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with

U.S. Man and the Biosphere Program of
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Prepared by

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THE UNITED STATES NATIONAL COMMITTEE FOR MAN AND THE BIOSPHERE
Department of State, IO/UCS
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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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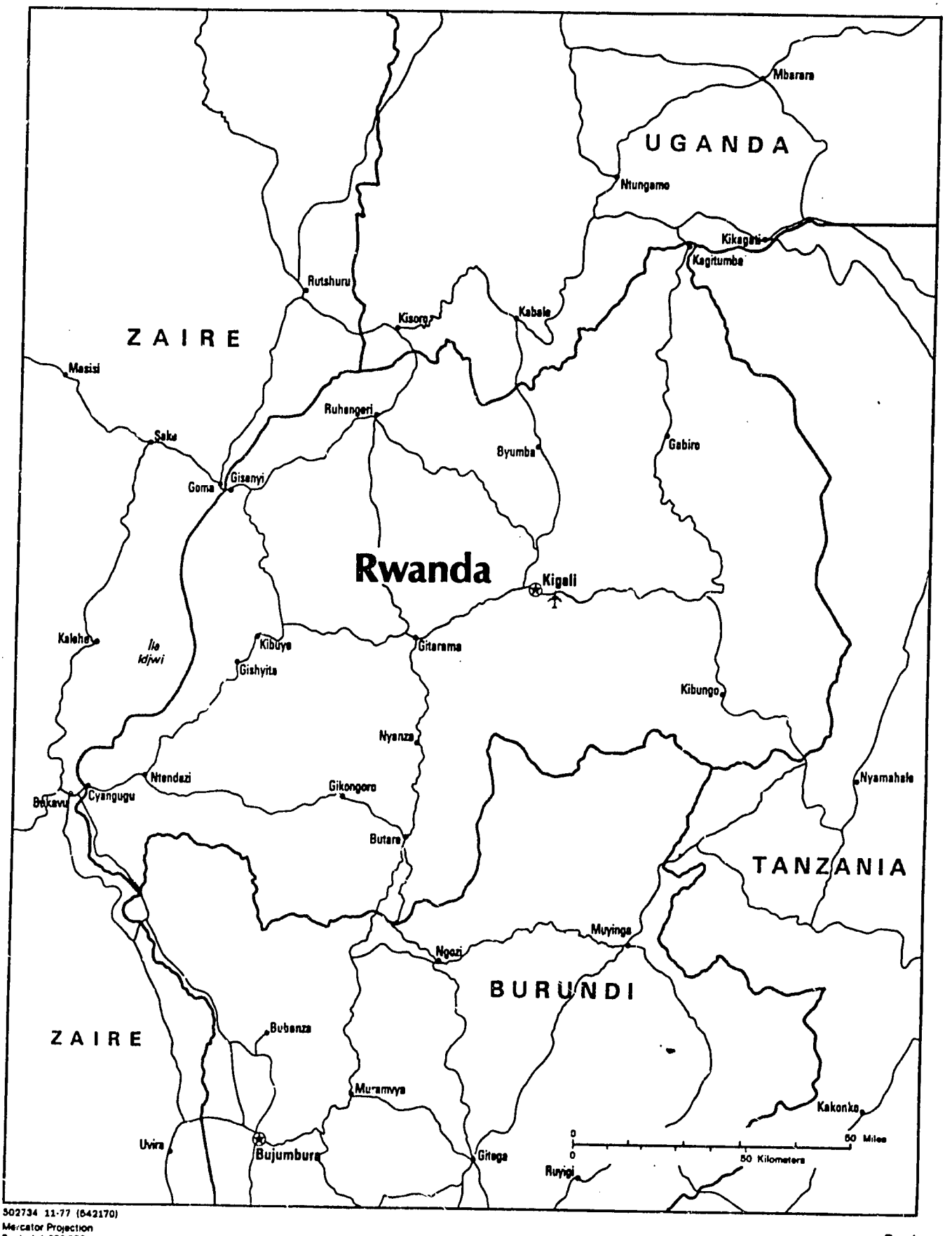
Rwanda



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SUMMARY

A small country located in the heart of central Africa, Rwanda has a moderate climate and an annual rainfall which is generally adequate for two growing seasons. Rwanda has also the advantages of a long history of centralized administration and a single language shared by all its citizens. However, Rwanda is a strictly agricultural country and lacks significant mineral resources. It does not have an outlet to the sea to facilitate agricultural exports. Internal transport is also a problem. Rwanda has a rapidly growing population which is already the densest in Africa, and very limited land resources. Given conditions of rapid population growth and limited natural resources, Rwanda faces a number of serious environmental problems.

Rapid population growth. Rwanda's population, which is 95 percent rural, is growing so rapidly that by the year 2000 virtually all arable land will be occupied. Associated with this rapid growth are problems of rural underemployment, lack of training in modern agricultural techniques, and a lack of urban, industrial employment opportunities, all of which act to increase the pressure on agricultural lands.

Deforestation. Rwanda's forests are an important climatic regulator, and are essential to rainfall catchment in this hilly country. However, the need for new agricultural land, coupled with the need for firewood and construction wood are placing an intolerable burden on the remaining forest preserves. Reforestation efforts are required on a more massive scale than those currently being undertaken and rapid development of alternative fuel resources (peat, hydroelectric power, and methane) will be necessary to conserve Rwanda's forest which, at the present rate of consumption, may be gone in 20 years. However, wood will continue to be the primary source of energy for rural Rwandese for the foreseeable future.

Livestock and pastures. Livestock competes with Rwanda's human population for land. There are too many animals and they are of low productivity and in poor general health. Animal trypanosomiasis, East Coast Fever and malnutrition are among the problems affecting Rwanda's cattle. Pasture lands are subject to overgrazing. Quality grasses have been replaced with less nutritious species over large areas. The effects of overgrazing are aggravated by indiscriminate burning of pasture lands. Programs of stock reduction, improved herd management, and improved breeding must be undertaken on a more massive scale than at present to preserve and restore pasture lands.

Erosion and soil fertility. Deforestation, overgrazing, shortened fallow periods, and traditional methods of food crop cultivation on Rwanda's hilly terrain threaten the fertility of Rwanda's fragile soils. Lack of adequate erosion control measures has caused a serious erosion of precious top soils. Pilot programs of ecologically-oriented agriculture and agricultural resettlement schemes, while promising, concern far too few of Rwanda's farmers to provide a solution to erosion and declining soil quality.

Rural health. Malaria, measles, unprotected and contaminated rural water supplies and chronic protein-calorie malnutrition are serious problems for most Rwandese. These factors limit human productivity. No long-term solutions have been found. Certain development projects designed to cope with some of the nation's environmental problems such as swamp clearance, reforestation and irrigation are likely to worsen some of these health problems by extending the environments suitable to disease-carrying vectors.

Flora and fauna. Twanda has two extensive national parks. However, lack of funds, and lack of park infrastructure and personnel have made it difficult to control unlawful encroachment on park land, poaching and trophy hunting. As a result, a number of rare and endangered species are threatened with extenction in Rwanda.

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1.0 Introduction

This draft environmental profile summarizes information concerning the natural resources of the Republic of Rwanda. It relies primarily upon research reported in European, U.S. and United Nations publications. Scholars at the national research institutions, Agronomical Sciences Institute of Rwanda (ISAR) and the University of Rwanda, have been actively engaged in environmentally oriented research for two decades, but most of the documentation they have produced is unfortunately not available in this country.

The draft report constitutes a first step towards creation of an environmental profile for use by the U.S. Agency for International Development and Rwanda Government Administrators. The data and interpretations provided in this report are preliminary and are neither sufficiently detailed nor accurate enough for serious development planning. The second step in this process should therefore be a series of coordinated field studies which would evaluate the information compiled here, gather new information, and define issues, problems and priority actions. A more complete environmental profile could then in a third step provide direction for efforts to manage, conserve, and rehabilitate the environment and natural resources of Rwanda.

This report represents a cooperative effort by the Man and the Biosphere (MAB) project staff of the Arid Lands Information Center. The primary research, writing, and analysis of the Rwanda profile was done by Eric J. Arnould through ALIC and the University of Arizona library resources. The cooperation of Dr. James Silliman, Profile Editor, James Corson AID/MAB Project Coordinator, James Hester AID Africa Desk Officer, and Mr. Frank Lambrecht is gratefully acknowledged.

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2.0 General Description

Rwanda is located in the heart of central Africa, north of Burundi, east of Zaire, south of Uganda, and west of Tanzania (Fig. 1). It has a diverse, but fragile tropical ecology beset by a complex of problems, foremost of which are its rapidly growing population, the densest in Africa, and its meager natural resources. The nation is committed to environmentally sound management of those resources within a framework of integrated national development (USAID 1980).

2.1 Geography and Climate

In general, Rwanda's land mass is high and rugged, with an exceptional degree of relief in which hydrological features play an important role. The west is mountainous, the east is rolling terrain (Fig. 2). The country is cooler and less rainy than is characteristic of tropical climates.

2.1.1 Geographic Regions

Rwanda, which lies between about 1 and 3 degrees south latitude and 29 and 31 degrees east longitude, is 26,000 square km in area, comparable to New Hampshire or Belgium. All of Rwanda lies between 1000 and 4500 meters elevation astride the East African Rift. From west to east the country may be divided into 6 geographical regions (Nyrop et al. 1969).

The Volcanic Region. The extreme northwest of the country is a volcanic zone extending some 50 km along the border with Zaire and Uganda. It consists of a lava plain above 2500 m in elevation (Fig. 3) of Tertiary and Quaternary age, punctuated by five volcanoes. Karisimbi is the highest peak, reaching over 4500 m, while Gahinga, the lowest peak, reaches 3474 m. This region, containing Volcano National Park, a lucrative pyrethrum plantation, and numerous family farms, is one of the most economically productive areas of Rwanda.

The Rift Valley. The second zone lies in the Rift Valley, including the nation's largest lake, Lake Kivu (1500 square km) to the north, and the Ruzizi river valley. The Ruzizi River, third largest in Rwanda, drains from Lake Kivu south to Lake Tanganyika in Burundi, and marks the southwestern border with Zaire. Tertiary rock is here overlain with later colluvial and alluvial deposits. The valley lies between 1000 and 1450 m (Fig. 3). It is the site of recent agricultural resettlement schemes and projected irrigation projects focused on the town of Cyangugu (Fig. 1).

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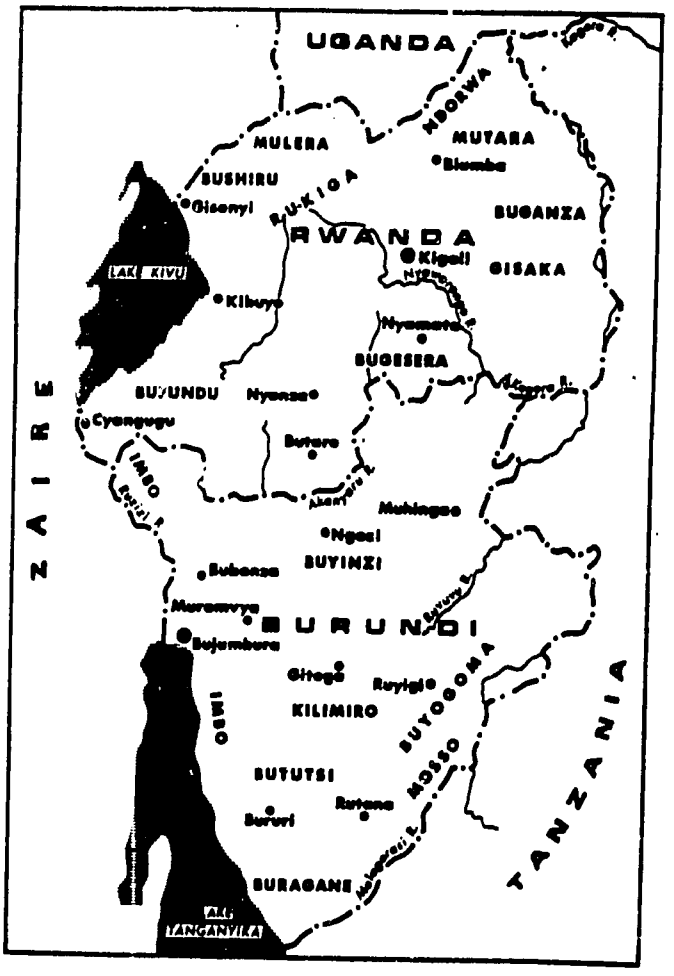
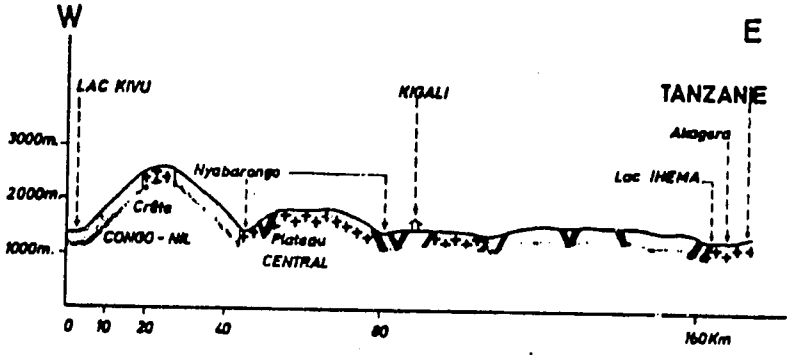


Figure 1. Rwanda and Burundi. Major Regions and Towns

Source: Nyrop et al. 1969.



+++ Granites
Quartzites
Sedimentary Rocks

Longitudinal Scale 1/2,000,000
Altitudinal Scale 1/150,000

Figure 2. Schematic Profile of Rwanda

Source: Gotanegre et al. 1974.

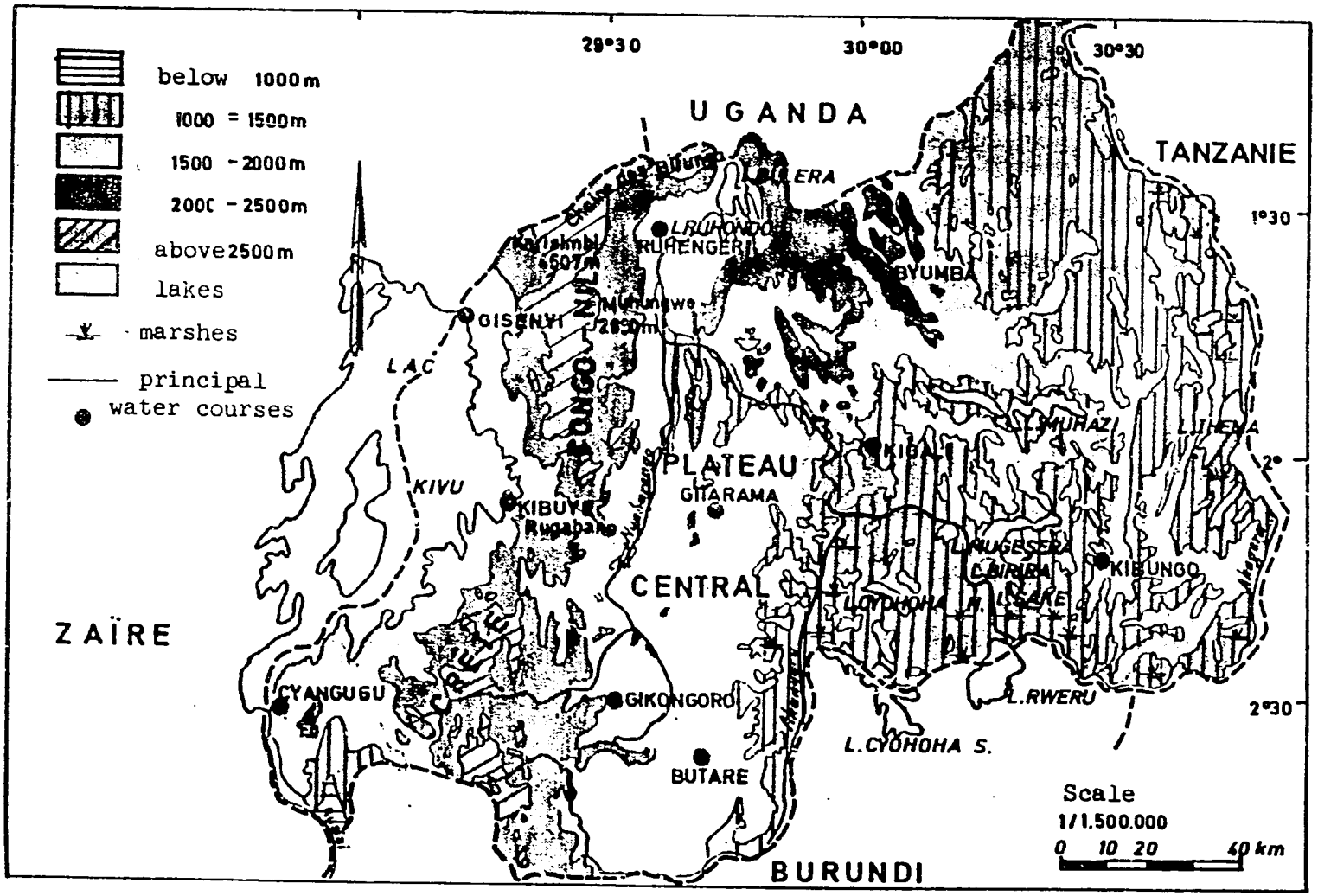


Figure 3. Topographic Regions

Source: Gotanegre et al. 1974.

The Western Slope. The steep, deeply ravined western slopes of the Zaire-Nile mountain crest form a third natural zone some 18 km wide above the Ruzizi valley. A dry, isolated area, the slopes vary in elevation from 1250 m near the town of Kibuye to 2450 m in the south (Fig. 3).

The Zaire-Nile Massif. Directly east of the western slope is the fourth zone, a mountainous massif which extends the length of the country and divides the Zaire and Nile watersheds. As shown in Figure 3, peaks in the Massif range between 2400 m and 3000 m in the north to 2750 m in the meridional segment of the mountain chain near the border with Burundi. Metamorphic rock, containing small gold deposits in the Nyungwe region, is overlain by fragile soils which support remnants of the Zaire-Nile forest.

The Central Plateau. The heartland of Rwanda forms the fifth geographic zone. It is a broad plateau punctuated by thousands of hills separated by low marshy valleys. It is bordered on the west by the Nyaborongo River, the second longest in Rwanda. It varies in elevation between 1500 and 2000 m as shown in Figure 3. Ancient eroded and folded Burundian quartz and schist with intrusive pre-Cambrian granites are covered with a continuous zone of dense human habitation. Important mineral seams underlie the region. The two largest towns Kigali, the capital, and Butare, the university and research center, are located in this region.

The Eastern Peneplain. Eastwards from Kigali is a broad peneplain which gradually slopes down to the Akagera River, which forms the border with Tanzania. This river system, first in national importance, also forms the southern border with Burundi where it is called the Akanyaru.

