (other than under 5 and 7)		Cropped[1] area (incl. fallow land)		Unused woodland (other than 9)		Total population	Population density per sq. km	Rural population	Rural population per square kilometre of		
		abs	%	abs	%	abs	%	abs	%	abs	%	abs	%	abs	%	abs	%				rural area	cropped area and unused woodland	cropped area
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Copperbelt	31,330	7,780[2]	24.8	3,584	11.4	Nil	Nil	585	1.9	Nil	Nil	3,416	10.9	3,835	11.0	12,360	39.4	818,000	2.8	72,000	3.1	5.3	19.8
Northern	147,810	Nil	Nil	5,305	3.6	17,455	11.8	17,442	11.8	2,873	1.8	25,423	17.2	52,816	35.8	26,396	17.8	545,000	3.9	531,000	3.6	6.7	10.0
Luapula	50,560	Nil	Nil	1,428	2.8	1,399	2.8	5,612	11.1	4,090	8.1	9,202	18.2	11,629	23.0	17,290	34.0	338,000	6.6	320,000	6.3	11.1	27.5
North-western	125,830	Nil	Nil	24,296	19.3	6,833	5.5	3,523	2.8	Nil	Nil	12,708	10.1	12,331	9.8	66,037	52.5	232,000	1.9	232,006	1.9	[illegible]	10.5
Eastern	68,100	1,707	2.5	8,849	12.8	4,102	5.9	16,880	24.4	Nil	Nil	484	0.7	14,848	21.5	22,259	32.2	510,000	7.2	474,000	7.0	[illegible]	31.0
Central	118,290	8,864[3]	7.8	5,117	4.4	10,518	9.3	23,724	20.4	Nil	Nil	10,884	8.4	17,782	15.3	38,111	33.8	713,000	8.2	305,000	2.8	[illegible]	17.1
Southern	85,280	7,337[4]	8.8	6,783	7.8	9,520	11.2	10,745	12.8	2,478	2.8	10,168	11.8	14,283	16.7	24,006	28.2	698,000	5.8	358,000	4.8	8.4	25.0
Western	126,600	Nil	Nil	8,800	5.2	8,938	7.1	Nil	Nil	Nil	Nil	32,106	25.4	14,536	11.5	64,222	50.8	410,000	3.2	395,000	3.1	5.0	27.2
Zambia	752,800	25,848	3.4	61,944	8.2	58,353	7.8	78,501	10.4	9,238	1.2	104,391	13.9	141,850	18.8	271,374	36.1	4,057,000	5.4	2,685,000	3.7	6.5	18.8

1) According to a list of forest estates as at 1st January, 1973, prepared by Forest Department, Ndola. This list includes also more recently gazetted and unsurveyed forest estates both of which could not be shown on the Land Use Map.

2) Incl. 2,283 sq.km forest estates.

3) Incl. 384 sq.km forest estates.

4) Incl. 298 sq.km forest estates and 88 sq.km National Park.

5) This category can be defined as land in which fields are made or former fields are still visible.

Source: Schultz, 1976.

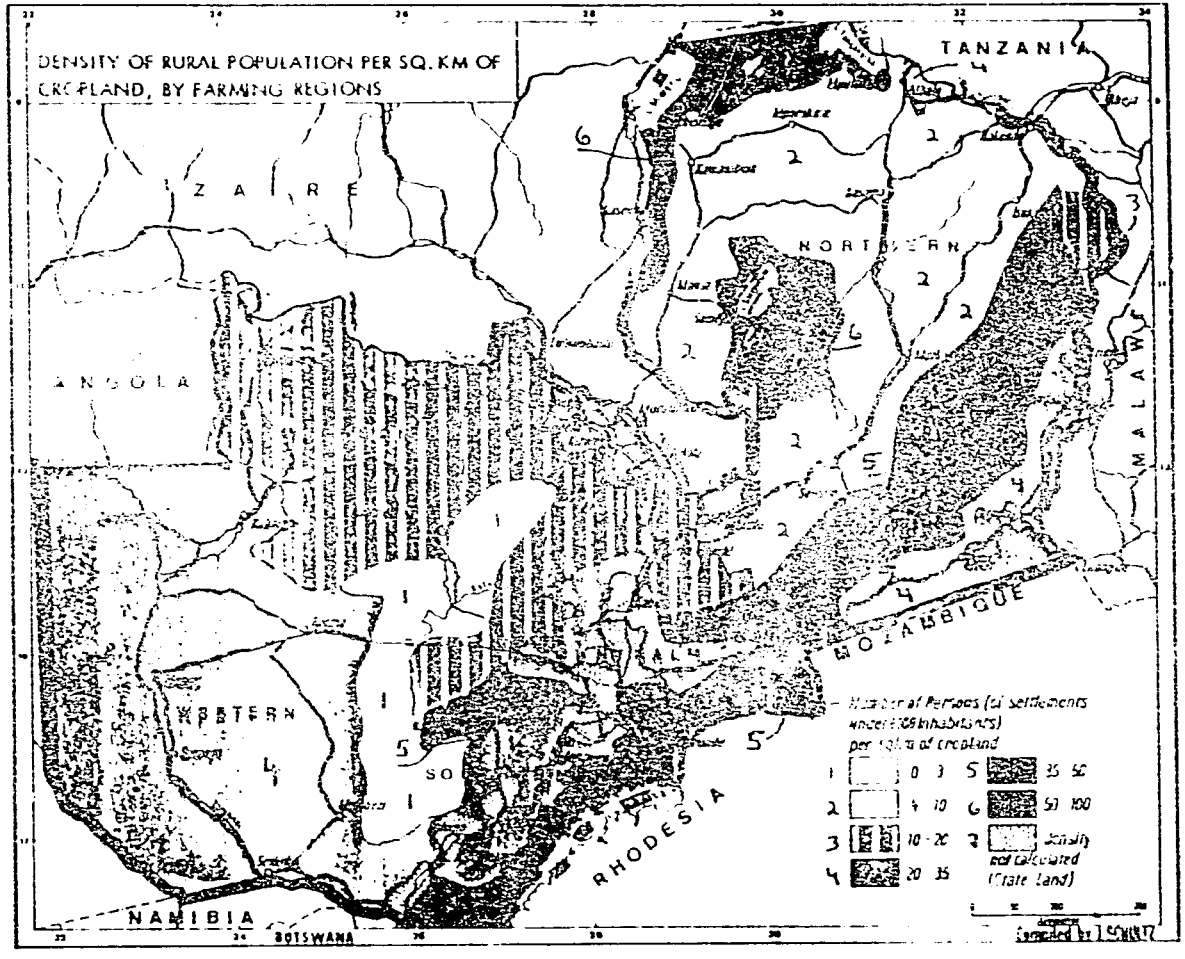


Figure 3. Density of Rural Population per Sq. Km of Cropland, by Farming Regions

Source: Schultz. 1976.

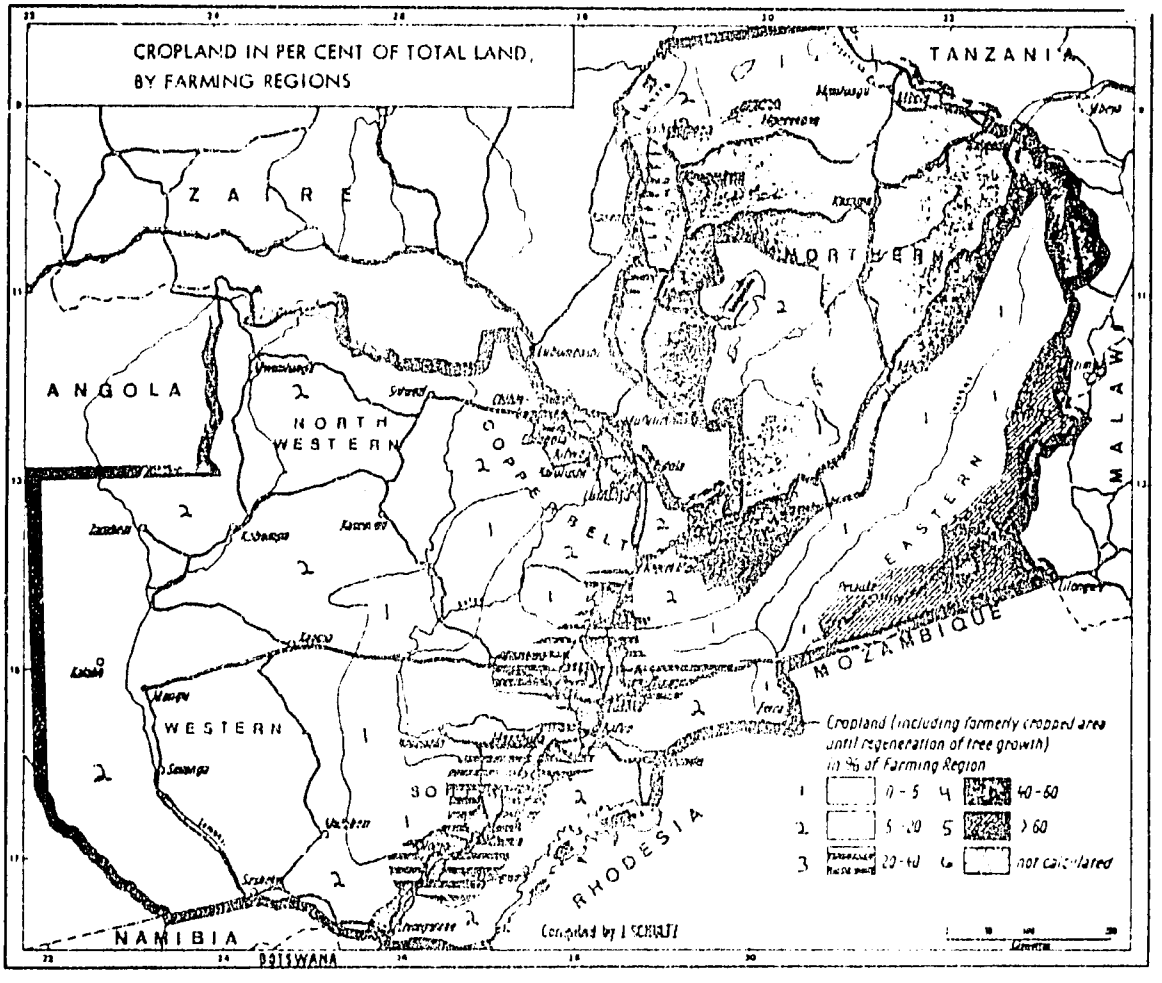


Figure 4. Cropland in Per Cent of Total Land, by Farming Regions

Source: Schultz. 1976.

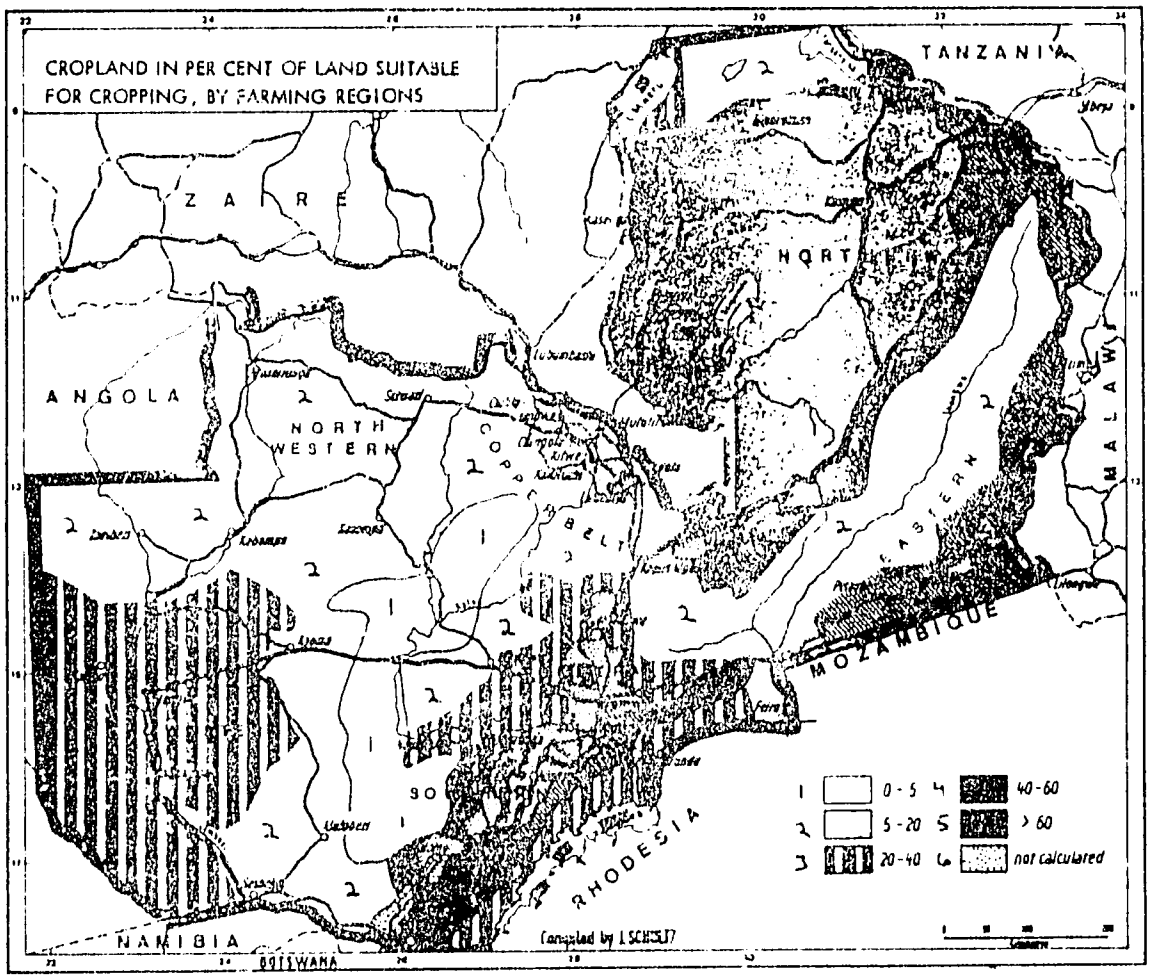


Figure 5. Cropland in Per Cent of Land Suitable for Cropping, by Farming Regions

Source: Schultz, 1976.

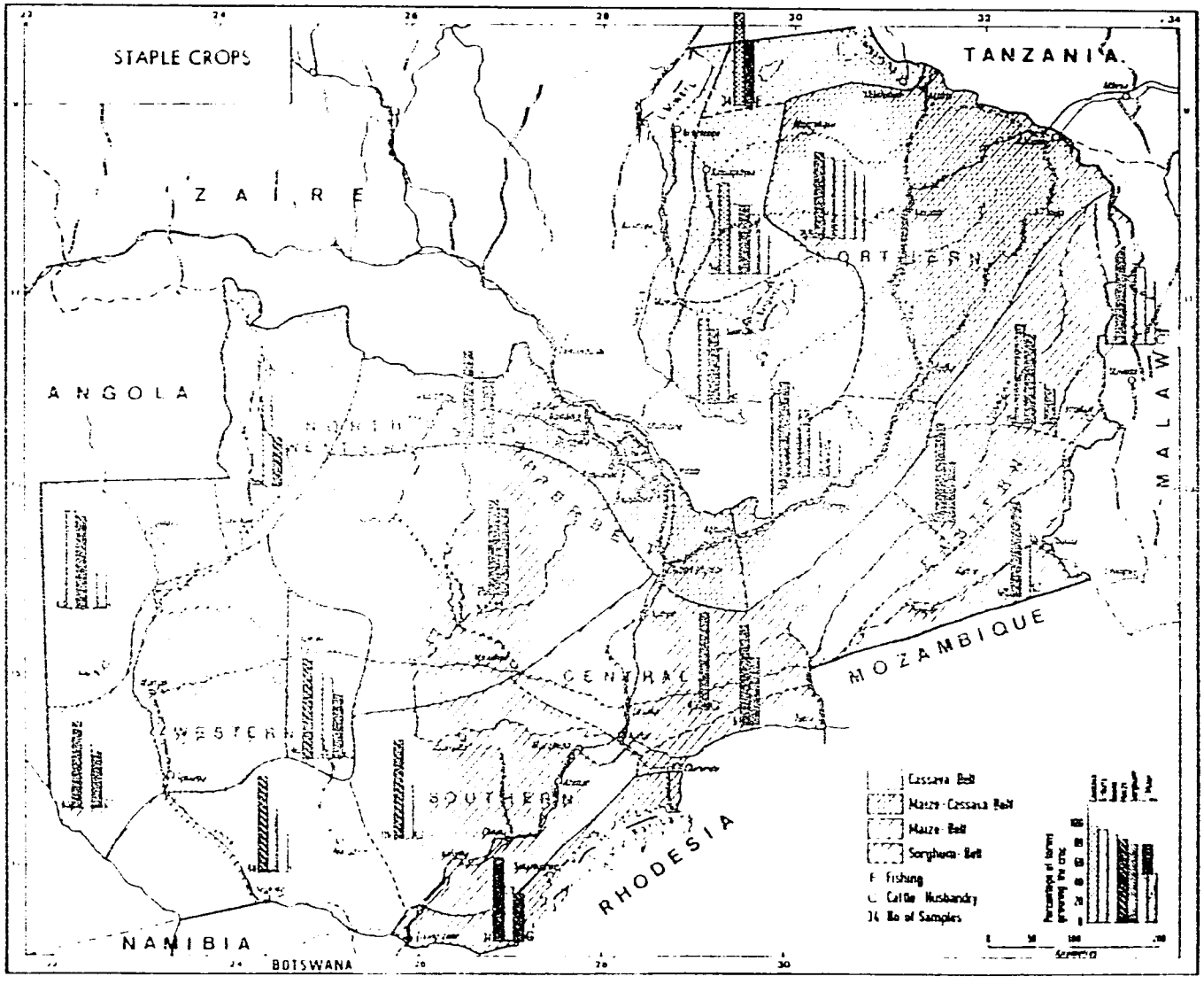


Figure 6. Staple Crops

Source: Schultz. 1976.

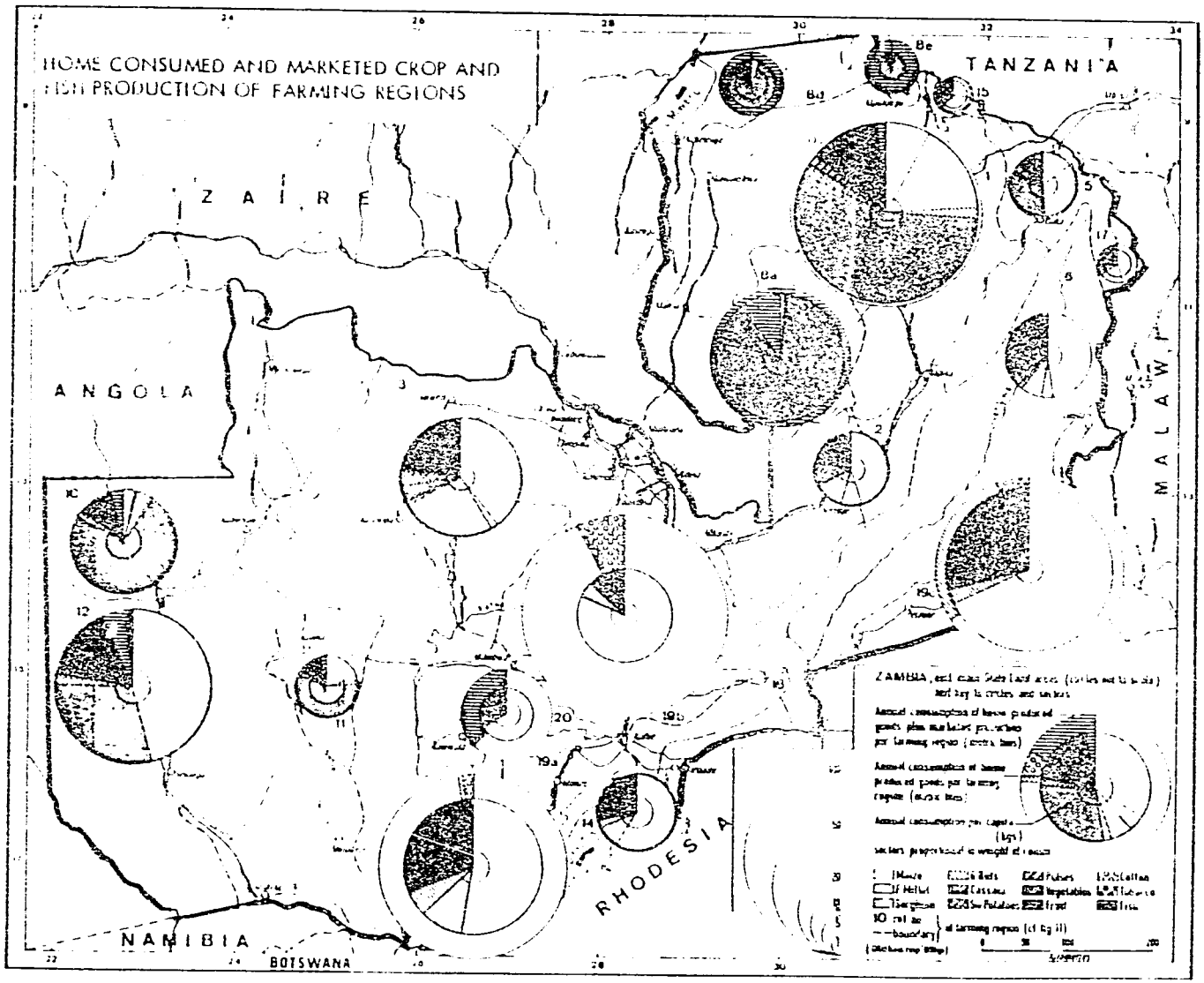


Figure 7. Home Consumed and Marketed Crop and Fish Production of Farming Regions

Source: Schultz. 1976.

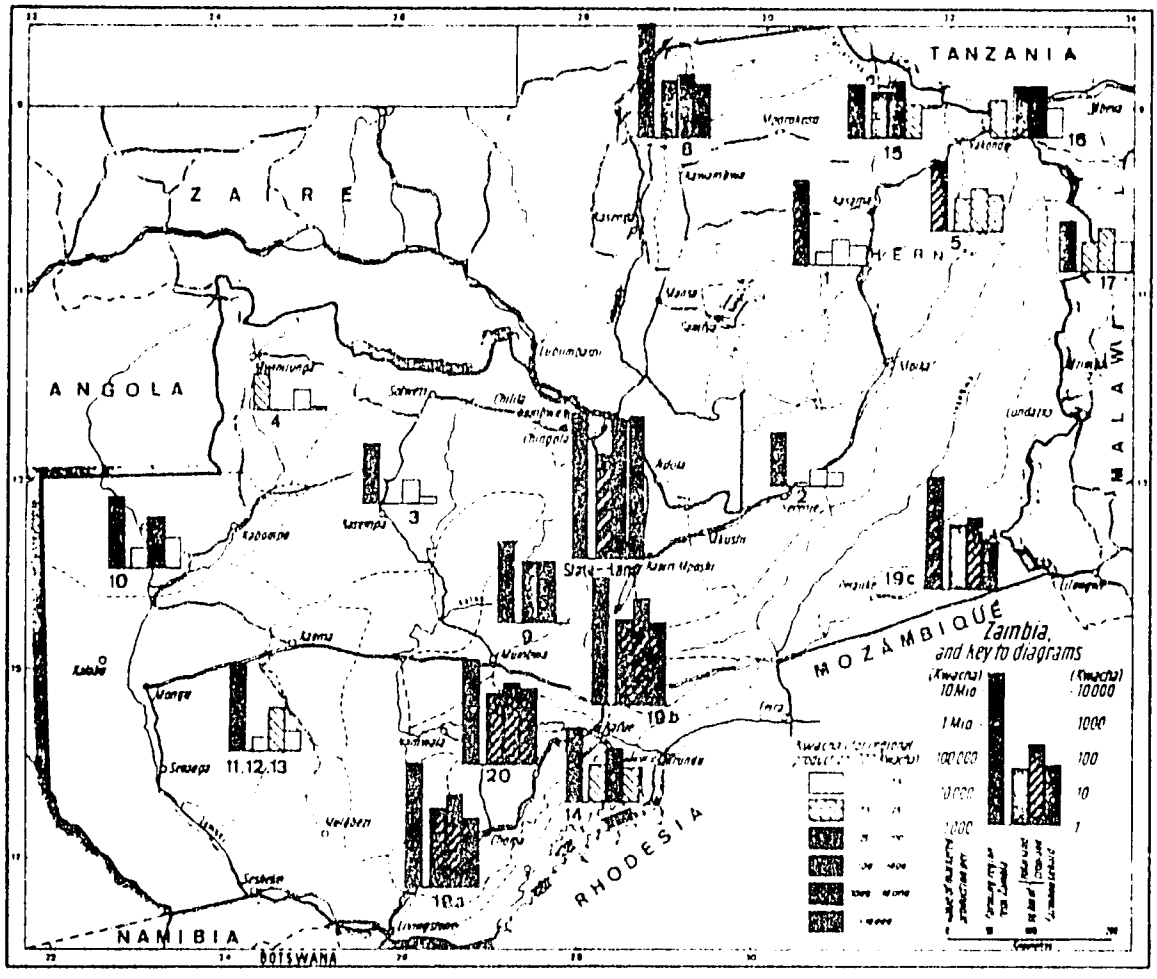


Figure 8. Value of Marketed Production, 1969 - 1972

Source: Schultz, 1976.