The savannah-covered plain, about 1000 m to 1500 m above sea level, is flatter than the western regions, but is punctuated by cuirasse-topped mesas and low marshes, some of which are permanent. In this region, too, are numerous lakes formed by recent tectonic damming of the older river courses. Some of them, such as Lakes Ihema and Rweru, are deep, open bodies of water. Others, Lakes Cyohoha, Mugesera and Muhazi for example, are shallow, finger lakes choked with papyrus (*Cyperus papyrus*).

Stretches of the major rivers are also bordered by papyrus swamps which vary from 5 to 40 m wide. The Akanyaru features an important swamp called the Grand Marais, where the

Rwanda Peat Project is located (Gaudet 1980), but the Kagera is also bordered with papyrus thicket. The Kagera National Park and annex hunting reserve in the northeast, the Mutara Ranching Project north of Byumba, fishing industries on Lakes Mugesera, Ihema and Rweru, the peat resources and hydroelectric irrigation potential of the Akagera River all make this area a focus for short-term development efforts.

2.1.2 General Climatic Features

Rwanda has an equatorial montane climate characterized by mild and stable temperatures, moderate and generally well distributed rain, and altitudinal zonation. The climate resembles that of of the plateau regions of the Horn of Africa and the equatorial Andes. Neither temperate nor tropical, Rwanda's climate is modified by local variation in rainfall and relief. For example, the eastern area of the country is semi-arid, while the Virunga mountain region is wet (Bultot 1972). A climatic table for Rubona is provided in Appendix I .

2.1.3 Rainfall

Most of Rwanda falls between the 1600 and 1000 mm isohyets (Kourzoun et al. 1977), as shown in Figure 4. The timing of precipitation is governed by two tropical anticyclones. Dry easterly air propelled by the south African anticyclone prevails over Rwanda. However, humid eastern air is propelled over Rwanda by the Indian anticyclone. When the easterly current dominates, convective cloud formation and rain occur. The easterly flow is strongest between February and May when Rwanda experiences its long rainy season ("Itumba"). The south African anticyclone prevails from May to September, preventing convection and causing the long dry season ("Icyi"). A shorter period of variable rainfall flows through November and into December. Westerly winds there again predominate, beginning the short dry season ("Urugaryi") (Bultot 1972, Gotanegre et al. 1974).

Rainfall is highly variable from year to year and from locale to locale, deviating from average levels by as much as 34 percent. The region around Lake Ihema receives less than 800 mm (Bouxin 1974). In the upland Rugege forest and on the Virunga volcanos, 1500 to 2000 mm and more of precipitation have been recorded at elevations around 1950 m (Spinage 1972, Bouxin 1976).

Considerable relief and consequent surface turbulence are the main factors responsible for regional variation in rainfall. Due to the flow of humid air up the Ruzizi Valley from Lake Tanzanyika, up to 1400 mm of orographic precipitation may fall on the green eastern slopes of the Zaire-Nile massif causing serious erosion and seasonal mudslides. The

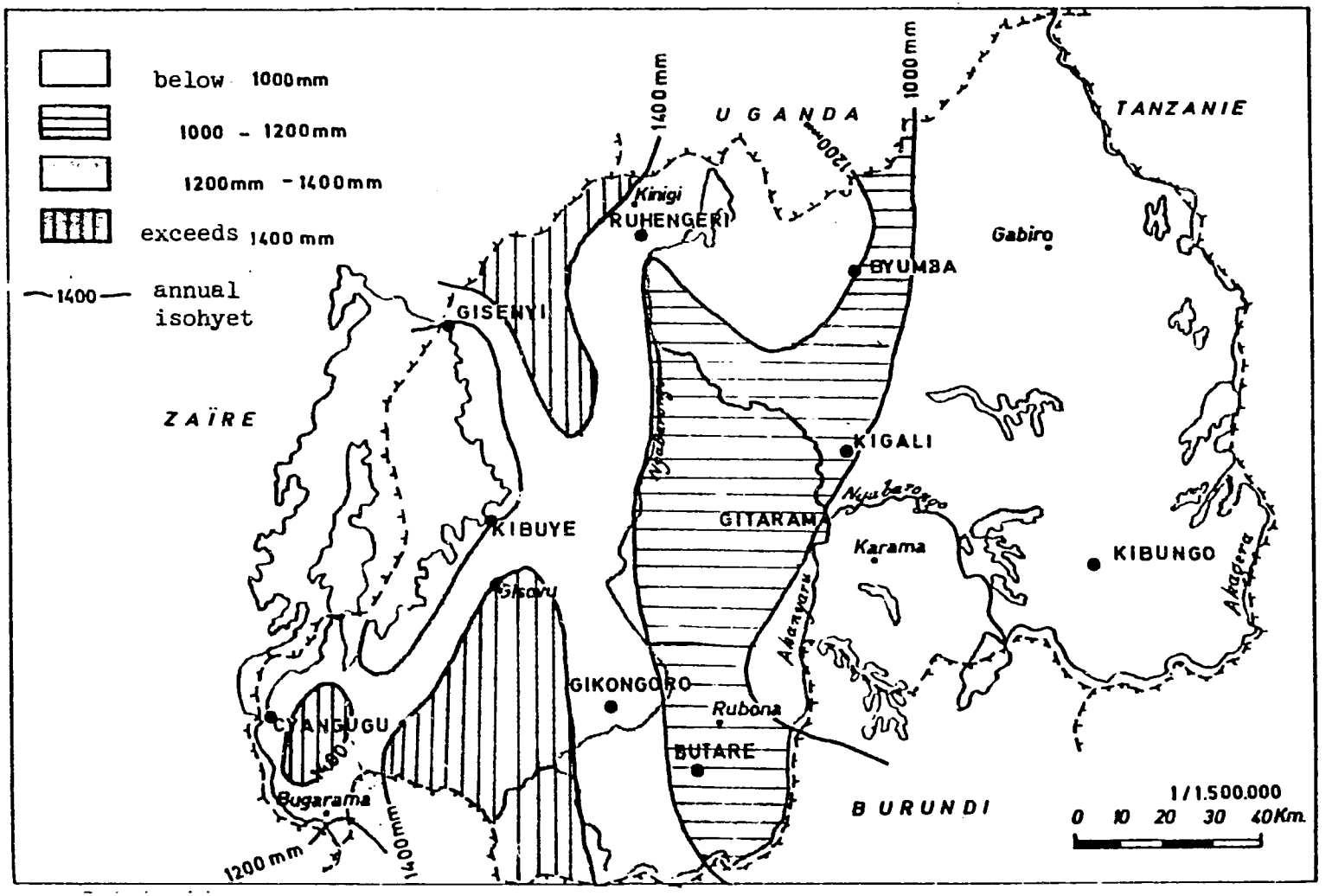


Figure 4. Rainfall Distribution

Source. Kourzoun et al. 1977.

Ruzizi valley also receives about 1400 mm. The "föhn" (a hot dry wind blowing downslope) prevents cloud formation on the western slopes of the massif and over Lake Kivu where less than 1200 mm of rain are received annually. At extremely high elevations of 4000 m and up, rainfall declines to less than 900 mm, comparable to amounts received on the southeast plains.

Sample rainfall profiles (Fig. 5) illustrate the variation in rainfall and rainfall distribution of various areas within Rwanda. Rainfall is relatively evenly distributed throughout the year in Kibuye, west of the Zaire-Nile divide, but only 1055 mm fall per year. Gisovu, which lies on the divide 900 m above Kibuye receives 1600 mm of rain, but it is very unevenly distributed. Heavy rainfall in April is followed by aridity in May. Central plateau areas, represented by the towns of Byumba, Kizali, and Butare experience a more pronounced dry season than in the west, and a more even distribution of annual rainfall. Rainfall decreases abruptly on the eastern peneplain. Gabiro receives just 783 mm. Despite the variation, rainfall is generally sufficient to permit two seasons of cultivation, one of which begins in September, the other in March (Gourou 1977, Gotanegre et al. 1974, Bultot 1972).

2.1.4 Evapotranspiration and Drought

Normally, the dry season lasts 60 to 65 days in the Virunga region, beginning in mid-June. On the Zaire-Nile crest it lasts 75 to 90 days, beginning at the end of May. On the central plateau the dry season lasts an average of 97 days, beginning around June 1. In the east a dry season of 110 days is not uncommon and it begins in mid-May (Bultot 1972, Gotanegre et al. 1974).

Due to the high incidence of solar radiation, evapotranspiration rates are between 80 to 90 percent on the central plateau, 65 percent on the Zaire-Nile crest and close to 100 percent in the Ruzizi Valley. Even with normal rainfall, these high evapotranspiration rates cause rapid drying of the soil, which makes unpredictable drought a serious problem and irrigation a necessity in drier areas (Bultot 1972, Nzamurambaho et al. 1972).

Despite its tropical latitude, rainfall amounts are less than might be expected at such close proximity to the Zaire basin. Periodic devastating drought is a problem. Such drought occurred in 1900-06 and 1943-44 and caused considerable loss of life, because Rwandan agriculture is dependent upon precipitation (Lugan 1974, Gotanegre et al. 1974).

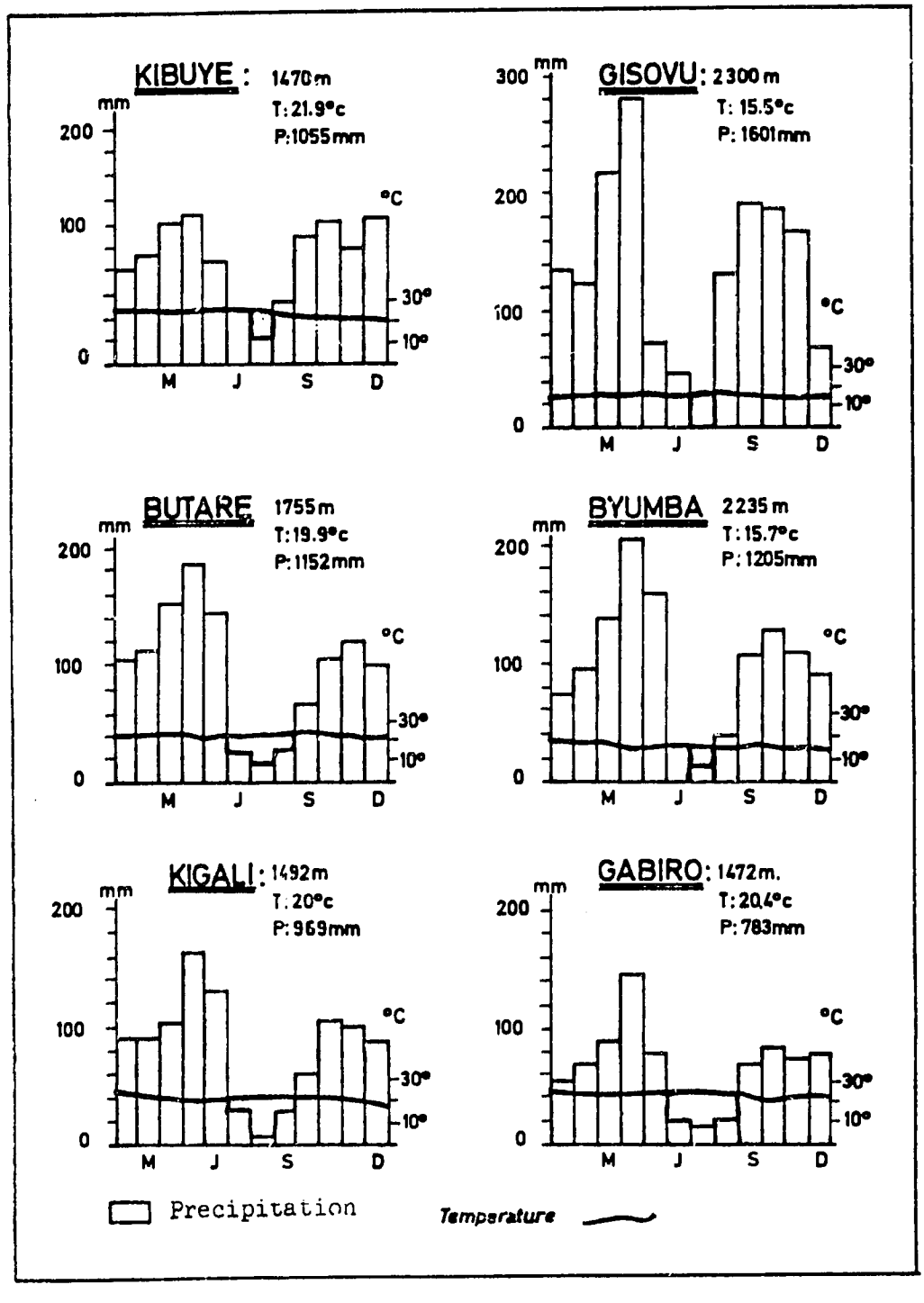


Figure 5. Sample Rainfall Profiles

Source: Gotanegre et al. 1974.

2.1.5 Temperature, Humidity, Wind

Temperature. Due to its elevation, Rwanda is quite temperate. On the central plateau, between 1500 and 1800 m, mean temperatures range from 19°C at Rubona (1706 m) to 20°C at Kigali (1490 m). Above 2000 m, as at Byumbu and Gisovu, mean temperatures are about 15°C. In the Ruzizi Valley, temperatures are subequatorial, reaching 24°C at Bugarama (900 m). Mean temperatures in northeast areas such as Gabiro are similar to those above Lake Kivu in the west, for example at Kibuye (20.7°C and 21.5°C, respectively).

Mean daily temperatures fluctuate less than 2°C. Temperature regularly declines 0.5 to 0.65°C with every 100 m of elevation. Temperatures at the volcano summits frequently fall to 6°C and the high altitude marshes in the mountains may experience freezing weather. Variations in temperature associated with altitude are an important determinant of the distribution of Rwanda's food and export crops.

Humidity. Mean monthly relative humidity lies between 55 percent and 85 percent on the plateau and in the Ruzizi Valley, respectively, whereas in the mountains it is a little greater, between 60 and 90 percent (Bultot 1972).

Wind. Rwanda is generally swept by breezes of relatively high velocity, from 5 to 10 km/hr. In the dry season, these are the swifter westerly and southwesterly flows, which are reinforced by the south African anticyclone. Winds are northeasterly to easterly currents in the rainy months. Gusty weather is common during the day in the rainy season. The relatively intense surface turbulence tends to diffuse some of the solar radiation (Bultot 1972).

2.2 Population

Unlike many African peoples deeply divided by colonial rule, the Rwandese have a long history of central authority and regional interdependence, a common language, and a deep attachment to the land (Lemarchand 1970, Lugan 1974, Maquet 1979). There is a profound commitment to rural life and agricultural pursuits among the 95 percent of the population which lives on the land.

2.2.1 Historical and Cultural Background

Rwanda has been occupied from very early times. Although the archaeological resources have been incompletely catalogued, 12 middle paleolithic sites (35,000-20,000 B.C.), 22 upper Paleolithic sites (20,000-11,000 B.C.) and some twenty Neolithic sites (11,000-5000 B.C.) have been reported (Fig. 6), the latter containing pottery and evidence of metallurgy (Gotanegre et al. 1974, Hiernaux and Maquet 1960).

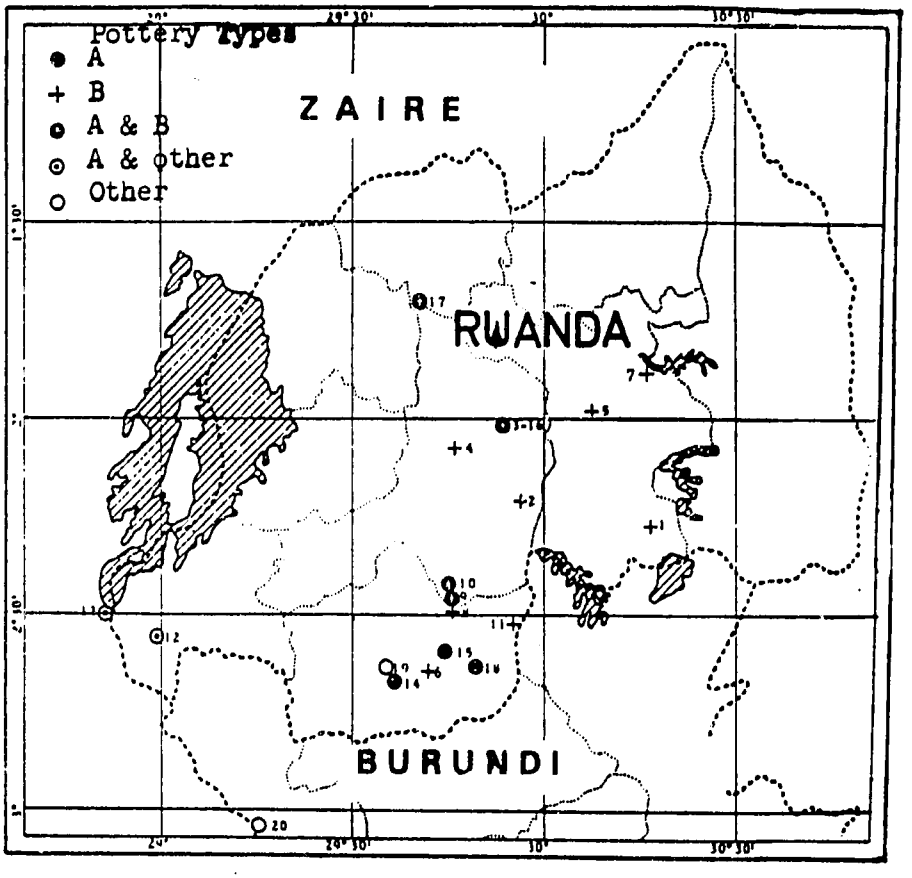


Figure 6. Neolithic and Metal Age Sites

Source: Hiernaux. 1980.

The Twa (or Batwa) pygmies of the northern and central montane forests were probably the original inhabitants of Rwanda. They number less than 1 percent of the population, and their hunting and gathering subsistence strategies seem to have had little effect upon the natural environment.

Between the 7th and 10th centuries the country was occupied by Hutu (or Bahutu) horticulturalists who comprise 90 percent of the modern population. The fertile, forested central plateaus have been profoundly affected by the shifting slash and burn methods of cultivation once practiced by the Hutu. Agriculture has since become increasingly more intensive and permanent, especially since the spread of banana cultivation in the 16th century. Small-scale Hutu chiefdoms developed from a patrilineal system of clanship and land tenure. These medieval principalities were governed by "sacred" kings. The third major population

group, the Tutsi (or Batutsi) migrated into Rwanda from the north between the 14th and 15th centuries. Practicing a nomadic pastoral economy based upon Ankole cattle, the Tutsi employed the practice of lending livestock to the Hutu at rates unfavorable to the Hutu to establish Tutsi political and economic hegemony over the central plateau agricultural peoples. The dispersion of cattle over the countryside through the "ubuhake" or cattle contract, had a major impact upon the soils and natural succession of floral communities in the cattle grazing regions.