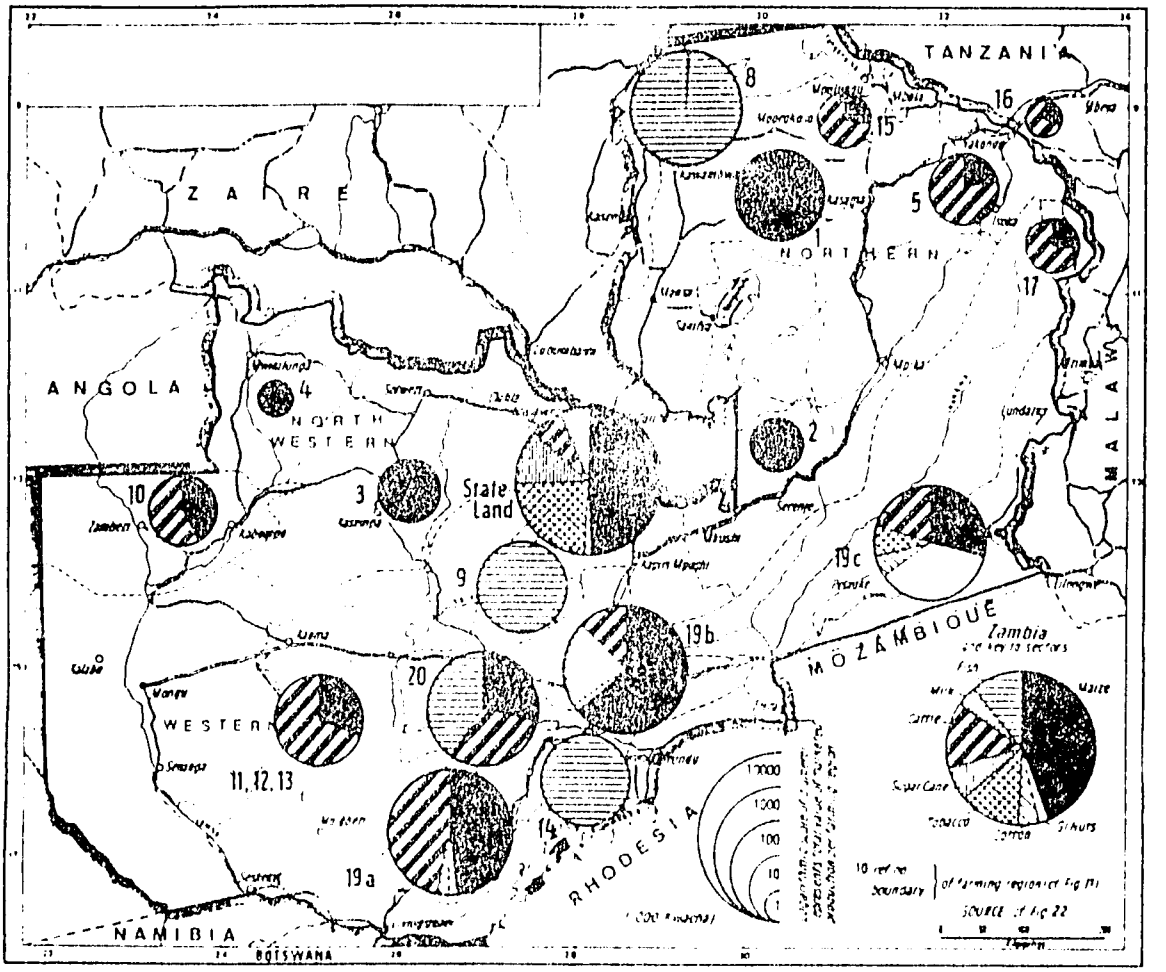


Figure 3. Main Commodities of Marketed Production, 1969 - 1972.

Source: Schultz, 1973.

Appendix VI

Fauna and Protected Areas

Table 1. Partial Listing of Zambian Mammals

Scientific Name	Common Name
ARTIODACTYLA (Even-toed Ungulates)	
Potomochoerus porcus	Bush Pig (Red River Hog)
Phacochoerus aethiopicus	Warthog
Hippopotamus amphibius	Hippopotamus
Giraffa camelopardalis	Giraffe
Cephalophus monticola	Blue Duiker (Maxwell's Duiker)
Cephalophus sylvicultor	Yellow-backed Duiker
Sylvicapra (Cephalophus) grimmia	Common Duiker (Grey Duiker)
Raphicerus campestris	Steinbok
Raphicerus (Nototragus) melanotis Sharpei spp.	Sharpe's Grysbok (Northern)
Ourebia ourebi	Oribi
Oreotragus oreotragus	Klipspriner
Tragelaphus scriptus	Bushbuck
Tragelaphus spekii	Sitatunga
Tragelaphus strepsiceros	Kudu
Taurotragus oryx Tragelaphus (Taurotgragus) oryx	Eland
Hippotragus equinus	Road antelope
Hippotragus niger	Sable antelope
Kobus ellipsiprymnus	Common waterbuck (Defassa waterbuck)
Kobus defassa	Defassa waterbuck
Kobus maraoni Kobus (Aaenora) kob	Puku
Kobus leche	Lechwe
Kobus leche smithemani	Black lechwe (Bangweolo)
Kobus leche kafuensis	Kafue lechwe (Brown lechwe)
Kobus leche leche	Red lechwe (Zambizi lechwe)
Redunca arundinum	Reedbuck (common reedbuck)
Damaliscus lunatus	Tsessebe (sassaby, korrigum, tiang, topi, hirola or Hunter's antelope)
Alcelaphus buselaphus lichtensteini	Lichtenstein's Hartebeest (spp.)
Connochaetes taurinus	Blue Wildebeest
Aepyceros melampus	Impala
Syncerus caffer	Buffalo (African buffalo)

Scientific Name	Common Name
PERISSODACTYLA (Odd-toed Ungulates)	
Hippotigris (Quagga) quagga	Burchell's zebra
Hippotigris burchelli	
Diceros bicornis	Black rhinoceros
Ceratotherium simum	White rhinoceros
HYRACOIDEA (Hyraxes)	
Denarohyrax arboreus	Tree dassie
Heterohyrax brucci	Yellow-spotted dassie (Rock Hyrax, Bruce's dassie)
PROBOSCIDEA (Elephants)	
Loxodonta africana	African elephant
TUBULIDENTATA (Aardvarks & Pangolins)	
Orycteropus afer	Aardvark
Manis temminchi	Pangolin
RODENTIA (Rodents)	
Paraxerus boehmi	Boehm's squirrel
Paraxerus cepapi	Bush squirrel
Heliosciurus gambianus and *H. rufobrachium*	Sun squirrel
Hystrix africaeaustralis	Porcupine
Cricetomys gambianus	Giant rat (Giant Gambian rat)
Pedetes capensis	Spring hare
Thryonomys sevinderianus	Cane rat
Lepus whytei	Hare (Whyte's hare)
CARNIVORA (Carnivores)	
Canus adustus	Side-striped jackal
Lycaon pictus	Wild dog (Hunting dog)
Poecilogale albinucha	African striped weasel (White-naped weasel)
Ictonyx striatus	Zorilla (Striped polecat)
Mellivora capensis	Honey badger (Ratel)
Lutra (Hyarictis) maculicollis	Spotted-necked otter
Aonyx capensis	Clawless otter (Cape clawless otter)
Genetta spp.	Genet
Viverra civetta	Civet (African civet)

Scientific Name	Common Name
Herpestes icheumon	Large grey mongoose (Egyptian mongoose)
Herpestes (Gallerella) sanguineus	Slender mongoose
Mungos mungo	Banded mongoose
Helogale parvula	Dwarf mongoose (Southern dwarf mongoose)
Proteles cristatus	Aard wolf
Crocuta crocuta	Spotted hyena
Panthera leo	Lion
Panthera paraus	Leopard
Acinonyx jubatus	Cheetah
Felis caracal (Caracal caracal)	Caracal
Felis suval (Leptailurus serval)	Serval
Felis lybica (Felis silvestris)	African wild cat (Kaffir cat)
LEMURIDAE (Primates)	
Galago crassicaudatus	Bush baby (Greater bushbaby)
Galago senegalensis	Night ape (Lesser Galago, Senegal bushbaby)
CERCOPITHECIDAE (Primates)	
Papio spp.	Babboon
Cercopithecus aethiops	Vervet monkey

Sources: Hanks. 1972.
Mitchell and Ansell. 1965

Table 2. Zambian Avifauna and Habitats

1. **Montane grasslands:** Nyika Plateau, Mafinga Mountains, above about 6,000 feet perhaps also small areas on the Mukutu Mountains. Typical of the grasslands are Coturnix coturnix Sarothrura affinis and Cisticola lais, and perhaps only on the Nyika, Francolinus levaillantii, Hirundo atrocaerulea, Cisticola ayresii and Euplectes psammocromius (this last in wetter grasslands near streams).

2. **Dry, wet and inundated grasslands:** While no completely rigid division between wetter or drier grasslands can be made, the following are more typical of dry grasslands: Ciconia abdimii, Elanus caeruleus, Otis denhami, Eupodotis senegalensis, Vanellus coronatus, Cursorius temminckii, Pterocles gutturalis, Mirafra africana, Eremopterix spp., Calendrella cinerea, Hirundo griseophyga Oenanthe pileata, Myrmecocichla nigra, Cicsticola juncidis and aridula, Anthus novaeseelandiae, vaalensis and Leucophrys, Euplectes progne, and Ortygospiza atricollis. On the other hand the following are more typical of wet grasslands: Grus caranculatus, Balearica pavonina, Coturnix chinensis, Crex egregia, Gallinago nigripennis, Macronyx spp., Cisticola brunnescens and natalensis, Schoenicola platyura. Euplectes macrourus and axillaris, Ortygospiza gabonensis and locustella, and Amandava subflava. Temporarily inundated grasslands on the periphery of larger areas of swamp are visited by various Ardeidae, Ciconiidae, Threskiornithidae, Anas spp., Plectropeterus gambensis, and Rostratula benghalensis.

3. **Swamp:** Such areas are merely the more or less permanently flooded portions of grasslands. Typical of dense reed growth and Papyrus, rather than of grasslands, are Ardea purpurea, Ardeola ralloides, Nycticorax nycticorax, Ixobrychus minutus, Circus aeruginosus, Limnocorax flavirostris, Sarothrura rufa, Centropus cupreicaudus, Alcedo cristata, Acrocephalus spp. (A. rufescens seems confined to Papyrus), Bradypterus baboecala, Cisticola galactotes and pipiens, Amblyospiza albifrons, Quelea erythrops and Euplectes orix; in the north-east, Muscicapa aquatica and Ploceus melanocephalus; and in the south-west, Ploceus xanthopterus. Where the subspecies Ploceus velatus katangae occurs, in the Northern and Luapula Provinces, it is strictly a swamp-dweller, in contrast to P. v. velatus, often found on dry land, while the subspecies Chloropeta gracilirostris bensoni may be endemic to Papyrus at the south end of Lake Mweru.

4. **Open waters, mud-flats:** Associated with the more open waters of swamps are Tachybaptus ruficollis, Phalacrocorax africanus, Anhinga rufa, Pelecanus spp., various Anatidae, Haliaeetus vocifer, Gallinula chloropus, Jacanidae, Larus cirrocephalus, Chlidonias spp., and Ceryle rudis. Such species can even occur on artificial dams of all sizes, but in general there is very little bird life except near the shores of the larger lakes.

The muddy edges of open water are inhabited by various Charadriidae and Scolopacidae, most of the palearctic migrants, though including the locally breeding Charadrius pecuarius and tricollaris, and among the Glareolidae, Glareola pratincola.

5. **Rivers:** Fringing evergreen growth is dealt with under habitat 6 below. However, certain species are dependent on the water itself for their food, often in the form of fish or crustaceans. Examples are Butorides striatus, Nycticorax leuconotus, Scopus umbretta, Bostrychia hagedash, Anas sparsa (probably feeding only on vegetable matter), Podica senegalensis, Ceryle maxima, Alcedo semitorquata, and Scotopelia peli.

Rather strictly confined to sand-rivers, such as the Luangwa and Zambezi, at least in the breeding season, are Alopochen aegyptiacus, Charadrius marginatus, Vanellus albiceps and Rhynchops flavirostris. Glareola nuchalis is confined to rocky stretches on rivers and larger perennial streams, and Motacilla clara to the latter and even quite small streams.

The vertical banks of such rivers as the Luangwa and Zambezi provide nesting sites for Merops nubicus and bullockoides, Arpus horus and Riparia paludicola.

6a. **Moist evergreen forest:** The term is used for any essentially riparian forest growth which is of edaphic origin. This habitat is best developed west of the Luangwa Valley, and north of about 14°, particularly in the Kawambwa and Mwinilunga Districts. However, the habitat is not confined to north of 14°, and the Syzygium forest flanking stretches of some of the larger rivers may also be included in the term. Typical birds, some of them confined to the north, are Musophaga rossae, Collius striatus, Lybius minor, Mesopicos grisecephalus, Chlorocichla flavicollis, Phyllastrephus canabisi and cerviniventris, Andropadus virens, Platysteira peltata, Turdus olivaceus, Cossypha bocagei, Bradypterus cinnamomeus, Apalis cinerea, Nectarinia verticalis or bannermani, and Pyrenestes ostrinus. The variety of species is greatest in northern Mwinilunga District, whence come the only Zambian records of such species as Sarothrura pulchra, Columba unicincta, Alcedo leucogaster, Ptyrticus turdinus, Neolestes torquatus, Baeopogon indicator, Bleda syndactyla, Artomyias fuliginosa, Terpsiphone rufiventer, Stizorhina fraseri, Apalis rufogularis, Nectarinia batesi and rubescens, and Ploceus superciliosus.

6b. **Bracken-briar:** Often fringing the preceding habitat, the resultant dense growth after destruction of the forest edge by fire. Characteristic are Tchagra minuta, Nectarinia venusta, Lagonosticta rubricata and Serinus capistratus; and in the north-west, also Cisticola lateralis and Prinia leucopogon.

7a. **Moist montane forest:** Confined to the north-east, at altitudes above about 6,000 feet, on the Nyika Plateau and the Mafinga and Mukutu Mountains. Structurally, this habitat resembles moist evergreen forest, but there are rather few birds common to the two

habitats. Examples of apparently replacing species, giving the montane representative in each case first, are Apaloderma vittatum/narina, Pogoniulus leucomystax/bilineatus, Batis capensis/margaritae, Turdus abyssinicus/olivaceus and Apalis porphyrolaema/cinerea. In addition, there is a subspecific difference in the case of Malaconotus multicolor and Zosterops senegalensis, common to the two habitats. Other species characteristic of the montane habitat are Columba arquatrix, Phyllastrephus flavostriatus, Andropadus tephrolaema, Melaenornis chocolatina, Turdus gurneyi, Alethe feulleborni Pogonocichla stellata, Bradypterus mariae, Laniarius fuelleborni, Onychognathus walleri and tenuirostris, Nectarinia mediocris and Ploceus baglafecht.

7b. **Montane bracken-briar:** This is analogous to habitat 6b. Characteristic are Cossypha caffra, Chloropeta similis, Cisticola hunteri, Nectarinia afra Estrilda melanotis, Serinus citrinelloides and striolatus.

8. **Baikiaea forest** (= Mutemwa woodland) (#3, Fig. 3.18): There is usually a dense understory, the birds of which are those characteristic of thickets, and dealt with under that term (see habitat 10). The canopy birds are similar to those of Brachystegia woodland, and Lybius frontatus, Parus griseiventris and Nectarinia shelleyi, otherwise virtually endemic to that habitat, do also occur in Baikiaea forest. In places where there may be a paucity or absence of thick undergrowth, three other such endemics, Monticola angolensis, Camaroptera stierlingi and Serinus mennilli, may also be present. The large tree Acacia giraffae, to which Lamprotornis australis seems peculiarly addicted, is often associated with Baikiaea forest.

9. **Cryptosepalum** (Mavunda) **and Marquesia forests** (#2, Fig. 3.18): Cryptosepalum forest occurs extensively on Kalahari Sands in southern Mwinilunga District, south to about Senanga, and in a small area north-west of Lake Bangweulu. It seems also best to include here the evergreen forest (Marquesia) relics that are scattered through the north of the territory.

In the Cryptosepalum forest Brachystegia woodland birds are well represented in the canopy, but the dense undergrowth is clearly less well suited to their occurrence. A number of moist evergreen forest species occur, though not all that can be expected from geographical considerations. Some of the undergrowth species, such as Smithornis capensis, Chlorocichla flaviventris, Cossypha natalensis, Camaroptera brachyura and Anthreptes collaris, are also plentiful in thickets (habitat 10). Pogoniulus makawai may be entirely endemic to Cryptosepalum, while in Zambia Guttera edouardi (subspecies kathleenae) and Malaconotus viridis are only known from this type of forest, and Batis margaritae (subspecies kathleenae) seems better represented than it is in moist evergreen forest. Marquesia thickets occur in small patches in northern Mwinilunga District and their avifauna is regarded as akin to that of moist evergreen forest, though with a greatly impoverished variety of species.

10. **Thickets:** Two categories are usually distinguished, but may be combined for ornithological purposes. Present in the first but not the second are Francolinus hildebrandti, Ceuthmochares aereus, Tauraco persa, Malaconotus multicolor and Ploceus bicolor. In the second only are Francolinus sephaena and natalensis, Tauraco porphyreolophus, Erythrocercus livingstonei and Erythropygia quadrivirgata. These differences can, however, be attributed to one or the other area being outside the geographical range of the particular species in question. Thus Ceuthmochares a. aereus is only known from the lowermost reaches of the Zambezi Valley, in Mocambique, while Francolinus hildebrandti and natalensis and the two Tauraco spp. are mutually exclusive. While there is no definite record of Erythropygia barbata from the first category, this species and quadrivirgata replace each other geographically.

11. **Brachystegia** (Miombo) **woodland** (#6, Fig. 3.18): Many species of bird characteristic of Brachystegia also occur in the savanna categories. Brachystegia tends to be more luxuriant, with a higher canopy, in the north of the territory, where the number of species of birds is slightly higher than in the south. Those unknown south of about 15° include Buccanodon anchietae, Myopornis boehmi, Elminia albicauda, Eremomela atricollis, Cisticola woosnami, Anthreptes anchietae and Ploceus angolensis. Unlike forests and thickets, grasses are represented in the ground flora, and the genus Cisticola occurs. A total of 112 species have been listed for this habitat, of which 23 species are virtually endemic.

12. **Mopane woodland** (#7, Fig. 3.18): Typical of Mopane, and in Zambia very largely confined to it, are Rhinoptilus cinctus, Agapornis lilianae, Lamprotornis mevesii and Plocepasser mahali. Among other species also typical are Pterocles bicinctus, Streptopelia capicola, Coracias spatulata, Halcyon chelicuti, Tockus erythrorhynchus, Glaucidium perlatum, Caprimulgus fossii, Trachyphonus vaillantii, Thamnolaea arnoti, Sylvietta rufescens, Parus niger and Nectarinia talatala.

There are many instances of species of birds present on one or the other side of the Luangwa or Middle Zambezi Valley but not on both (such species often inhabiting Brachystegia), the arid Mopane of the valley floor apparently acting as a barrier. There are also instances of subspecific differences on the two sides.

13. **Chipya woodland** (#8, Fig. 3.18): The avifauna is in no way peculiar, and many of the species also occur in woodlands. The grasses and associated shrub growth are inhabited by some species absent from the shorter undergrowth of Brachystegia, examples being Francolinus afer, Turnix sylvatica, Centropus superciliosus, Turdoides jardineii, Cisticola chiniana and erythrops, Prinia subflava, Tchagra senegala, Euplectes capensis and ardens, Lagonosticta rhodoparei or rubricata, and Pytilia melba. Conspicuous in the trees (not necessarily feeding therein), but absent from Brachystegia, are Coracias caudata, Merops pusillus, Tockus nasutus, Pycnonotus barbatus, Bradornis pallidus, Parus leucomelas and Nectarinia senegalensis. Most of the species on

these two lists could also be expected in abandoned cultivation (habitat 22 below).

14. **Savanna:** This includes Diplorhynchus shrub savanna (cf. Sec. 3.4.1 under Lusese woodland), Combretum-Arformosia-Pterocarpus-Acacia savanna (#10, Fig. 3.18), and Burkea-Dialium-Baikiaea-Colophosermum savanna (#9, Fig. 3.18). Ornithologically they are difficult to distinguish from Chipya. However, comparing the Chipya of the Bangweulu area (annual rainfall average as much as 50 inches) with savanna in Barotseland west of the Zambezi, south of 17° (comparable figure less than 25 inches), some differences may be noted. In the latter area, Francolinus afer is replaced by swainsonii, Centropus superciliosus by senegalensis, Parus leucomelas by niger, while Cisticola erythrops is absent, and there is no Euplectes sp. Also Lagonosticta rhodopareia may be entirely replaced around Bangweulu by rubricata.

Special Habitats

15. **Cliffs:** In scattered localities in the Eastern and Northern Provinces, and in the basalt gorges below the Victoria Falls. Of importance only as breeding and roosting sites for Falco biarmicus, peregrinus and fasciinucha, Apus aequatorialis and barbatus, Corvus albicollis and Onychognathus morio.

16. **Rocks:** Caprimulgus tristigma, Anthus lineiventris, Pinarornis plumosus, Thamnolaea cinnamomeiventris, Cercemela familiaris, Cisticola aberrans, Hirundo daurica and fuliqula, and Fringillaris capensis are only normally found near rocks (the Cisticola where there are rocks in Brachystegia woodland). Aquila verreauxi and Buteo rufofuscus are rather strictly confined to rocky hills in south-eastern Zambia, the former probably subsisting largely on the rock-dwelling dassie Dendrohyrax brucei. Due to a virtual complete absence of rocks from the Barotse Province, only the Caprimulgus has been recorded therefrom. The difference between this habitat and cliffs is not altogether clear-cut, and the Thamnolaea can also be found on cliffs. In some localities Hirundo fuliqula nests under bridges.

17. **Particular trees:** Gypohierax angolensis only occurs normally near Raphia or Elaeis palms. Falco chicquera is nearly always near Borassus palms, probably most usually breeding in the top of the bole. Cypsiurus parvus is largely dependent on Borassus, Hyphaene and Phoenix palms for breeding, the nests being attached to the fronds, though sometimes alternatively on buildings or under bridges. Cichladusa arquata is nearly always near Borassus or Hyphaene palms. Throughout their respective ranges in Zambia, Streptopelia decipiens and Eremomela usticollis are markedly associated with Acacia trees in rather dry country, and Lamprotornis australis with Acacia giraffae, as already mentioned under Baikiaea forest (habitat 8 above). Parisoma lugens, only known on the Nyika Plateau, may be entirely confined to Acacia

abyssinica. The alluvial Acacia albida trees provide nesting sites for herons, storks and ibises, and the flowers are eaten by flocks of Agapornis lilianae.

18. **Particular mammals:** Vultures (Accipitridae) are well known to be dependent on ungulates, feeding at their carcasses. Leptoptilos crumeniferus is also a carrion eater. Bupnagus spp. live on particular ungulates, and on domestic cattle in some areas. Ardeola ibis merely follows ungulates, especially buffalo and domestic cattle, to feed on the insects disturbed. Motacilla flava sometimes associates with cattle for the same purpose.

Man-made or Man-induced Habitats

19. **Human habitations:** Motacilla aguimp, Corvus albus, Passer griseus (subspecies ugandae) and domesticus, and Lagonosticta senegala are strongly associated with human dwellings, both for feeding and for breeding purposes (only the Corvus probably never actually nests thereon). P. domesticus is almost certainly entirely dependent on man in Zambia, into which it first penetrated, from the south, in 1965. Tyto alba, Apus affinis and some Hirundo spp. (especially abssinica) use brick buildings for breeding, the Tyto actually within them and presumably feeding on Rattus rattus.

20. **Bridges and/or culverts:** Hirundo abyssinica uses both for breeding, as does semirufa the latter. H. rufigula breeds colonially under a bridge near Kitwe. Apus caffer uses old nests of H. abyssinica (and indeed on buildings). Cypsiurus parvus sometimes uses bridges (and even buildings) for breeding, instead of palms.

21. **Gardens:** Nectariniidae visit gardens to feed at the flowers of introduced shrubs.

22. **Cultivation:** Francolinus afer and Streptopelia capicola and senegalensis are often common in cultivation, feeding on fallen seeds. In abandoned cultivation (most usually in Brachystegia woodland), while the woodland birds also frequenting savanna may be expected to survive, those listed under the two savanna habitats (nos. 13 and 14 above) may be able to establish themselves. Indeed, cultivation abandoned more than about ten years is perhaps little more than an artificially induced savanna.

23. **Roads:** A long list could be made of the species to be seen more especially on earth roads, and only a few of the most frequent ones can be mentioned. Among those which are nocturnal all the Caprimulgidae are represented, to which they seem to be attracted by better visibility for their insect prey. This may also apply to Bubo africanus, the only owl at all common on roads. Burhinus and Rhinoptilus spp. also occur on roads at night, R. chalcopterus sometimes being numerous. Among diurnal species, certain Accipitridae and Falconidae can frequently be seen perched near

roads, on bare trees, the reason again apparently being improved visibility for prey. Examples are Melierax metabates, Buteo buteo, Aquila wahlbergi, Milvus migrans and Falco dickinsoni. Among the Columbidae, Streptopelia capicola is especially common on roads, which it visits perhaps mainly to obtain grit. But Streptopelia senegalensis, Turtur chalcospilos and Oena capensis also occur, and other examples are Francolinus afer, coqui and shelleyi, Bucorvus cafer, Upupa epops and Motacilla aguimp, while noticeable on the grassy edges are Uraeginthus angolensis, Vidua spp. and Sernus mozambicus. During the rains Hirundo senegalensis and probably other Hirundo spp. may be seen at temporary pools on roads gathering mud for nest-building.

24. **Aerodromes:** These may be regarded as a form of artifically induced dry grassland (see under habitat 2), and many of the species listed for the subdivision thereunder do also frequent aerodromes, but more especially Ciconia abdimii, Stephanibyx coronatus, Cursorius temminckii, Calandrella cinerea, Hirundo griseopyga, Oenanthe pileata, Cisticola juncidis and the three Anthus spp.

Source: Benson et al. 1971.

Table 3. Herpetofauna

Scientific Name	Common Name	Range in Zambia
	REPTILIA	
PELOMEDUSIDAE		
Pelomedusa subrufa	African Marsh Terrapin	SW & E of Zambia.
Pelusios nanus	Dwarf Terrapin	Chambeshi-Lukulu confluence in the northern province.
Pelusios subniger	Pan Terrapin	Widespread and probably present in all provinces.
Pelusios castaneis	Swamp Terrapin	Throughout.
Pelusios bechuanicus	Okavango Terrapin	Zambezi River above Victoria Falls and on the Kafue Flats.
Pelusios sinuatus	Serrated Terrapin	Common in the large rivers and lakes but displaced from the upper Zambezi and Kafue Rivers.
TESTUDINIDAE		
Geochelone pardalis	Leopard Tortoise	Middle Zambezi and Luangwa valleys, but found throughout Eastern province; found in the southern parts of the Kafue National Park and at Livingstone.
Kinixys belliana	Bell's Hinged Tortoise	Widespread in Zambia.
	CROCODYLIA	
CROCODYLIDAE		
Crocodylus cataphractus cuvier	Slender-snouted Crocodile	Lake Miveru and Luapula River.
Crocodylus niloticus lavrenti	Nile Crocodile	Rivers and lakes throughout Zambia, unless locally exterminated.
	SQUAMATA	
GEKKONIDAE		
Hemidactylus mabouia	House gecko	Widespread in Zambia and particularly at low altitudes.
Hemidactylus platycephalus	Boabab gecko	Zambezi Valley as far west as the Matetsi Confluence upstream from Lake Karita.
Lygodactylus angolensis	Dwarf gecko	Widespread.
Lygodactylus capensis		Widespread in Zambia, but apparently replaced by L. angolensis in the Northern Province.
Lygodactylus angularis		Northern Province.
Lygodactylus chobiensis		Upper Zambezi and middle Zambezi Valley; also recorded from Kafue National Park and Lusaka.
Pachydactylus punctatus	Spotted ground gecko	Zambezi and Luangwa Valleys.
Pachydactylus oshaughnessyi	O'Shaughnessy's banded gecko	Central and eastern provinces.
Pachydactylus bibroni	Bibron's gecko	Widespread; very common in the Zambezi and Luangwa Valleys.
Pachydactylus tuberculosus	Tuberculed gecko	Northern Province.
Pachydactylus tetensis	Tete Rock gecko	Kariba area.
AGAMIDAE		
Agama hispida	Spiny agama	Common throughout.
Agama kirkii	Kirk's Rock agama	Zambezi and Luangwa Valleys.
Agama cyanogaster	Blue-headed tree agama	Common throughout.

Scientific Name	Common Name	Range in Zambia
CHAMAELEONIDAE		
Chamaeleo goetzel		Endemic to the Nyika Plateau.
Chamaeleo dilepis	Common flap-necked chameleon	Common throughout.
Rhampholen nchisiensis		Nyika Plateau.
SCINCIDAE		
Mabuya maculilabris	Speckle-lipped Forest Skink	Western and northern Zambia.
Mabuya megalvica	Grass-top skink	Mbala area.
Mabuya planifrons	Teita skink	Southern end of Lake Tanganyika.
Mabuya quinquetaeniata	Rainbow skink	Zambezi, Luangwa and Mulungushi Valleys.
Mabuya capensis	Cape skink	Linwa Plain west of the Zambezi.
Mabuya variegata	Variegated sand skink	Linwa Plain.
Mabuya lacertiformis	Bronze rock skink	Zambezi Valley.
Mabuya varia	Variable skink	Throughout.
Mabuya striata	Striped skink	Lealui, Barotseland.
Lumecia ahchietae	Anchieta's skink	Widespread in the well-watered plateau regions.
Riopa sundevallii	Writhing skink	Widespread.
Riopa afer		Widespread in Northern Province, also recorded in Luangwa River area.
Ablepharus seydeli	Snake-eyed skink	Kasempa and Mevenzo areas.
Ablepharus wahlbergii		Widely distributed throughout the savannah woodlands.
Scelotes tetradactylus		Meveru-Wantipa.
Scelotes angolensis		Lunwa Plain.
Scelotes ater		Mbala area.
Typhlacontias gracilis		Kalahari sand regions of western Zambia.
Typhlosaurus lineatus		West of the Zambezi.
CORDYLIDAE		
Gerrhosaurus validus	Plated rock lizard	Zambezi Valley.
Gerrhosaurus major	Tawny plated lizard	Middle Zambezi Valley and the Luangwa Valley.
Gerrhosaurus multilineatus	Angola plated lizard	Northwestern Province.
Gerrhosaurus nigrolineatus	Black-lined plated lizard	Widespread.
Gerrhosaurus flavigularis	Yellow-throated plated lizard	Luangwa Valley and the Eastern Province.
Tetradactyllus ellenbergeri	Ellenberger's whip lizard	Mambwe, Chongwe River and Lunga Game Reserve.
Cordylus tropidosternum	Eastern spiny-tailed lizard	Northern Province.
Chamaesaura macrolepis	Large-scaled snake lizard	Northern and Eastern Provinces.
LACERTIDAE		
Nucras boulengeri	Scrub lizard	Isvka Boma (A.M.)
Latastia johnstoni		Northern and Eastern Provinces.
Eremias lugubris		Kariba Lake.
Ichnotropis squamulosa		Widespread but apparently absent from Northern Province.
Ichnotropis bivittata		Mbala area.
Ichnotropis capensis		Widespread in western Zambia.
VARANIDAE		
Varanus niloticus	Nile monitor/Water leguaan	The largest lizard found in Zambia; common wherever there are permanent rivers, streams and lakes.
Varanos exanthematicus	Savannah monitor/Tree leguaan	Widespread; probably most abundant in the Zambezi and Luangwa Valleys.

Scientific Name	Common Name	Range in Zambia
AMPHISBAENIDAE		
Zygaspis quadrifrons		Common in southwestern Zambia.
Zygaspis niger		West of the Zambezi, Kalabo area.
Monopeltis anchietae		Southwestern Zambia.
Monopeltis capensis		Middle Zambezi Valley.
Monopeltis mauricei		Sesheke and the Kafue National Park.
Tomuropeltis Pistillum		Upper and middle Zambezi; Eastern Province.
Tomuropeltis ellenbergeri		Kalabo area.
TYPHLOPIDAE		
Typhlops gracilis	(Blind snakes)	Only recorded in Zambia from the Northern and Luapula Provinces.
Typhlops schmidti		Northwestern, Copperbelt and Northern Provinces.
Typhlops schlegelii		Most widely distributed blind-snake in Zambia; appears to be absent from the upper Zambezi flood plains.
LEPTOTYPHLOPIDAE		
Leptotyphlops longicauda	(Worm snakes)	Zambezi and Luangwa Valleys.
Leptotyphlops emini		Widespread in the Northwestern and Copperbelt Provinces.
Leptotyphlops conjunctus		Southern, Central and Eastern Provinces.
Leptotyphlops scutifrons		Eastern Province.
BOIDAE		
Python sebae	African python	Nsato; Lusato; Lumwengo; Mboma.
COLUBRIDAE		
Lycodonomorphus bicolor	Lake Tanganyika Water Snake	Endemic to Lake Tanganyika.
Boaedon fuliginosus	Common House Snake	Common throughout.
Boaedon olivaceus	Olive Water Snake	Mbala area.
Mehelya capensis capensis	Cape File Snake	Throughout, although nowhere common.
Mehelya nyassae	Nyasa File Snake	Widely scattered records.
Lycophidion capense	Cape Wolf Snake	Widespread.
Amblyodipsas polylepis polylepis		Widespread.
Amblyodipsas ventrimaculata		Western Province.
Amblyodipsas katangensis		Ndola.
Xenocalamus mechowii mechowii	(Quill-snouted snakes)	Northwestern Province.
Xenocalamus mechowii ornatus		This southern race recorded from Western and Southern Provinces.
Polemon christyi		Northwestern and Northern Provinces.
Chilorhinophis gerardi gerardi		Kasempa, Luanshya and Kabwe.
Chilorhinophis gerardi tanganyikae		Lake Tanganyika.
Hypsotophis wilsoni		Kabompo and Kalabo.
Aparallactus lunulatus	(Centipede-eating snakes)	Southern and Eastern Provinces.
Aparallactus capensis		Throughout.
Natriciteres variegata	Forest Marsh Snake	Northern Province.
Natriciteres olivacae	Olive Marsh Snake	Widely distributed; often common.
Limnophis bicolor bangweolicus	Bangweulu Water Snake	Common in the upper Zambezi flood plain; Mala Plateau, Kafue Flats, and Lukanga Swamp; Northern and Luapula Provinces.
Pseudaspis cana	Mole Snake	Widespread.
Duberria lutrix zambiana	Slug-eater	Nyika Plateau.
Boiga blandingii	Blanding's Tree Snake	Mporokoso.

Scientific Name	Common Name	Range in Zambia
Dipsodoboa shrevei	Shreve's Tree Snake	Northwestern , Copperbelt, Central and Northern Provinces.
Crotaphopeltis hotamboeia	Black-templed Cat Snake	Common throughout.
Crotaphopeltis barotseensis	Barotse Cat Snake	Kalabo area.
Telescopus semiannulatus	Tiger Snake	Throughout.
Meizodon semiornatus	Semiornate Snake	Widespread, but nowhere common.
Philothamnus hoplogaster	Southern Green Snake	Common and most widespread species of green snake in Zambia.
Philothamnus ornatus	Ornate Green Snake	Northern and Northwestern Provinces.
Philothamnus heterolepidotus	Slender Green Snake	Northern and Northwestern Provinces.
Philothamnus irregularis	Western Green Snake	Common in Western Province; also found in Northwestern, Copperbelt, Northern and Eastern Provinces.
Philothamnus semivariegatus	Variegated Bush Snake	Throughout.
Scaphiosis albopunctatus	Grey-breaked Snake	Northern Province.
Prosymna angolensis	Shovel-snouted Snake	Kalabo.
Prosymna ambiqua	Grey Shovel-snout	Mbala and the Eastern Province.
Hemirhaegerrhis nototaenia	Bark Snake	Widespread; probably most abundant in the middle Zambezi and Luangwa Valleys.
Psammophylax tritaeniatus	Striped Grass Snake	Widely distributed; not recorded from Western Province.
Psammophylax variabilis	Variable Grass Snake	Eastern and Western Provinces.
Rhamphiophis acutus wittei	Striped Beak Snake	Northern and Luapula Provinces.
Rhamphiophis acutus		R. a. jappi: Kalabo and Zambezi; R. a. wittei: Northern and Luapula Provinces.
Rhamphiophis oxyrhynchus	Rufous Beaked Snake	Southern and Eastern Provinces.
Dromophis lineatus		Western, Southern, Central and Northern Provinces.
Psammophis sibilans	Olive Grass Snake	Common throughout.
Psammophis brevirostris	Chain-marked Grass Snake	Mporokoso and Mbala areas.
Psammophis subtaeniatus	Stripe-bellied Sand Snake	Southern, Central and Eastern Provinces.
Psammophis jallae	Jalla's Sand Snake	Kalabo.
Psammophis angolensis	Dwarf Sand Snake	Throughout.
Dispholidus typus typus	Boomslang	Western, Southern, Central and Eastern Provinces.
Dispholidus typus kivensis		Northern Province.
Dispholidus typus punctatus		Northwestern, Copperbelt, Luapula and Northern Provinces.
Thelotornis capensis capensis	Cape Vine Snake	Mbala.
Thelotornis capensis oatesii		Throughout, except around Mbala where replaced by the typical form.
Dasypeltis scabra	Common Egg-eating Snake	Throughout.
ELAPIDAE		
Elapsoidea guentheri	African Garter Snake	Northwestern, Copperbelt, Central, Southern and Northern Provinces.
Elapsoidea semiannulata semiannulata		Kalabo.
Elapsoidea semiannulata boulengeri		Eastern Zambia.
Boulengerina annulata	Water Cobra	Endemic to Lake Tanganyika.
Naja haje	Egyptian Cobra	N. h. annulifera: Middle Zambezi Valley, possibly Luangwa Valley; N. h. enchietae: Western and Southern Provinces.
Naja melanolenca	Forest Cobra	Northwestern, Copperbelt, Luapula, Northern Provinces; scattered records from Central and Eastern Provinces.
Naja nigricollis	Black-necked Spitting Cobra	Most paltuea areas; Luangwa valley.
Naja mossambica	Mozambique Spitting Cobra	Middle Zambezi and lower Luangwa valley, Southern Province.
Dendroaspis polylepis	Black Mamba	Throughout Zambia.
Dendroaspis jamesoni	Jameson's Mamba	Lake Bangweulu.

Scientific Name	Common Name	Range in Zambia
VIPERIDAE		
Atractaspis congica		Malba.
Atractaspis bibronii		Throughout.
Causus rhombeatus	Rhombic Night Adder	Throughout.
Causus bilineatus	Lined Night Adder	Northwestern and Western Provinces; Bengweulu Swamp.
Causus defilippii	Snouted Night Adder	Common in Eastern Province; records from Northern Province, Lake Bengweulu, Sevenje, Livingstone.
Bitis arietans	Puff Adder	Throughout (responsible for more cases of snake-bite than any other species).
Bitis gabonica	Gaboon Viper	Northwestern, Copperbelt, Luapula, Northern Provinces.
Bitis nasicornis	Nose-horned Viper	Lake Bengweulu area.
Atheris nitschei	Bush Viper	Northeast border area.
	AMPHIBIA	
PIPIDAE		
Xenopus laevis	Clawed Frogs	Widespread in Western, Southern and Central Provinces
Xenopus muelleri		Widespread in Luangwa Valley and Eastern Province; also recorded from Kalabo.
BUFONIDAE		
Bufo regularis	Square-marked Toad	Common throughout.
Bufo Pusillus	Lesser Square-marked Toad	Widespread in Eastern Province.
Bufo garmani	Garman's Toad	Widespread in Savanna.
Bufo lemairii	Yellow Swamp Toad	Luapala, Northern and Western Provinces.
Bufo carens	Red Toad	Widely distributed, but not yet recorded from Northwestern Province.
Bufo urunguensis	Urungu Toad	Kalambo Falls.
Bufo vertebralis	Flat Toad	Victoria Falls.
Bufo taitanus	Teita Dwarf Toad	B. t. taitanus: Western, Copperbelt, and Eastern Provinces. B. t. nyikae: Nyika Plateau.
MICROHYLIDAE		
Breviceps mossambicus	Rain Frogs	Western Province.
Breviceps poweri		Southern, Central, Copperbelt and Eastern provinces.
Phrynomerus bifasciatus	Red-banded Frog	Kafue National Park and Kalabo.
RANIDAE		
Pyxicephalus adspersus	African Bullfrog	Western, Southern, Central and Eastern Provinces
Pyxicephalus delalandii	Delalande's Pyxie	Western, Southern and Eastern Provinces.
Pyxicephalus marmoratus	Mozambique Pyxie	Central and Eastern Provinces.
Pyxicephalus tuberculosus	Beaded Pyxie	Eastern and Northern Provinces.
Rana occipitalis	Giant Swamp Frog	Southern end of Lake Tanganyika.
Rana angolensis	Angola River Frog	Plateau and highland regions of Zambia.
Rana fasciata	Striped Grass Frog	Nyika Plateau.
Rana darlingi	Golden-backed Frog	Western and Southern Provinces.
Rana albolabris	White-lipped Frog	Ikelenge in the Northwestern Province.
Hildebrandtia ornata	Ornate Burrowing Frog	Central and Eastern Provinces.
Ptychadena oxyrhynchus	Ridged Frogs	Widespread.
Ptychadena superciliaris		North-Western, Western, Central, Southern and Eastern Provinces.

Scientific Name	Common Name	Range in Zambia
Ptychadena obscura		Mbala.
Ptychadena subpunctata		Upper Zambezi from Ikelenge to Victoria Falls.
Ptychadena mascareniensis		Western, Central and Northern Provinces.
Ptychadena porosissima		Nymabela Plain, Sandaula Plain, Mbala and Nyika Plateau.
Ptychadena grandisonae		Mbala, Ikelenge, Kalabo and Nantumba Plains near Mumbwa.
Ptychadena upembae		Western, Central, Eastern and Northern Provinces.
Ptychadena uzungwensis		Northwestern, Western, Northern and Eastern Provinces.
Ptychadena ansorgii		Mpulungu, at the southern end of Lake Tanganyika.
Ptychadena taenioscelis		Western, Southern, Central, Copperbelt and Eastern Provinces.
Ptychadena chrysogaster		Western, Northern and Eastern Provinces.
Ptychadena keilingi		Ikelenge and the Isombu stream in the Northwestern Province.
Ptychadena mossambica		Southern, Central, Copperbelt, Northwestern and Eastern Provinces.
Phrynobatrachus natalensis	Puddle Frogs	Common throughout.
Phrynobatrachus acridoides		Eastern Province.
Phrynobatrachus perpalmatus		Northern parts of Luapula and Northern Provinces.
Phrynobatrachus gutturosus		Ngoma, Kafue National Park.
Phrynobatrachus moorii		Status uncertain.
Phrynobatrachus ukingensis		
Phrynobarachus parvulus		Western and Northern Provinces.
Cacosternum boettgeri		Southern Province at Livingstone and Bilili Hot Springs.
Arthroleptis stenodactylus	Squeaking Frogs	Northwestern, Copperbelt, Central, Northern and Eastern Provinces.
Arthroleptis globosa		Central and Northern Provinces.
Arthroleptis xenodactyloides		Nyika Plateau.
Hemisus marmoratus	Shovel-snouted Frogs	Northwestern, Southern, Central and Eastern Provinces.
Hemisus guineensis		Ikelenge in the Northwestern Province.
Chiromantis xerampelina	Grey Tree Frog	Widespread in Southern, Central and Eastern Provinces; very common in the middle Zambezi and Luangwa valleys.
Leptopelis lebeaui		From Chilongowelo and Mpulungu.
Leptopelis bocagii	Bocage's Burrowing Frog	Widespread.
Kassina ingeri		Recorded only from Kalabo and Kalengo in Western Province; almost certain to occur also in southeastern Angola.
Kassina wittei		Kasama.
Kassina senegalensis		Northwestern, Western, Southern, Copperbelt and Eastern Provinces.
Afrixalus wittei	Spiny Reed Frogs	Kalabo and Kabompo District.
Hyperolius pictus	Reed Frogs	Nyika Plateau.
Hyperolius bocagei		Northern Province.
Hyperolius kivuensis		Northern Province of Zambia around the southern end of Lake Tanganyika.
Hyperolius nasutus		Throughout.
Hyperolius granulatus		Mbala and Nyamkolo.
Hyperolius quinquevittatus		H. q. quinquevittatus: Ikelenge and Mbala; H. q. mertensi: endemic to Nyika Plateau.
Hyperolius marmoratus	Marbled Reed Frog	Throughout.

Source: Broadley, 1971.

Table 4. Fish Occurring in Zambia

Species	Kafue System	Middle Zambezi System	Upper Zambezi System	Bangweulu System	Mweru System
FAMILY LEPIDOSIRENIDAE:					
Protopterus annectens		×			×
FAMILY MORMYRIDAE:					
Mormyrus ellenbergeri			×		
Mormyrus lacerda	×		×		
Mormyrus sp. cf. *M. ovis* ...				×	× ×
Mormyrus longirostris		×		×	×
Mormyrus proboscirostris					×
Mormyrops deliciosus		×		×	×
Gnathonemus sp. cf. *G. rhynchophorus*				×	× ×
Gnathonemus petersii					×
Gnathonemus monteiri				×	×
Gnathonemus macrolepidotus ...	×	×	×	×	×
Petrocephalus catostoma	×	×	×	×	×
Myomyrus macrodon					×
Cyphomyrus discorhynchus ...		×	× ×	×	×
Marcusenius castelnaui	× ×		×		
Marcusenius stappersii				×	×
Marcusenius ansorgi			× × ×		
FAMILY KNERIIDAE:					
Kneria auriculata	×	×	×	×	×
Kneria polli				×	×
Kneria angolensis			×		
FAMILY CLUPEIDAE:					
Poecilothrissa moeruensis					×
Microthrissa stappersii					×
Microthrissa acutirostris					×
FAMILY CHARACIDAE:					
Hepsetus odoe	×		×		×
Hydrocyon vittatus		×	×	×	×
Petersius rhodesiensis	×		× ×	×	×
Bryconaethiops boulengeri ...				×	× ×
Micralestes sardina				×	
Micralestes acutidens	×	×	×	×	×
Alestes grandisquamis				×	×
Alestes macropthalmus				×	×
Alestes liebrechtsii					×
Alestes peringueyi				×	
Alestes lateralis	×		×	× ×	
Alestes imberi		×		×	×
FAMILY CITHARINIDAE					
Distichodus maculatus				×	×
Distichodus mossambicus		×			
Distichodus schenga		×			
Nannocharax multifasciatus ...	×		×	×	×
Nannocharax luapulae				×	×
Nannocharax sp.	× × × ×		× × × ×		
FAMILY CYPRINIDAE:					
Labeo altivelis		×		×	×
Labeo congoro		×			
Labeo simpsoni				×	
Labeo annectens	× ×		× ×	×	×
Labeo cylindricus	× ×	×			
Labeo lunatus			× 0		
Varicorhinus nasutus		×			
Barbus caudovittatus				×	× ×
Barbus stappersii					×
Barbus trachypterus				×	×
Barbus marequensis	× ×	×			
Barbus codringtoni			×		
Barbus poechii	×		×		
Barbus trimaculatus		×		×	×
Barbus paludinosus	×	×	×	×	×
Barbus afrohamiltoni				×	
Barbus afrovernayi	×		×	×	×
Barbus manicensis	× ×	× ×	×	×	×
Barbus eutaenia	×	×	×	×	×
Barbus multilineatus	×		×	×	×
Barbus haasianus	× ×		× ×	×	× ×
Barbus myersi				×	
Barbus puellus	× ×		×	×	×
Barbus brevidorsalis				×	×
Barbus owenae				×	
Barbus fasciolatus	×	×	×	×	×

continued

Table 4, continued

Species	Kafue System	Middle Zambezi System	Upper Zambezi System	Bangweulu System	Mweru System
FAMILY CYPRINIDAE—*continued*					
Barbus tetrastigma				×	
Barbus brachygramma					×
Barbus viviparus	×	×	×	×	×
Barbus barotseensis	×	×	×	×	×
Barbus lineomaculatus	×	×	×	×	×
Barbus pseudognathodon					×
Barbus labialis	×		× ×		
Barbus tangandensis	×		×	×	×
Barbus neefi			× 0		
Barbus thamalakanensis			×		
Barbus sp.					× × × ×
Barbus sp.					× × × ×
Barbus sp.			× × × ×		
Barbus (*Beirabarbus*) *radiatus* ...	× ×	×	×	×	
Barbus (*Clypeobarbus*) sp. ...			× × × ×		
Coptostomabarbus wittei	× × ×				× × × ×
Coptostomabarbus sp.					
Engraulicypris brevianalis ...			× × ×	× ×	
Engraulicypris moeruensis ...				×	×
Barilius intermedius				× ×	×
Barilius zambezensis		×	×	×	×
FAMILY SCHILBEIDAE:					
Schilbe mystus	×	×	×	×	×
Eutropius depressirostris		×			
Eutropius bangwelensis				×	×
Eutropius nasalis					×
Eutropius sp.			× × × ×		
FAMILY CLARIIDAE:					
Heterobranchus longifilis		×		×	×
Heterobranchus boulengeri ...					×
Clarias mossambicus	×	×	×	×	×
Clarias mellandi	×		×	×	×
Clarias obscurus					×
Clarias theodorae	×	×	×	×	×
Clarias macrurus					×
Clarias buthupogon				×	×
Clarias sucmarginatus			× ×	×	×
Clarias sp. cf. *C. stappersii* ...	×		×	×	×
FAMILY MOCHOKIDAE:					
Chiloglanis newmanni	× ×	×	× ×	×	×
Euchilichthys guentheri				×	
Euchilichthys royauxi					×
Synodontis zambezensis		×			
Synodontis polystigma					×
Synodontis ornatipinnis				×	×
Synodontis unicolor					×
Synodontis nebulosus		×			
Synodontis macrostigma	×				
Synodontis woosnami			×		
Synodontis nigromaculatus ...			×	×	×
Synodontis colyeri				×	
FAMILY AMPHILIIDAE:					
Amphilius platychir		×	×	×	×
FAMILY MALAPTERURIDAE:					
Malapterurus electricus		×			
FAMILY BAGRIDAE:					
Chrysichthys mabusi				×	×
Leptoglanis rotundiceps		×	× ×	×	
Leptoglanis brevis					×
Auchenoglanis occidentalis ...				×	×
Auchenoglanis ngamensis			×		
FAMILY ANGUILLIDAE:					
Anguilla bicolor		×			
Anguilla mossambica		×			
Anguilla nebulosa labiata ...		×			
Anguilla marmorata		×			

continued

Table 4, continued

Species	Kafue System	Middle Zambezi System	Upper Zambezi System	Bangweulu System	Mweru System
FAMILY CYPRINODONTIDAE:					
Nothobranchius orthonotus ...		×			
Nothobranchius taeniopygus ...	×		× ×	×	
Aplocheilichthys johnstoni ...	×	×	×	× ×	
Aplocheilichthys moeruensis ...				×	×
Aplocheilichthys hutereaui ...			× ×		×
Aplocheilichthys katangae ...	×		×	×	×
Hypsopanchax sp.			× × × ×		
FAMILY CICHLIDAE:					
Tilapia macrochir	×	introduced	×	×	×
Tilapia mossambica			×		
Tilapia andersonii	×		×		
Tilapia melanopleura	×	×	×	×	×
Tilapia sparrmanii	×	×	×	×	×
Serranochromis angusticeps ...	×	Plateau tributaries only	×	×	
Serranochromis macrocephala ...	×	Plateau tributaries only	×	×	×
Serranochromis robustus	×	Plateau tributaries only	×	×	×
Serranochromis thumbergi ...	×	Plateau tributaries only	×	×	×
Serranochromis sp.					× × × ×
Tylochromis bangwelensis ...				×	
Tylochromis mylodon					×
Hemichromis fasciatus			×		
Sargochromis codringtoni		×	×		
Sargochromis mellandi				×	×
Pelmatochromis robustus	×		×		
Haplochromis darlingi		×	×		
Haplochromis frederici	×		×		
Haplochromis carlottae	×		×		
Haplochromis philander	×	×	×	×	×
Haplochromis polyacanthus ...					×
Haplochromis stigmatogenys ...				×	
FAMILY ANABANTIDAE:					
Ctenopoma multispinis	×		×	×	×
Ctenopoma ctenotus	× ×		× ×	×	× ×
FAMILY MASTACEMBELIDAE:					
Mastacembalus moeruensis ...					×
Mastacembalus mellandi	×		×		
Mastacembalus signatus				×	
Mastacembalus stappersi ...					×
TOTAL NUMBER OF SPECIES IN EACH SYSTEM	56	54	77	88	98

× Recorded by Jackson (1961).

× × A new distribution record since 1961.

× × × Previously unknown from Zambia.

× × × × Previously unknown from Zambia and possibly representing an undescribed species.

× 0 Described since 1951.

Source: Bell-Cross, 1965.

Table 5. IUCN Data on Zambian Endangered Species

MAMMALS

AFRICAN WILD DOG

Lycaon pictus

Order: CARNIVORA Family: CANIDAE

STATUS: Depleted throughout its range. Vulnerable to continued persecution, shrinkage of range and reduction in numbers of natural prey.

DISTRIBUTION: Throughout the savanna regions of Africa south of the Sahara, but now restricted to non-farming areas, west as far as the Ivory Coast and eastern border of Guinea then north to Mali, Niger and the southern parts of Algeria.

POPULATION: Depleted throughout its range. An IUCN survey in 1971 revealed a fair number outside the nature reserves in South Africa, about 340 in Kruger National Park, but none in Natal, the Orange Free State and most of the Cape Province; absent from the northern part of Namibia and depleted elsewhere; widely spread in Botswana, common in their national parks and outside; persisting only in game reserves in Rhodesia; good populations within the protected areas of Zambia but controlled outside owing to predation on the domestic animals of the increasing human population; rare in Tanzania even in national parks. Uncommon in the Ouadi Rime-Ouadi Achim faunal reserve in Chad.

HABITAT: Open or wooded savanna.

CONSERVATION MEASURES TAKEN: They are relatively free from persecution in the large national parks and game reserves of most African states, but prejudice against them as killers still persists, and they are still sometimes killed in protected areas.

CONSERVATION MEASURES PROPOSED: They should be given full protection of the law; control measures should be carefully supervised and eased wherever possible.

REMARKS: They are primarily diurnal and hunt in packs of 6-20 -sometimes up to 40 in number. They are commonly regarded as harmful to game and domestic stock, but they play an important role in the balance of their environment.

LEOPARD

Panthera pardus

Order: CARNIVORA Family: FELIDAE

STATUS: Vulnerable. Exterminated from large parts of its former range and depleted elsewhere. In some areas persecution and loss of habitat have taken a severe toll; at least five geographic races are threatened with extinction. But it is still widespread and maintaining good numbers, even increasing when not persecuted.

DISTRIBUTION: Africa, and most of southern Asia from Turkey across the USSR and China to Korea, southwards to Arabia, Sri Lanka and Java. Now very local and rare in the desert areas of northern Africa and the Middle East. Once the most widespread of the felids; it is still common where prey is plentiful and protection assured, but has declined significantly and sometimes critically in about half of Africa. Exterminated from large parts of its former range in southern Africa, eastern Africa (notably Somalia and Ethiopia), and certain sectors of West Africa (especially in the coastal states). Depleted elsewhere, notably parts of Kenya, northern Tanzania, western Zambia, Ngamiland in Botswana, parts of Angola and Mozambique, also Chad, Mali and Senegal, and parts of the coastal states of West Africa.