European colonial intervention lasted from the turn of the 19th century through 1962, but there was little European settlement. Germany ruled until 1924. Its policy of indirect rule notably led to territorial stabilization but to a strengthened Tutsi monarchy, and increased inter-ethnic conflict. From an ecological point of view, the most far-reaching changes came from the introduction of Arabica variety coffee and from the introduction of money as an alternative to cattle as a means of exchange and a symbol of wealth.

From 1924 until independence in 1962, Belgium held a United Nations Mandate over the territories of Rwanda-Urundi. The Belgians engaged in limited colonization, but encouraged the development of plantations devoted to quinine, coffee, and subsequently, tea. The Belgians also instituted a program of reforestation and erosion control on the hillsides which eventually affected thousands of hectares. In their efforts to modify the more feudal ties of clientage between Tutsi and Hutu, they reformed cattle ownership. One result of their intervention is the polycropping mixed agriculture practiced by 350,000 rural households today (Nyrop et al. 1969).

Belgian political activities also fostered the emergence of Hutu class consciousness and nationalism, and ultimately the reversal of the Tutsi monarchy, establishment of majority rule, and the development of parliamentary political forms.
The first post-independence regime was dominated by Hutu people of the central region, which led to new political divisions along regional, rather than ethnic lines. A military coup in 1973 led to a more centralized system of administration with a stronger presidency, reversing the trend towards economic nationalism, and favoring a more moderate stand on ethnic relations. This has led to domination of government posts by the previously disenfranchised northerners. Goals of the current regime include national unification, agricultural intensification and the promotion of integrated rural development (Lemarchand 1970, 1977, U.S. AID 1980).

2.2.2 Population Size, Growth and Distribution

Rwanda is the most densely populated country in Africa, and like most African nations, has a young and growing population. Although they are an important national resource, the people suffer from a lack of education and from health problems which prevent realization of their full productive capacity.

The population was estimated at 2.8 million in 1960, 3.6 million in 1970, and between 4.5 and 4.9 million in 1978 (U.S. Bureau of the Census 1979, U.S. AID 1980). Projection of current growth trends indicate a population of 8 million in Rwanda by 1990 (Gotanegre et al. 1974).

Figure 7 shows population growth since 1933. The effects of past food shortage, famine and the post-war acceleration of population growth are apparent. Since 1950 the rate of growth has varied from 3 percent to the current estimate of 2.9 percent annually, one of the highest in Africa (Gotanegre et al. 1974, U.S. Bureau of the Census 1979, U.S. AID 1980). The crude birth rate (CBR) has varied between 40 and 54/1000 since 1940. The current estimate is 49/1000, but recent interviews at the Gahiru hospital east of Kigali turned up an alarming CBR of 59/1000 (Elswood 1979, Gotanegre et al. 1974, U.S. Bureau of the Census 1979). The completed fertility rate among Rwandese women is four to five live births.

Estimates of mortality place the crude death rate (CDR) at 19 or 20/1000, down from 27/1000 in 1960 (Gotanegre et al. 1974, U.S. AID 1980). Mortality varies with elevation and proximity to malarial swamps. Some sort of health care is available within 25 km to most people at the commune administrative level. The CDR is 18.1/1000 at Ruhengeri (above 2000 m) but ranges as high as 25.5/1000 below 1500 m. Infant mortality was estimated at 133/1000 in 1970 and at 128/1000 by the 1978 census (U.S. AID 1979, 1980).

Birth rates are quite variable, ranging from 111/1000 in Byumba Prefecture to 155/1000 in Cyangugu Prefecture (Gotanegre et al. 1974). Deaths among the 1-4 age group are about 27/1000, down from 41/1000 in 1960. Crisis periods for this group are at six months, when breast milk becomes inadequate for nutrition and at two years, when the child is displaced by a new baby. Recently weaned infants frequently contract kwashiorkor (Elswood 1979). Despite high death rates, the life expectency has risen from 37 years in 1960 to 46 years in 1979.

Like many developed countries, Rwanda's population pyramid is steep, as shown in Figure 8. Estimates of the proportion of

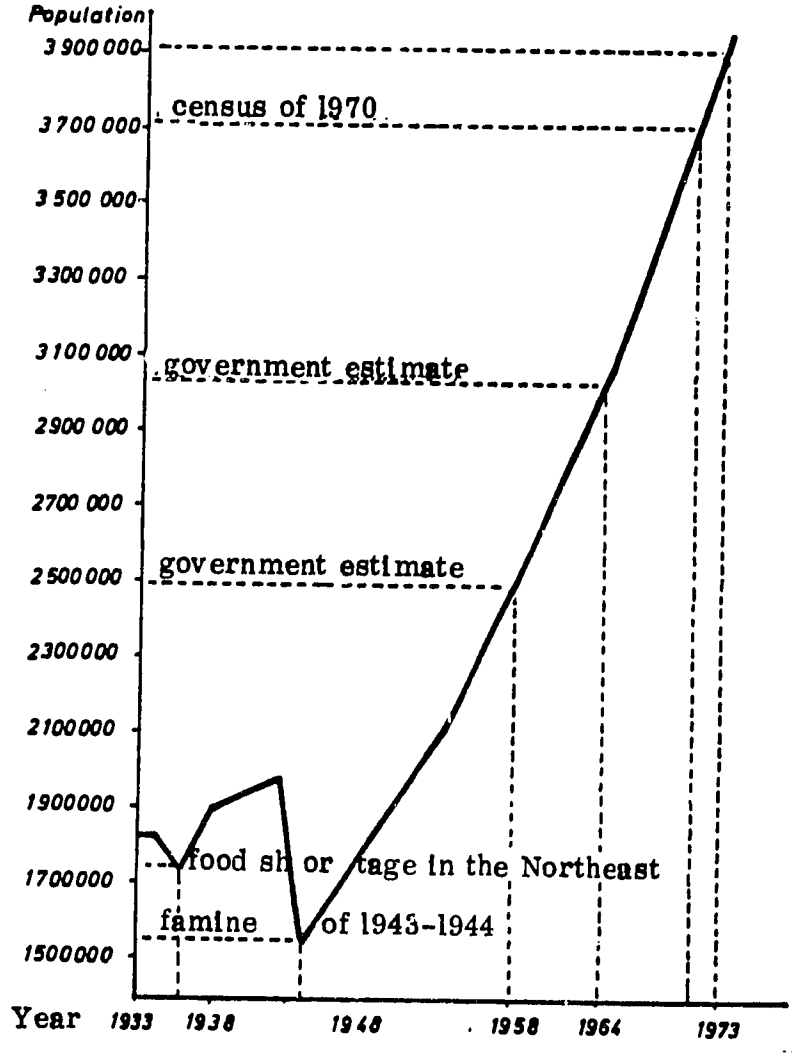


Figure 7. Population Growth, 1933-1973.

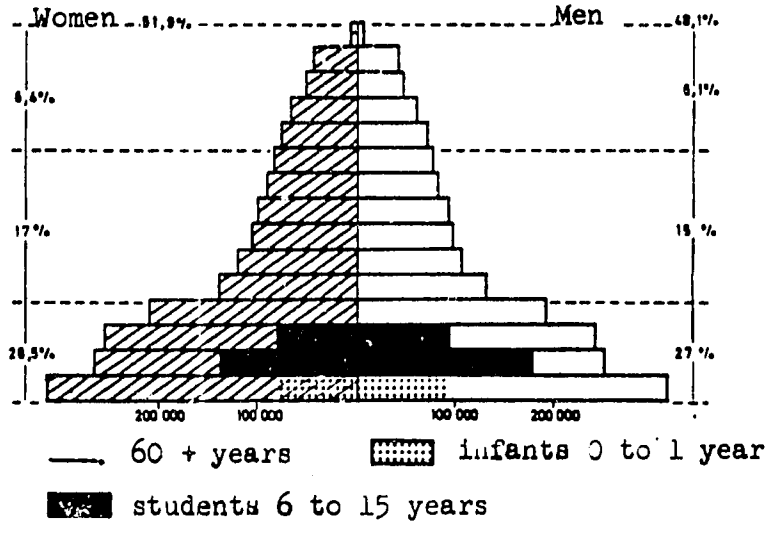


Figure 8. Population Composition. 1974.

Source: Gotanegre et al. 1974.

of citizens under 15 years of age vary from 50 percent (Elsewood 1979) to 46 percent (U.S. AID 1980). However, 52 percent of the population is at least potentially economically active (15-64 years of age). This amounted to 2.4 million persons in 1978.

Rwanda is remarkable for the density of its population: 171 persons per square km, absolute density, and 300 per square km on agricultural land. The predominately rural character of the population is also striking. Only 3 to 4 percent of the population is urbanized, but even the largest towns are small. The urbanized population is expected to increase to 7 percent by 1985 (Préfol and Delepierre 1975).

Kigali has 125,000 residents (an over 20-fold increase from 1960) while Butare, the educational and second commercial capital, has 15,000. The eight other prefecture capitals have less than 10,000 inhabitants each. The urban growth rate is just 6 to 8 percent and is fueled principally by rural migration. Most Rwandese live in small family farming households (urugo) of which there are some 880,000 with an average of 4.7 persons per household (Delepierre 1978).

The population is far from evenly distributed, and this variation is due to the superior soils, rainfall, and climate of the higher elevations and the restriction of livestock to these areas. Distribution by Prefecture is shown in Figure 9. Figure 10 gives a more detailed breakdown.

Fifty-five percent of the population inhabits just 33 percent of the cultivable land, and in general the highest densities are found in areas of superior soils and good rainfall. The Butare Prefecture, the traditional heartland of Rwanda, is in a class by itself with over 320 persons per square km, and over 451 per square km around the town. In the east, where settlement is discouraged by aridity and the tsetse fly, densities are below 130 persons per square km. Low densities along the Akagera River border with Tanzania are partly due to the existence of Akagera National Park. Cyangugu Prefecture in the southwest is a pioneering zone where the establishment of agricultural resettlement zones, or "paysannats" has raised densities to 300, and even over 451 persons per square km in some places.

2.2.3 Health and Nutrition

Many tropical diseases are endemic or epidemic in Rwanda. In addition, nutritional ailments are common. These problems

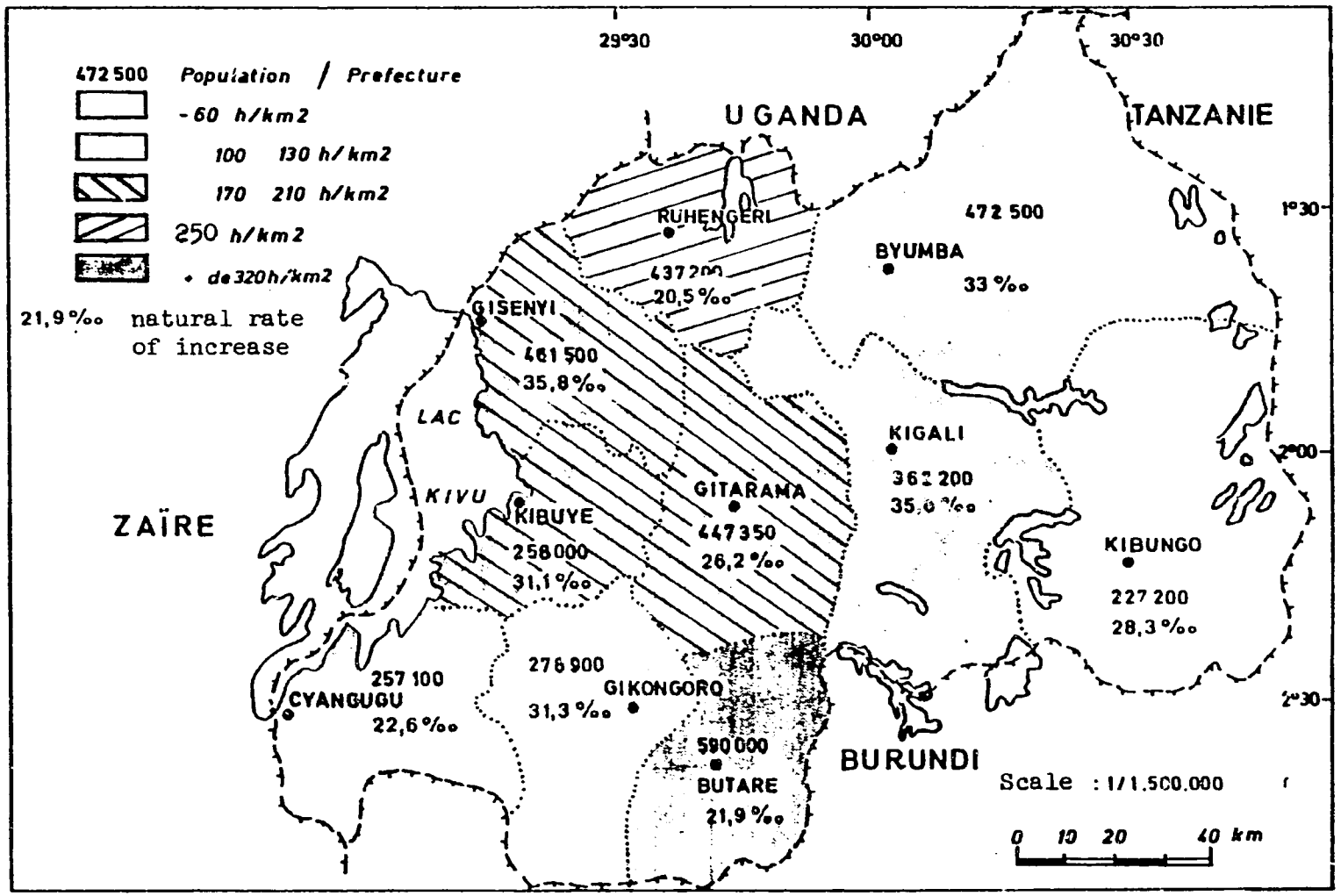


Figure 9. Population of Rwanda by Prefecture

Source: Gotanegre et al. 1974.

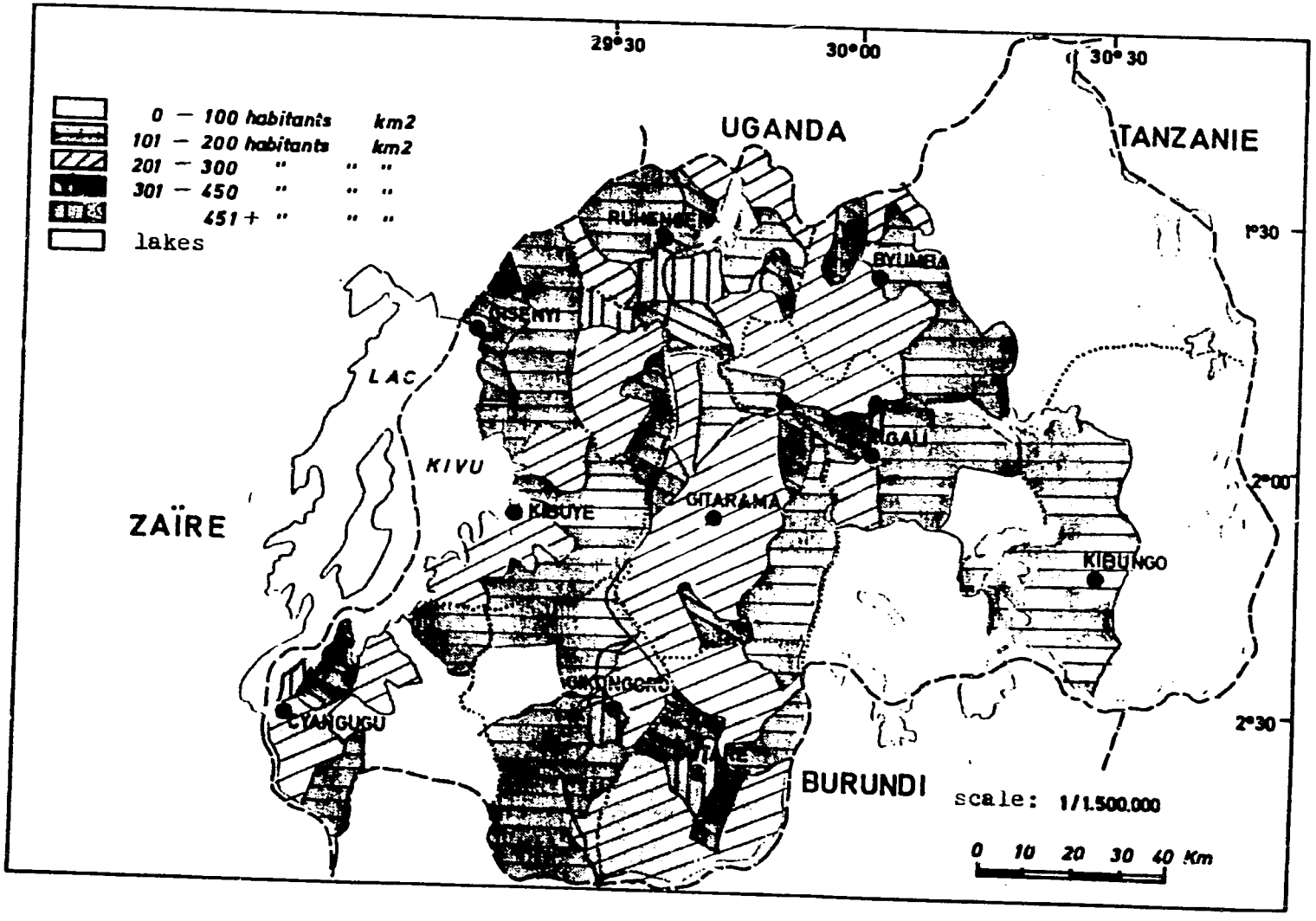


Figure 10. Population Distribution

Source; Gotanegre et al. 1974.

are in part due to the lack of medical care, in part to a climate highly favorable to many pathogens, and in part to the underdevelopment of food production and storage.

National budget allocations to health services have shown a regular increase over the past decade. Several missionary groups also continue to maintain medical facilities, notably at Ruhengeri and Gashiru, as well as in the capital, Kigali. Clinics are available to many people [there is one hospital bed for ever 611 persons (U.S. AID 1980)].

Rudimentary transportation and lack of popular understanding of modern health care contribute to the underutilization of available facilities. Only 100 out of every 10,000 persons are admitted to hospitals and clinics annually. In rural areas, the occupancy rate of hospital beds is only 24 percent, while in town, where transport and knowledge are better, occupancy rates reach 75 percent.

The extreme dispersion of the population, which makes health care delivery difficult, also limits the development of sanitation. Just half the population has access to sewage disposal facilities. Two thirds of the population is said to have access to safe water provided by the many springs and seeps in the countryside, and by standpipes and household distribution systems in towns. Improving water supply is an important goal. In the Bubazi rural development zone alone 57 springs were improved in a 2 year period (Zutter 1979). However, many rural springs are threatened by too much traffic and by lack of protection from waste (U.S. AID 1980, White et al. 1972).