POPULATION: The leopard has had to give way to the advance of agriculture, deforestation, and depletion of its prey. In areas taken over for agriculture and stock-raising it has been either exterminated or depleted; but it is still widespread and maintaining good numbers where it persists. During the 1960s leopards were relentlessly trapped to meet a worldwide demand for their furs, and some populations were severely reduced. Efforts were made to correct this situation in several countries, notably Tanzania, Zambia and Botswana, e.g. through national predator management policies. In parts of southern Africa, the leopard is still considered vermin. In the miombo woodland zone poaching pressure has varied greatly, and in large areas density rises to one animal per five sq km. Because of tsetse fly, and dry and infertile soils, the miombo biome will be little affected by human activities exept for the 10-15 percent which constitute alluvial floodplains or "dambo" drainage systems.

HABITAT: Leopards inhabit a variety of biomes, from tropical rain forest, miombo woodland, savanna and rocky areas with heavy or scattered vegetation to the high, cold regions of the Himalayas, and the suburbs of Nairobi. In general, they are still widely found in all biomes of Africa south of the Sahara except for outright desert. One important factor is cover, both for hunting and for lying-up to feed and rest. Human modification of savanna ecotypes tends to the removal of trees and bush, although the leopard has proved to be exceptionally resilient and tolerant of changes to its habitat.

CONSERVATION MEASURES TAKEN: The leopard is widely protected as a game animal; where not protected, as in Nigeria, South Africa and Namibia, it is fully protected in parks and reserves. Where it is still not protected or where it preys on man's increasing herds of domestic stock it has been persecuted severely. International action has been necessary to curb the drain on protected populations from illegal trapping and smuggling through these same countries into the world trade channels. The International Fur Trade Federation imposed a three-year voluntary ban on its members' use of leopard skins, from September 1971 to September 1974. However, in 1972, the demand for leopard skins was higher than ever before. Included in Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973; trade in these animals between acceding nations is subject to severe restriction, trade for primarily commercial purposes is banned.

CONSERVATION MEASURES PROPOSED: The leopard should remain in Appendix 1 of the International Convention until the livestock industry in Africa and Asia is prepared to admit that the wildlife conservationists have an interest as legitimate as that of the ranching community. It should likewise be banned to the international fur trade until major producer and consumer countries indicate their readiness to accept controls to regulate a sustained-yield offtake. In Africa much more severe penalties are required to deter poaching and preventive killing by livestock owners.

CHEETAH

Acinonyx jubatus

Order: CARNIVORA Family: FELIDAE

STATUS: Vulnerable. Severely reduced and faces a prospect of increasing attrition and even more limited distribution as the human population expands into its favoured habitats. Even inside national parks and game reserves its prospects cannot be regarded as good.

DISTRIBUTION: The African race, A. j. jubatus: south of the Sahara from Nigeria, Sudan and Somalia to southern Africa. At present, survives throughout much of its former range, but in much reduced numbers and seems to diminish even where protected in national parks and reserves. Its distribution is discontinuous and numbers vary from common to rare - or even absent in some areas where it was formerly common.

POPULATION: The remaining African populations may total less than 15,000, within a probable range of 8,000 - 25,000. Rough estimates of population sizes, based on informed local opinion and, for order of magnitude purposes only, indicate less than 2,000 in Kenya, less than 200 in Uganda, less than 1,000 in Tanzania, about 500 in Angola, less than 1,000 in Zambia, 200 in Mozambique, 50 in Malawi, 2,000 in Botswana, 400 in Rhodesia, 1,500 in South West Africa, 700 in South Africa, less than 1,000 throughout the Sahel zone, a few hundred in the savanna woodland zone of West Africa, rather more than 1,000 in Sudan, around 1,000 in Ethiopia, 300 or so in Somalia, and 300 or less in Zaire. In rough terms, these figures almost certainly represent half the cheetah totals in Africa in 1960, and present figures could well be reduced by one-half within another 10 years, perhaps by 1980, as a result of degradation or loss of habitat, and over-hunting, particularly by ranchers.

HABITAT: Open semiarid grasslands (but seldom areas of tall grass) scrubland (occasionally quite dense) and various types of savanna woodland, in all cases essentially in association with medium or small-sized herbivores; exceptionally, forest margins but never forest itself. These habitats are being reduced by agriculture, degradation or rangelands and competition from domestic stock following upon increasing occupation by human communities. Loss and degradation of habitat and associated depletion of prey species have been the principal factors in the cheetah's decline.

CONSERVATION MEASURES TAKEN: Totally protected in almost every country except South Africa and Namibia, where it is still considered vermin (amending legislation pending). Ranching interests in Kenya, Tanzania, Zambia, Rhodesia, Angola, Namibia and South Africa, however, often destroy cheetah suspected of marauding livestock. The cheetah occurs in less than half the parks and reserves of Africa, and totals no more than 3,000 animals in these protected areas. Moreover, when it is reduced to relict populations in

isolation from each other, it becomes singularly susceptible to disease, carnivore competition, shifts in prey community makeup, changes in vegetation configuration, and other natural limiting factors. In the main, its stability in protected areas shows a decline. Included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973; trade in these animals between acceding nations is subject to severe restriction, trade for primarily commercial purposes is banned. The International Fur Trade Federation operated a three-year voluntary ban among its membership on the use of cheetah furs in 1971/74.

CONSERVATION MEASURES PROPOSED: In terms of adaptability to change, the cheetah is one of the most vulnerable mammals. Conservation requirements, particularly outside parks and reserves, include more careful enforcement of protective laws and regulations, supervision of control so that only individual nuisance animals are removed when depredation occurs, control of over-grazing, and protection of wild prey species to reduce risk of predation on domestic animals. At the same time, the legitimate interests of ranchland communities in Africa should be recognized especially in those areas where pastoralists are attempting upgraded livestock husbandry and sometimes need to protect themselves in the event of undue predation.

AFRICAN ELEPHANT

Loxodonta africana

ORDER: PROBOSCIDEA Family: ELEPHANTIDAE

STATUS AND SUMMARY: Vulnerable. Now restricted to Africa south of the Sahara. Numbers, which lowest current estimates put at 1.3 million, are declining over most of its range, primarily because of over-exploitation for ivory; somewhat over 100,000, for example, must have died to supply the 1976 African ivory exports. In the longer term the main threat is constriction of the elephant's range due to expanding human populations. Protected by law in most countries and found in many national parks and reserves; however, protection is usually difficult to enforce. Suppression of poaching and of illegal ivory dealing are clearly essential, combined with the setting aside of sufficiently large blocks of land for the elephant and other measures aimed at establishing a satisfactory basis for its coexistence with man.

DISTRIBUTION: Africa south of the Sahara. Within about the last 300 years it occupied virtually all sub-Saharan Africa except the very driest areas, viz. sub-desert steppes of the Sudanese Arid Zone, desert and sub-desert of the Somali Arid Zone, and the coastal desert and sub-desert of the South West Arid Zone. Today it is scarce and very local in South Africa, South West Africa/Namibia, Angola, Rhodesia, Ethiopia, Uganda and West Africa, long extinct in northern Somalia, and recently extinct in the Gambia, Guinea-Bissau, Lesotho and Swaziland. Existing populations are generally regarded as belonging to one of two races, nominate L. a. africana of the savannas and L. a. cyclotis of the forests (see under Remarks).

POPULATION: Data collected by the IUCN/SSC African Elephant Specialist Group in the first systematic enquiry into elephant numbers and trends throughout Africa, suggest that in 1976 there were not less than 1.3 million elephants spread over 34-36 countries. Informants cited 45 examples of declining populations and it is thought that elephants are undergoing an overall decline in 23 countries. In three countries - Tanzania (with approximately 300,000 elephants), Zaire and Somalia - trends are uncertain. In South Africa, Namibia, Botswana and Rhodesia populations are stable, having recovered from the low ebb to which they were reduced at the beginning of the century. Trends in the remaining 4-6 countries are unknown.

In general, despite the still apparently substantial size of the total African elephant population, the future of the species is by no means assured if one considers the rate at which elephant habitat is being occupied and elephants are being exploited; with more than half the populations declining, the African elephant is considered a vulnerable species.

HABITAT AND ECOLOGY: Habitats vary from desert-scrub, thorn-bush and savanna to dense lowland and montane dry and humid forests. The elephant is a very adaptable grazer and browser, feeding on grass,

shrubs or trees and their leaves, twigs, terminal shoots, bark, roots or fruit. Where elephants are numerous, their habit of barking or felling trees may cause deforestation, but there is some evidence to suggest that this is a partial rather than the whole cause of this type of habitat change.

A social animal living in family units of 2-20 led by old females, but at times will form much larger aggregations. Bulls tend to live separately in small groups or alone, with occasional short term associations with family units when a female is in oestrus. A year round breeder; gestation about 22 months; puberty attained at 8-18 years of age; maternal care continues until puberty and may continue to be excercised indefinitely in respect of female calves within the family unit; potential longevity: 50-70 years.

THREATS TO SURVIVAL: Three main threats: (1) in the long-term, range reduction caused by an expanding human population and its subsequent demand for land, combined with the difficulty of reconciling the presence of wild elephants with human settlement and agriculture; (2) habitat changes induced by elephants being restricted to smaller and smaller areas, when their more concentrated impact on the vegetation may exceed its regenerative capacity, a problem sometimes aggravated by severe drought; the elephant's ability to survive successfully in areas set aside for its protection is, however, a matter of some controversy, depending on one's assessment of the speed at which it can respond to changes in resource availability; (3) in the short term the greatest threat is human predation arising from demands for ivory, for meat (particularly in West Africa) and for crop protection, the increased price of ivory and consequent boom in the ivory trade being the principal factor in the drastic decline of elephants in East Africa and elsewhere.

CONSERVATION MEASURES TAKEN: The African elephant is listed in Appendix 2 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), trade in it between acceding nations therefore being subject to regulation and monitoring. Most African countries have game laws which restrict shooting of elephants to licensed hunters or Game Departments, but the laws are often abused or poorly enforced. Poaching is also rife in many national parks and reserves in which the elephant is nominally protected.

CONSERVATION MEASURES PROPOSED: The IUCN/SSC Elephant Group has developed a four-point action programme for Research, Conservation, Economics and Education. Measures particularly needed include more effective enforcement of existing laws, reinforcement of anti-poaching units; a study of the ivory trade and new legislation to end illegal dealing; continual monitoring of the population dynamics of the African elephant; and, in the longer term, guarantees that large self-sufficient units of land inhabited by elephant poulations will be reserved in perpetuity. That in turn will depend on developing effective methods of reconciling the interests of such reserves with those of the human occupants of neighbouring areas, for example by ensuring that the latter derive direct and substantial benefits from appropriate management of elephants as a wildlife resource.

REMARKS: Two subspecies are usually recognized, the savanna-dwelling nominate *africana* and the smaller forest-dwelling *cyclotis*. Intermediates occur where the two meet and taxonomists differ about whether recognition should be at superspecies or subspecies level.

BLACK RHINOCEROS

Diceros bicornis

Order: PERISSODACTYLA Family: RHINOCEROTIDAE

STATUS AND SUMMARY: Vulnerable. Distribution now very sporadic in its African savanna habitats. Population thought to be anywhere between 10,000 and 30,000 with the minimum figure perhaps the more realistic. Decline attributed to poaching for its horn and habitat loss. Protected by law and occurs in national parks and reserves, although protection is often inadequate. Main conservation need is an effective ban on trade in rhino horn and particularly on its importation to Asian countries.

DISTRIBUTION: African savanna zone. Formerly widespread from South West Africa/Namibia and southwestern Cape Province north through Botswana, Rhodesia, Mozambique, Malawi, Zambia, Angola, Zaire, Tanzania, Uganda and Kenya to Somalia, Ethiopia, and the Sudan, thence westwards to the Central African Empire, northern Cameroun and Chad; also in Nigeria and further west, but no longer. In general, the species is still to be found over most of the extensive area indicated, but has been locally exterminated, with the survivors scattered in remnant populations mostly in parks and reserves.

POPULATION: Not known with any precision but probably 10,000 - 30,000 and everywhere depleted. In Zambia a 1975 report indicated the species was 'holding its own' and still common in the Luangwa Valley, where a 1973 UN/FAO survey had arrived at an estimate of 12,000 and an absolute minimum of 4,000.

HABITAT AND ECOLOGY: Transitional zone or ecotone between grassland and forest, preferably thick thorn bush or acacia scrub, but also more open country and occasionally evergreen forest. The black rhino is a browser and lives on a variety of bushes and shrubs; it is usually inactive during the heat of the day. The only stable social unit is the mother-child association. A calf is produced by the female about every 2½-3½ years, the gestation period being approximately 15 months.

THREATS TO SURVIVAL: Poaching for its horn which is considered by many Asian peoples to have aphrodisiac properties. World demand for rhino horn has increased in the last few years and as a consequence the price has increased. Progressive deterioration and loss of habitat due to rapidly increasing human populations poses another grave threat to the rhino's future. In some areas, e.g., Tsavo East National Park, habitat destruction by elephants, sometimes made worse by drought, has also been detrimental.

CONSERVATION MEASURES TAKEN: Listed in Appendix 1 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora, trade in it or its products subject to strict regulation by

ratifying nations, trade for primarily commercial purposes banned. Listed in Class B of the 1968 African Convention on the Conservation of Nature and Natural Resources, and as such may only be hunted or collected under special authorisation granted by the competent authority. Legally protected throughout its range and occurs in many national parks and reserves; but protection is often inadequate.

CONSERVATION MEASURES PROPOSED: Effective protection against poaching. Control of trade in rhino horn. A ban on the import of rhino horn to Asian countries would be extremely beneficial to the species.

LECHWE

Kobus leche

Order: ARTIODACTYLA Family: BOVIDAE

STATUS: Vulnerable. Depleted, present overall trend in numbers uncertain; not yet in danger of extinction, but its future will depend on protection of the floodplain habitat in which it exists and on careful management of populations. Three races are recognized: the red lechwe, K. l. leche; Black lechwe, K. l. smithemani; and the Kafue lechwe, K. l. kafuensis.

DISTRIBUTION: From northern South West Africa and Botswana, the Caprivi Strip, southeastern Angola and Zambia into southern Zaire. K. l. leche in Zambia's Busanga Plains north of Kafue National Park. Scattered populations exist in the major drainage systems of West Zambia, notably the Zambesi (Bulozi) floodplain from about Mongu to the west of Victoria Falls, and its western tributaries, i.e., the Luanginga and Lungwevungu rivers. K. l. smithemani: confined to Bangweulu Swamp in Zambia. Populations of Lake Mweru and the Chambeshi floodplains now appear to be extinct. K. l. kafuensis: restricted to the Kafue Flats in Zambia.

POPULATION: All subspecies have undergone marked declines in population, attributed in part to uncontrolled market and subsistence hunting, and in part to a decrease in habitat. K. l. leche: in Zambia in 1960 reports indicated 250 lechwe in the Busanga and Masozhi areas, 150 on the Luswishi river, 500 on Chisenga Island, 1,000 on the Simaraha flats and unknown numbers elsewhere. In 1966, however, no lechwe were seen on Chisenga Island, but 600 were observed in the Lukanga Swamp. By 1971 the Busanga Flats population had increased to 1,200 and is still increasing. K. l. smithemani: populations declined from over 150,000 in 1900-36 to a stable, pre-calving level of 16-17,000 in 1969-72, increasing to a pre-calving total of 21,500 in June 1973, as a result of a dry year (improving food conditions) increased law enforcement and reduced human disturbance and animal predation in 1972-73. K. l. kafuensis: present populations are estimated to be 93,975 (+ - 9.1%) based on aerial stratified sampling in 1970-72. Earlier populations probably did not greatly exceed the present total, although the range has been much reduced. Red and black lechwe populations, however, have undoubtedly been reduced by overhunting, and red lechwe, in particular, continue to be subjected to heavy hunting pressure in many parts of their range.

HABITAT: Confined to inundated floodplains on the fringes of swamp or rivers and marginally on adjoining dry floodplains. This habitat has been destroyed by flooding (e.g., construction of dams and reservoirs), or damaged by prolonged drought or the disappearance of permanent streams as a result of land abuse. The black lechwe are well below the carrying capacity of their range as a result of uncontrolled hunting; the Kafue lechwe populations, on the other hand, appear to be limited by food availability at the height of the

floods and show signs of extreme nutritional stress during these periods. Some 250,000 cattle graze the Kafue Flats in the dry season (July-December), and the flooding regime has been subjected to interference by two hydro-electric dams, one at the outlet to the floodplain (Kafue Gorge, completed in 1971) and one at the inlet (Iteshi-Teshi, to be completed in 1982). When both are in operation, the water regime of the flats will be competely controlled and will reduce the area of optimum low flood grazing.

CONSERVATION MEASURES TAKEN: The black and Kafue lechwes are totally protected by law, and the red lechwe is legally protected throughout much of its range, but enforcement has often proved difficult. Populations of the species occur in national parks or reserved areas in Angola, Botswana, Zambia and Zaire.

CONSERVATION MEASURES PROPOSED: More effective game law enforcement, better land management to maintain stream flow, and protection of the major areas of lechwe habitat from development. The majority of the black lechwe range is in the process of being gazetted as a Special Game Management Area in which permanent settlement and cultivation will be excluded, but fishing and, eventually, controlled hunting will be allowed. President Kaunda has initiated a project to reintroduce black lechwe to the Nashinga Swamp on the Chambeshi river in Chinsali District, by translocation of animals from Bangweulu.

Source: IUCN. 1978.

AFRICAN SLENDER-SNOUTED CROCODILE

Crocodylus cataphractus

Order: CROCODYLIA Family: CROCODYLIDAE

STATUS: Endangered.

DISTRIBUTION: West and central Africa, from Senegal to northern Angola, including Fernando Poo; in eastern Africa only in Lake Tanganyika near Ujiji.

POPULATION: Numbers have been drastically reduced throughout its range, mostly in the past 20 years. Over-exploited for meat and hides; and for eggs in Upper Volta.

HABITAT: Estuaries, lakes and savannah streams.

BREEDING RATE IN WILD: Little known.

CONSERVATION MEASURES TAKEN: In Zambia protected in national parks and game reserves, classed as game-animal. Protected as Class B species by the African Conservation Convention. In Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

CONSERVATION MEASURES PROPOSED: Maintenance of stringent conservation measures.

NUMBERS IN CAPTIVITY: At least 6 males, 2 females and 37 specimens of unknown sex in 27 zoos.

BREEDING POTENTIAL IN CAPTIVITY: Unknown.

NILE CROCODILE

Crocodylus niloticus

Order: CROCODYLIA Family: CROCODYLIDAE

STATUS: Vulnerable. Numbers have been drastically reduced almost everywhere, largely during the last 20 years to supply leather to meet a worldwide demand.

DISTRIBUTION: All of Africa except the northwest and central Sahara; also Malagasy Republic but probably few in the Comores. Formerly along the south coast of the Mediterranean and east to Syria; also in the Seychelles. Now extinct in Cape Province and rare in Natal south of Tugela river, South Africa.

POPULATION: Destruction of habitat, e.g., damming of rivers, draining of swamps and lakes, and other human pressures, militate against any rehabilitation of the species. All reports agree that populations can only be restored by stringent conservation measures.

HABITAT: Large rivers and lakes, fresh water marshes, river mouths and estuaries, rarely in mangrove swamps.

BREEDING RATE IN WILD: Extensive literature, not yet reviewed.

CONSERVATION MEASURES TAKEN: In Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Protected under class "B" by the African Conservation Convention of 1968. Protected in Uganda. However, in many African States the Nile Crocodile still has no legal protection, although it is legally protected in most national parks and game reserves. Importation into the United States is prohibited under provision of the Endangered Species Act.

CONSERVATION MEASURES PROPOSED: Enforced protective legislation should be in operation throughout the entire geographical range. The collecting of crocodiles and their eggs should be controlled. State Game Departments should assume responsibility for controlling crocodile rearing and restocking projects. The IUCN Survival Service Commission, through its Crocodile Specialists Group, offers advice to interested government agencies for such projects.

NUMBERS IN CAPTIVITY: Still to be reviewed.

BREEDING POTENTIAL IN CAPTIVITY: Rearing of Nile Crocodiles under controlled conditions has been shown to be quite feasible.

Source: IUCN. 1975.

Table 6. National Park Data

South Luangwa National Park (1)

LEGAL PROTECTION: Total, except against mining under special authority.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Previously a game reserve.

GEOGRAPHICAL LOCATION: East centre, northeast of Lusaka and mainly to the west of the middle reaches of the Luangwa River: S 12°28'-13°14'; E 30°58'-32°08'.

ALTITUDE: 500-1100 metres.

AREA: 905,000 ha.

LAND TENURE: Government owned, expropriated by law.

PHYSICAL FEATURES: The park sector of the Luangwa River averages about 580 m a.s.l. and from it the valley floor rises gently westwards to 760 m at the foot of the 1400 m Muchinga escarpment, which forms the north-western boundary. Structurally the valley is a rift, filled with Karroo sediments and overlain by recent sediments along the main river courses. These sediments are finely dissected into ridges with low interfluves. Mudstone plains occur at Chifungwe and Lunda. The main river and tributaries have a meander belt. Mean annual temperature 25°C, wet season from November to March, when heavy storms giving 832 mm rainfall.

VEGETATION: Woodland savanna with Acacia sp., Combretum sp. and Terminalia sericea on freely draining alluvium; also thickets. Older alluvial soils support patches of Colophospermum mopane woodland with a 15 m canopy. The floodplain grassland is composed of Oryza, Echinochloa and other species, bordered by some riparian forest. Miombo woodland, mainly Brachystegia sp., Julbernardia sp. and Isoberlinia angolensis, is widespread and up to 25 m tall on deeper sandy soils. In the shallow stony soils near the escarpment Brachystegia stipulata and Julbernardia globiflora are the dominant species.

NOTEWORTHY FAUNA: The park is remarkable for the great abundance and variety of larger mammals, especially ungulates. However, primates are equally characteristic. The most common park mammals include:

Order	Common Name	Scientific Name
Artiodactyla	Buffalo	Syncerus caffer
	Common waterbuck	Kobus ellipsiprymnus
	Giraffe	Giraffa camelopardalis thornicrofti (a subspecies endemic to the valley)
	Hartebeest	Alcelaphus lichtensteini

Order	Common Name	Scientific Name
	Hippopotamus	Hippopotamus amphibius
	Impala	Aepyceros melampus
	Greater Kudu	Tragelephus strepsiceros
	Puku	Kobus vardoni
	Roan antelope	Hippotragus equinus
	Sable	Hippotragus niger
	Cookson's Wildebeest	Connochaetes taurinus cooksoni (a local subspecies)
Carnivora	Leopard	Panthera pardus*
	Cheetah	Acinonyx jubatus*
	Hyaena	Crocuta crocuta
	Wilddog	Lycaon pictus*
Perissodactyla	Black rhinoceros	Diceros bicornis
Primates	Baboon, Chacma	Papio ursinus
	Moloney's monkey	Cercopithecus albogularis moloneyi
	Vervet monkey	Cercopithecus aethiops
Proboscidea	Elephant	Loxodonta africana

Birdlife is prolific and the park is particularly noted for storks, geese, cranes and for the riparian colonies of carmine bee-eaters. For the Nile crocodile* the Luangwa River is now one of the major remaining refuges.

RESERVATION PURPOSE(S): To provide total protection to all natural features and to ensure a stable equilibrium of the environment's ecosystem.

AREA ZONING:

1. In parts of the Luanga riverine area visitors are not allowed to view game in vehicles or on foot.
2. In remaining areas only foot safaris are conducted adjacent to the river and its two major tributaries.
3. The park is not yet open to visitors.

DISTURBING ACTIVITIES:

1. Inadequate control of bush fires.
2. Insufficient anti-poaching patrols in the western part of the park.
3. Some elements of mineral prospecting take place occasionally.

TOURISM:

1. Two full catering lodges with a total of forty-eight beds.
2. Three non-catering camps with a total of thirty beds.

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* Listed as endangered in IUCN. 1978.

3. Zambia National Tourist Bureau and Norman Carr safaris have each a number of tented camps for walking safaris.
4. Normal tourist season is open June - October. But with the completion of an all-weather road between Chichele and Mfuwe Lodges, a limited but very good green season game viewing is open around the Mfuwe area.
5. Access to the areas is serviced by a gravelled all-weather road from Chipata to an airport of international standard at Masumba close to the national park.

SCIENTIFIC RESEARCH: Routine ecological monitoring of habitat and population dynamics; particularly or large herbivores.

SPECIAL SCIENTIFIC FACILITIES: Research office block, field laboratory, herbarium and limited mapping facilities.

STAFF: 60 wildlife officers and assistants (ranges and guards) responsible to a wildlife warden, 2 biologists.

BUDGET: About US $400,000 per annum.

LOCAL PARK ADMINISTRATON: Wildlife Warden, P.O. Box 37, Chipata, Zambia.

North Luangwa National Park (2)

LEGAL PROTECTION: Total, except against mining under special authority.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Was a game reserve under previous legislation.

GEOGRAPHICAL LOCATION: East central Zambia, in the upper Luangwa valley: S 11°30'-12°20'; E 31°45' - 32°35'.

ALTITUDE: 500-1100 metres.

AREA: 463,600 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: Extends from the 1400 m Muchinga escarpment in the west to the northern part of the Luangwa River in the east. The valley floor is a wide area of alluvial flats extending over the underlying Karroo rocks. The river is seasonally flooded. Grassy plains are absent. Mean annual temperature is 22°C and mean annual rainfall of 800 mm comes in a single wet season from November to April.

VEGETATION: Miombo Brachystegia woodland on the freely draining sandy soils and miombo scrubland mixed with Colophospermum mopane on heavier soils. A complex of riverine forests is found on meander belt.

NOTEWORTHY FAUNA: Common mammals include:

Order	Common Name	Scientific Name
Artiodactyla	Buffalo	Syncerus caffer
	Eland	Taurotragus oryx
	Hippopotamus	Hippopotamus amphibius
	Impala	Aepyceros melampus
	Kudu	Tragelephus strepsiceros
	Puku	Kobus vardoni
	Cookson's Wildebeest	Clonnochaetes taurinus cooksoni
Carnivora	Leopard	Panthera pardus*
	Lion	Panthera leo
Perissodactyla	Black rhino	Diceros bicornis*
	Zebra	Equus burchelli
Primates	Baboon	Papio ursinus
	Vervet monkey	Cercopithecus aethiops
Proboscidea	Elephant	Loxodonta africana

The river provides a habitat for the crocodile Crocodylus niloticus*.

RESERVATION PURPOSE(S): To maintain as wilderness area with protection of natural communities and indigenous species of plants and animals.

AREA ZONING:

1. Zone providing for strict national park status with access by visitors restricted to walking safaris.
2. Some geological and palaeontological expeditions have found some interesting fossil sites which may be designated as separate zones in future.

DISTURBING ACTIVITIES:

1. Extensive poaching.
2. Uncontrolled seasonal bush fires by intention, as the park is set aside as a wilderness area which receives little management.

TOURISM: Access track but no lodges are present in the park. The only form of tourism permitted is conducted camping and walking on wilderness trails.

SCIENTIFIC RESEARCH: Limited ecological monitoring particularly of large mammal counts by aircraft. The park is set aside to form future baseline for ecological studies.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 30 wildlife officers (rangers, scouts and guards) responsible to a wildlife warden.