Serious endemic diseases include malaria and trypanosomiasis (sleeping sickness) though human trypanosomiasis is rare in recent years. The virulence of these diseases is responsible for the low animal and human population densities in the east, and along the river valleys below 1500 m. Control of the disease vectors, mosquitos (*Anopheles*) and tsetse flies (*Glossina morsitans, G. palipides)* is difficult (van den Berghe and Lambrecht 1956). Another killer is measles. It was the most frequent cause for admission to the Kigali hospital between 1975 and 1978 (30 to 40 percent of admissions) and resulted in death 20 percent of the time (Lepage and de Mol 1979). In other studies of hospital deaths, bronchial and lobar pneumonia, and dysentery were responsible for 25 and 11 percent of deaths respectively (Nyrop et al. 1969). Other erdemic health problems include gout, peptic ulcer, cholera, tuberculosis, syphilis, and typhoid (Elswood 1979, Gatera 1976, Wierman and Snyder 1979, Meheus et al. 1979, Colaert et al. 1979). Endemic parasites include anklyostomiasis, bilharzia, and filariasis, including *Ascaris* and elephantiasis (Elswood 1979, Price 1976). Among epidemic diseases, spinal meningitis and louse-borne typhus have recently been reported (Bosmans et al. 1980, Meheus et al. 1974).

Nutritional disease is common in Rwanda. It accounted for 11 percent of all hospital deaths in the late 1960s (Myrop et al. 1969). Symptoms in the general population include: 1) low overall adult body size; 2) low levels of albumin and beta globulin blood serum proteins: 3) high gamma globulin blood serum protein serum fractions: 4) poor nitrogen and poor lipid absorption due to low intake; 5) normachromic anemia; 6) vitamin A deficiency manifested in skin disease, particularly around Kigali; 7) parenchymatous goiter at rates up to 28.4 percent at Kitabe (May 1965); 8) kwashiorkor (protein-calorie malnutrition) amongst children (Vanhecke and Buginya 1980); 9) primary adult lactose intolerance is also reported from the Lake Kivu area (Cox and Elliot 1974). Most nutritional problems are due to chronic underconsumption and seasonal imbalance in nutritional intake (May 1965). Only 85 percent of the daily 2100 caloric requirement is met (U.S. AID 1980, Gotenegre et al. 1974). Per capita protein intake is 10 grams shy of the 60 gram daily minimum (U.S. AID 1980). Animal proteins and fats are scarce. One half of Rwandese consume no fats for months on end. Only 30 percent of Rwandese consume meat more often than once every two weeks. Annual per capita milk consumption is only 8 liters (May 1965).

2.3 Land Use

2.3.1 General Features

About 1.2 million ha of Rwanda's 2.5 million ha surface area is arable land (Table 1). Close to 800,000 ha were cultivated in 1965, 966,000 ha in 1972, and 1 million ha in 1976 (Gotanegre et al. 1974, Nordconsult-Electrowatt 1976). About 135,000 ha of unused land is considered reclaimable for agriculture (Table 2) including 70,000 ha of swamps and valleys and 64,000 ha of the Mutara Hunting Preserve, should it be opened for settlement. Ninety percent of the population practices

subsistence agriculture on "family agricultural enterprises" (FAE) of about 1.12 ha, a decrease from 1.32 ha in 1965 due to increased population (Gotanegre et al. 1974, Neel 1975). Préfol and Delepierre (1975) found an even smaller average FAE size of 1.04 ha (Table 3).

Table 1. Estimated Available Arable Land, 1970 (ha)

Available for use	1,250,000
In use	800,000
Unused and available	450,000
Reclaimable	135,000
Maximum unused potential	585,000

Source: Préfol and Delepierre. 1975a.

Table 2. Unusable Surface Area, 1970 (ha)

I. Surveyed Area		
1. Lakes		
Lake Kivu	102,380	
Other lakes	25,390	
2. Marshes and valleys	83,840	(70,550 reclaimable)
3. Natural Forest		
Nyungue	108,800	
Gishwati	28,200	
4. Parks and Preserves		
AKagera National Park	270,900	
Volcano National Park	12,000	
Mutara Hunting Preserve	64,273	(64,273 reclaimable)
II. Unsurveyed Area		
1. Private Concessions	16,320	
2. Research Stations		
ISAR	4,621	
AIDR	13,500	
3. Artificial Forests	27,156	
4. Roads and Paths	6,208	
5. Permanent Water Courses	7,268	
Total	783,556	
Total Reclaimable	134,823	
Total Unusable	648,733	

Source: Préfol and Delepierre. 1975a.

Table 3. Land Use on Family Agricultural Enterprises (FAE), by Prefecture

Prefecture	Food Crops	Fallow	Coffee	Residential Parcel	Total Area	Number of FAE	Area/FAE (ares)
Butare	55.356	18.452	2.520	9.904	86.232	110.040	78,4
Byumba	50.439	16.813	2.196	8.359	77.804	92.660	83,8
Cyangugu	33.656	11.219	2.842	4.626	52.343	51.400	101,8
Gikongoro	33.980	13.592	2.078	4.950	54.600	55.000	99,3
Gisenyi	48.681	9.736	1.852	7.690	67.959	85.440	79,5
Gitarama	51.493	17.164	3.773	7.272	79.702	80.800	98,7
Kibungo	56.608	28.304	2.132	3.890	90.934	43.230	210,3
Kibuye	33.679	11.226	1.798	4.480	51.183	49.700	102,0
Kigali	48.555	19.422	3.012	5.070	76.059	56.330	135,0
Ruhengeri	67.762	22.587	2.030	7.839	100.218	87.100	115,0
Total	480.209	168.515	24.230	64.080	737.034	712.000	103,6

Source: Préfol and Delepierre. 1975a.

There are probably close to 600,000 ha still available for agro-pastoral use in Rwanda (Table 1), enough for about 522,000 more FAE. At the current rate of growth of 25,000 new families per year, Rwanda's arable land will be saturated by the year 2000 (Préfol and Delepierre 1976a). Recognition of this fact has led to recommendations for more intensive agriculture (U.S. AID 1980, Nordconsult-Electrowatt 1976). Elements of a more intensive land use strategy include:

1. Resettlement schemes, called "paysannats," using new agricultural techniques (Sylvestre 1974).

2. Massive irrigation projects on underutilized lands (Nordconsult-Electrowatt 1976, Welsh 1980).

3. Erosion control, including Setaria hedges, dikes, etc.

4. Reforestation of 10 percent of every FAE.

5. Penning livestock to conserve manure for fertilizing fields and/or creation of compost bins (Zutter 1979, BAR 1976).

6. Intercropping with nitrogen fixing, oleaginous plants such as soybeans and groundnuts (Zutter 1979).

Land classified as unusuable for agriculture amounts to about 650,000 ha (Table 2). Included in this figure are about 140,000 ha of primary forest on the Zaire-Nile crest, and 27,000 ha of artificial forests. There are 282,000 ha in the two national parks as well, some of which are forested or covered with wooded savanna. Forest wood is used primarily for firewood and construction timber (Préfol and Delepierre 1976a). Additional unusable lands are contracted to foreign companies or are in use for other purposes, such as roadways and research facilities (Table 2).

2.3.2 Crops

Thirty-nine percent of Rwanda's land or about 1 million ha is cultivated. Climatic zonation due to topography provides a diversity of conditions which suit a wide range of crops. Eighty-seven percent of the cultivated land is devoted to subsistence crops, but over 46,000 ha are devoted to cash crops, principally coffee, tea, pyrethrum, cotton and quinine (Gotanegre et al. 1974, Nwafor 1979). Although most family agriculture enterprises (FAE) cultivate just over one hectare,

polyculture is the rule. For example, in the Bugazi rural development zone, two crop zones are distinguished. Between 1600 and 1800 m, coffee, bananas, sorghum, beans, sweet potatoes, sugar cane, avocado and papaya are grown, while between 1800 and 2200 m peas, potatoes, maize, tobacco, eleusine, cabbage and Japanese plums are grown (Zutter 1979).

The major crops cultivated, and their elevational zonation are listed in Table 4. The largest areas are covered by legumes followed by cereals and bananas; these are the three basic elements of the Rwandese diet. Banana is especially popular. Nine varieties of banana *(Musa triploide acuminata)* are grown. Bananas provide 50 percent of the total agricultural tonnage and 34 percent of the food energy (Bulletin Agricole duRwanda 1979). Eighty percent of the annual crop is consumed as beer (Champion 1970). The full agricultural potential of the cereals, particularly wet rice, grown on the Cyangugu agricultural settlment, has yet to be realized (Gotanagre et al. 1974).

Table 4. Areas Cultivated in Principal Crops

Crop	Area (ha)	Percent of Total Cultivated Area	Altitudinal Zones (meters)
Legumes	264,300	34.6	Below 1800 : beans Above 1800 : peas
Sorghum & Millet	229,964	30.1	Below 2500
Banana	152,800	20.7	1500 - 2000
Maize	49,920	6.5	Below 1800
Coffee	26,900	3.5	1500 - 1800
Tea	16,000	2.0	1500 - 2200
Root Crops	13,304	1.6	Below 1800 : Sweet potatoes, Cassava Above 1800 : Potatoes
Groundnuts	8,874	.01	Below 1500
Soybeans	1,404	<.01	Below 1800
Pyrethrum	3,000	<.01	2200-2700
Quinine	1,000	<.01	?
Rice	630	<.01	Below 1400
Sugar Cane	100	<.01	Below 1800

Source: Gotanegre et al. 1974, Gourou 1977, B.A.R. 1979.

Coffee is the most widely cultivated cash crop. Many new plantings and restorations of trees have been undertaken through the effort of OCIR (Rwanda Office of Industrial Crops) and the cooperative movement (Zutter 1979). Development plans call for the expansion of tea production, in order to surpass coffee as an export earner in the next 10 years (Gotanegre et al. 1974). Pyrethrum, cultivated intensively on an agricultural settlement just outside the Volcano National Park, has undergone considerable recent expansion, and quinine (*Chinchona ledgeriana, C. succiruba)* has recently made an important comeback on world markets stimulating development of local processing (BAR 1976). Experimentation and extension to increase the range of cash crops, particularly fruits, legumes, medicinal and cosmetic herbs are being pursued (Gotanegre et al. 1974). Farmers are willing to experiment with new crops such as soy beans and sunflower, and success with new techniques and crops has led to some optimism about the future of agriculture, despite the very serious shortage of land (Vennetier 1978, Zutter 1979, Stauffer 1980).

Crop production by weight and value for selected crops is presented in Table 5. Food crops represent the largest share in value. Bananas, sweet potatoes, and legumes are the leaders of this group, showing consistent large increases in tonnage and value over the past decade. Since virtually all of this is destined for local consumption, national revenues remain dependent on cash crop exports. Tea and quinine, at least, have shown steady growth thanks to accelerating world demand. However, Rwanda is not a major producer of any of its cash crops and is thus highly vulnerable to world market fluctuations.

2.3.3 Livestock

Livestock, particularly cattle, are an integral part of Rwanda life. Most households have some animals and about half of household land is set aside for pasture. Livestock numbers, distribution and density in 1974 are summarized in Figure 11. There were 750,000 head of cattle in 1974, primarily of the unproductive native Ankole variety (May 1965) and some Ankole/Jersey hybrids. One head of Ankole can live on one hectare of pasture annually, and the number increases at the rate of 3 percent per year (Nwafor 1979). By 1976 cattle had increased to 800,000 head on 835,000 ha. At this point stabilization of herd size has become a necessity since there is no new pasture land available.

Densities of cattle are less than 17 head per square km in Cyangugu, Byumba and Kibungo Prefectures because of the devastating effects of tsetse fly-borne trypanosomiasis

Table 5. Production and Value of Cultivars

	1970/71		1975		1979	
	Metric Tons (000's)	Value (000's $ US)	Metric Tons (000's)	Value (000's $ US)	Metric Tons (000's)	Value (000's $ US)
Bananas	1,651[1]	107,315	1734	112,710	2000	130,000
Sweet Potatoes	413	15,694	675	25,850	700	26,600
Cassava	345	8,625	365	9,125	425	10,625
Dry Beans	144	14,400	153	15,300	170	17,000
Potatoes	124	4,158	135	4,455	140	4,620
Dry Peas	65	6,500	57	5,700	60	6,000
Sorghum	134[a]		135[b]			
Maize	64	3,200	67	3,350	70	3,500
Coffee	16	8,000	26	13,000	23	11,500
Groundnuts	7	812	14	1,624	15	1,740
Millet	2	66	3	99	4	132
Tea			4[b]			
Quinine	268		333		1000	

Sources: All values from U.S. AID 1980, except [a](Gotanegre et al. 1974), [b](Gourou 1977), [c](U.S.D.A. 1980).

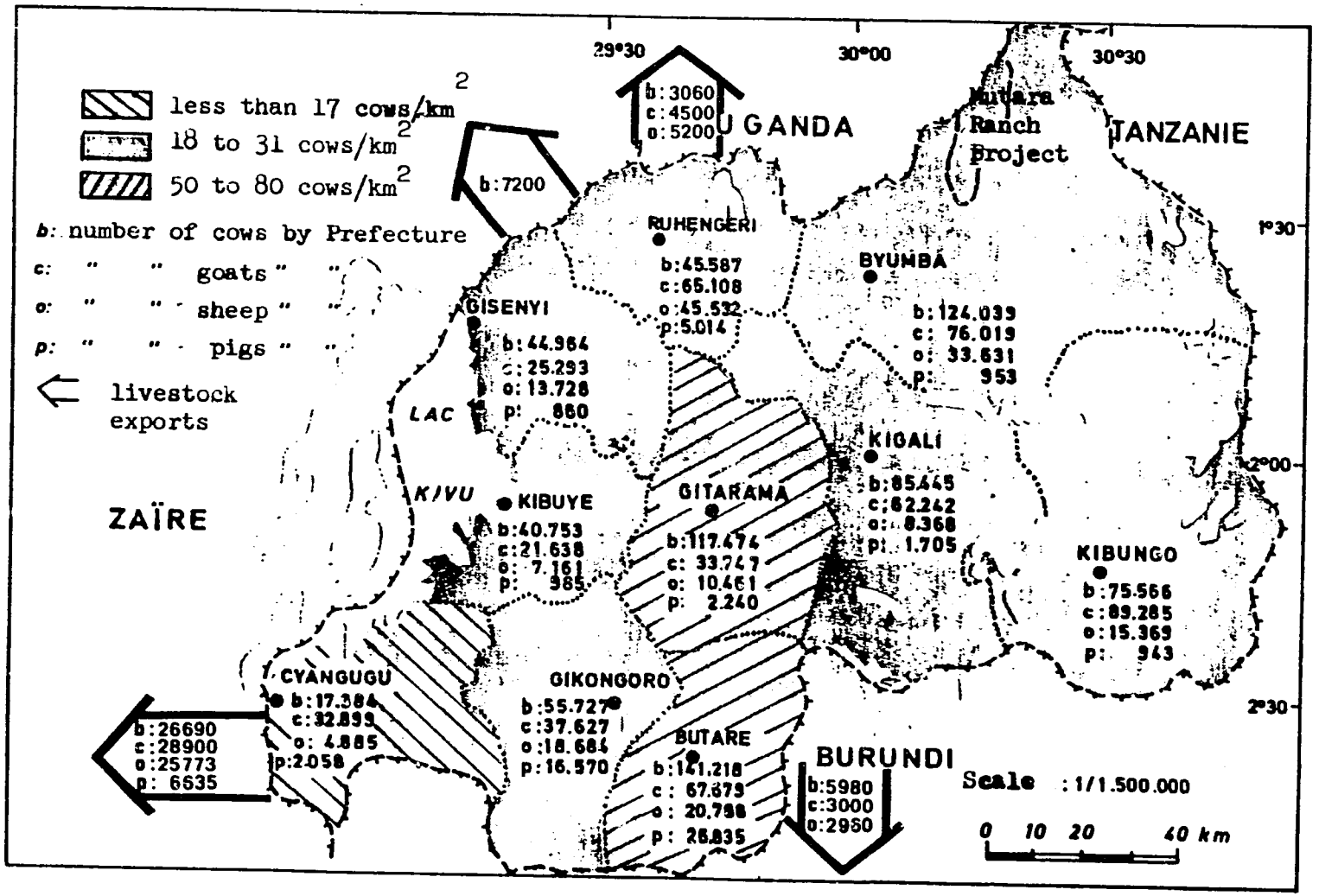


Figure 11. Distribution of Livestock

Source: Gotanegere et al. 1974.

below 1500 m. In the traditional centers of the Tutsi monarchy on the higher plateau, densities of 50 to 80 head per square km are found. The Mutara Ranching Project in northern Byumba Prefecture (4500-2000 m) aims to transform that area into a vast ranch. Such a scheme is prompted by the deleterious effects of overgrazing upon the regeneration of nutritional grasses on arable land, and the generally poor health of the animals, due to parasites, tick-borne disease, and malnutrition (Rattray 1960, Préfol and Delepierre 1976, Kiltz 1979).

Small ruminants and pigs are also of importance, particularly in households which cannot afford cattle. There were over 670,000 head of goats and sheep in Rwanda in 1979, concentrated in Kigali, Byumba and Kibungo Prefectures. Production of pigs, a colonial introduction, is most highly developed in Butare and Gikongoro Prefectures. In these Prefectures are over 27,000 head, 50 percent of the countrywide total of 5700 animals.

An increase of pork production has been proposed to raise the number of pigs from one per twelve households to one per household. The reasoning behind this proposal is that pigs grow well in pens, thus reducing pressure on pastures, and they reproduce faster, grow more quickly, and require less food than cattle. Problems with expanded pig production include the high cost of a diet suitable for optimum growth and weight gain, low market value and farmer resistance to stabling (Deschuytener 1972).

Exports of cattle and production of meat have remained relatively stable over the past decade (USDA 1980). Exports to Zaire, Uganda and Burundi reach 16,240 head of cattle annually, about 2 percent of the national herd, 71,000 small ruminants, about 11 percent of the herd, and 6635 pigs, about 12 percent of the herd. Just 15,000 metric tons of meat are produced annually despite overstocking and human protein deficiency (U.S. AID 1980, 1965; Deschuytener 1974).

Part of the explanation for the apparent overstocking of livestock is that cattle have a deep-seated <u>social</u> significance. Ownership is a symbol of ethnic identity to the Tutsi, and of economic success to everyone. Livestock exchanges figure in all important life crisis events (birth, baptism, marriage, etc.). They are also associated with a patron-client relationships based upon the so-called cattle contract ("ubuhake"), which was a fundamental element of political life under the "ancient regime." To most Rwandese, a large herd represents not only an irreplaceable store of wealth, but also an aesthetic pleasure. Therefore management schemes most likely to succeed are those which incorporate

both the instrumental and expressive aspects of Rwandese livestock production, as for example a stock reduction and breed improvement program which incorporates both traditional aesthetic and modern production goals.