BUDGET: About US $120,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 37, Chipata, Zambia.

Lukusuzi National Park (3)

LEGAL PROTECTION: Total, except against mining under special clearance.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Was a game reserve under previous legislation.

GEOGRAPHICAL LOCATON: Eastern province plateau, between Lundazi and Chipata: S 12°30'-13°07'; E 32°25'-32°50'.

ALTITUDE: 800-1240 metres

AREA: 272,000 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: The eastern half is level plateau, while on the west more hilly broken country leads to the escarpment overlooking the Luangwa valley. Largely underlain by a variety of gneissic and granitic rocks with numerous outcrops and metamorphic quartzite hills. The climatic pattern comprises a long cool dry season and a short hot wet season.

VEGETATION: Principally miombo Brachystegia-Julbernardia woodland on both the plateau and escarpment soils. Different types of vegetation are, however, associated with the frequent granitic outcrops and the riverbanks. Edaphic dambo grasslands follow drainage lines on the plateau.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla	Buffalo	Syncerus caffer
	Common duiker	Sylvicapra grimmia
	Cookson's Wildebeest	Connochaetes taurinus cooksoni
	Eland	Taurotragus oryx
	Hartebeest	Alcelaphus lichtensteini
	Klipspringer	Oreotragus oreotragus
	Roan antelope	Hippotragus equinis
	Sable antelope	Hippotragus niger
	Warthog	Phacochoerus aethiopicus
Carnivora	Hyaena	Crocuta crocuta
Proboscidea	Elephant	Loxodona africana*
Perissodactyla	Zebra	Equs burchelli
	Black rhinoceros	Diceros bicornis*

RESERVATION PURPOSE(S): To maintain the area in a wilderness status with the protection of natural features, communities and indigenous plants and animals.

AREA ZONING: None.

DISTURBING ACTIVITIES: Uncontrolled seasonal bush fires and sporadic poaching.

TOURISM: Public access is by a bush track from the main road to the east: the track traverses the park and descends the escarpment to the Luangwa. There are no tourist facilities.

SCIENTIFIC RESEARCH: Preparation of a management plan to ensure the maintenance of the major habitats and preservation of key areas.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 30 wildlife officers (ranger, scouts and guides) responsible to a wildlife warden.

BUDGET: About US $90,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 37, Chipata, Zambia.

Luambe National Park (4)

LEGAL PROTECTION: Total, except against mining under special authority.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Was previously a game reserve.

GEOGRAPHICAL LOCATION: On east bank of Luangwa River, between the three larger Luangwa valley parks: S 12°25'-12°35'; E 32°10'-32°25'.

ALTITUDE: 500-710 metres.

AREA: 25,400 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: A predominately alluvial area sloping gently to the Luangwa River which forms its western boundary. The valley floor rocks belong to the Karroo system. The climate is hottest in the late dry season (October) and coolest in the mid-dry season (July).

VEGETATION: Alluvial areas dominated by Colophospermum mopane woodland with miombo Brachystegia-Julbernardia woodland on the small areas of free draining sandy soil away from the river.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla	Buffalo	Syncerus caffer
	Bushpig	Patamocnoerus porcus
	Eland	Taurotragus oryx
	Hippopotamus	Hippopotamus amphibius
	Impala	Aepyceros melampus
	Roan antelope	Hippotragus equinus
	Wildebeest	Connochaetes taurinus cooksoni
Carnivora	Lion	Panthera leo
Perissodactyla	Black rhino	Diceros bicornis
Proboscidea	Elephant	Loxodonta africana*

RESERVATION PURPOSE(S): To protect natural features, communities and indigenous species of plants and animals.

AREA ZONING: None.

DISTURBING ACTIVITIES:

1. Seasonal bush fires.
2. Slight poaching.
3. Local overstocking of elephant, impala and hippopotamus.

TOURISM: One twelve-bed non-catering lodge. The park opens to visitors June - October. There are seasonal dusty roads.

SCIENTIFIC RESEARCH: Large mammal populations aerial sureys. Habitat studies were conducted in the past.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 10 wildlife officers responsible to a wildlife warden.

BUDGET: About US $30,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 37, Chipata, Zambia.

Mweru Wantipa National Park (5)

LEGAL PROTECTION: Total, except against mining under special authority.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Was a game reserve under previous administration.

GEOGRAPHICAL LOCATION: Close to northern border, between lakes Mweru and Tanganyika, Luapula and Northern provinces: S 08°27'-09°00'; E 29°15'-30°00'.

ALTITUDE: 900-1400 metres.

AREA: 313,400 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: The eastern half of the park changes periodically from grassland and swamp to a large open lake: Lake Mweru Wantipa. The cycle is erratic but the water level appeared to reach its nigh point in 1974. The area is very young geologically with marked faults around the high water mark. To the west of the lake basin the land slopes upwards gently to a range of highly dissected hills of granites, quartz and porphyrites. In about one year in five total rainfall may be as much as 1300 mm, the wet season falling mainly between November and April.

VEGETATION: The swamp and lake area are dominated by dense Papyrus thickets with some reed Phragmites. The area close to the lake has thickets of Bussea and Combretum. The remainder is covered with miombo Brachystegia-Julbernardia woodland on the sandy-loam soils derived from underlying igneous rocks. Large grassy acid dambos occur in the miombo woodland and there is another small permanent swamp, Kabwe marsh, some distance from the main lake.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla	Buffalo	Syncerus caffer
	Bushbuck	Tragelaphus scriptus
	Blue duiker	Cephalopnus monticola
	Eland	Taurotragus oryx
	Grysbok	Raphicerus sharpei
	Hartebeest	Alcelaphus lichtensteini
	Hippopotamus	Hippopotamus amphibius
	Klipspringer	Oreotragus oreotragus
	Puku	Kobus vardoni
	Reedbuck	Redunca arundinum
	Roan antelope	Hippotragus equinus
	Sable	Hippotragus niger
	Sitatunga	Tragelaphus spekei

Order	Common Name	Scientific Name
	Warthog	Phacochoerus aethiopicus
	Waterbuck	Kobus ellipsiprymnus
	Yellow-backed duiker	Cephalophus sylvicultor
Carnivora	Leopard	Panthera pardus*
	Lion	Panthera leo
	Bushy-tailed mongoose	Bdeogale crassicauda
Perissodactyla	Black rhino	Diceros bicornis*
	Zebra	Equus burchelli
Primates	Blue monkey	Cercopithecus mitis
	Colobus monkey	Colobus angolensis
	Baboon	Papio sp.
Proboscidea	Elephant	Loxodonta africana*

RESERVATION PURPOSE(S): To maintain a wilderness area with protection of natural features, communities and indigenous species of plants and animals.

AREA ZONING:

1. Complete wilderness area permitting entry only to authorized persons.
2. Public access and restricted residential area.
3. Commercial fishing is permitted on part of the lake.

DISTURBING ACTIVITIES:

1. Illegal hunting.
2. Bush fires.
3. Seasonal pressure from fishing interests.
4. Potential red locust breeding area.

TOURISM: Little, but there is access by motorable road from east and west and suitable camping places outside the park.

SCIENTIFIC RESEARCH: Investigation of the red locust by the International Red Locust Institute afforded oportunities for botanical and zoological research.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 26 wildlife officers (guards and scouts) under a ranger and a warden.

BUDGET: About US $45,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 5, Kasama, Zambia.

Sumbu National Park (sometimes spelled Nsumbu) (6)

LEGAL PROTECTION: Total, except against mining under special permission.

DATE ESTABLISHED: 25 February 1972 by Statutory Instrument No. 44 of 1972. Was a game reserve under previous legislation.

GEOGRAPHICAL LOCATION: Northern province, on the south-west shore of Lake Tanganyika: S 08°30'-09°05'; E 30°15'-30°45'.

ALTITUDE: 800-1250 metres.

AREA: 202,000 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: About 100 km of rocky shoreline of Lake Tanganyika, interspersed with some small beaches and including Cape Nundo which features a great balanced boulder of local ritualistic significance. Most of the area away from the lake is a plateau but it is traversed by the Lufubu river, which also forms the northern half of the eastern boundary before entering the lake. Above the river to the northwest is the 700 m Chansamansaka escarpment and another escarpment, the Kapembwa bounds the view to the east. Annual rainfall of 1400 mm, mainly falling between November and April. The area has numerous small sites of archaeological interest usually near the beaches.

VEGETATION: The valleys opening on to the lake are dominated by tall Acacia albida and Trichilia roka. Valley sides, the hills near the lake and some plateau areas have dense Bussea-Combretum thicket. At higher elevations and further from the lake the vegetation is either light miombo dominated by Afromosia angolensis or the denser Brachystegia-Julbernardia type of miombo woodlands. Wide alluvial flats with open grassland and Pteleopsis anisoptera gallery forest occur along the Lufubu and Nkamba river.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla	Buffalo	Syncerus caffer
	Blue duiker	Cephalophus monticola
	Eland	Taurotragus oryx
	Grysbok	Raphicerus sharpei
	Hartebeest	Alcelaphus lichtensteini
	Hippopotamus	Hippopotamus amphibius
	Klipspringer	Oreotragus oreotragus
	Puku	Kobus vardoni
	Reedbuck	Redunca arundinum
	Roan antelope	Hippotragus equinus
	Sable	Hippotragus niger

Order	Common Name	Scientific Name
	Waterbuck	Kobus ellipsiprymnus
	Yellow-backed duiker	Cephalophus sylvicultor
Carnivora	Leopard	Panthera pardus*
	Lion	Panthera leo
Perissodactyla	Zebra	Equus burchelli
Squamata	Tanganyika water cobra	Boulengerina annulata
Proboscidea	Elephant	Loxodonta africana*

Grey-headed and lesser black-back gulls Larus cirrocephalus and fuscus, white-winged and whiskered terns Chlidonias leucoptera and hybrida and skimmers Rhynchops flavirostris are among the more obvious bird species of the rivers and shores of the lake, in which the Nile crocodile is still to be seen and the Tanganyika water cobra Boulengerina annulata can also be commonly observed.

RESERVATION PURPOSE(S): To protect all natural features, both marine and terrestrial, and also to afford protection of communities and indigenous species of plants and animals.

AREA ZONING:
1. Lake shore area for tourist usage.
2. Wildeness area.

DISTURBING ACTIVITIES:
1. Poaching of wildlife.
2. Bush fires.
3. Illegal fishing and fishing camps.

TOURISM:
1. A thirty-two-bed catering lodge at Kasaba Bay.
2. An eighteen-bed catering lodge at Nkhamba Bay.
3. A ten-bed non-catering lodge at Nsumbu. There is an all weather airstrip providing access to the above tourists lodges. The lodges are open all the year round serving on the average 3,500 visitors per year.

SCIENTIFIC RESEARCH: Preparation of management plans for the park's development and conservation.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 25 wildlife officers (guards) under a ranger and a warden.

BUDGET: About US$ 100,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 5, Kasawa, Zambia.

Lusenga Plain National Park (7)

LEGAL PROTECTION. Total, except against mining under special authority.

DATE ESTABLISHED: 25 February 1972 by Statuatory Instrument No. 44 of 1972. Was a game reserve under previous legislation.

GEOGRAPHICAL LOCATION: North of Kawambwa, Luapula Province: S 09°15'-09°30'; E 29°05'-29°20'.

ALTITUDE: 800-1300 metres.

AREA: 88,000 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: In the south-western corner a plain formed by the weathering of a volcanic plug dome, leaving rocky outcrops of syenite in concentric rings separated by weathered softer rock, forms a saucer-shaped depression. This plain with its ridges form the highest point, the ground sloping away to north and east to the Kalungwishi river, on which there are three big waterfalls. Rainfall totals 1400 mm, falling mainly between November and April.

VEGETATION: The plain has grassland fairly, typical of Northern Province upland dambos. Around the margins are remnants of 'musnitu' swamp forest and dry evergreen forest of Marquesia acuminata and macroura. The remaining area is covered with dense Brachysteria-Julbernardia miombo with a few patches of Pteleopsis anisoptera on alluvial soils.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Blue duiker	Cephalophus monticola
	Buffalo	Syncerus caffer
	Bushbuck	Tragelaphus scriptus
	Eland	Taurotragns oryx
	Hartebeest	Alcelaphus licntensteini
	Reedbuck	Redunca arundinum
	Roan antelope	Hippotragus equiuus
	Sable	Hippotragus niger
	Warthog	Phacocoerus aethiopicus
	Waterbuck	Kobus ellipsiprymnus
	Yellow-backed duiker	Cephalophus sylvicultor
Carnivora:	Leopard	Panthera pardus*
Perissodactyla:	Zebra	Equus burchelli
Primates:	Blue monkey	Cercopithecus mitis
	Vervet monkey	Cercopithecus aethiops
Proboscidea:	Elephant	Loxodonta africana*

RESERVATION PURPOSE(S): To protect all natural features, communities and indigenous species of plants and animals.

ZONING: None.

DISTURBANCES OR DEFICIENCIES: Uncontrolled fires and poaching. Low priority for protection under game reserve legislation has resulted in depleted animal populations.

TOURISM: No accommodation or roads in park, but two good camping sites just outside the boundary and not far from two of the waterfalls.

SCIENTIFIC RESEARCH: Vegetation and habitat mapping for preparation of management plans.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 9 wildlife officers (guards).

BUDGET: Reported as US$ 5000 in 1971.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 5, Kasama, Zambia.

Isangano National Park (8)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972 by Statuatory Instrument No. 44 of 1972. Was a game reserve under previous legislation.

GEOGRAPHICAL LOCATION: At the north-eastern edge of the Lake Bangweulu flats, Northern Province: S 11°00'-11°25'; E 30°20'-30°45'.

ALTITUDE: About 1100 metres.

AREA: 84,000 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: Flats and flood plain areas on granite and quartzitic sandstones and shales of the plateau series. The eastern boundary is formed by the Chambeshi river and the Lubansensni river runs through the centre of the park. High rainfall totals 1500 mm or more in some years.

VEGETATION: Swamp forest dominated by Erythrophleum and Pterocarpus together with tall grasslands and watershed plain grasslands. Along the main rivers there are some Papyrus and Phragmites areas and lake basin chipya woodland of Acacia albida and afrormosia Pericopsis angolensis also occurs.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Black lechwe	Kobus leche smithemani*
	Buffalo	Syncerus caffer
	Bushbuck	Tragelaphus scriptus
	Eland	Taurotragus oryx
	Hartebeest	Alcelaphus lichtensteini
	Reedbuck	Redunca arundinum
	Roan antelope	Hippotragus equinus
	Warthog	Phacochoerus aethiopicus
Perissodactyla:	Zebra	Equus burchelli
Probiscidea:	Elephant	Loxodonta africana*

RESERVATION PURPOSE(S): To maintain and protect the area as a wilderness area to safeguard against any form of disfigurement of natural features, communities and indigenous species of plants and animals.

ZONING: None

DISTURBANCES OR DEFICIENCIES: Poaching, uncontrolled bush fires, fishing villages and illegal entry. Low priority under game reserve status has resulted in reduced animal populations.

TOURISM: No accomodation or other facilities. Very rough tracks unsuitable for normal motor vehicles come fairly close to its borders but access can only be achieved by foot and boat.

SCIENTIFIC RESEARCH: None.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 2 wildlife officers (guards) under a ranger and a warden.

BUDGET: About US$ 15,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 5, Kasama, Zambia.

Lavushi Manda National Park (9)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972 by Statutory Instrument No. 44 of 1972. Was a game reserve under previous legislation.

GEOGRAPHICAL LOCATION: South-west of Mpika, Northern Province: S 12°00'-12°40'; E 30°35'-31°10'.

ALTITUDE: 1100-1800 metres.

AREA: 150,000 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: The Lavushi Manda hills, some 500-600 m in height, along the south-eastern side of the park roughly divide the plateau series to the west from the basement rocks to the east. They are extremely rugged, with high vertical cliff faces on the south-east and dissected by several narrow canyons containing perennial water courses. A fair-sized river, the Lukulu, flows through the northern half of the park to its south-western corner before turning westwards to the Zaire border. The park is noted for its dambos and there is a small sandy plain in the north. Rainfall totals 1300 mm mainly falling between November and April.

VEGETATION: Most of the area supports Miombo Brachystegia-Julbernardia woodland, interspersed with dambo plains. Dense gallery forest occurs along the rivers, with palms in the canyons. Numerous euphorbiaceae and aloes are a feature of the hill vegetation.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Common duiker	Sylvicapra grimmia
	Hartebeest	Alcelaphus lichenstieni
	Klipspringer	Oreotragus oreotragus
	Reedbuck	Redunca arundinum
	Roan antelope	Hippotragus equinus
	Sable	Hippotragus niger
	Waterbuck	Kobus ellipsiprymnus
Carnivora:	Leopard	Panthera pardus*
	Lion	Panthera leo
Perissodactyla:	Black Rhino	Diceros bicornis*
	Zebra	Equus burchelli
Probiscidea:	Elephant	Loxodonta africana*

There are no spectacular concentrations of birds, but some interesting small species such as the bar-throated apalis Apalis thoracica and the double-collared sunbird Nectarinia chalybea are found in the hills.

RESERVATION PURPOSE(S): To maintain as a wilderness area with protection of natural features, communities and indigenous species of plants and animals.

ZONING: None.

DISTURBANCES OR DEFICIENCIES: Uncontrolled fires and poaching. Low protection priority under game reserve legislation has resulted in low stocks of wild animals.

TOURISM: No accommodation available, but the park is close to and readily accessible from the Great North Road in the dry season.

SCIENTIFIC RESEARCH: A national Parks and Wildlife Service field base has been established to the west of the park at Chiundaponde.

SPECIAL SCIENTIFIC FACILITIES: None

STAFF: 2 wildlife officers (guards)

BUDGET:

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 5, Kasama, Zambia.

Kasanka National Park (10)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Previously a game reserve.

GEOGRAPHICAL LOCATION: Serenje district, Central Province: S 12°25'-12°35'; E 30°05'-30°23'.

ALTITUDE: 1100-1300 metres.

AREA: 39,000 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: A flat to gently rolling plateau area with extensive wetlands. The rocks are mainly sandstone, quartzite, shale and schist of the Katanga and Muva syatems. Two large rivers flow through the park, the Kasanka river passing through the extensive Kapabi swamp which lies in the east of the park. There are also several small lakes. Annual rainfall is between 1200 and 1300 mm, falling mainly between November and April.

VEGETATION: The area is dominated by miombo Brachystegia-Julbernardia woodlands. The extensive wetlands support Papyrus and Phragmites stands and there are some areas of open grassland and dambos, and also of 'mushitu' swamp forest.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Buffalo	Syncerus caffer
	Bushbuck	Tragelaphus scriptus
	Eland	Taurotragus oryx
	Grysbok	Raphicerus sharpei
	Hartebeest	Alcelaphus lichtensteini
	Hippopotamus	Hippopotamus amphibius
	Puku	Kobus vardoni
	Sitatunga	Tragelaphus spekei
	Waterbuck	Kobus ellipsiprymenus
	Warthog	Phacochoerus aethiopicus
Perissodactyla:	Zebra	Equus burchelli
Primates:	Blue monkey	Cercopithecus mitis
	Moloney's monkey	Cercopithecus albogularis moloneyi
Probiseidea:	Elephant	Loxodonta africana*

RESERVATION PURPOSE(S): To maintain as a wilderness area with protection of natural features, communities and indigenous species of plants and animals, in particular, the large population of sitatunga.

AREA ZONING: None.

DISTURBING ACTIVITIES: Uncontrolled bush fires and poaching.

TOURISM: No visitor accommodation; accessible only by rough bush track unsuitable for private cars, but suitable sites for camping can be found near the park boundary.

SCIENTIFIC RESEARCH: In the past, some preliminary research studies were conducted on the status of the sitatunga (Tragelaphus spekei) population.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 10 wildlife officers (guards) under a ranger and a warden.

BUDGET: About US$ 25,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 5, Kasama, Zambia.

Kafue National Park (11)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972, Statutory Instrument No. 44 of 1972, and previously on 15 September 1951 by Proclamation No. 8 of 1951.

GEOGRAPHICAL LOCATION: South central Zambia, west of Lusaka, parts of Central, Southern and North-Western provinces: S 14°00'-16°40'; E 25°15'-26°45'.

ALTITUDE: 970-1470 metres.

AREA: 2,240,000 ha.

LAND TENURE: Government land expropriated by law.

PHYSICAL FEATURES: A gently undulating plateau area with a few hills situated along the mid reaches of the Kafue river and its two major tributaries, the Lufupa and the Lunga, which flow into the park from the north. At the extreme north-west corner of the park there is a perennial swamp which drains into the Lufupa via the Busanga flood plain. Alluvial areas of varying size also occur along the Kafue and its other tributaries. Karroo sediments occur centrally and to the north-east, with Kalahari sands forming the underlying geology of western areas.

VEGETATION: Mainly miombo or Brachystegia dominated woodland, with areas of mopane Colophospermum mopane in the south. In the north, the miombo-termitaria woodland surrounds areas of open grassy flood plains of 'dambos.' Patches of teak Baikiaea plurijuga occur throughout but are more common in the south, the Ngoma forest being one example.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Buffalo	Syncerus caffer
	Hartebeest	Alcelaphus lichensteini
	Puku	Kobus vardoni
	Reedbuck	Redunca arundinum
	Red lechwe	Kobus leche leche*
	Waterbuck	Kobus deffasa
		Kobus ellipsiprymnus crayshawi
	Yellow-backed duiker	Cephalopnus sylviculter
Carnivora:	Lion	Panthera leo
Perissodactyla:	Black rhino	Diceros bicornis*
Primates:	Baboon	Papio cynocephalus
		Papio ursinus
Probiseidea:	Elephant	Loxodonta africana*

RESERVATION PURPOSE(S): To maintain wilderness area with protection of natural features, communities and indigenous species of plants and animals.

AREA ZONING:

1. Area where visitors are allowed on foot only.
2. Area where visitors are allowed in vehicles or on foot.
3. Area where visitors are not allowed.

DISTURBING ACTIVITIES:

1. Poaching and setting up fires along a territorial road which runs through the park.
2. Itezhi-tezhi dam has inundated approximately 300 km^2 of the park.

TOURISM: One catering lodge at Ngoma with forty-two beds. There are also five non-catering camps with a total of thirty-six beds. Limited foot safaris are conducted in the Lusenga plains.

SCIENTIFIC RESEARCH: One biologist responsible for routine ecological monitoring and up-dating management plans.

SPECIAL SCIENTIFIC FACILITIES: Herbarium and mapping facilities.

STAFF: Warden, 100 supporting staff, biologist and assistants.

BUDGET: About US$ 300,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 109, Kalamo, Zambia.

Blue Lagoon National Park (12)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 16 February 1973 by Statutory Instrument No. 38 of 1973. Previously a private ranch.

GEOGRAPHICAL LOCATION: West of Lusaka, Mumbwa district, Central Province: S 15°21'-15°43', E 27°15'-27°32'.

ALTITUDE: 970-1010 metres.

AREA: 45,000 ha.

LAND TENURE: Donated to Zambian Government, which added further areas by lawful expropriation.

PHYSICAL FEATURES: North bank of the Kafue Flats, part of the south-eastern boundary being formed by the Luwato lagoon, an oxbow lake of the old river channel which tends to dry out only at the end of the dry season. The land slopes up gently northwards from the flood plain. The seasonal inundation reaches its maximum in June when 30% of the park is under water.

VEGETATION: Three vegetation zones: 1) flood plain grasses and sedges, principal species near the high flood level being Vetiveria nigritana and wild millets Setaria sphacelata and avettae, while areas more deeply flooded support rice grass Oryza barthii and small patches of Papyrus; 2) a narrow intermediate termitaria grassland zone; and 3) open woodland dominated by Acacia, Combretum and Terminalia with an understorey of tall grass. Fig trees Ficus sycomorus are common locally.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Buffalo	Syncerus caffer
	Bushbuck	Tragelaphus scriptus
	Kafue lechwe	Kobus leche Kafuensis*
	Kudu	Tragelephus strepisiceros
	Roan antelope	Hippotragus equinus
	Sable antelope	Hippotragus niger
Carnivora	Cheetah	Acinonyx jubatus*
	Wild dog	Lycaon pictus
Perissodactyla:	Zebra	Equus burchelli

The Kafue lechwe is one of three subspecies, all classified as vulnerable, and about 25,000 are estimated to enter the park seasonally out of a total population of about 100,000 in the Kafue Flats. The park is an important feeding ground for waterfowl, including glossy ibis Plegadis falcinellus and spur-winged goose Plectropterus gambensis.

RESERVATION PURPOSE(S): To provide total protection for all natural features.

AREA ZONING: None.

DISTURBANCES OR DIFICIENCIES: Uncontrolled bush fires, poaching of animals and fish. It is expected that the Kafue Gorge dam (see ZAM. 1.1) will have a major effect on the flood regime.

TOURISM: No lodge but a tented camp with non-catering facilities has been established. Access by a 90 km gravel road branching off the Lusaka-Mumbwa highway; also an airstrip. A 4 km causeway has been built out into the flats to facilitate viewing.

SCIENTIFIC RESEARCH: Ecological studies have been started.

SPECIAL SCIENTIFIC FACILITIES: None: the area is covered from Lochinvar National Park on the other side of the Kafue valley.

STAFF: 6 guards and a ranger under a wildlife warden.

BUDGET: About US$ 50,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 1, Chilanga, Zambia.

Lochinvar National Park (13)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Originally a privately owned ranch, then a game management area.

GEOGRAPHICAL LOCATION: North-west of Monze, Southern Province: S 15°43'-16°01'; E 27°11'-27°19'.

ALTITUDE: 970-1038 metres.

AREA: 41,000 ha.

LAND TENURE: Government expropriated by laws.

PHYSICAL FEATURES: 3 zones: 1) the northern third forms part of the Kafue Flats floodplain and is subject to a regular pattern of flooding, which commences rapidly in December, reaches a maximum in May and gradually recedes to its lowest level by November; 2) a flat termitaria zone south of the floodplain, with sandy clay to clay soils which become waterlogged in the wet season; and 3) woodland in the southern quarter of the park, two groups of hot springs being located on a fault zone towards the west. Annual rainfall is around 1000 mm.

VEGETATION: Floodplain grasses vary from area to area but include rice grass Oryza barthii, Vossia cuspidata, Echinochloa stagnina and Panicum repens. Herbs include Aeschynomene fluitans and Numphaea capensis. The termitaria grasslands are dominated by a wild millet Setaria sphacelata, tree growth being confined to the termite mounds and commonly comprising Euphorbia candelabrum. The woodlands at higher elevations in the south of the park are dominated by such fire climax species as Acacia, Albizia and Combretum.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Arciodactyla	Eland	Taurotragus oryx
	Kafue lechwe	Kobus leche kafuensis
	Wildebeest	Connochaetes taurinus
	Oribi	Ourebia ourebi
	Kudu	Tragelaphus strepsiceros
	Bushbuck	Tragelaphus scriptus
	Duiker	Cephalophus spp.
	Impala	Aepyceros melampus

The area is also very rich in birdlife, with almost 400 species recorded, including white and pink-backed pelicans Pelecanus onocrotalus and refuscens, darter Anhinga rufa, purple and goliath herons Ardea purpurea and goliath, spur-winged goose Plectropterus gambensis, fish eagle

Cuncuma vocifer, secretary bird Sagittarius serpentarius, Swainson's francolin Pternistis swainsoni, helmeted guineafowl Numida meleagris, crowned crane Balearica pavonina, wattled crane Bugeranus carunculatus, Denham's bustard Neotis denhami, wattled plover Afribyx senegallus and red-billed hornbill Tockus erythrorhynchus.

RESERVATION PURPOSE(S): To provide total protection to all natural features.

AREA ZONE: None.

DISTURBING ACTIVITIES:

1. Poaching.
2. Bush fires.
3. Gypsum mining.
4. Cattle frequently stray into the park.
5. Trespassing by fishermen.
6. Possible adverse effect from the Gorge and Itezhi-tezhi high dam impoundments.

TOURISM: One non-catering lodge with ten beds, and one newly opened camping site.

SCIENTIFIC RESEARCH: Physiological and ecological studies on the lechwe population still going on being conducted by University of Zambia and other local and international scientific organisations.

SPECIAL SCIENTIFIC FACILITIES: A small abattoir, office block with a field laboratory.

STAFF: One biologist and assistants, 8 guards and a ranger under a warden.

BUDGET: About US$ 50,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 1, Chilanga, Zambia.

West Lunga National Park (14)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972 by Statutory Instrument No. 44 of 1972. Was a game reserve under previous legislation.

GEOGRAPHICAL LOCATION: Mwinilunga district, North Western Province: S 12°30'-13°07'; E 24°35'-25°00'.

ALTITUDE: 1120-1200 metres.

AREA: 168,400 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: A flat or gently undulating area with a few rocky outcrops lying between the West Lunga river on the west and the Kabompo river on the east. The junction of the rivers is at the south-west corner of the park. Permanent swamps occur along the Kabompo and there are also three seasonally inundated grassy plains.

VEGETATION: Most of the park is covered by dry evergreen Cryptosepalum pseudotaxus forests, characterized by dense thickets of shrubs, climbers, scramblers and saplings. These are found on the Kalahari sands but small patches of Brachystegia-Julbernardia miombo woodland occur on the alluvial soils. There is also an intermediate type of woodland, known as Chipya, dominated by Acacia goetzei and Burkea africana but with a mixture of Cryptosepalum forest. Significant amounts of open grassland occur and some Papyrus swamp.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Blue duiker	Cephalophus monticola
	Buffalo	Syncerus caffer
	Bushpig	Potomochoerus porcus
	Eland	Taurotragus oryx
	Hartebeest	Alcelaphus lichtensteini
	Hippopotamus	Hippopotamus amphibius
	Impala	Aepyceros melampus
	Klipspringer	Oreotragus oreotragus
	Oribi	Ourebia aurebi
	Puku	Kobus vardoni
	Sitatunga	Tragelaphus spekei
	Yellow-backed duiker	Cephalophus sylvicultor
Perissodactyla:	Zebra	Equus burchelli
Primates:	Blue monkey	Cercopithecus mitis

Bird life is varied and abundant and includes a local red-throated subspecies of crested guinea fowl Guttera edouardi kathleenae. Crocodile are present.

RESERVATION PURPOSE(S): To provide total protection for all natural features and ecological communities.

ZONING: None.

DISTURBANCES OR DEFICIENCIES: Poaching and uncontrolled bush fires.

TOURISM: No visitor accommodation but good camping sites on the Kabompo river and near the park headquarters at Jivindu, from which a pontoon ferry gives access to the park and its system of rough tracks.

SCIENTIFIC RESEARCH : Vegetation and habitat mapping underway.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 10 guards and a ranger under a warden; 1 biologist includes the part in his terms of reference.

BUDGET: About US$ 30,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 1, Chilanga, Zambia.

Liuwa Plain National Park (15)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Previously the Paramount Chief's game reserve.

GEOGRAPHICAL LOCATION: Western province, Kalabo district: S 14°10'-14°48'; E 22°07'-23°00'.

ALTITUDE: About 1000 metres.

AREA: 366,000 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: An extremely flat sand plain at 1000 m, flanked by the Luambimba river to the east and the Luanginga river to the west. Seasonally inundated areas occur along the rivers.

VEGETATION: Mainly Kalahari short grass sand plains and some watershed grasslands. Around the edges of the sand plains, except in the west, is a belt of Burkea africana with some Zambian teak Baikiaea plurijuga, forming Burkea-Colophospermum-Baikiaea woodland. The river valleys have a narrow belt of valley and floodplain grasslands.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Buffalo	Syncerus caffer
	Red lechwe	Kobus leche leche*
	Roan antelope	Hippotragus equinus
	Tsessebe	Damaliscus lunatus
	Wildebeest	Connochaetes taurinus
Perissodactyla:	Zebra	Equus burchelli

Birdlife includes a variety of waterfowl on the pans and such species as the secretary bird Sagittarius serpentarius, crowned crane Balearica pavonina and wattled crane Bugeranus carunculatus.

RESERVATION PURPOSE(S): To provide total protection for all natural features.

AREA ZONING: None.

DISTURBING ACTIVITIES:
1. Poaching.
2. Bush fires.

TOURISM: Undeveloped.

SCIENTIFIC RESEARCH: Vegetation and habitat mapping and inventoring avifauna species for park management plan is under way.

SPECIAL SCIENTIFIC RESEARCH: None.

STAFF: 6 guards and a ranger under a warden; 1 biologist includes the park in his terms of reference.

BUDGET: About US$ 35,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 158, Mongu, Zambia.

Sioma Ngwezi National Park (16)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Previously the Paramount Chief's game reserve.

GEOGRAPHICAL LOCATION: South-west, bordering the Caprivi Strip: S 16°55'-17°40'; E 23°02'-23°50'.

ALTITUDE: 900 metres.

AREA: 527,600 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: A realtively flat area west of the Zambezi and bordered by the Mashi River on the south-west. Very sandy, underlain by Kalahari sands, with a mosaic of woodland and sandy plains. Very arid apart from a few isolated waterholes.

VEGETATION: Kalahari sandveld with good stands of teak Baikiaea plurijuga, areas of mopane Colophospermum mopane and small patches of a mixed woodland of Burkea-Colophospermum-Baikiaea associations.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Buffalo	Syncerus caffer
	Giraffe	Giraffa camelopardalis infumata
	Kudu	Tragelaphus strepsiceros
	Roan antelope	Hippotragus equinus
	Sable antelope	Hippotragus niger
	Steinbok	Raphicerus campestris
	Tsessebe	Damaliscus lunatus
Carnivora:	Cheetah	Acinonyx jubatus*
	Lion	Panthera leo
Probiseidea:	Elephant	Loxodonta africana*

While there are no spectacular concentrations of large birds, a number of interesting and varied dry country species are to be seen, including the greater kestrel Falco rupicoloides, Bradfield's hornbill Tockus bradfieldi, the pied barbet Lybius leucomelas, Burchell's glossy starling Lamprotornis australis and black-cheeked waxbill Estrilda erythronotos. The ostrich formerly occurred but is extinct in this area.

RESERVATION PURPOSE(S): To provide total protection to all natural features.

AREA ZONING: None.

DISTURBING ACTIVITIES:

1. Poaching.
2. Bush fires.
3. Threat of timber (teak harvest).

TOURISM: None; no road system, apart from tracks for four-wheel drive vehicles, exists at present. No visitor accommodation and no visitor permits are issued at present.

SCIENTIFIC RESEARCH: Vegetation and habitat mapping are underway.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: 6 guards and a ranger under a warden.

BUDGET: About US$ 35,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 158, Mongu, Zambia.

Mosi-oa-Tunya National Park (17)

LEGAL PROTECTION: An enclosed portion of 1000 ha is totally protected, except against mining; the remainder is only protected against hunting, and defacing of vegetation or geomorphological features.

DATE ESTABLISHED: 25 February 1972, by Statutory Instrument No. 44 of 1972. Previously a trust area.

GEOGRAPHICAL LOCATION: Southern border with Rhodesia, Victoria Falls: S 17°49'-17°54'; E 25°41'-25°55'.

ALTITUDE: 790-900 metres (approximately).

AREA: 6600 ha.

PHYSICAL FEATURES: The park comprises the left bank of the Zambezi river and half of Victoria Falls together with the series of deep gorges below the falls. The maximum height of the falls is 108 m with a water flow of 540 million litres a minute. These levels occur around March or April. Low water in November can reduce flow to 10.5 million litres a minute. Above the falls the river is 1690 m wide. Archaeological remains of stone and iron age man are present.

VEGETATION: Dominant vegetation is mopane Colophospermum mopane forest with small areas of teak and miombo woodlands. The narrow riverine forest along the Zambezi is more extensive in the 'rain forest' area where it is permanently dampened by spray from the falls. Here ferns are widespread and a profusion of flowering plants.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Buffalo	Syncerus caffer
	Bushbuck	Tragelaphus scriptus
	Common duiker	Sylvicapra grimmia
	Hippopotamus	Hippopotamus amphibius
	Warthog	Phacochoerus aethiopicus
	Waterbuck	Kobus ellipsiprymnus
	White rhinoceros	Ceratotherium s. simum
Carnivora:	Leopard	Panthera pardus*
Primates:	Baboon Chaema	Papio ursinus
	Vervet monkey	Cercopithecus aethiops pygerythrus
Proboseidea:	Elephant	Loxodonta africana*

NB. All the above animals occur wild in the park, some of the animal species in the Zoological Park are not indigenous to the area, e.g. white rhinoceros Ceratotherium s. simum were imported from Natal. A 1000 ha fenced Zoological Park, upriver from the Falls, includes some exotic species as well as native animals. Birds include the

rare Taita falcon Falco fasciinucha, the black swift Apus barbatus and the carmine bee-eater Merops nubicoides in the gorge and several posserines such as shrikes, flycatchers and sunbirds in the rain or 'spray' forest.

RESERVATION PURPOSE(S): To protect the Victoria Falls and to control development in the immediate vicinity.

AREA ZONING: None.

DISTURBING ACTIVITIES: Mostly urban development, tourist development, and hdyroelectricity power lines.

TOURISM: A seventy-bed non-catering camp, a camping ground and one Inter-Continental Hotel are inside the Park. The most visited park in the country.

SCIENTIFIC RESEARCH: Management plan is in preparation.

SPECIAL SCIENTIFIC FACILITIES: Field museum of the Naticnal Museums of Zambia.

STAFF: 10 guards under a wildlife ranger.

BUDGET: About US$ 90,000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Ranger, P.O. Box 86, Livingstone, Zambia.

Nyika National Park (18)

LEGAL PROTECTION: Total, except against mining.

DATE ESTABLISHED: 25 February 1972 by Statutory Instrument No. 44 of 1972. Previously a controlled hunting area with game reserve provisions.

GEOGRAPHICAL LOCATION: Extreme north-eastern Zambia, adjoining the border with Malawi: S 10°32'-10°45'; E 33°35'-33°43'.

ALTITUDE: 1295-2225 metres.

AREA: 8000 ha.

LAND TENURE: Government expropriated by law.

PHYSICAL FEATURES: The small Zambian portion of the high Nyika plateau, a steeply undulating area bounded by precipitous escarpment country on the west, where the terrain slopes sharply down to the lower Shire river valley. The soils are uniformly deep, well drained, sandy clays derived from the underlying basement schists. Rainfall is around 1000 mm, but cloud and mist at ground level is common in the dry season between June and September and keep the park well watered. Frost of -5°C to -10°C may occur between May and October.

VEGETATION: The escarpment soils support miombo Brachystegia-Julbernardia woodland. Relict patches of montane forest remain on the plateau. These do not exceed 20 ha, the largest being the Chowo forest on the east and the Manjanjere forest on the west at the northern end of the park. The three vegetation types of the plateau, which intergrade, are: dry evergreen forest with Myrica, Nuxia, Olea and Rapanea; moist riparian forest with Aningeria, Cola, Parinari and Podocarpus; and wet seasonal swamp forest with Agauria, Maesa and Myrica. Upland grasslands and a great variety and abundance of orchids are other features of a park of outstanding botanical interest.

NOTEWORTHY FAUNA:

Order	Common Name	Scientific Name
Artiodactyla:	Blue duiker	Cephalophus monticola
	Bushbuck	Tragelaphus scriptus
	Klipspringer	Oreotragus oreotragus
	Reedbuck	Redunca arundinum
	Red duiker	Cephalophus natalensis
Nyracoidea:	Dasie	Dendrohyrax arboreus
Primates:	Maloney's monkey	Cercopithecus albogularis moloneyi
Rodentia:	Nyasa black	Heliosciurus lucifer
	Red squirrel	Nandinia binotata
	Bush squirrel	Paraxerus
	Four-striped rat	Rhabdomys pumilio
	Long-tailed pouched rat	Beamys hindei major

Birds include the secretary bird Sagittarius serpentarius, white necked raven Corvultur albicollis and many sunbirds Nectarinia sp. An endemic subspecies of the chameleon Chamaeleo goetzei nyikae is present and the dwarf species Rhampholeon nchisiensis may also occur. The bush viper Atheris nitschei rungwensis has been recorded. The area is rich in Lepidoptera, notable the swallowtails Papilio phorcas and bromius.

RESERVATION PURPOSE(S): To provide total protection to all natural features and communities.

AREA ZONING: None.

DISTURBING ACTIVITIES: Bush fires.

TOURISM: A non-catering rest house with 10 beds. Walking trails are available. The only motorable access is through Malawi and is all-weather, though tending to be difficult during the rains.

SCIENTIFIC RESEARCH: Comparative studies of avifauna, butterflies and mammals with other montane areas in Central Africa. A vegetation comparison is planned.

SPECIAL SCIENTIFIC FACILITIES: None.

STAFF: Two guards under a ranger and a warden.

BUDGET: About US$ 8000 per annum.

LOCAL PARK ADMINISTRATION: Wildlife Warden, P.O. Box 37, Chipata, Zambia.

Sources: IUCN. 1977.
Zambia, National Parks and Wildlife Service. 1977.

Table 7. Game Management Areas

West Zambezi GMA No. 1

This GMA remained poorly stocked with animals. That part of the GMA west of the Kalongola to Shangombo Road remained closed. The animal status on the Soloana was unknown due to the insecurity of patrolling the area.

Concern for the safety of migrating wildebeest from Liuwa National Park into Angola remained. More frequent sightings of elephants were also reported in that part of the GMA between Sioma-Ngwezi National Park and the Zambezi River in Sesheke West. The presence of these animals in that area was attributed to the harassment that they were subjected to in the park and Imusho areas.

Kasonso Busanga GMA No. 2

This GMA was opened for hunting after three years of closure for security reasons. The northern portion of this GMA was reported to have suffered from heavy poaching during the period it was closed, still held appreciable herds of buffalo. A rhino was also sighted in the area. Human sleeping sickness was diagnosed in one of the hunters that hunted the northern part of the GMA.

The southern sector of the GMA held fairly good stocks of wildlife, notably sable. Over the years, human settlement, advancing from Kaoma eastwards and the Tobacco Board of Zambia new estates, were encroaching on this GMA and influence was felt in the park. This ever-increasing human settlement in this sector of the GMA is viewed as one of the greatest threats to the wildlife status of this area and park.

Chizera, Musele Matebo, Lukwakwa, Chibwika Ntamabo GMAs Nos. 3,4,5 and 6

There was little information on the status of these GMAs. Security problems prevented the staff from patrolling the area. The GMAs remained closed to hunting.

Lunga-Luswishi GMA No. 7

At the beginning of the year, as previously, this GMA was heavily infiltrated by poachers. During the year, however, the Kitwe Honorary Wildlife Rangers intensified patrols and by the end of the year, there was little trace of poaching activity. By the end of this effort, good populations of eland, hartebeest reedbuck bushbuck and warthog were seen, as well as some buffalo, impala, kudu and roan, with signs of lion, leopard, sitatunga and elephant.

Some poachers in this area received stiff fines plus imprisonment for nine months with hard labour, which was rare elsewhere in courts handling game cases.

Sichifula and Mulobezi GMAs Nos. 8 and 9

The animal stocks continued to be excellent in these GMAs.

Bilili Springs GMA No. 10

Land use conflicts between agricultural resettlement and wildlife conservation arose when it was proposed to resettle people in this GMA. Over the past few years, this area has been reclaimed from tsetse fly infestations by the Department of Veterinary and Tsetse Control Services. The control of tsetse fly left the area suitable for cattle restocking. However, a more appropriate land use for the area may be wildlife utilisation, as seen by the fact that in 1978, K32,000 was collected in revenue from the sales of licences for this GMA. Additionally, $200,000 in foreign exchange could potentially be obtained from the safari clients allocated to the GMA.

Kafue Flats Game Management Area No. 11

Apart from the effects of the Itezhi-tezhi Dam, this GMA remained relatively unchanged. Poaching of lechwe, especially on the north bank, continued. The Choma and Lusaka Honorary Wildlife Ranger groups were able to bring the poaching in this GMA under some control.

Namwala Game Management Area No. 13.

With the flooding of the Itezhi-tezhi Dam, large areas of the original Game Management Area was no longer in existence. The building of the new fly picket barrier on the Itezhi-tezhi Road led to an incredible increase of villages in the southern sector, which meant that a large part of the sector was heavily settled and the animal habitat of the area destroyed.

Animals were concentrated around rivers and dambos in the northern and western portions of the GMA. There were few breeding herds of elephants though buffalo were found in abundance. Lion and leopard were found scattered throughout the GMA. Sables were abundant throughout the area. The same applied to zebra and hartebeest. A number of good kudu and waterbuck trophies were available and there were some good impala and puku on the riverine. Eland were scattered and more prevalent late in the season. Roan were limited in number. Crocodile and hippo were numerous throughout the Kafue River frontage of the GMA.

Anti-poaching was previously unsatisfactory and it was only with the combined efforts of Big Game Safaris and Honarary Rangers that the situation was brought under some control.

Mumbwa Game Management Area No. 14

Brachystegia, the predominant woodland in the area, provided most of the feeding for browsers and was taking the stripping of bark and browse quite well except in parts where a certain kind of root grows to which elephants are very partial.

There was a high density of tsetse fly population at the start of the season; this population became less as the season wore off. Widespread throughout the area were elephant-breeding herds of up to sixty, and bachelor herds of up to ten were seen, as also were bulls in pairs and in singles.

There was a very high population of buffalo which were frequently observed in herds of up to 500 or more with numerous smaller herds and bachelor bulls in threes, twos and singles. Prides of up to twenty-five lions each were seen, and leopards were even more widespread than lion. Eland were plentiful in herds of sixty to eighty each were common. Sable and kudu were common, and puku were found only along the Kafue River.

Mumbwa Game Management Area was free of poaching in certain areas, but the eastern part was heavily poached. Like Numwala GMA, this GMA has human settlement encroachment on the north-eastern portions along the Mumbwa Kaona Road.

Luano and Lower Zambezi Game Management Areas Nos. 15 and 16

Both these GMAs remained inaccessible due to security reasons. The animal status was not known.

West Petauke No. 17, Chisomo No. 18 and Sandwe No. 19 GMAs

For the first time after three years of closure these GMAs were open to limited hunting. However, the safari companies did not hunt the GMA.

Reports indicated a lower animal population compared to the pre-closure period. A lot of poaching was taking place mostly by Petauke residents.

Lupande Game Management Area No. 20

The animal population was reported low. Although there was some recovery of animal stocks following its closure for three years, the animal population did not return to its pre-closure densities. Due to the presence of licensed hunters, poaching was on a limited scale during the dry season. The northern sector of the GMA benefited a good deal from the migrating buffalo and wildebeest from the Nsefu portion of the park.

Lumimba Game Management Area No. 21

This GMA continued to have, in general, heavy animal populations.

Musalangu Game Management Area No. 22

The latest animal status for a selected species in 1979: Elephant was reported plentiful; Rhino was frequently sighted, but becoming more and more restricted to thickets. There were signs of trapping of this animal in the area. Kudu: Lower Musalanga held considerable numbers, unlike other parts of the GMA and valley although male kudu were noticeably few as in South Luangwa National Park. Kudu was for this reason off the hunting list for the year. Roan, on the higher ground, was

reported to be fairly common although previous observations indicated that this animal was becoming rare.

Machiya-Fungulwe Game Management Area No. 23

This GMA is associated with Lunga Luswishi GMA. It has low animal stocks.

Munyamadzi Game Management Area No. 24

This GMA's animal status remained good. The elephant population showed a decline over the past years. Through the safari operations, this GMA received good anti-poaching cover during the dry season. Poaching associated with this GMA was more on the national park sides than in the GMA itself.

Kafinda Game Management Area No. 25

Except for the small species of antelopes, this GMA continued to have low animal numbers of the larger animal species. The GMA was covered by patrols from the Ndola Honorary Rangers.

Bangweulu Game Management Area No. 26

Poaching was taking place, especially around Samfya where, due to shortage of staff, sale of game meat was taking place openly. This GMA is large and because of its water habitat is difficult to patrol. The opening up of the area through the Serenje-Samfya Road will increase the poaching in the area.

Chambeshi Game Management Area 27 and Luwingu Game Management Area No. 28

The status of these GMAs remained relatively unchanged, that is, they carried little wildlife.

Tondwa Game Management Area No. 29 and Kaputa Game Management Area No. 30

The animal stocks here remained very much unchanged over the 1978 status. In regard to anti-poaching, the area received attention from the Department, Hunters Zambia Limited, and Honorary Rangers.

Mansa Game Management Area No. 31

There was little change over the animal status of this GMA.

Nkala Game Management Area No. 32

No hunting took place in this GMA. To some extent, it was used mainly as a tourist game viewing area.

Source: Zambia. 1979.

Table 8. Number of Animals Killed in Crop and Human Protection Control

Year	Elephant	Hippo	Buffalo	Rhino	Lion	Leopard	Hyena	Wild Dog	Jackal	Crocodile
1966	264									
1967	334	34	4		23	13				
1968	379	56	22	2	7	9				
1969	342	44			14	6				
1970	381	52	8	7	16	8				
1971	470	156	6	2	6	7		7		2
1972	424	96	25		14	6	1	1		
1973	235	89	10		4	1				4
1974	180	102	10		20	3				24
1975	179	102	2		12	7	1			3
1976	325	162	17		7	14				
1977	186	76	9		9					11

Source: Banage. 1978.

Table 9. Growth of Safari Hunting

Year	No. Hunting Companies	No. Hunting Clients	No. Animals killed by clients	No. CHA/GMA Permits issued and used
1950	1	NA		
1951	1	13		
1952	1	5		
1953	1	4		
1954	1	8		
1955	1	13		
1956	1	12		
1957	1	10	120	
1958	1	10	NA	
1959	1	10	124	
1960	1	8	104	
1961	1	4	46	96
1962	1	5	45	93
1963	1	15	197	97
1964	1	18	NA	NA
1965	2	12	NA	112
1966	2	21	NA	113
1967	2	65	NA	119
1968	2	73	1338	86
1969	2	133	NA	90
1970	2	153	2587	58
1971	2	106	1609	81
1972	1	101	1504	74
1973	1	93	1521	NA
1974	1	199	1809	NA
1975	2	107	1447	NA
1976	2	NA	1332	277
1977	4	125	1605	257

Source: Banage. 1978.

Table 10. Number of GMA Permits Sold, 1979

GMA	1978	1979
West Zambezi No. 1	1	—
Kasonso Busanga No. 2	—	37
Chizera No. 3	—	—
Musele-Matebo No. 4	—	—
Lukwakwa No. 5	—	—
Chibwika-Ntambu No. 6	—	—
Lunga-Luswishi No. 7	—	—
Sichifula No. 8	20	24
Mulobezi No. 9	17	17
Bilili Springs No. 10	31	17
Kafue Flats No. 11	12	53
Mazabuka No. 12	—	—
Namwala No. 13	—	28
Mumbwa No. 14	23	61
Luano No. 15	—	—
Zambezi No. 16	—	—
West Petauke No. 17	—	3
Chisomo No. 18	—	12
Sandwe No. 19	—	5
Lupande No. 20	—	11
Lumimba No. 21	69	86
Musalangu No. 22	68	50
Machiya-Fungulwe No. 23	—	—
Munyamadzi No. 24	66	59
Kafinda No. 25	11	8
Bangweulu No. 26	17	15
Chambeshi No. 27	—	—
Luwingu No. 28	—	—
Tondwa No. 29	8	20
Kaputa No. 30	7	2
Mansa No. 31	—	—
Nkala No. 32	12	—
TOTALS	362	518

Notes: The 1979 totals include Safaris, Non-Safaris, Zambians and Non-Zambians.

Source: Zambia. 1979.

Table 11. Animals Harvested in GMA's, 1979

Animals Killed	2	8	9	10	11	13	14	17	18	19	20	21	22	24	25	26	29	30	*Totals* 1979	1978
Buffalo	26	32	18	18	34	10	45	—	14	7	13	110	50	56	4	10	17	10	474	244
Baboon	11	—	7	8	30	—	19	—	—	—	5	6	9	22	—	—	9	9	135	42
Bushbuck	4	14	—	2	1	—	3	—	1	—	1	37	14	8	—	—	—	3	78	65
Bushpig	40	30	35	35	20	10	60	—	32	28	3	92	80	96	16	—	28	4	609	13
Crocodile	2	4	—	—	—	—	6	—	—	—	3	32	37	13	—	—	—	1	98	168
Duiker, common	19	20	14	17	34	10	29	—	8	7	8	59	9	46	4	—	17	10	311	6
Duiker, yellow	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	1
Duiker, blue	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	2
Eland	14	12	5	5	3	8	9	—	3	4	—	18	14	10	—	2	4	1	112	68
Elephant	18	6	6	5	2	5	17	1	1	4	62	70	108	42	4	1	6	3	381	365
Hippo	4	—	—	9	1	1	3	—	4	—	2	31	10	8	—	2	—	—	73	155
Hartebeest	15	28	9	3	7	5	25	—	—	—	1	12	2	1	1	—	11	7	137	140
Hyena	2	—	—	1	—	—	1	—	—	1	2	20	6	3	—	—	—	—	36	78
Impala	20	32	16	18	34	10	29	—	8	9	8	84	43	52	4	—	17	10	394	220
Grysbok	—	14	—	4	—	—	5	—	—	2	1	27	20	—	—	—	—	—	73	20
Jackal	1	—	1	1	—	1	—	—	—	—	—	1	—	—	—	—	—	—	4	4
Kudu	2	40	5	4	1	5	18	—	1	—	—	3	2	—	—	—	—	—	81	132
Klipspringer	—	4	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	3
Lechwe, black	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	11	—	—	11	19
Lechwe, Kafue	—	—	—	—	34	—	—	—	—	—	—	—	—	—	—	—	—	—	34	32
Leopard	4	17	1	2	1	2	11	—	2	2	1	12	20	11	—	—	1	—	97	116
Lion	11	11	5	4	2	2	11	—	4	2	2	31	26	12	—	—	1	1	125	137
Oribi	2	24	16	18	37	10	31	—	8	7	5	24	9	46	4	—	17	9	267	53
Puku	11	14	11	8	30	—	15	—	8	9	8	59	33	46	5	—	17	10	284	107
Rhino	—	—	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	—	3	9
Reedbuck	11	8	4	4	3	5	13	—	—	—	—	2	2	—	1	5	6	6	70	57
Roan	17	16	5	7	3	7	8	—	—	—	1	8	4	—	—	2	8	5	91	58
Sable	21	17	9	8	3	8	26	—	—	—	—	5	—	—	—	2	1	1	101	73
Sitatunga	1	1	—	—	2	1	—	—	—	—	—	—	—	—	—	—	1	1	7	9
Steinbok	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	3
Tsessebe	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	13
Waterbuck	11	—	4	5	—	1	10	—	—	—	2	—	2	—	—	—	—	—	35	126
Warthog	22	28	16	18	34	10	14	—	8	7	3	59	33	46	4	2	17	10	331	154
Wilddog	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	125
Wildebeest, cookson's	—	—	—	—	—	—	—	—	—	—	—	42	34	3	—	—	—	—	79	158
Wildebeest, blue	9	7	9	6	—	—	2	—	—	—	—	—	—	—	—	—	—	—	33	82
Zebra	11	14	5	6	7	3	19	—	2	1	1	58	43	18	—	—	7	4	199	377
Bird licence	4	3	—	4	—	1	13	4	4	3	—	2	14	14	—	—	5	2	73	—
TOTALS	313	399	202	225	323	115	443	5	108	93	132	913	625	555	47	44	190	108	4.840	3.325

1 No hunting took place in the GMAs which do not appear in the Table

2 No. 1 West Zambezi GMA
No. 2 Kasonso Busanga GMA
No. 3 Chizera GMA
No. 4 Mumbi Mafebo GMA
No. 5 Lukwakwa GMA
No. 6 Chibwika-Ntambu GMA
No. 7 Lunga-Luswishi GMA
No. 8 Sichifulia GMA
No. 9 Mulobezi GMA
No. 10 Bilili Springs GMA
No. 11 Kafue Flats GMA
No. 12 Namwala GMA
No. 14 Mumbwa GMA
No. 15 Luano GMA
No. 16 Zambezi GMA
No. 17 West Petauke GMA
No. 18 Chisomo GMA
No. 19 Sandwe GMA
No. 20 Lupande GMA
No. 21 Lumimba GMA
No. 22 Musalangu GMA
No. 24 Munyamadzi GMA
No. 25 Nsefula GMA
No. 26 Nsefula GMA
No. 29 Lundazi GMA
No. 30 Nsefula GMA

Source: Zambia. 1979.