2.3.4 Forest Exploitation

The remaining natural forests of Rwanda consist of shrub savanna mixed with riverine gallery forest and xerophilic thickets in the relatively undisturbed eastern lowlands; woody savanna with pockets of secondary mountain forest in upland Ruhengeri, Kibuye, Gikongoro and Cyangugu; and Afro-alpine forest in the Virunga mountains and along the Zaire-Nile spine (Fig. 12).

About 12 percent of Rwanda, or 2.6 million ha, is considered to be forest land (Gotanegre et al. 1974), but most has now been modified by clearing, burning, grazing, and cultivation. Only 140,000 ha of primary forest remain of the formerly extensive Zaire-Nile forest (Préfol and Delepierre 1975a). Over 50 percent of the eucalyptus planted during the Belgian mandate has been damaged. Recent reforestation efforts have covered about 27,000 ha in the submontane region. Most new plantations are less than 20 years old, and are dispersed in plots of less than 2 ha (Gotanegre et al. 1974).

With the stated goals of controlling clearing, and improving firewood protection and production, two cooperative sawmills have been established, one each at the north and south ends of the Zaire-Nile mountain forest. Their annual production is 240 and 176 cubic m of cut wood, respectively (Gotanegre et al. 1974). However, almost 4 million cubic m of wood are needed each year for household firewood, plus another 60 thousand cubic m for construction and industry (Gourou 1977). Shortages are acute throughout the country. The Kibuye Prefecture alone has a deficit of 39,000 ha of wood lots, even though it is a forested area (Stauffer 1980). Most of the other Prefectures experience comparable shortages. Remaining reserves are under intense pressure, with adverse effects on erosion control and rainfall catchment (Spinage 1972). Small scale reforestation is under way under laws which date to the 1920s (Stauffer 1980), and renewed efforts are being made to utilize natural peat as a firewood substitute (Gaudet 1980).

Both the technical knowledge and legislation required to accomplish sound forest management already exist in Rwanda. The policy of afforestation on marginal lands and planting of field boundaries and terraces is decades old. Recent surveys in Kibuye Prefecture show 17,000 ha suitable for afforestation there, and work by van den Bergh and Lambrecht (1956, 1962) suggests that marginal lands in the Bugesera and Mutara regions are suitable for afforestation. A number of species which

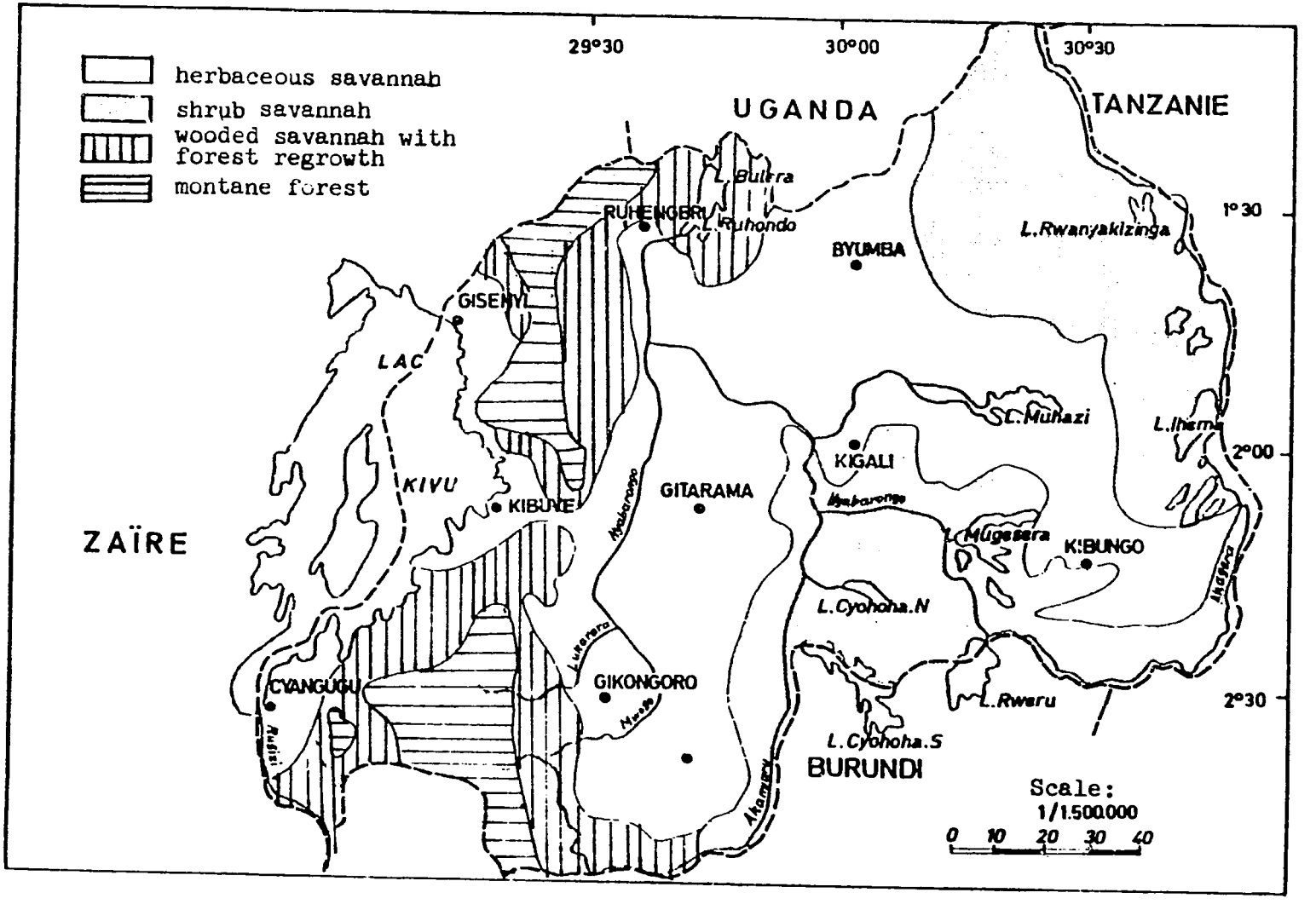


Figure 12. Distribution of Forest Resources

Source: Gotanegre et al. 1974.

combine rapid growth, drought control, and/or erosion control properties have been successfully employed in reforestation schemes. They include *Eucalytpus maidenii, E. saligna, Acacia neansii, Cyprus* spp., *Markhamia* spp., *Ficus* spp., *Maesopis* spp., and *Grevillea* spp.

3.0 Environmental Resources

3.1 Geology, Mineral and Energy Resources

3.1.1 Geology

Figure 13 illustrates the major geological divisions of Rwanda. Basically, the entire land mass consists of Precambrian rocks from which harder lithologies have obtruded and softer ones eroded (Gourou 1977). However, faulting, vulcanism and tectonic movement have altered much of the basement structure, and alluvial deposition has masked certain parts.

The still active Virunga volcanoes have spread late Tertiary and early Quaternary lavas over Precambrian Burundian series rocks in the northwest. The basement rock has a fold and fault structure and forms a northern extension of the Itombwe syncline (Chorowicz and na Bantu Mukonki 1980). The volcanos are centered over a deep megavent oriented north-south and flanked by faults oriented east-west which have channeled lava to the volcanoes (ibid.). As expected of rock originating in a single magma reservoir, rocks from all volcanoes are highly uniform, consisting of members of the potassic-alkali series: plagioclases, augite, olivine, leucite basanites, trachybasalts, trachytes and volcanic glass. There is some inter-volcano variation. On the north flank of Rubona, for example, magnesochromite and mellilite occur (Denaeyer 1969, Naumov and Polyakov 1971).

A principal fault runs north-south beneath Lake Kivu from which numerous faults of northeast-southwest orientation fan out, evidence of the region's tectonic stress. South of the lake, the volcanic series rocks occur again to the east of the fault line. In this region, western slopes of the Zaire-Nile crest consists of basaltic rocks (Gotanegre et al. 1974).

Much of the eastern land mass is underlain by Burundian quartz and schist. However, the Zaire-Nile mountains and their eastern slopes extending as far as Gitarama, Gikongoro and Butare, consist of Ruzizian series metamorphic rock. A corridor of similar rock extends southwest from Kigali to the region of Quaternary alluvial and fluvial deposits on the southern border.

Between Gitarama and Gikongoro in the west and the Nyarabongo River basin in the east, intrusive Precambrian granites are revealed. These rocks also dominate the land forms of the regions north and south of Lake Cyohoho. Another zone of such rock intrudes to the east of Gisenyi between the Virunga piedmont and the Ruzizian rock of the Zaire-Nile divide.

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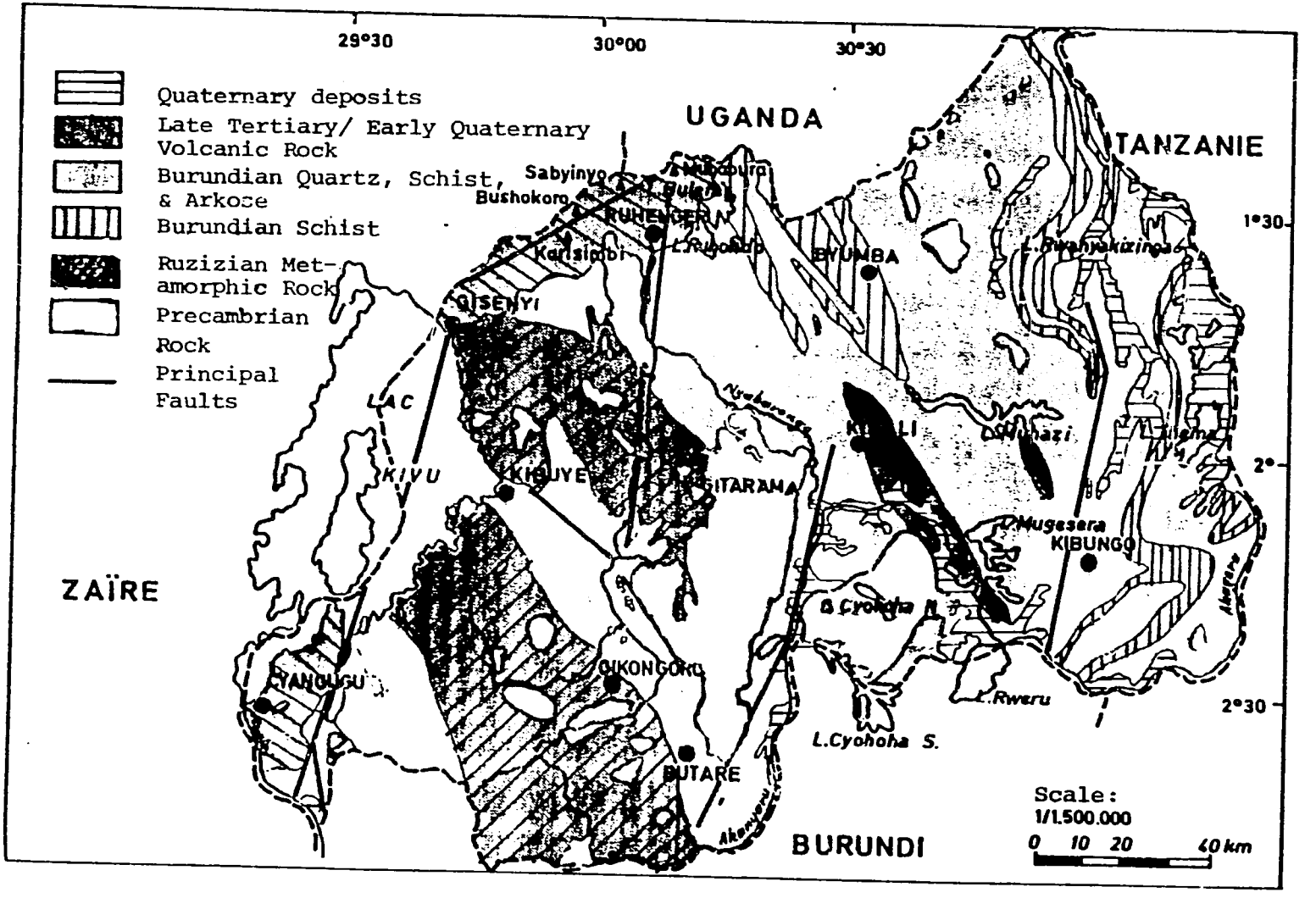


Figure 13. Geological Formations

Source: Gotanegre et al. 1974.

Long sinuous viens of purely Burundian schist occur around Byumba and elsewhere in the lower eastern region. These punctuate the more complex Burundian series rocks and the young Quaternary deposits of fluvial and alluvial origin.

Rocks of the Burundian series have provided most of the minerological interest. However, the metamorphic rock of the Zaire-Nile massif is the source of minor gold deposits in Cyangugu Prefecture.

3.1.2 Mineral and Energy Resources

The major mineral resources of Rwanda are of two sorts: those originating in Lake Kivu and those found in the central, eastern and northwestern mineral belts. Indications are that the Kagera River basin may also be a source of further mineral reserves (Lemarchand 1977). Although mineral-bearing strata have been surveyed, geological investigation remains to be directed towards the deeper unexploited strata.

Lake Kivu is the source of at least two resources. One of these is methane gas. Below 275 m, there is no liquid circulation in the lake so that gas from organic fermentation and volcanic emissions builds up. It is estimated that 57 million metric tons of methane reserves exist, the rough equivalent of 36 million metric tons of diesel fuel. The methane regenerates at the rate of 3 million cubic meters per year. Thus, annual production of 1.5 million cubic meters at the Regideso plant at Cape Rubona would not upset the hydrological equilibrium (Gotanegre et al. 1974). About 23 percent methane is retrieved from pumped water, for a total annual production of about one million cubic meters at present (Lemarchand 1977).

In addition to methane, Lake Kivu contains one million tons of zinc captured on micron-sized sphalerite resin globules which occur in concentrations of 2 ppm. The resins themselves consist of complex polymers. They are a promising tool for the removal of certain metal pollutants and may find commercial applications in helping concentrate valuable trace metals. The sources of the zinc and dissolved constituent gases (CO_2, HS_4, H_2S) are the hydrothermal springs at lake bottom. The springs thus provide a renewable natural resource of potential commercial interest (Degens et al. 1972).

The principal zones of known mineral-bearing rock are shown in Figure 14. In the central zone, tungsten occurs in granitic associations in which graphite schists are common. Tungsten usually occurs as wolframite (deMagnee and Andesca 1960). Quality of ores in this region varies from 250 grams of wolframite per

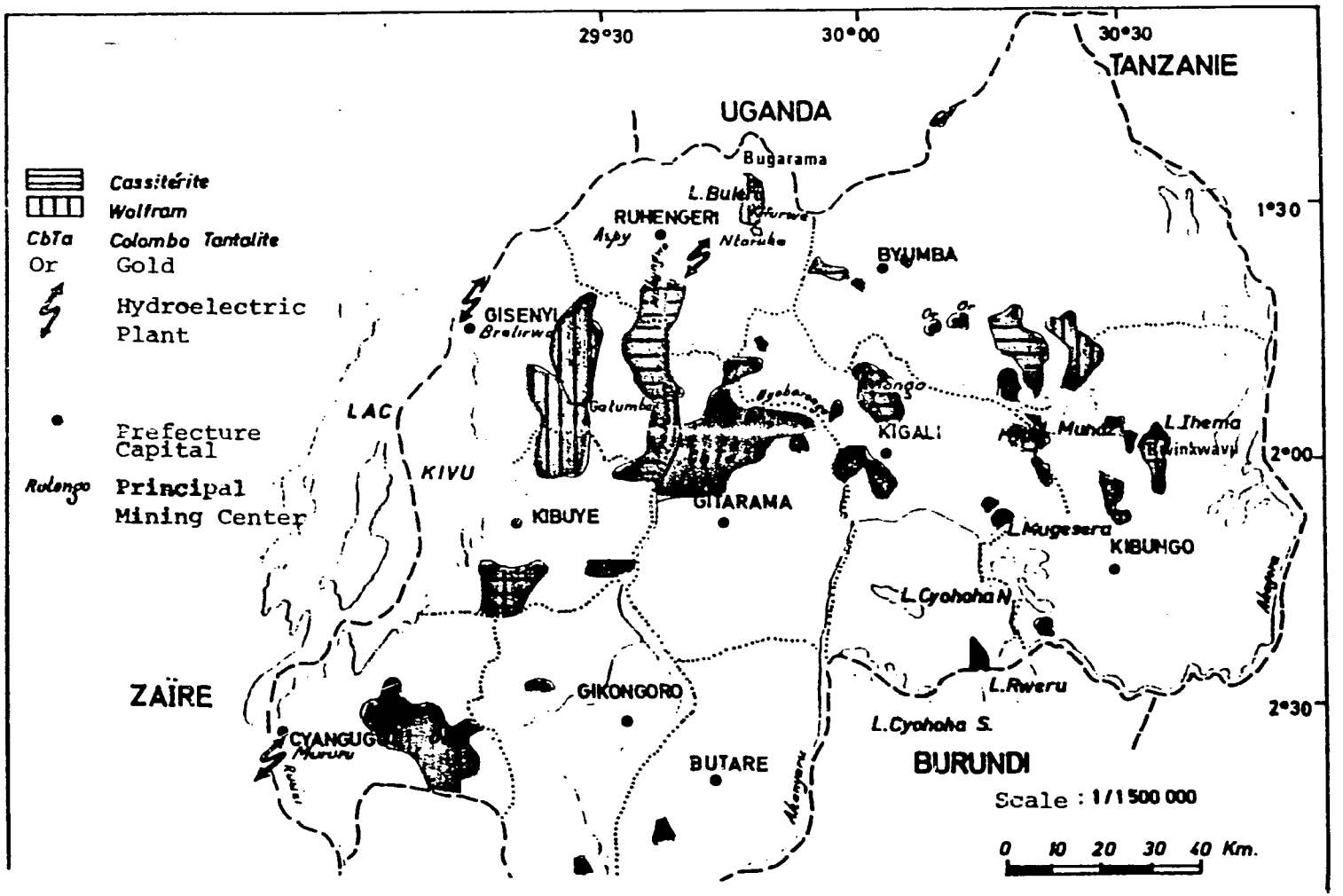


Figure 14. Principal Mineral Zones

Source: Gotanegre et al. 1974.

cubic meter at Kifuwe, 20 km east of Ruhengeri, and 500 grams of wolframite per cubic meter at Bugarawa on the northern border with Uganda, to 2000 grams per cubic meter at Bumbogo, 20 km northwest of Kigali.

In the western mineral zones, the tungsten is localized in a tectonic zone of a quartz mass, and is frequently associated with a cassiterite-bearing schistic mass, but of independent origin (deMagnee and Andesca 1960).