Table 12a. Wildlife Act Law Enforcement

Command	Arrests	Convictions	Pending	Acquittals	Imprisonment	Withdrawals	Confiscations	Fines K
Luangwa	283	163	38	22	48	—	2 vehicles 2 firearms 45 ivories 4 rhino horns 24 MLG 2 rifles 45 army ammunition	15 383
Kafue National Park	270	161	87	17	3	21	4 muzzle loader	7 225
Northern	206	150	38	18	40	—	29 tusks 11 boats 1 canoe 9 axes 18 nets 1 lion skin Some fish	7 975
Central	337	249	42	23	23	—	—	19 945
North-Western	130	107	16	9	43	15	10 guns 7 bicycles	2 745
Bangweulu	143	130	5	8	13	—	5 firearms 5 bicycles	4 546
Chilanga anti-poaching	18	10	8	—	—	—	—	1 400
TOTAL, 1979	1 357	970	234	97	170	36	224 Items	59 219
TOTAL, 1978	1 454	904	288	93	62	12	350 Items	57 129

Source: Zambia. 1979.

Table 12b. National Parks and Wildlife Act Law Enforcement Returns for 1979 by Honorary Rangers, Safaris, Save the Rhino Trust and Others

Unit/Company	Arrests	Convictions	Pending	Acquittals	Imprisonment	Withdrawals	Confiscations	Fines K
Kalomo	47	24	2	—	2	—	4 firearms	1 570
Kitwe	87	83	3	4	—	—	31 bicycles 5 vehicles 68 skins 680 snares 473 ammunition	23 877
Kabwe	3	2	1	—	—	—	—	300
Chinsali	6	—	—	—	—	—	—	—
Midlands	119	15	102	2	4	—	—	1 260
Ndola	28	9	19	—	—	—	—	1 240
Save the Rhino Appeal	54	38	11	—	17	—	—	5 610
Safaris (Hunters Ltd)	21	8	13	—	—	—	—	—
Choma	165	140	10	5	—	10	—	7 573
TOTALS ..	530	319	161	11	23	10	1 261 Items	41 730
GRAND TOTALS—Table 1 and 2 ..	1 887	1 289	395	108	193	46	1 485 Items	100 949

Source: Zambia. 1979.

Appendix VII

Selected Laws Pertaining to Environmental Issues

Sources: Caponera. 1979.
Johnson and Johnson. 1977.
Moore and Christy. 1978.
U.S. Environmental Protection Agency. 1976.

Soils and Water

- Water Ordinance, No. 34 of 1948, as ammended by:

  The Water Rights Regulations, 1950
  The Water Board Regulations, 1950
  The Water Rights Regulations, 1950

  - defines public and private water classifications
  - defines water rights for various classifications sets out the order of priority in water use (domestic; irrigation and fishing; industrial and mining)
  - Provides for water coarse channel improvement
  - regulates water coarse obstructions
  - empowers the government to take action against water wastage
  - allows the government to make anti-pollution measures part of the conditions for granting water rights
  - makes polluting of public water a punishable offense

- Water Ordinance Cap. 231, 1957.

  - regulations on fouling or polluting public waters

- Natural Resources Conservation Act, No. 53 of 1970 and subsidiary legislation:

  Provincial Natural Resources Committees Regulations, 1971
  District Natural Resources Committees Regulations, 1971

  - empowers government to require landowners to take measures for flood control and control of erosion; the government may implement these measures if needed and recover the cost from landowners
  - empowers the government to restrict land use near water coarses
  - authority extends to control and drainage of water
  - anti-pollution measures may be required of landowners within designated conservation areas
  - make local governments responsible for overseeing safe drinking and domestic water supplies
  - makes water conservation and protection of water sources the responsibility of the Ministry of Natural Resources, and empowers the ministry to impose measures on landowners

Fauna

- National Parks and Wildlife Act, No. 57, 1968.

  The National Parks and Wildlife (Protected Animals) Order, 1971
  The National Parks and Wildlife (Protected Animals) (Amdt.) Order, 1971.
  The National Parks and Wildlife (Game Animals) Order, 1971.
  The National Parks and Wildlife (Prescribed Tropnies) Regulations, 1971
  The National Parks and Wildlife (Methods of Hunting) (Restriction)

Regulations, 1971
The Game Management Area Declaration Order, 1971
The National Parks and Wildlife (Prohibition of holding both a district game licence and a national game licence) Regulations, 1971
The National Parks Declaration Order, 1972

- establishes the current National Parks and Game Management Areas system
- prohibits hunting except as part of game management
- restricts trade in trophies, including ivory and rhinoceros horn; restricts import/export of wild animals and trophies

- Plumage Birds Protection Ordinance, Chap. 117, 1948.

- Stock Diseases Ordinance, Cap. 112, 1958.

- Tsetse Control Ordinance, Cap. 129, 1962.

- Fish Conservation Ordinance Cap. 263, 1962.

  - empowers the restriction and regulation of fishing
  - pronibits certain methods
  - licencing
  - regulate introduction of new species

- Fisheries Act, No. 21 of 1974.

  - empowers the government to regulate fishing, and to designate protected or restricted areas

Flora

- Noxious Weeds Ordinance, Cap. 102, 1953.

- Forests Ordinance Cap. 105, 1965.

  - provides for the control of forests and forest produce; declaration of forest reserves, protected areas, lists of reserved trees

- Forests Act, No. 39 of 1973.

  - regulated floating of timber on inland waterways
  - provides for conservation and development of forest in protected areas, for measures against soil erosion and flooding in national protected areas

Hazardous Substances and Pollution

- Pharmacy and Poisons (Amendment) Act 49 of 1965.

- Dangerous Drugs Act (Commencement Order), 1967.

- The Ionising Radiation Act No. 19, 1972.

  - establishes a Radiation Protection Board and a Radioisotope Advisory Board
  - restricts the use and disposal of radioactive substances

- Actions for Smoke Damage (Prohibition), 1959.

  - authorizes the government to indemnify industries against damages arising from escape of gases, fumes, or smoke
  - requires indemnified industries to make 'reasonable' efforts to minimize escape of gases, fumes, or smoke

Land Use and Planning

- Agriculture Lands Ordinance Chapter 101, 1961.

  - establishes Agricultural Lands Board

- The Town and Country Planning Ordinance No. 32, 1961.

- The Lands Acquisition Act, No. 2, 1970.

- Registration and Development of Villages Act, No. 30 of 1971.

- Mining Regulations Statutory Instrument 107, 1971.

  - regulates water use by mines
  - regulates drainage of underground areas, flood prevention in mines, discharge of effluent water
  - sets occupational health and safety standards

Public Health

- Public Health Act, No. 12 of 1930 with subsequent amendments.

  - gives Ministry of Health authority to regulate drainage of land, streets, and premises
  - gives the Ministry authority over standing water which may provide mosquitoes with breeding areas; also other powers concerning sanitation including regulation of irrigation within townships
  - empowers the Ministry to set standards for effluent discharge from any source, and to regulate factories which may potentially pollute the water

Protection of Natural or Historical Monuments

- Natural and Historical Monuments and Relics Ordinance Cap. 90, 1962.
  - establishes Commission for the Preservation of Natural and Historical Monuments and Relics
  - defines national monuments
  - provides for notification of discoveries
  - regulates excavations, alterations, removals
- Protected Places and Areas (Amdt.) Act No. 4, 1968.

Appendix VIII

Organizations

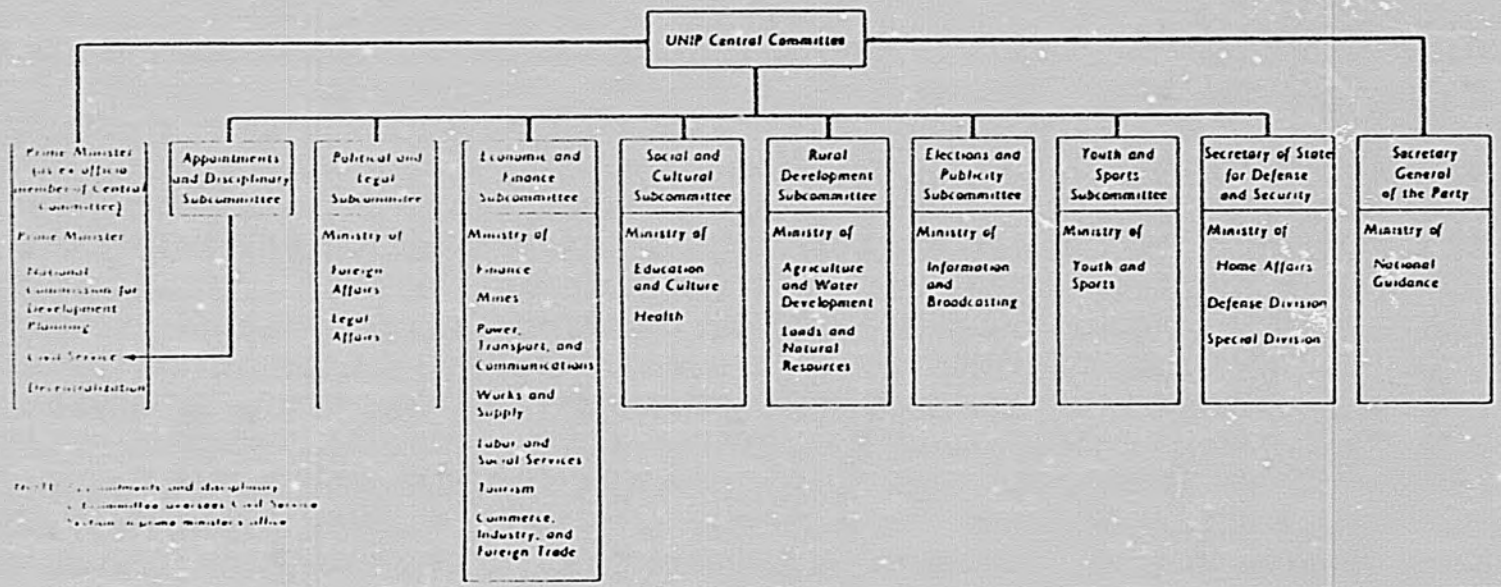

Figure 1. Relationship of UNIP to Ministries and Other Major Government Offices

Source: Nyrop et al. 1979.

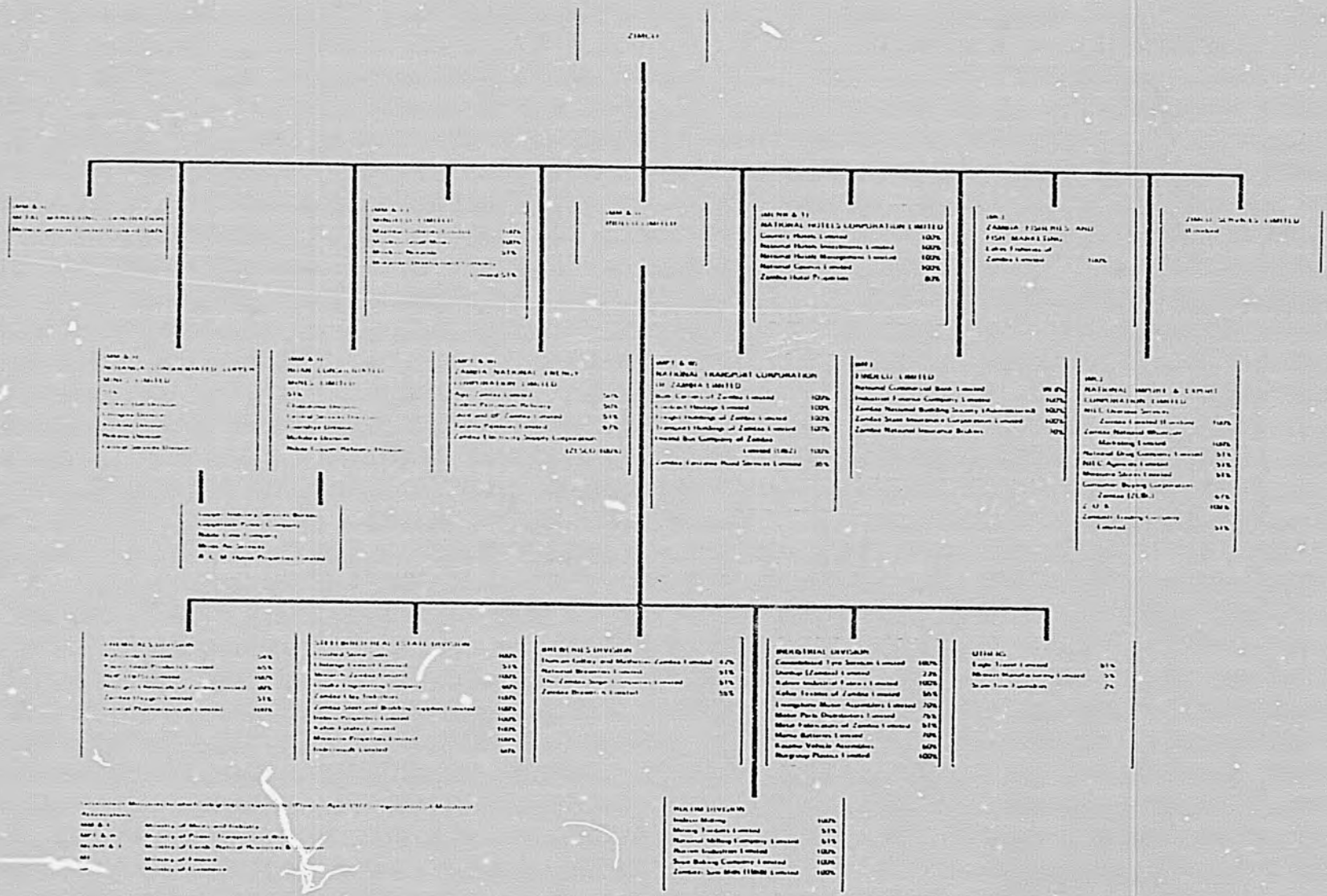

Figure 3. Zambia Industrial and Mining Corporation Limited and Its Subsidiary Companies' Organizational Structure (as of June 1979)

Source: World Bank. 1977.

Table 1. The Government

HEAD OF STATE

President: Dr. KENNETH DAVID KAUNDA (took office October 24th, 1964).

THE CABINET

(*June* 1980)

Prime Minister: DANIEL M. LISULO

Secretary of State for Defence and Security: A. GREY ZULU.

Minister of National Guidance: ARNOLD SIMUCHIMBA.

Minister of Home Affairs: WILTED J. PHIRI.

Minister of Foreign Affairs: WILSON M. CHAKULYA.

Minister of Education and Culture: Prof. LAMECK GOMA.

Minister of Health: RAJAH KUNDA.

Minister of Finance and Technical Co-operation: KAUBY MUSOKOTWANE.

Minister of Commerce and Industry: REMY CHISUPA.

Minister of Mines: MUFAYA MUMBUNA.

Minister of Power, Transport and Communications: Brig.-Gen. G. KINGSLEY CHINKULI.

Minister of Works and Supply: HASWELL Y. MWALE.

Minister of Labour and Social Services: JOSHUA LUMINA.

Minister of Tourism: ROGER C. SAKUHUKA.

Minister of Information and Broadcasting: MARK TAMBATAMBA.

Minister of Youth and Sports: BEN KAKOMA.

Minister of Agriculture and Water Development: ALEXANDER B. CHIKWANDA.

Minister of Lands and Natural Resources: CLEMENT M. MWANANSHIKU.

Source: Europa. 1980.

Table 2. Miscellaneous Organizations

Governmental

Note: Recent sources conflict on the structure of Zambia's government, indicating that changes are to be expected. Some of the functions listed here may have been eliminated or merged with other offices.

- Ministry of Lands and Natural Resources
  (also appears as Ministry of Lands, Natural Resources and Tourism)
  Responsible for environmental affairs.
  - Office of the Conservator of Natural Resources
    Oversees water resources conservation and development (among other duties).
  - Department of Wildlife, Fisheries, and National Parks
  - Natural Resources Advisory Board
    Has advisory and supervisory functions for natural resources conservation, development, and exploitation.
  - Department of Forestry
  - Chief Conservator of Forests
    (relationship to Dept. of Forestry not clear)
    Responsible for control and management of natural forests, prevention of flood and soil erosion, conservation of existing water supplies.
  - Water Board
    Responsible for control and exploitation of public water resources.

- Ministry of Rural Development
  Responsible for control and development of water resources in connection with irrigation; soil conservation.
  - Department of Agriculture
  - Department of Water Affairs

- Ministry of Power, Transport, and Works
  Responsible for development of water resources as a source of power.
  - Meteorological Department
    Oversees collection and analysis of hydrological data

- Ministry of Health
  Responsible for sanitary aspects of water resources, including prevention and control of water pollution (among other responsibilities).

  - Central Board of Health
    Has advisory functions in the field of public health.

- Ministry of Mines and Mining Development
  Responsible for pollution control and safety in mines.

Other Organizations

- University of Zambia

  - Biology Department
    Unit of Land Use Training

  - Kafue Basin Research Committee

  - Seminar on Pollution and Environment

  - Technology Development and Advisory Unit

  - School of Engineering

  - Geography Department

- Natural Resources Development College

- National Council for Scientific Research

- Zambian Council for Social Development

Membership in International Organizations

- IUCN

- Organization Internationale contre le Criquet Migrateur Africain (OICMA)

- African Training and Research Centre in Administration and Development

Note: This table is not meant to be comprehensive, as it is impossible from outside of Zambia to identify all organizations interested in environmental aspects.

Sources: Caponera. 1978.
Trzyna and Coan. 1976.
U.N. Economic Commission for Africa. 1972.
UNEP. 1979.

Appendix IX

Supplementary Bibliography

I. Climate

II. Geology, Minerals, Soils

III. Flora and Fauna

IV. Water Resources and Management

V. Land Use and Agriculture

VI. Public Health, Socio-economic Aspects, Development, Pollution

Bibliography

1. Climate

Bailey, M. 1969. On extreme daily rainfall in Zambia. Meteorological Notes, Series A, No. 4. Lusaka: Department of Meteorology.

-----. 1970. Annual temperature extremes in Zambia. Meteorological Notes, Series A, No. 6. Lusaka: Department of Meteorology.

-----. 1970. Dry spells. Climate Data Publication 14. Lusaka: Department of Meteorology.

-----. 1970. Extreme winds in Zambia. Meteorological Notes, Series A, No. 5. Lusaka.

-----. 1970. Rainfall probabilities in Zambia. Hydro-meteorological Report 4. Lusaka.

Bhalotra, Y.P.R. 1973. Disturbances of the summer season affecting Zambia. Lusaka: Department of Meteorology.

Cislerova, M. and P. Hutchinson. 1973. The redesign of the raingauge network of Zambia. Meteorological Notes, Series A., No. 12. Lusaka.

Das, J.C. 1974. Return period analysis of short duration rainfall in Zambia. Hydrometeorological Report No. 7. Lusaka: Department of Meteorology.

Hutchinson, P. 1974. The climate of Zambia. Lusaka, Zambia Geographical Association (Occasional Paper No. 7). 95 pp.

Miussky, P. 1970. Agrometeorological observing practices. Agrometeorological Report 1. Lusaka.

-----. 1973. The influence of some weather parameters on growth, development and yield of cotton in Zambia. Agrometeorological Report 4. Lusaka.

Miussky, P. and R. Frost. 1971. Meteorological conditions affecting the growth, development and yield of cotton and maize in central Zambia. Agrometeorological Report 3. Lusaka.

Nieuwolt, S. 1970. The climate of Zambia. Occasional Studies 3. Zambia Geographical Association, Lusaka.

-----. 1971. Climatic variability and weather types at Lusaka, Zambia. Arch. f. Met. Geophysik u. Bioklimatologie, Vienna.

-----. 1971. The 1969/70 rainfall season in the Lusaka region, Zambia. East African Geographical Reivew, 9.

Spain, E.S. 1972. The diurnal variation of the meteorological elements throughout Zambia. Meteorological Notes, Series A., No. 11. Lusaka.

Zambia. Department of Meteorology. 1971. Variability of rainfall in Zambia. Climate Data Publication 17. Lusaka: Department of Meteorology.

-----. 1972. The diurnal variation of the meteorological elements throughout Zambia. Climate Data Publication 21. Lusaka.

2. Geology, Minerals, Soils

Armstrong-Smith, G. 1972. Copper mining and pollution. Black Lechwe:18-19.

Binda, P.L. and J.R. Mulgrew. 1974. Stratigraphy of copper occurrences in the Zambian Copperbelt. Cent. Soc. Géol. Belg., Gisements Stratiformes et Provinces Cuprifères. Liège, Belgien. pp. 215-233.

Brammer, H. n.d. Soils of Zambia. Lusaka: Department of Agriculture, (Research), Rural Information Services, Ministry of Rural Development.

Bwerinofa, O.K. 1977. The Southern Province Tin Belt, Zambia. Conf. on the Utilisation of Mineral Resources in Developing Countries, Lusaka. 21 pp.

Charman, J.A. 1971. Aspects of pollution in the mining industry of Zambia. Proc. Seminar on Pollution and Environment. Lusaka.

-----. 1972. Ministry of Mines and Mining Development for the Year 1972, Annexure - Research Laboratory Report. Kitwe.

-----. 1973. The changing picture of the underground working environment in the copper industry in Zambia. First Seminar on Pollution and Environment. Lusaka.

Clemmey, H. 1974. Sedimentary geology of a late precambrian copper deposit at Kitwe, Zambia. Cent. Soc. Géol. Belg., Gisements Stratiformes et Provinces Cuprifères. Liège, Belgien. pp. 255-265.

Cooray, P.G. and A. Lane. 1978. A guide to the minerals of Zambia. Lusaka: NCCM and RCM Ltd.

Drysdall, A.R., R.L. Johnson, T.A. Moore and J.G. Thieme. 1972. Outline of the geology of Zambia. Geologie en Mijnbouw 51:3:265-276.

Fleischer, V.D., P.J. Forbes, D.D.A. Piesold and J.D. Sandy. 1976. Failure and subsequent stabilization of No. 3 Dump at Mufulira Mine, Zambia. Institution of Mining and Metallurgy, Transact., Sect. A., 85, Oct. 1976, A 144-A 162, London.

Fleischer, V.D., W.G. Garlick and R. Haldane. 1976. Geology of the Zambian Copperbelt in K.H. Wolf, ed., Handbook of Stratabound and Stratiform Ore Deposits; Regional Studies and Specific Deposits, 6, Cu-, Zn-, Pb- and Ag-Deposits. Elsevier, Amsterdam. pp. 223-352.

Maclean, A.H. 1970. Moisture characteristics of some Zambia soils. Soil Survey Report 5, Mount Makulu Research Station, Zambia.

Maclean, A.H. and T.U. Yager. 1972. Available water capacities of Zambian soils in relation to pressure plate measurements and particle size analysis. Soil Sci. 113:23-29.

Meneghel, L. 1977. The occurrence of uranium in the Katanga System of Northwestern Zambia. Geol. Survey, Occ. Paper 89. Lusaka. 26 pp.

MINDECO Ltd. 1971. Zambia's mining industry. GRZ: Lusaka.

Money, N.J. and A.R. Drysdall. 1973. The geology, classification, palaeography and origin of the Mid Zambezi coal deposits of Zambia in K.S.W. Campbell, ed., Gondwana Geology. Australian National Univ. Press. pp. 249-270.

Money, N.J. and R.S. Prasad. 1977. Uranium mineralisation in the Karroo System of Zambia. Geol. Survey, Occ. Paper No. 92. Lusaka. 14 pp.

N.C.C.M. 1976. Nchanga Consolidated Copper Mines Ltd. Annual Report 1976. Kitwe.

-----. 1977. Nchanga Consolidated Copper Mines Ltd. Annual Report 1977. Kitwe.

Parsons Corporation. 1969. Ultrarapid reconnaissance soil survey of Barotse and Northwestern Provinces, Zambia. Los Angeles and New York.

Prasad, R.S., N.J. Money and J.G. Thieme. 1977. The geology of the uranium mineralisation in the Bungua area, Siavonga District. Geol. Survey Zambia, Occ. Paper 90. Lusaka. 15 pp.

de Swardt, A.M.J and A.R. Drysdall. 1973. Mining and prospecting in Zambia with reference to the Geological Survey. Overseas Geol. and Mineral. Resources, 41, 50th Anniversary Geol. Surv. and Mines Dept. Uganda. London. pp. 16-32.

Ter Bruggen, J.W. 1972. Introduction into mining and metallurgy on the Zambian Copperbelt. Geologie en Mijnbouw, 51(3):361-370. Amsterdam, Elsevier.

Wakefield, J. 1978. Samba: a deformed porphyry type copper deposit in the basement of the Zambian Copperbelt. Instit. Mining and Metallurgy, Transact., B, pp. B43-B52.

Zambia. 1969. Mines and Minerals Act 46. Lusaka: Government Printer.

-----. 1972. Mining dumps regulations' supplement to the Republic of Zambia Government Gazette dated the 28th April, 1972. Lusaka: Government Printer.