Tin ores in the form of cassiterite are found in primary strata or in transport products eroded from these strata. Alluvial layers above buried strata may contain small but easily extractable amounts of cassiterite. Buried alluvial layers in valley bottoms also contain the mineral, submerged due to its weight (Gotenegre et al. 1974).

In the central and eastern mineral belt, stanniferous strata are found fractured and crushed, but they contain the greatest share of known reserves. In the west and northwest, the mineral is extracted from richer, but less numerous pockets of pegmatite.

Until the inauguration of the 1976-81 Five Year Plan most mineral resources in Rwanda were exploited on small artisan concessions. Expatriates worked many of these during the colonial era. The techniques of extraction were simple, labor intensive and profitable but were wasteful of extractable ores (Magnée and Andesca 1960). Part-time miners, working to meet subsistence needs, still work many of the claims, but Somirwa, a parastatal company, now dominates the mining industry.

3.1.3 Peat Resources

It is estimated tha Rwanda has 6 billion cubic meters of peat reserves, a promising alternate fuel resource in an era of dwindling petroleum supplies. However, in Rwanda as elsewhere in Africa, studies of peat bogs and marshes are in the preliminary phases. The peat bogs have both agricultural and energy potential. The agricultural potential of peats is discussed in Section 3.2.2.

The Rwandan Peat Project is currently exploring the energy producing potential of peat in the Grand Marais papyrus (*Cyperus papyrus)* swamp. Investigators judge that the tonnage of peat that could be recovered down to two feet is great enough to last Rwanda for many decades if technical problems related to drainage of the cut zones can be resolved (Martin 1979, Gaudet n.d.)

Papyrus peat is of fair quality; its ash content is 5-25 percent. Papyrus peat has many advantages an an energy resource. Unlike

diesel fuel or kerosene, it is a naturally low-sulfur fuel. It contains just 0.23 percent to 0.4 percent sulfur and produces pollutants at a rate very far below fossil fuels of comparable caloric output (Gaudet 1980). Another advantage of peat as a fuel over wood or charcoal, which are commonly used in Rwanda, is that it provides a more uniform and easily controllable heat than these fuels (Gaudet 1980).

Indications from the Burundian Peat Project are that little economic incentive will exist for rural households to substitute peat for wood or detritus as a fuel for the next 5 to 10 years (Gaudet 1980). However, schools, brick producers, bakeries, a planned cement works and other concerns might adopt peat as an alternative to wood because it should cost less per caloric unit than wood or charcoal.

3.1.4 Problems, Planning and Policy

Table 6 shows the slow but steady growth of mineral exports over the past decade. Mineral exports play an important role in the nation's finances and development plans, but there are a number of obstacles to further exploitation. Due to the artisinal nature of the extraction process, mining has not been well planned, and has suffered from irregularities in production. Surface reserves have been exhausted while deeper ores have been ignored. Uncontrolled milling operations have created downstream water pollution (Gotanegre et al. 1974). Long transport routes to overseas ports limit the ability of Rwandese ores to compete on the world market, while market fluctuations have great impact on the Rwanda export/import balance.

Table 6. Estimated Mineral Reserves and Production (metric tons)

	Reserves	Share of World Reserves (%)	1974	1975	1976	1977	1978
Tin Concentrates	20,000	>1	2095	2083	2225	2231	2146
Tungsten	3,000	1	502	589	808	825	708
Beryl	340,000	1	100	?	46	?	70
Columbo-Tantalite	Small	>1	40	?	45	?	49
Gold (kg)	?	?	-	-	35	63	

Sources: Lemarchand. 1977.
Anonymous. 1978b.
U.S. Bureau of Mines. 1976.

The high cost of transporting ore is due to the high cost of petroleum products, which nearly double the cost of the ore en route. Regional political instability has also caused periodic cut-offs of transport routes in the recent past.

Recognizing that a new effort of refinancing, prospecting, and modernization of its mineral and energy extraction process was needed, the government launched a number of new efforts as part of the 1976-81 Five Year Plan. The Bashyamba and Nyahabingo cassiterite and tungsten mines were to be opened or redeveloped, as were the abandoned gold mines in Cyangugu Prefecture.

SOMIRWA (Société des Mines du Rwanda) was to assume leadership in this endeavor , with a budget of 1,086 million Rwandese francs. Forty-one percent of this money was destined for tin smelting; thirty percent was to go to the renewal of production equipment, 12 percent for social programs, 11 percent for research and ore enrichment, and 6 percent for preparatory work on the mines. By the end of 1977 only work on tin smelting had not yet been inaugurated.

In addition to the development of these mineral resources, a cement works at Amashyuza near Cyangugu has been projected to exploit 2 million cubic meters of lime and to employ some of the nation's peat reserves as fuel (Gotanegre et al. 1974). Construction of a canning plant on Lake Kivu near the present brewery (Bralirwa), to take greater advantage of the methane reserves, has been undertaken as well (Lemarchand 1977). In addition, preliminary work on the development of the nation's peat reserves has begun with favorable prospects (3.1.3).

3.2 Soils

3.2.1 Characteristics and Distribution

Eleven major soils regions have been defined in Rwanda (d'Hoore 1960). Each of them may be subdivided into catenas (subgroups) depending upon the proximity of local basement rock, slope, hydrological features, altitude, use, and floristic associations. Soil type boundaries roughly follow the pattern of geological zonation discussed in Section 3.1.1.

In the northwest, extending over the volcano region from Gisenyi to Ruhengeri, are found skeletal lithosols on recent lavas with sizable pockets of eutrophic brown soils derived from volcanic ash. Such soils are sometimes termed andosols. Samples from Kora and Ruhengeri show the presence of large amounts of hydrous aluminum silicates. The soils have these additional characteristics: high natural moisture, low bulk density, high cation exchange capacity, high phosphate sorption, but low P-retention, high potassium content, and if improperly cultivated, a propensity to undergo irreversible drying (Andriesse et al. 1976, Gotanegre et al. 1974).

A narrow zone extending above the Ruzizi Valley south from the Piedmont and almost to the Burundian border on the western slopes of the Zaire-Nile crest is characterized by weakly developed, undifferentiated lithosols. Excessive relief, erosion, and aridity account for their presence. Below and west of this zone, but parallel to it, is a third zone of humid ferrasols. Such soils contain less plant nutrients than the eutrophic brown soils found in the Virunga, but are richer than the ferrilitic soils found elsewhere. They are acidic, and they have a higher exchangeable base content, better structure, higher biological activity and exhibit more developed A-C horizons than do either the lithosols or the ferrisols (Frankhart et al. 1974). In one sample, the amount of organic material present in the soils varied from 64.3 kg per cubic meter to 19.1 kg per cubic meter in primary forest and in extensively cultivated soils respectively (Frankhart et al. 1974). Above 1700 m, the mountain soils have a humiferous surface, weaker structure, and various base saturation levels, which are low under savannah plant communities. The base horizon is massive with low bulk density (Ibid). The ferrasols in this region may be associated with good quality europhic brown soils but the latter are frequently found in locations inaccessible for agriculture.

The fourth soil zone, which extends along the Ruzizi River consists of halomorphic alkaline or saline soils associated with vertisols. These soils are derived primarily from the surrounding slopes whence come their insoluble constituents. The clay fraction consists largely of amorphous gels and the soils are generally low in organic materials, but with a high reserve of weatherable materials. The cation exchange capacity is high. The vertisols, however, have a higher organic component. The halomorphic soils and the vertisols often have poor internal drainage, which, in conjunction with the high rates of potential evapotranspiration in the Ruzizi, favor the accumulation of water-borne salts.

East of the Zaire-Nile spine is a fifth zone of soils. Soils of the undifferentiated humic ferralitic variety, some of which also contain an engimatic dark horizon, extend over an irregular zone which includes Rubona, Kigozi, Kitega, Lubenga in the north In the south they extend along a narrow corridor toward Bujumbura in Burundi. Soils without the dark horizon are found above 1400 m. At the higher elevations the organic reserve remains relatively stable, but on the savannahs the organic matter is frequently incinerated. Soils with a dark horizon are found above 1300 m on very weathered parent material. They are quite infertile. The presence of the dark horizon indicates an increase in the carbon/nitrogen ratio of at least one unit greater than the associated ferrilitic soils.

To the east of Rubona humic ferrasols are found in a sixth soil zone which extends north towards Kigali and south to Ngozi. These soils have characteristics which have already been described. Below and surrounding this small zone is a sprawling area of weakly developed lithosols on plateau slopes. These soils have a low level of profile development, apparently attributable to the parent materials which are high in quartz and quartzites, and to erosion.

A seventh zone extends to the southeast of Kigali almost to Butare and covers the region which lies between Kigali and Nyanza to the east. Undifferentiated yellow and red ferrilitic soils are found here on both quartz and basaltic parent materials, and are associated with fertile vertisols in topographic depressions (Denaeyer and Gerards 1973). Figure 15 illustrates a typical pedological sequence for the region illustrating the topographic zonation of various catenas. Typically, higher ground exhibits red soils, slopes have yellow soils, leached kaolisols are found just above the valleys, and the valleys have brown tropical soils (vertisols) or hydromorphic soils. The red soils exhibit an A-C profile. Ferralitic sequences show A-C or A-D profiles on the upper slopes, and both these two profile types and A-B-C or A-B-D profile development on the lower slopes. Vertisols may have an A-B-C profile (Troupin 1966).

On these soils naturally-occurring forest and wooded savannah can be quite dense. The poverty of the chemical substrates is then somewhat compensated by the mineral reserves of the vegetation and superficial soil layers. The forested soils are generally of better quality than the savannah soils.

A large part of the east central plateau south and east of Nyanza, around Ngozi, Kitega* and Kigali consists of weakly developed lithosols on ferruginous crusts at the highest elevations, below which are humic ferrilitic soils and ferrilitic soils with a dark horizon. The ancient ferruginous crusts, characteristic of Tertiary surfaces in Africa, are the product of erosion under successive climatic regimes. The consensus is that they are in the process of degradation.

The northeastern part of Rwanda beyond Bunia to the lip of the Kagera River Basin comprises a ninth zone in which the soils most closely resemble those of the profile presented in Figure 13. This zone extends all the way south to Burundi. Humic ferrasols are associated with undifferentiated ferrilitic soils on various parent materials. Low rainfall and frequent burnoff negatively affected the soil quality.

Soils in the Kagera National Park and Mutara Hunting Reserve have been quite closely examined. At elevations between 1500 and 1600 m, almost all are humiferous kaolisols with a humus horizon. Vertisols are found in the valleys. Two main catenas

* Located in Burundi

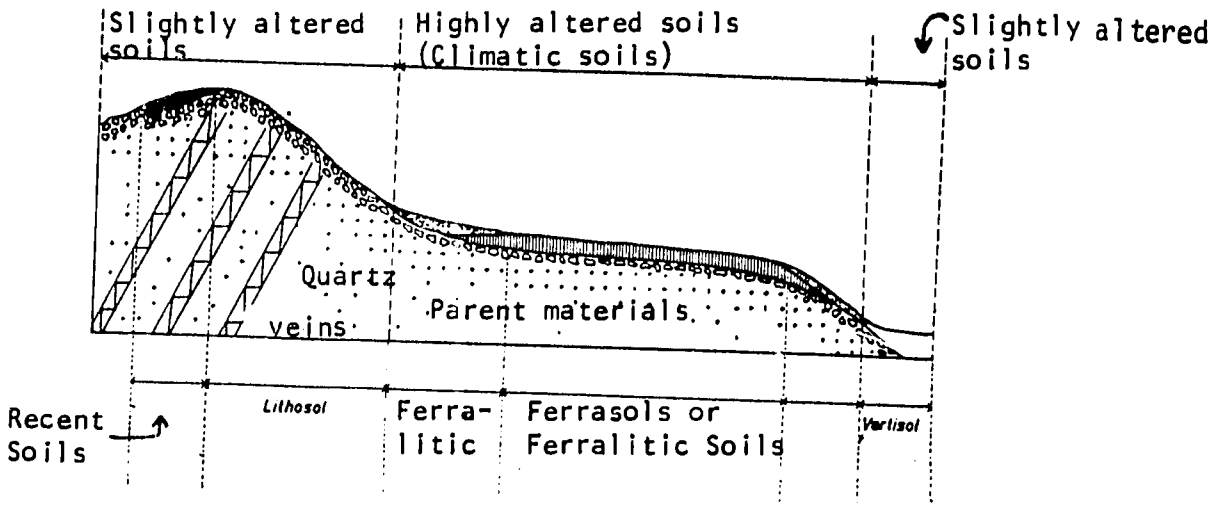


Figure 15. Topographic Sequence of Soils Influenced by Quartz or Quartzite Parent Materials

Source: Troupin. 1966.

have been identified. The homogenous granitic basement rock of the Mutara has produced the Kizirakoma catena. Red ferrisols lie on high ground. These are mineral soils with kaolinite and free oxides making up more than 50 percent of the clay fraction. The zonation of the soils conforms to the profile presented in Figure 13. The second of these major catenas is called the Rukamba and has evolved upon a heterogenous Burundian series substrate in the Mubari-Migongo region from mudstone, schist and phyllites. Ferrasols dominate this succession which is otherwise similar to the profile in Figure 15. These are poor soils with a weak reserve of alterable minerals.

Two minor catenas have also been identified in the Akagera Park region which have developed on doleritic dykes in the granite zone (Mogari catena), and on Quaternary radial faults on the left bank of the middle Akgera River (Kalenge catena). Both have developed in colluvial deposits. Mogari soils are quite fertile (Spinage 1969/1970).

The final soils zone consists of the Akagera River Basin proper. Mineral hydromorphic soils and juvenile lithosols coexist on riverine and lacustrine alluvium. Where hydromorphic soils predominate, seasonal or permanent water-logging is a factor and may produce gleys, i.e., iron-reduced argilous matter, mottled grey in color.

The swamps of Lakes Ihema, Hago, Rwampango and along the Akanyaru River contain peat bogs, the soils of which are extremely high

in organic matter. Their characteristics include high amounts of nitrogen, low pH, low apparent density, high total porosity, but they are poor in micronutrients (magnesium, copper, zinc, maganese and calcium. They tend to be acidic.

3.2.2 Agricultural Suitability

While the agricultural potential of the soils of Rwanda is variable, most soils are of limited potential at the current level of development of agricultural technique and technology. All would benefit from green manuring, and inputs of micronutrients (Sys 1975). Nonetheless, new land continues to be brought under cultivation, commonly with traditional methods (Préfol and Delepierre 1976b).

The eutrophic brown soils are suited for intensive cultivation at higher elevations, and at lower and medium elevations have already been exploited for bananas and coffee. They are suitable for potatoes, sorghum and wheat as well as pyrethrum, especially elevations above 1800 m. The lithosols are not of high agricultural potential but need to be protected from erosion. On slopes of less than 30 percent, *Setaria* hedges are recommended, and on slopes of greater than 30 percent, dikes, ditches and *Setaria* plantings should be undertaken to slow runoff (Gotanegre et al. 1974, Freeman and Fricke 1980).

The humic ferrasols found in the west of Rwanda are of fair agricultural quality when they are derived from basaltic parent materials, and better when derived from quartzes, as around Budaha. They respond well to intensive cropping when green manure, compound sweepings and manure are added. This type of cultivation can increase chemcial nutrients in the soil, and the addition of calcium and magnesium enrich the pH-H_2O-Aluminum complex within them. Even under extensive regimes, bananas and coffee do well on the high convex slopes, while tea flourishes on the concave surfaces and marsh bottoms above 1500 m (Gotanegre et al. 1974).

In the Ruzizi, reclamation of the halomorphic soils, such as on the Bugarama paysannat, must be carefully engineered. The water table must be lowered by installation of underground drainage systems to facilitate percolation and the arable layer desalinized by the application of excess soft water, to judge by experiences elsewhere with such soils (d'Hoore 1964). Irrigated rice and cotton would do well here.

The humic ferrilitic soils of the north central plateau are heavily used for traditional cultigens. The fertility of the

soil depends on the thickness of the epipedon, or surface horizon, and the quality of superficial organic matter. Frequent extensive cropping, the vertical pattern of agricultural zonation and erosion threaten the integrity of these soils. Rice and sugar cane may be profitably grown in some of the valleys and tree crops and tea can be grown at higher elevations. The entire eastern 45 percent of the country shares soils which are variants of those pictured in the profile in Figure 15. They have a limited but relatively untapped agricultural potential. Though heavy and containing occasional calcareous layers, valley vertisols are sometimes suitable for sweet potatoes. Groundnuts could be grown on the intermediary slopes, and coffee could be planted on the higher ground where no cuirasses exist. Irrigation of some kind would increase the agricultural potential, although the hydrological resources may not support year-round systems (Bodeux 1972). In the Bishenyi basin, experiments with irrigation have shown that the soils vary in their water requirements from one to two soakings per month of 5 cm of water on argilous soils, to three to four soakings per month on less argilous soils (Nzamurambaho et al. 1972). For the Bishenyi basin of 4000 hectares, 448,000 cubic meters of water would be required for irrigation which would in turn require some sort of water control on the Bishenyi river.

Cultivation is currently prohibited in the Akagera National Park, but only the rarer ferrisols found there and in the contiguous Mutara Hunting Preserve are favorable for agriculture. They can support both cereals and banana. The dominant ferrasols are poor and best suited for their current use as pasture and forest reserve. The leached kaolisols found on the break between slope and valley are good for plant growth. They are well-drained in contrast to the vertisols which are poorly drained, heavy and calcareous. Chemical analyses suggest that some 50-60 percent of the Akagera Park zone is unsuitable for agriculture.

There is some hope that the hydromorphic soils of the fluvial and lacustrine marshes, i.e., the peat bogs, offer some agricultural promise through reclamation. Peasant farmers have long used the marshes for the dry season cultivation of root crops. Papyrus (*Cyperus papyrus*), which is the major organic constituent of these soils, is known for its nitrogen fixing potential (Moore 1980). However, the hydrology and flora of the Rwanda marshes differs from that in Burundi where reclamation efforts are farther along (Gaudet 1980) so that lessons drawn from Burundi's experience are not directly applicable in Rwanda. The problems encountered in using these soils for agriculture include seasonal waterlogging, acidity, substantial fertilizer needs, high investments in research and technology to drain them, and, once drained, a tendency towards irreversible drying. However, as of

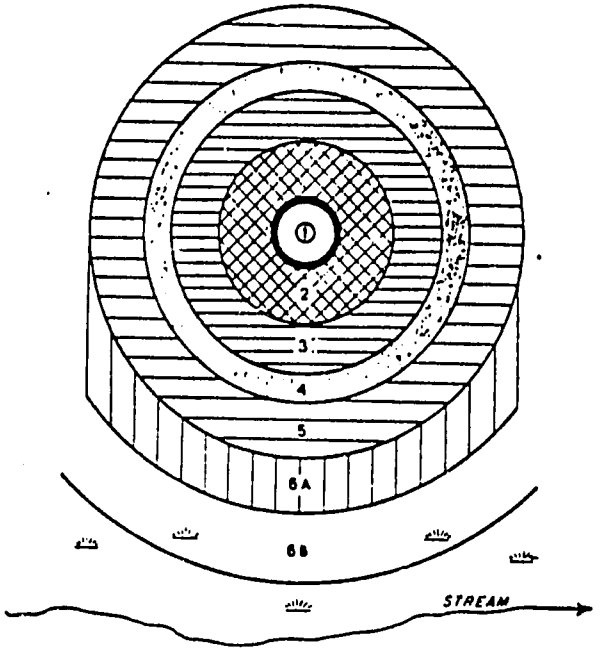
1974 experiments were underway to reclaim substantial acreage along the Nyarabongo River between Lake Mugesera and its confluence with the Akanyaru; 300 ha had already been reclaimed on the Ruzizi plains between Byumba and Ruhengeri Prefectures. Some 1183 ha had also been reclaimed in the region of Gitarama.

3.2.3 Use of Soils

Cultivation (Section 2.3.1) and grazing (Section 2.3.2 and 3.4.2) are the two primary uses of Rwanda's soils. Pastures cover 35 percent of the available land and are concentrated on the undifferentiated ferallitic soils and cuirassed ferasols of the east and central Prefectures. Cultivation covers 65 percent of the arable land. Of this 95 percent is cultivated on small family agricultural enterprises (FAE) employing more or less traditional techniques, and 3.5 percent (1550 square km) is cultivated on the agricultural resettlement projects employing improved techniques (Sylvestre 1974, Gotanegre et al. 1974, Préfol and Delepierre 1975).

A representation of the FAE system of soils management is shown in Figure 16. It is a series of concentric zones, decreasing in intensity of use away and downslope from the central compound (Fig. 17). Immediately surrounding the compound is a banana grove which receives large amounts of organic fertilizer. A decade or so of continuous cultivation can improve the nutrient and moisture content of the ferrilitic or ferralitic soils (Champion 1970, Frankhart et al. 1974). Banana grove soils have been termed "humic anthropoic soils." Outside the banana grove is a two-tiered zone of permanently cultivated "intergraded anthropoic soils," where sorghum, beans and coffee are grown, below 1800 m or peas, maire, wheat, cabbage and tea are grown above 1800 m. Some organic manure is applied but the soils are often deficient in boron and zinc (Sys 1975) and the phosphorous-retention qualities fall below those of the banana plantation. Soils beyond this zone are "weak humic ferosols" or ferisols (Frankhart et al. 1974) which are less intensively worked and may be fallowed. Nutrient content is less than that of soils in the other cultivation zones or of similarly derived soils under permanent savannah or forest regrowth. Iron deficiency is a frequent limiting condition on plant growth in soils which are not fertilized (Sys 1975). On bottom land below 1800 m vertisols are brought into seasonal cultivation of sweet potatoes, sugar cane, manioc and fruit crops. Above 1800 m potatoes, tobacco and Japanese plums may be grown (Gabthauler and Zutter 1979).

This abstract representation of traditional soils managements should be recognized as idealized. The pattern is modified by the presence



1	URUGO –	THE HOMESTEAD
2	URUTOKE –	OCCUPIED BY BANANA
3	IMIRIMA –	INNER FARMLANDS, INTENSIVELY EXPLOITED AND WITHOUT A FALLOW PERIOD
4	INDARE –	COFFEE PLANTATION
5	URWURI –	OUTER FARMLANDS, LESS INTENSIVELY EXPLOITED AND WITH A FALLOW PERIOD
6A	IGIKUKA –	VALLEY CULTIVATED IN THE RAINY SEASON
6B	IMIGENDE –	VALLEY CULTIVATED IN DRY SEASON

Figure 16. Arrangement of Agricultural Land Use in a Typical Rwanda Settlement

Source: Nwafor. 1979

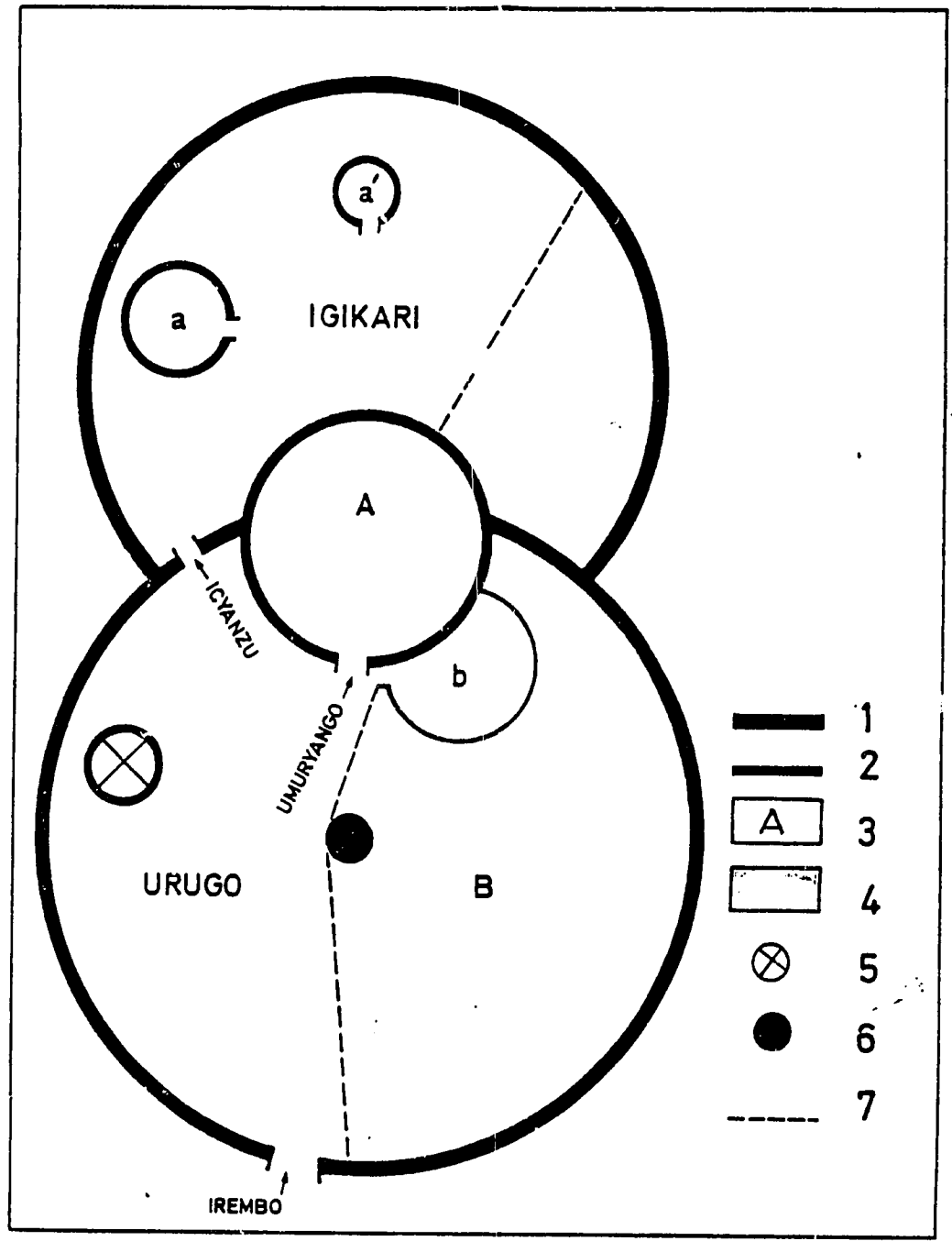


Figure 17. Plan of a Traditional Homestead (Rugo)

1. Living fence of Ficus or Euphorbes creating two courtyards.
2. Walls. 3. Huts: a) children, a') ancestors, A) adults
4. Kitchen garden. 5. Granary. 6. Hearth to drive off flies
7. Palisade. B. Cattle corral. b) Shelter for calves.

Source: Gotanegre et al. 1974.

of large contiguous banana stands on favorable eutrophic brown soils between Lake Kivu and the Zaire- Nile spine in the region of Rusenyi and Budaha for example, or by the occasional monocrop plantations of tea, coffee, quinine and pyrethrum (Gotanegre et al. 1974).

A new pattern of intensive soil use for the production of high yield crops has been designed for the agricultural settlement schemes. In 1972 they involved 33,000 families, but this number has increased since (Sylvestre 1974). Four of these settlements or paysannats have been established on ferrasols and cover 1190 square km: Mayaga, Mirenye, Ntele, and Icyanya. They grow bananas, coffee and food crops. One has been established on 3600 hectares primarily of brown eutrophic soils just southwest of the Virunga National Park to grow pyrethrum and food crops (Spinage 1972). Fifty square km of vertisols and halomorphic soils in Cyangugu are the location of a rice, cotton and food producing paysannat where irrigation is being employed. Two more settlements, Rusomo and Mutara, located on 100 and 150 square km respectively, of poorer ferrasols and ferrisols grow groundnuts, coffee and food crops (Sylvestre 1974).

Icyanya paysannat with several thousand families is typical of the new resettlement zones (Fig. 18). It is divided into self-contained agricultural perimeters such as Masaka (Fig. 19). Each perimeter is divided into a number of "type parcels" of 1.8 to 2.2 ha depending upon soil fertility. Figure 20 shows the pattern of soils use on an individual type parcel. Subsistence crops are supposed to be rotated and grown with the addition of modern technical inputs. However, Sylvestre (1974) reports that the traditional methods of cultivation are employed, and that the recommendations of the extension agents are not regularly followed. Productivity of the poorer and drier soils on which the paysannats are located under the traditional regime is limited. They are highly susceptible to erosion damage. One response of the settlers to the situation in Icyanya has been to bring surrounding marsh lands under extensive cultivation despite the difficulty of working them and despite prohibitions against their cultivation (Sylvestre 1974).

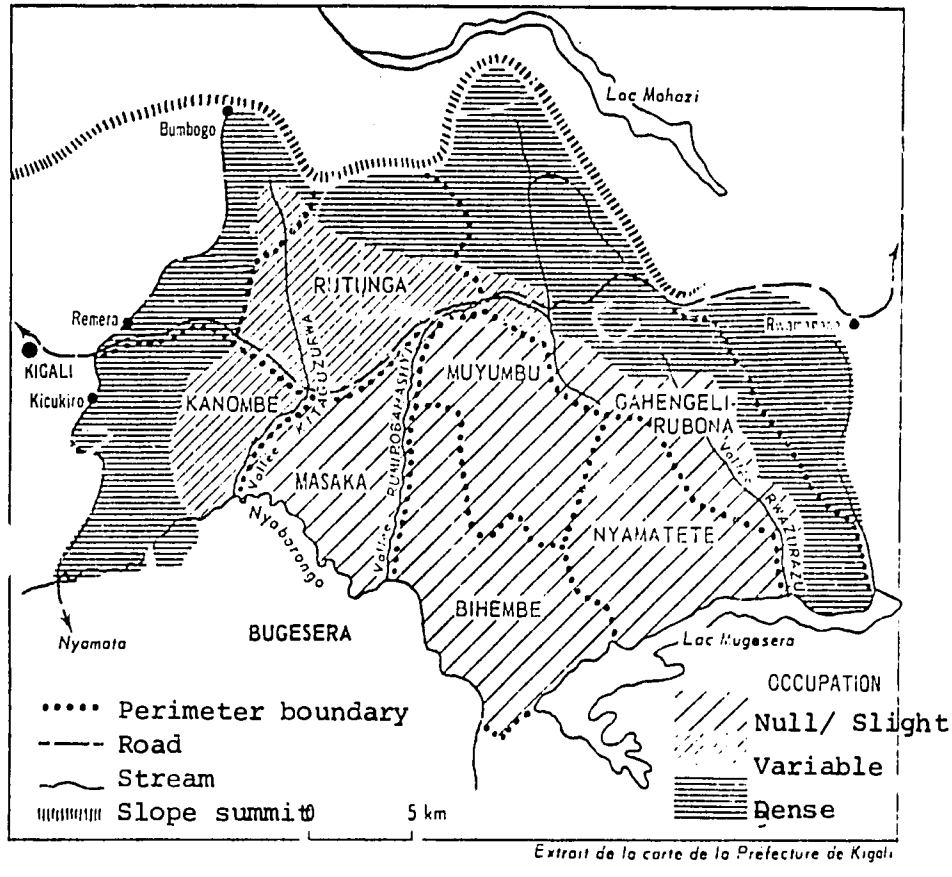


Figure 18. Icyanya Paysannat, Gitarama Prefecture

Source: Sylvestre. 1974.

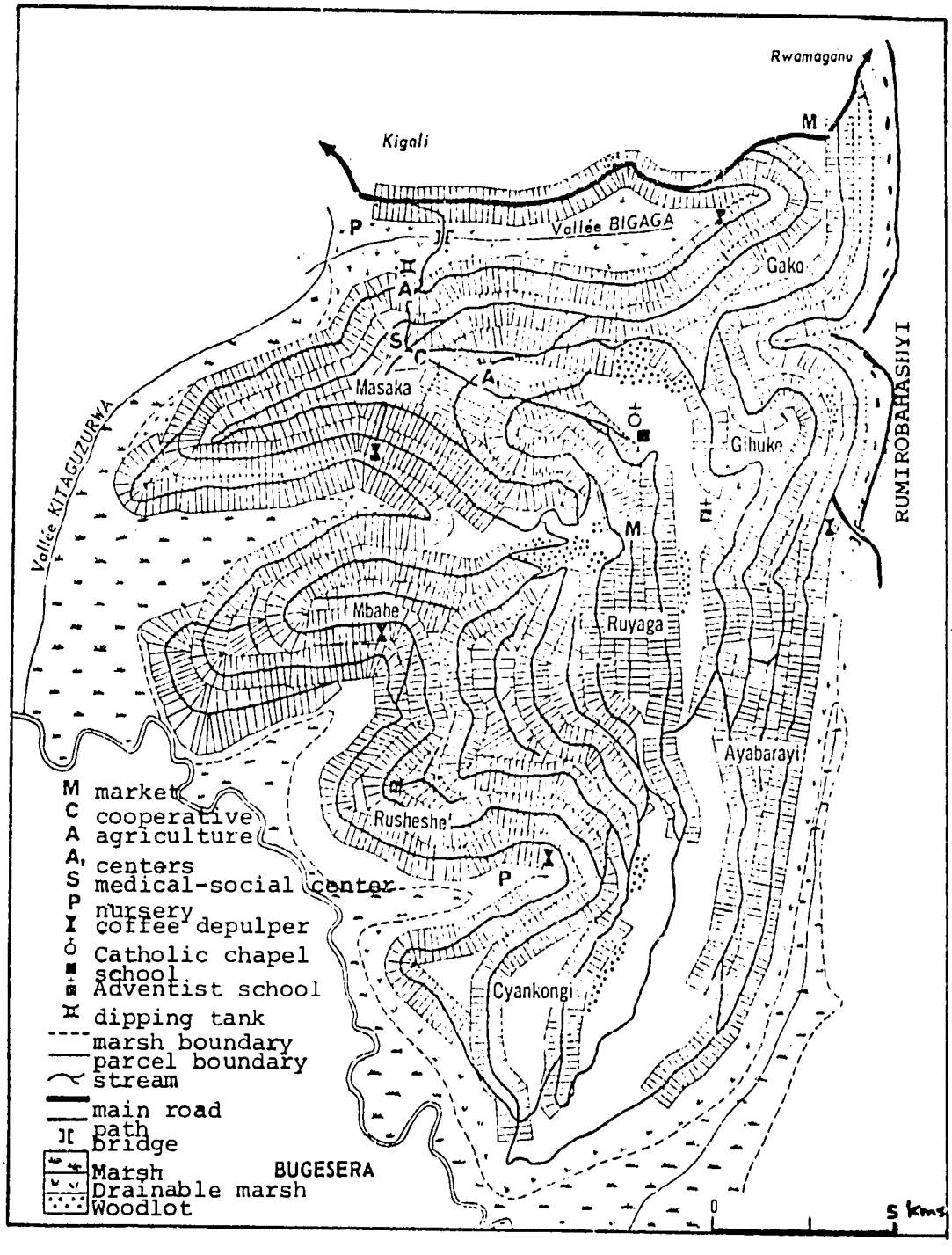


Figure 19. Masaka Perimeter, Icyanya Paysannat

Source: Sylvestre. 1974.

Subsistence Crop Plot

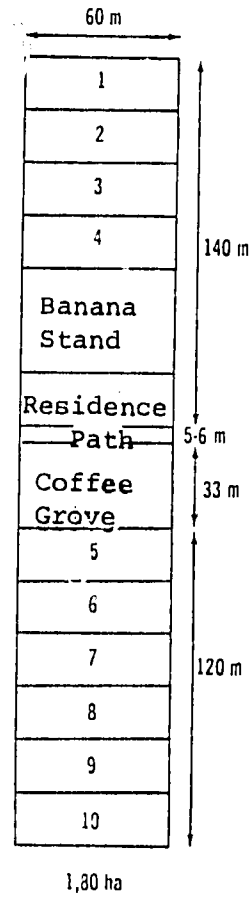


Figure 20. Type Parcel, Icyanya Paysannat

Source: Sylvestre. 1974.

3.3 Water Resources

3.3.1 Groundwater

Information about the groundwater resources of Rwanda is limited, although supplies seem adequate. Most data was compiled during the decade 1952-1962 when some towns were provisioned with piped supplies. UNICEF has begun an ambitious project capping clean springs to extend supplies of potable water to the rural regions (Gourou 1977). Modern wells, of which there are now several hundred, are sunk into two types of saturated layers: quaternary lacustrine or fluviolacustrine formations (sands, gravels and granitic sands), and tertiary volcano layers in metapmorphic rock. Most wells do not seem to be deep.

3.3.2 Surface Water

The rich surface water resources of Rwanda include a number of large lakes (Table 7), particularly Lake Kivu (Fig. 21), three major rivers, about 20 secondary streams, many seasonal watercourses and numerous springs and seeps, some of which have thermal and/or mineral qualities (Fig. 22).

Lake Kivu was formed by ancient tectonic damming of its northern outlet and is the largest body of water in Rwanda. It covers 2370 square km. The maximum depth is almost 500 m in the northern basin. Its volume is estimated at 569 million cubic meters (Degens et al. 1972, Kourzoun et al. 1977). The lake water exhibits exceptionally stable stratification. High zinc and methane gas content prohibits development of aquatic life (Degens et al. 1977). Table 8 provides a partial analysis of the mineral and salts content of its waters.

Lake Visoke is the only large crater lake in the Virunga volcano region. It is drained by subterranean channels. Its waters are soft (5.0 ppm) and slightly acidic. In the Virunga region several high altitude swamps and marshes are also found; one, Kamizanzovu, covers 14 square kms (Spinage 1969/1976).