-----. 1970. Mount Makulu Research Station. Soil profile descriptions and analytical data for some soils of Zambia 1968-69. Soil Survey Report 6. Mount Makulu, Zambia.

3. Flora ard Fauna

Anonymous. 1978. The Luangwa Valley elephant problem. NPWS/Com. 7 (Restricted). Chilanga: Department of Wildlife and National Parks.

Ansell, W.F.H. 1969. The black rhinoceros in Zambia. Oryx 10(3):176-92. Also in Black Lechwe 11(2):25-35.

-----. 1978. Mammals of Zambia. Lusaka: Government Printer.

Armstrong, R. 1978. Fishing: Zambia's premier source of protein. Enterprise 3:7-13.

Astle, W.L. 1969. The vegetation and soils of Chishinga ranch, Luapula Province, Zambia. Kirkia 7, No. 1, 73-102.

Bell, R.H.V. and J.J.R. Grimsdell. 1973. The persecuted black lechwe of Zambia. Oryx 12(1):77-92.

Bell, R.H.V., J.J.R. Grimsdell, L.P. Van Lavieren and J.A. Sayer. 1973. Census of the Kafue lechwe by aerial statified sampling. East African Wildlife Journal 11:55-74.

Bowmaker, A.P. and G.W. Coulter. 1965. Lake Tanganyika in M.A.E. Mortimer, ed., The Fish and Fisheries of Zambia. Lusaka: Ministry of Lands and Natural Resources. pp. 49-52.

Brenan, J.P.M. 1970. Flora Zambesiaca. Vol. 3. London.

Brown, J.B. 1978. Lusaka fuelwood project. Ndola: Forestry Department.

Carey, T.G. 1971. Hydrobiological survey of the Kafue flood plain. Fisheries Research Bulletin, Zambia 5, 245-295, Dept. of Wildlife, Fisheries and National Parks. Chilanga, Zambia.

Christensen, G. 1973. Development plan for the fishing industry in Zambia. Chilanga: Central Fisheries Research Institute.

Clarke, J.E. 1972, 1973, 1974. Annual Reports 1970, '72, '73. Department of Wildlife, Fisheries and National Parks. Lusaka: Government Printer.

Clarke, J.E. and Loe, I.E. 1974. Guide to the National Parks of Zambia. Lusaka: Anglo-American Corp.

Craddock-Williams, V. 1978. The lure of the flats: wildlife conservation and tourism development in the Lower Kafue Basin. National Seminar on Environment and Change, Lusaka.

Endean, F. 1968. The productivity of 'miombo' woodland in Zambia. Kitwe: Forestry Department.

Fanshawe, D.B. 1969. The vegetation of Zambia. Forest Research Bulletin 7. G.P. Lusaka.

-----. 1972. Useful trees of Zambia for the agriculturist. G.P. Lusaka.

FAO. 1968. Wildlife, fisheries and livestock production. Multi-purpose survey of the Kafue River Basin, Zambia. FAO/UN Final Report, Vol. 5. Rome, FAO, FAO/SF: 35/ZAM.

Grimsdell, J.J.R. and R.H.V. Bell. 1972. Population growth of red lechwe, Kobus leche leche Gray, in the Busanga Plain, Zambia. East African Wildlife Journal 10, 117-22.

-----. 1972. The black lechwe and the Bangweulu flood plains. Black Lechwe 10:4, 6-9.

-----. 1975. Ecology of the black lechwe in the Bangweulu Basin of Zambia. Lusaka: National Council for Scientific Research.

-----. 1975. Black lechwe research project, final report. NCSR/TR31. Lusaka: National Council for Scientific Research.

Handlos, W.L. 1979. Introduction to the ecology of the Kafue flats. Proceedings of the National Seminar on Environment and Change, April 1978. Lusaka.

Handlos, D.M., W.L. Handlos and G.W. Howard. 1976. A study of the diet of the Kafue lechwe (Kobus leche) by analysis of rumen contents. In Proceedings of the Fourth Regional Wildlife Conference for Eastern and Central Africa. Ministry for Lands, Natural Resources and Tourism. Lusaka, Zambia. pp. 197-211.

Hardie, A.D.K. and C.L. Ingram. 1971. Utilization potentials and problems for exotic conifers in Zambia with special reference to Pinus kesiya. Forest Research Bulletin 24, Forest Dept., Ndola.

Kaweche, G.B. and A.N. Mwenya. 1978. Recreation hunting in Zambia. Paper for the 5th Regional Wildl. Conf. for E. and C. Afr., Gaborone, July 1978. Chilanga: Dep. Nat. Pks. and Wildl. Serv. (mimeo).

Korzeniowski, A.M. 1970. Forest industries feasibility study. FAO/UNDP/SF Forestry Project No. 304 Zambia, Rome.

Lawton, R.M. 1967. Bush enchroachment in Zambia. Pest Articles and News Summaries, Section C, 13(4):335-353.

-----. 1967. The conservation and management of the riparian evergreen forests of Zambia. The Commonwealth Forestry Review 46(3), No. 19, 223-232.

Mabaye, A.B.E. 1976, 1977. Annual Reports 1974, 1975. Department of Fisheries, Republic of Zambia. Lusaka: Government Printer.

Marks, S.A. 1977. Buffalo movements and accessibility to a community of hunters in Zambia. East African Wildlife Journal 15(4):257-67.

Mihalyi, L.J. 1973. Timber production in Zambia. ZGA Magazine 21:1-25.

Miller, P. 1978. Kafue Basin. Black Lechwe 12:3, 18-20.

Mukanda, P.C. 1976. Anti-poaching activities in Zambia. Proc. 4th Reg. Wildl. Conf. for E. and C. Afr. Chilanga: Dep. Nat. Pks. and Wildl. Serv.

Muncy, R.J. 1973. A survey of the major fisheries of the Republic of Zambia. Rome: FAO, FI: DP 9/10 ZAM 511/3.

Muyanga, E.D. and P.M. Chipungu. 1978. A short review of the Kafue fishery since 1968. Paper presented at the National Seminar on Environment and Change: The Consequences of Hydroelectric Power Development on the Utilization of the Kafue Flats, April 1978. Lusaka.

Mwenya, A.N. and G.B. Kaweche. 1978. Wildlife conservation in the Kafue Flats in the light of hydro-electric development. Paper for Nat. Sem. on Utilisation of the Kafue Flats, 8-10 April, 1978. Lusaka: University of Zambia (mimeo).

Rees, W.A. 1978. The ecology of the Kafue lechwe: As affected by the Kafue Gorge Hydro-electric Scheme. J. Appl. Ecol. 15:205-17.

-----. 1978. Do the dams spell disaster for the Kafue lechwe? Oryx 14(3):231-5.

Reilly, C. 1979. The Zambian flower that has beaten pollution. Black Lechwe 12(5)49-51.

Rensburg, H.J. van. 1968. Growth and seasonal composition of natural grassland in Zambia. Journal of the British Grassland Society 23(1):51-52.

-----. 1968. Palatability of plants in Zambia. G.P., Lusaka.

-----. 1969. Introduced legumes in natural grassland and in established pasture in Zambia. G.P., Lusaka.

Rottcher, D. 1976. Research on wildlife diseases in Zambia. In Proceedings of the Fourth Regional Wildlife Conference for Eastern and Central Africa. Ministry of Lands, Natural Resources and Tourism, Lusaka, Zambia. pp. 147-57.

-----. 1976. Post mortem findings on 103 lechwe from the Lochinvar National Park. Unpublished typescript.

Sayer, J.A. and L.P. Van Lavieren. 1975. The ecology of the Kafue lechwe population of Zambia before the operation of hydro-electric dams on the Kafue River. East African Wildlife Journal 13:9-37.

Schuster, R.H. 1976. Reproductive social organisation of Kafue lechwe: Implications for management and survival. In Proceedings of the Fourth Regional Wildlife Conference for Eastern and Central Africa. Ministry of Lands, Natural Resources and Tourism. Lusaka, Zambia. pp. 163-83.

Sheppe, W.A. 1972. The annual cycle of small mammal populations on a Zambian flood plain. Journal of Mammalogy 53:445-460.

Sinclair, R.G. 1971. The problems of wildlife management in game management areas. Paper for the Research and Management Meeting, Dec. 1971. WFNP/CONF. 5. Chilanga: Dep. Wildl. Fish and Nat. Pks. (mimeo).

Stier, J.C. 1973. Subsistence hunting in the Luangwa Valley. Chilanga: Dep. Wildl. Fish and Nat. Pks. (mimeo).

-----. 1973. Safari hunting in the Luangwa Valley. Chilanga: Dep. Wildl. Fish. and Nat. Pks. (mimeo).

Tamblyn, N. 1970. Forest industries feasibility study, Zambia. FAO/UNDP, FOI:SF/ZAM 5, Technical Report 2, Rome.

Tanner, I. 1977. The poaching threat. Black Lechwe 12(3):32-8.

Verboom, W.C. 1972. Grasslands of the Southern and Central Provinces of Zambia. Land User Services Div., Min. of Rural Devel., Lusaka.

Verboom, W.C. and M.A. Brunt. 1970. An ecological survey of Western Province, Zambia, with special reference to the fodder resources. Land Resource Study 8, Vol. I and II, Directorate of Overseas Surveys, Tolworth, Surbiton, Surrey, England.

Williams, R. 1972. Relationship between the water levels and the fish catches in Lakes Mweru and Mweru Wantipa, Zambia. Afr. J. Trop. Hydrobiol. Fish. 1(2):21-32.

Williams, V.C. 1978. The lure of the flats: Wildlife conservation and tourism development in the Lower Kafue Basin. Paper for the Nat. Sem. on the Utilisation of the Kafue Flats, 8-10 April, 1978. Lusaka: University of Zambia.

Zyambo, G.C.N. 1978. Annual Report 1977. Nat. Parks Wildl. Serv., Zambia. Lusaka: Government Printer.

4. Water Resources and Management

Adams, B. and R. Kitching. 1979. The simulation of transmissivity, storativity and evapotranspiration in a digital model of a fissured dolomite aquifer near Ndola, Zambia. Hydrological Sciences Bulletin 24(4):487-498.

Aune, B. 1969. Pan evaporation in Zambia. Hydro-meteorological Report 1, Dept. of Meteorology, Lusaka.

-----. 1970. Potential evaporation in Zambia. Hydro-meteorological Report 2, Dept. of Meteorology, Lusaka.

Balek, J. 1970. Water balance of Luapula and Lake Tanganyika basin. Water Resources Research, Report WR 6, National Council for Scientific Research, Lusaka.

-----. 1971. Luano catchments research project. Book 2: Daily fluctuation of the potential evaporation. Water Resources Research, Report WR 9, National Council for Scientific Research, Lusaka.

-----. 1971. Water balance of the Zambezi basin. Water Resources Research, Report WR 8, National Council for Scientific Research, Lusaka.

Bond, G. 1953. The origin of thermal and mineral waters of the middle Zambezi valley and adjoining territories. Transactions of the Geological Society of South Africa, LVI.

Burgman, J.O.S., E. Eriksson, L. Kostov and A. Muller. 1979. Application of Oxygen-18 and Deuterium for investigating the origin of groundwater in connection with a dam project in Zambia. Isotope Hydrology 1978:27-42. (=Proceedings of an International Symposium on Isotope Hydrology jointly organized by the International Atomic Energy Agency and the United Nations Educational, Scientific and Cultural Organization, Neuherberg 19-23 June 1978)

D.H.V. 1979. Kafue Flats Hydrological Studies, Interim Report. Amersfort, Netherlands.

Emmelin, L.O. 1977. Itezhitezhi Dam. In: World Dams Today. Tokyo: Japan Dam Foundation. pp. 406-410.

Garbrecht, G. 1971. Difficulties Encountered and Foreseen in Water Engineering. First Seminar on Pollution and Environment, Lusaka.

-----. 1971. Examples of water pollution problems in Zambia. In Pollution and Environment in Zambia: Seminar Report, pp. 28-33. Lusaka: Wildlife Conservation Society, Zambia.

Hadwen, P. 1972. The groundwater resources of the Grater Ndola area. Groundwater Resources Paper No.1 of the Hydrogeology Branch, Dept. of Water Affairs, Lusaka.

Legg C.A. 1974. A Reconnaissance Survey of the Hot and Mineralised Springs of Zambia. Lusaka: Geological Survey Department.

Maclean, A.H. 1970. Mongu vegetable schemes - soil problems of importance in irrigation planning. Kafue Irrigation Research Station, Zambia.

N.C.C.M. 1972. Kafue Water Quality Control Report. G. Armstrong-Smith, Chairman, Copperbelt Mine Effluent and Water Pollution Committee, 7 March.

-----. 1972. Kafue Water Quality Control Report. G. Armstrong-Smith, Chairman, Copperbelt Mine Effluent and Water Pollution Committee, 10 Aug.

N.C.C.M. and R.C.M. 1978. Kafue Water Quality Control Report. J.A. Charman, Industry Pollution Adviser, Research and Development Department, Kitwe Laboratory. 29 March.

-----. 1978. Kafue Water Quality Control Report. J.A. Charman, Industry Pollution Adviser, Research and Development Department, Kitwe Laboratory. 4 Sept.

Rijken, J.H.A. and J.M. Clutten. 1972. The water problem in relation to mining at Konkola Division, Nchanga Consolidated Copper Mines Limited. Geologie en Mijnbouw 51(3):399-408.

Starmans, G.A.N. and S. Shalash. 1971. The Surface Water Resources of Zambia. Lusaka Ministry of Rural Development, Department of Water Affairs.

Williams, G.J. 1976. The Kafue hydroelectric scheme and its environmental setting. In: G.J. Williams and G.W. Howard, eds., Development and Ecology in the Lower Kafue Basin in the Nineteen Seventies, 13-27. University of Zambia, Lusaka. Zambia.

-----. 1977. Transferred Water Use in the Kafue Flats. Development and Ecology in the Lower Kafue Basin in the Nineteen-seventies. Lusaka: Kafue Basin Research Committee, University of Zambia:69-75.

Zambia, Ministry of Rural Development. 1975. Irrigation Development in the Kafue Basin. Lusaka, mimeo.

Zambia, Ministry of Water and Natural Resources. 1978. New Water Act. Department of Water Affairs Ref. HYLO 6/5/38 as proposed 6/6/1978.

Symoens, J.J., M.Burgis, and J.J.Gaudet, 1981. The Ecology and Utilization of African Inland Waters. Nairobi: UNEP, Reports and Proceedings Series, pp. 191.

5. Land Use and Agriculture

Anthony, K.R.M. and V.C. Uchendu. 1970. Agricultural change in Mazabuka District, Zambia. Studies in Agric. Economics, Trade and Development 9, no. 3, 215-266. Food Research Institute, Stanford University.

Anton-Smith, J. and J.W. Bryden. 197[illegible]. Mis-Use of Insecticides and Arboricides in Zambia. First Seminar on Pollution and Environment, Lusaka.

Astle, W.L. 1971. Management in the Luangwa Valley. Oryx, 11:135-9.

Astle, W.L., R. Webster, and C.J. Lawrence. 1970. Land classification for management planning in the Luangwa Valley of Zambia. Journal of Applied Ecology 6:143-169.

Beaumont, A.N. 1978. Developing the Crop Potential of the Kafue Flats. National Seminar on Environment and Change, Lusaka.

-----. 1979. Developing the Crop Potential. Proceedings of the national Seminar on Environment and Change, April 1978. Lusaka.

Bessell, J.E., R.A.J. Roberts, N. Vanzetti, and G.M. Elliot. 1969. Agricultural labour productivity investigation (UNZALPI). Report no. 2: Analysis of pilot year data. No. 3: Some determinants of agricultural labour productivity in Zambia. No. 4: Labour requirements for crops and livestock. No. 5: Income and expenditure patterns in relation to the age of cultivator and education of family. University of Nottingham and Zambia.

Bingham, M.G. 1978. The Livestock Potential of the Kafue Flats. Paper presented to the National Seminar on Environment and Change: The Consequences of Hydro-Electric Power Development on the Utilisation of the Kafue Flats. Lusaka, April 1978 (mimeo).

-----. 1979. Livestock Potential of the Kafue Flats. Proceedings of the National Seminar on Environment and Change, April 1978. Lusaka.

Dodge, D.J. 1977. Agricultural Policy and Performance in Zambia. History, Prospects, and Proposals for Change. Berkeley: Institute of International Studies, University of California. xiii + 285 pp.

Fielder, R.J. 1973. The Role of Cattle in the Ila Economy: A conflict of views on the uses of cattle by the Ila of Namwala. Africal Social Research, 15:327-361.

F.A.O. 1968. Multipurpose Survey of the Kafue River Basin, Zambia. Rome, 7 vols.

Harkema, R.C. 1971. The geographical distribution of cattle in Zambia. Occasional studies 4, Zambia Geographical Association, Lusaka.

-----. 1972. Zambia's cotton production and textile industry, Geography 57, no. 4.

-----. 1972. Zambia's emerging coffee and tea production. ZGA Magazine 18, 23-43.

Kajoba, G.M. 1974. Some aspects of land tenure in Kitwe. ZGA Handbook Series, 3:77-91.

Kay, G. 1969. Agricultural progress in Zambia. In Thomas, M.E. and Whittington, G.W., eds., Environment and land use in Africa. pp. 495-524.

Lombard, C.S. and A.H.C. Tweedie. 1974. Agriculture in Zambia since independence. Lusaka: NECZAM.

Mansfield, J.E. and J.A. Jones. 1973. Assessment of Chitemene (shifting) cultivation and allied systems in Mansa District, Luapula Province, Zambia by random dot-sampling of airphotos. Supplementary Report 10, Land Resources Division, Tolworth Tower, Surbiton, Surrey, England.

Mansfield, J.E., et al. 1974. Land resources of the Northern and Luapula Provinces, Zambia: a reconnaissance assessment, Vol. 1-4. Land Resources Division, Tolworth Tower, Surbiton, Surrey, England.

Miussky, P. 1970. Agrometeorology in the service of agriculture. Agrometeorological Report 2, Lusaka.

-----. 1973. Agrometeorological conditions and maize growth-development and yield production in Zambia. Agrometeorological Report 5, Lusaka.

Ranger, T.O. 1971. The agricultural history of Zambia. Lusaka.

Schultz, J. 1975. The contributors to agrarian market production in Zambia. Die Erde 106, no. 1, 10-20.

-----. 1976. Land Use Map of Zambia. Erdkunde 30, no. 2.

Trapnell, C.G. and J.N. Clothier. 1957. The Soils, Vegetation and Agricultural Systems of Northwestern Rhodesia. Report of the Ecological Survey. Lusaka: Government Printer.

Verboom, W.C. n.d. Conservation notes for field staff in Zambia. 1. soil, 2. vegetation, 3. water. Min. of Rural Development, Lusaka.

-----. 1973. Common weeds and arable lands in Zambia. Land Use Services Division, Min. of Rural Development, Lusaka.

Zambia, Dept. of Agriculture. 1970. Pasture recommendations for Central and Eastern Provinces. Mt. Makulu Research Station.

Zambia, Land Use Services Division. n.d. Annual Report 1974. Lusaka Ministry of Rural Development.

Zambia, Land Use Services Division. 1970. A Guide to Agricultural Planning. Lusaka Ministry of Rural Development.

Zambia, Ministry of Lands and Agriculture. 1977. Department of Agriculture Annual Report for Namwala District. October 1976 - September 1977 (mimeo).

6. Public Health, Socio-economic Aspects, Development, Pollution

Acharya, U.R. 1971. Meteorological Aspects of Air Pollution in Zambia. First Seminar on Pollution and Environment, Lusaka.

Anderson, J. 1971. Luapula Blindness: A review and reappraisal. Medical Journal of Zambia, 5:47.

Bahl, M.R. 1975. Impact of piped-water supply on the incidence of typhoid fever and diarrhoeal disease in Lusaka. Medical Journal of Zamiba, 9:56.

Bailey, M. 1973. Meteorological Aspects of Air Pollution. Second Seminar on Pollution and Environment, Lusaka.

Balaraman, T.S. 1971. Certain Aspects of Air Pollution in Zambia. First Seminar on Pollution and Environment, Lusaka.

Brown, J.B. 1977. The Charcoal Industry in Zambia: An investigation and development study. Ndola: Forestry Department.

-----. 1978. Combined paper on Charcoal and the Control of Illegal Felling of Trees for Firewood and Charcoal Production. Ndola: Forestry Department.

Chidumayo, N. in press. Woodfuel in Zambia. Lusaka: Department of Natural Resources.

Clark, A.P.L. 1975. The sources of lead pollution and its effects on children living in the mining community of Kabwe, Zambia. London: London School of Hygiene and Tropical Medicine, University of London.

Collins, J. 1971. Kwashiokor - Some Reflections. Medical Journal of Zambia, 1:105.

Cox, H., et al. 1972. Intensive Development Zones als Strategie zur Entwicklung ländlicher Räume in Sambia. Forschungsinstitut der Friedrich-Ebert-Stiftung, Bonn-Bad Godesberg.

Curry-Lindahl, K. 1971. Pesticides as an Environmental Threat. First Seminar on Pollution and Environment, Lusaka.

Davidson, J.C. and J.L. Noak. 1967. Malnutrition in Zambian Children. Medical Journal of Zambia, 1:5.

Dietz, A.J., J.M. Van Haastrecht and H.R. Scheffer. 1977. Local Effects of Two Large-Scale-Industrial Projects in the Kafue-Mazabuka Area in Zambia: The Kafue Estate and Nakambala Sugar Estate. Nijmeegse Geografische Cahiers, No. 8. Universiteit Nijmegen: Geografische en Planologisch Institut KATH.

Dunlop, R.C. 1973. A Tourism Plan for the Luangwa Valley. Working Document No. 4. Rome: FAO.

Egere, J.U. and J.N. Nwankwo. 1972. Diabetes Mellitus at Kitwe Central Hospital: A review of 170 cases. Medical Journal of Zambia, 6:107.

Elliott, C., ed. 1971. Constraints on the economic development of Zambia. Oxford University Press, Nairobi.

FAO. 1972. The Possibility of Charcoal Manufacture and Marketing on an Industrial Scale in Zambia. Rome: FAO Investment Centre, confidential report No. ADC 5/72 ZAM6.

-----. 1973. Luangwa Valley Conservation and Development Project. Working Documents Nos. 1-5. FAO:DP/ZAM/68/510. Rome.

Gesellschaft Für Regionale Strukturentwicklung. 1971. Southern Province of Zambia: Prospects of regional development, Bonn.

Grout, G.E. 1973. The Supply of Cordwood for Lusaka and Kabwe, 1974-78. Ndola: Forestry Department, Management Division.

Hamlyn, F.G. and A. Njos. 1974. Effects of Dust from the Cement Works in Chilanga on the Soil in nearby Areas. Advanced Report. Chilanga: Mount Makulu Research Station, Zambia.

Hellen, A. 1968. Rural economic development in Zambia, 1890-1964. Afrika-Studien 32, IFO-Instutut für Wirtschaftsforschung, München.

Iwugo, K.O. 1976. The Present Status of the Water Pollution Problems in the Kafue Township Area. Zambian Journal of Science and Technology, 1: 17.

Jackman, M.E. 1973. Recent population movements in Zambia: some aspects of the 1969 census. Zambian Papers No. 8. Lusaka: Institute for African Studies.

Kalapula, E.S. 1976. Kafue River Basin Development: Its effect on ecology and land use. Unpublished M.A. thesis, Arizona State University.

Kay, G. 1968. A regional framework for rural development in Zambia. African Affairs 67, no. 266, 29-43.

Maimbo, F.J.M. and J. Fry. 1971. An investigation into the change in the terms of trade between the rural and urban sectors of Zambia. African Social Research 12:95-110.

Marks, S.A. 1977. Hunting behavior and strategies of the Valley Bisa in Zambia. Human Ecology, 5(1):1-36.

-----. 1979. Profile and process: subsistence hunters in a Zambian community. Africa 49(1):53-67.

Marter, A. and D. Honeybone. 1976. The economic resources of rural households and the distribution of agricultural development. University of Zambia: Rural Development Studies Bureau.

Matschke, H. 1974. Pollution Control on Zambia's Mines. Enterprise, 3:73.

-----. 1975. Pollution Control in Zambia. The Zambian Nurse, 7:17.

McGlashan, N.D. 1972. Blindness in Luapula Province, Zambia. In N.D. McGlashan (ed.)., Medical Geography. London: Methuen.

Mihalyi, L.J. 1972. Research Report on the Investigation into the Nature, Economic and Social Significance of the Charcoal Industry in Zambia. Lusaka: University of Zambia.

Millum, T. 1972. Chipapa - a study in some problems of rural development. ZGA Magazine 18, 1-23.

Nwankwo, J.N. 1972. Lung Carcinoma at Kitwe Central Hospital. Medical Journal of Zambia, 6:47.

-----. 1978. Preliminary Survey of Air Quality in Zambia by Chemical Analysis of Precipitation. Water Quality Research Report WQ3, National Council for Scientific Research, Lusaka, NCSR/TR 46.

Nwankwo, J.N., C.G. Elvinder and Piscator, M. n.d. Cadmium, Zinc, Lead and Copper Concentrations in soil and food materials around a zinc smelter in Zambia.

-----. n.d. Cadmium, Zinc and Lead Concentrations in Autopsies performed at Kabwe General Hospital.

Nyirongo, J.B. 1967. Inspectors discuss New Factories Act. Zambian Review, 5:39.

Rennie, J.K. 1978. Traditional Society and Modern Development in Namwala District. Paper presented to the National Seminar on Environment and Change. Lusaka, April 1978 (mimeo).

Reilly, C. 1973. Cancer and the Consumption of Home-produced beers and spirits in Zambia: a possible connection. First International Conference on Basic Medical Sciences in Africa, Luska (unpublished). Abstracted in Zambia Science Abstracts.

Reilly, A. and C. Reilly. 1972. Patterns of Lead Pollution in the Zambian Environment. Medical Journal of Zambia, 6:125.

Rothchild, D. 1971. Intersectional conflicts and resource allocation in Zambia. Prepared for delivery of the 14th annual meeting of African Studies Association, Nov. 3-6, 1971, Denver, Colorado.

Simonis, E. and H. Simonis, eds., 1971. Socioeconomic developmen in dual economies. Afrika-Studien 71, IFO-Institut für Wirtschaftsforschung, Munich.

Sonawane, D.B. 1974. The city of Kitwe: a general appraisal. ZGA Handbook Series, 3:113-23.

Todd, W. 1973. Some interesting problems and their solution in the accurate lead-in-blood monitoring of employees working in the lead area of Broken Hill Mine. Second Seminar on Pollution and Environment, Lusaka.

Umerah, B.C., I.Y. Yikona and A. Regisford. 1976. Investigations for Byssinosis in Kafue Textile Industry. Medical Journal of Zambia, 10:142.

Vail, L. 1977. Ecology and history: the example of eastern Zambia. Journal of Southern African Studies 3(2):129-155.

Williams, G.J.and G.W. Joward, ed. 1977. Development and ecology in the lower Kafue Basin in the Nineteen seventies. University of Zambia Kafue Basin Research Committee.

Young, C.E. 1971. Rural-urban terms of trade in Zambia. African Social Research 12:91-94.

Zambia, Forestry File. n.d. Investigation into firewood and charcoal for Lusaka and Kafue. File No. 05.HI/INV/85. Ndola: Forestry Department.