Recent geological alteration of the Nile drainage system has produced a number of major lakes in the north and east of Rwanda (Spinage 1969). Lakes Bulera (55 sq km) and Luhonda (23 sq km) are located in northern Ruhengeri Prefecture. In the southeast, Lakes Cyohoha (45 sq km) and Ruqwero (100 sq km) form part of the southern border with Burundi. These are part of the Akanyaru River system which also includes the Grand Marais to the west of these lakes, the site of a peat project.

Two shallow finger lakes are found in northern Kibungo and southern Muhazi Prefectures. Four major and three minor lakes

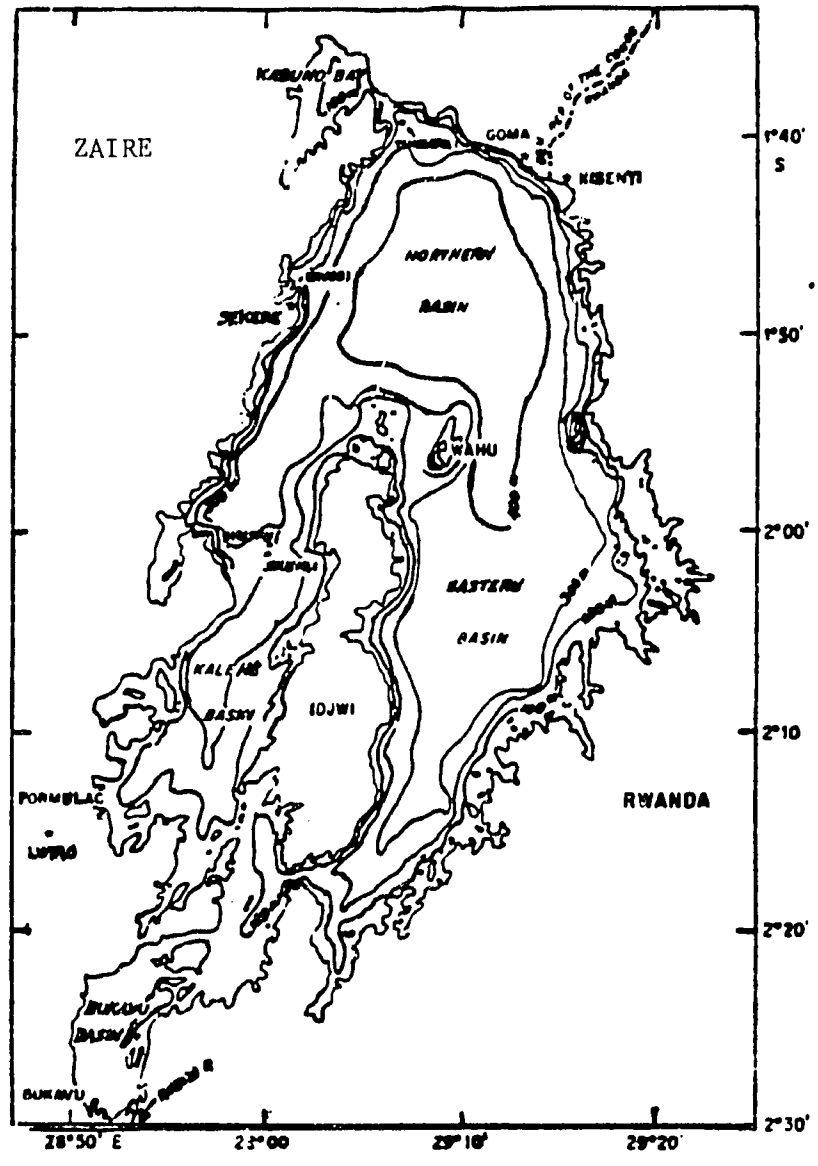


Figure 21. Bathymetry of Lake Kivu, showing the Bukavu, Eastern and Northern Basins. The greatest water depth, almost 500 m, occurs in the central part of the northern Basin.

Source: Degens et al. 1972.

Table 7. Principal Lakes of Rwanda

Name	Approximate Surface Area (square km)	Name	Approximate Surface Area (square km)
Kivu	2370	Cyohoha South	45(18 in Rwandese territory)
Bulera	55		
Mugesera	45	Nasho	18
Ihema	40	Rwamapango	12
Muhazi	29	Mahindi	10
Rwanyakainga	25	Kivumba	9
Luhondo	23	Cyohoha North	9
Hago	20	Rugwero	100(4 in Rwandese territory)
Rwerikama	19		
Sake	18		

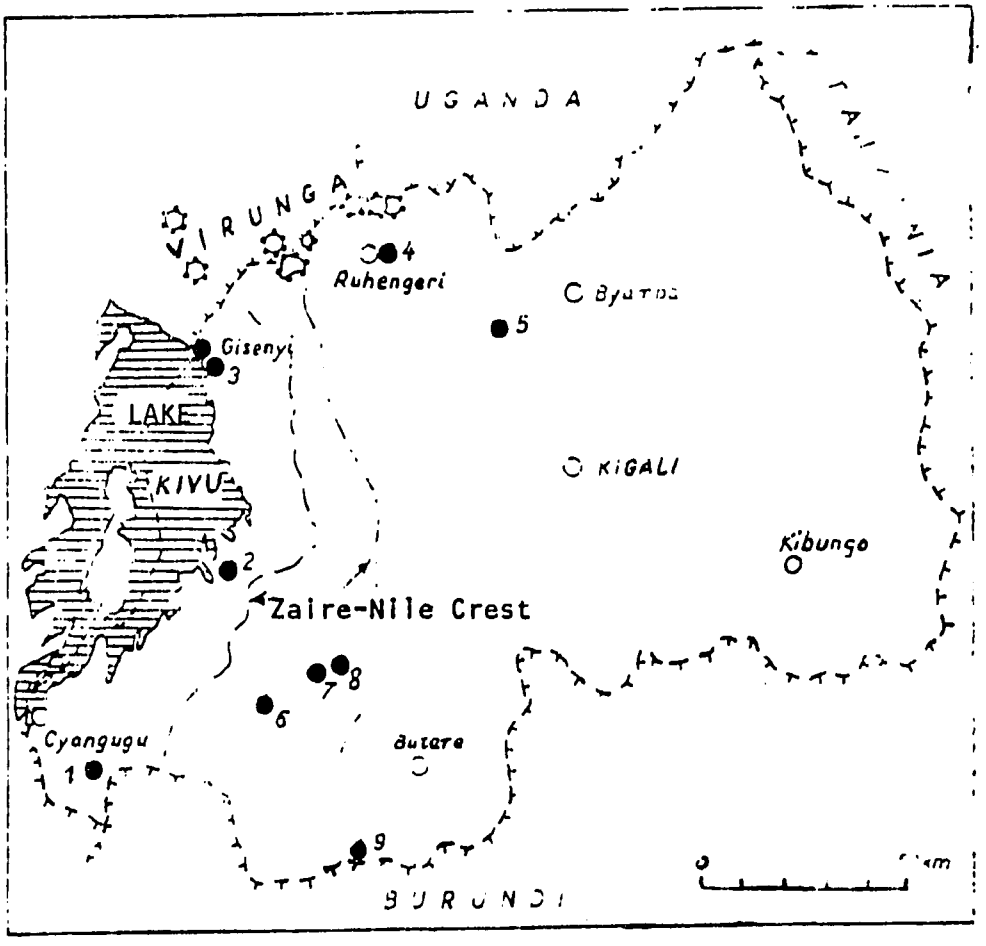


Figure 22. Mineral and Thermal Sources

Key

1. Mashyuye	4. Cyabauatika	7. Munwa
2. Gishyita	5. Giterere	8. Ntaresi
3. Gisenyi	6. Kunyu	9. Akagera

Sources: U.S. Army. 1962. (Table 7)
Bertossa. 1969. (Fig. 22)

Table 8. Water Analyses of Lake Kivu (Northern Basin)

Depth	Ca	Mg	K	Na	Cl	SO_4	ΣCO_2 (m mole/	NH_4	P	Si	NO_3 + NO_2	Temp (°C)	pH
	(mg/l)						kg)	(µgA/l)					
Surface	4.8	87	97.4	121.6	55	23.8	12.5	18	.8	231	1.9	24.3	9.2
100	64.0	147	145.4	192.0	int.**	25.0	29.3	487	18.8	424	.38	22.6	7.1
200	83.1	182	178.8	244.6	int.	166.4	42.0	1314	32.7	428	.27	23.5	6.8*
350	110.9	394	315.2	465.2	int.	214.0	133.0	5460	53.2	1056	.48	25.7	6.6*
440	112.6	417	338.0	487.4	int.	220.0	121.0	7105	54.8	1226	.32	26.2	n.d.***

*Questionable **analytical interference ***not determined

Source: Degens et al. 1972.

are found in the Akagera National Park. All of them are formed by overflows of the Akagera River (Spinage 1969). Fishing is a major activity on the three larger lakes: Rwanyakinga (25 square km), Mahindi (10 square km) and Ihema (40 square kms) (Kiss 1977). Data concerning the ecology and chemistry of these lakes is lacking.

Basic data concerning the major rivers systems in Rwanda has yet to be compiled (van der Leedens 1977). There are three major rivers. The Ruzizi drains Lake Kivu south to Lake Tankanyika in Burundi some 150 kms away. It is fed by the springs in Lake Kivu and rainfall run-off from the Virunga and Zaire-Nile crest. The Ruzizi is a narrow, rapidly flowing stream falling almost 2000 meters in its short course, and is relatively unaffected by seasonal fluctuations in the rainfall regime. The Nyarabongo River, which lies to the east of the Zaire-Nile watershed, is fed by the Susa River flowing from the Virunga Piedmont and the Mukungwe. It ultimately debouches into the Akagera River. Average maximum level of the Nyaranbongo at its confluence with the Mukungwe River is 2 m deep, reached sometime between December and April depending upon rains. The mean low level of the river is 0.4 meters usually reported in August. The difference between the highest and lowest levels is on the order of 80 percent indicating that most of the precipitation which falls within the upstream catchment area flows into the river through runoff. Mean highest flow reported for April is 4,600 cubic meters and mean lowest flow is 1,200 cubic meters reported in September (Spinage 1969/1970).

The Akagera River is the largest of the three river systems and is the largest river flowing into Lake Victoria in Uganda as well. Its catchment area is 59,829 square km of which 19,943 square km are in Rwanda. It receives significant runoff from the Virunga. It is a slow sluggish stream which meanders through papyrus swamps for much of its length. These swamps are a major source of water loss through evapotranspiration. Water loss is

reportedly two to three times the evaporation loss over open water (Kourzoun et al. 1977).

The Kagera in the mid 1970s was flowing well above its pre-1960 levels. There is perhaps a hundred year cycle between maxima and minima (Spinage 1970). Exceptionally small fluctuation in seasonal maximum and minimum levels is attributed to the natural regulating effect of the extensive lakes and swamps. Mean annual runoff reaching the river is less than 50 mm because of the effects of the Virunga Mountain rain shadow on the eastern region of Rwanda (Kourzoun et al. 1977).

Surface water resources are unevenly distributed in Rwanda. Figure 23 indicates that about 1/4 of Rwanda's surface is drained by less than 1/2 km of water course for every square kilometer. This region includes both the Virunga and the Kagera National Parks and parts of the two eastern Prefectures. The central plateau has 1/2 - 3/4 km of watercourse per square km. Although no hydrological data is reported for the secondary streams of this region, data from the Karuzi and Nyabiho Rivers in Burundi is probably comparable. The Karuzi reaches a maximum depth of 2.5 and a minimum of 0.4 m, while the Nyabiho reaches a maximum of 1.75 and a minimum of 0.75 m (Bodeux 1972). The high percentage of rainfall lost through evapotranspiration (83 percent), (only 100-200 mm of runoff reaches them annually) limits the irrigation potential of these streams.

The western third of Rwanda, as well as the area between Kigali, Byumbu and Lake Bulera averages more than 3/4 km of watercourse for every square km. Many of the streams in this region are seasonal, particularly those on the western slope of the Zaire-Nile massif. The seasonality of streams indicates the lack of water-retaining properties of the soil. The inability of the soil to capture runoff is due in part to the cutting of forest vegetation. In the northwest 200-300 mm of precipitation reaches the rivers in the form of runoff except in the Virunga where rivers may receive 300 to 400 mm (Kourzoun et al. 1977).

It should be noted that all of Rwanda lies in a zone of 0-500 mm deficit in river water resources. This figure represents the difference between the amount of precipitation and the amount of rainfall loss through evapotranspiration. This measure is generally accepted as an indicator of natural water supply (Kourzoun et al. 1977). The annual deficit in river water limits the irrigation potential of the secondary streams, however, as Bodeux (1977) suggests, irrigation might be practiced for a brief period both at the beginning and at the end of the dry seasons.

In addition to lacustrine and riverain resources, Rwanda has thousands of springs and seeps in the hill regions. Many of these are tapped for drinking water for people and animals

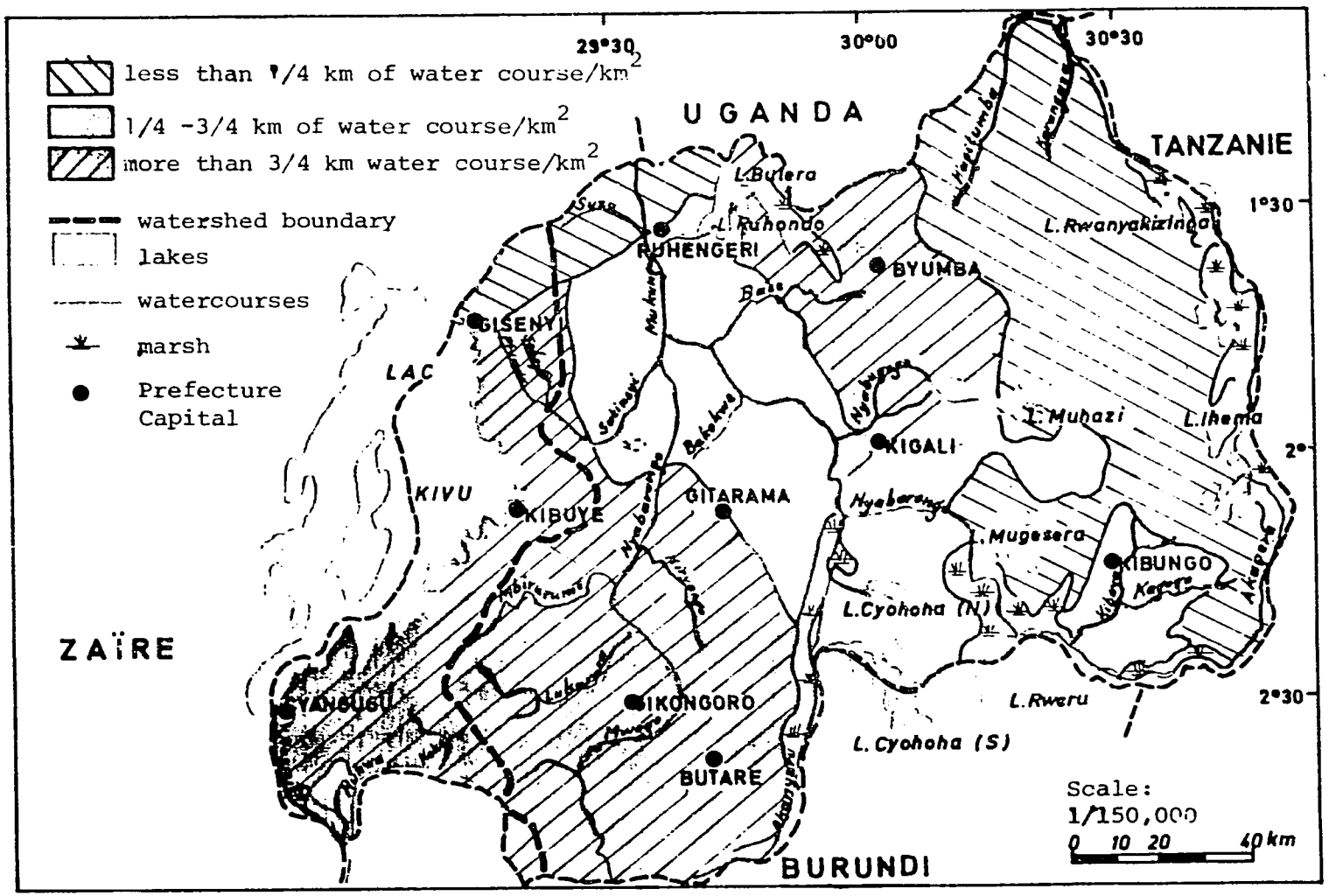


Figure 23. Surface Water in Rwanda

Source: Gotanegre et al. 1974.

(White et al. 1972). Others have thermal and mineral properties. The location of several springs is indicated in Figure 22. Name, geological association, water temperature and relevant chemistry are presented in Table 9. At present these sources are not commercially exploited (Bertossa 1969).

3.3.3 Water Use, Policy and Planning

Use. Both ground and surface water are used primarily for human and animal consumption, and secondarily for transportation, irrigation and industry. The development of irrigation has begun on the Ruzizi plains and in the marshy plains of Mutara, though information is not available about consumption. The danger of salinization of soils from the Ruzizi due to the salt content of the river waters has been noted. The mines and light industries also use some water but again no data is available about consumption. The following indications were available in the mid-1970s concerning demand upon groundwater for consumption of all kinds:

1. In Bugesera, 2 million cubic m per year required, 1 million cubic m in Kajesera for rural consumption, livestock, mines and the tourist park. Surface water is lacking in these zones.

2. Gisenyi and Bungoye each need 5 million cubic m per year. This water is extracted from the lacustrine, fluvatile and alluvial deposits and the Virunga Mountain Piedmont.

3. Kigali and its environs draw at least 10 million cubic m per year for urban and rural consumption, mines industry and livestock. This water is extracted from the Nyabarongo drainage system (Figure 23). Demand upon this system should increase dramatically at current rates of urban growth (8 percent per year).

4. Butare and the central plateau draw at least 10 million cubic m per year. The waters are drawn from marshes without drainage, and from the Akanyaru river basin alluvial deposit (U.N. Secretariat 1973).

These figures estimate annual need at 30 million cubic meters. By the year 2000 this figure will jump to 1460 million cubic meters for drinking, irrigation and industry. An additional 2.2 to 10 million cubic meters will be called on if ambitious large-scale irrigation projects associated with the Rusmo Falls high dam are constructed (UNDP 1978).

Policy. Water law and policy derives from Belgian sources, which are themselves close to French law, and both spring from the

Table 9. Thermal and Mineral Springs in Rwanda

Name	Geological Association	Water Temperature	Chemistry (Milligrams/Liter)
Mashyuye	Ruzizian quartzite and micaschist	60°C	K+ 53.1 Na+ 337.5
Gishyita	Recent granites, metamorphic schist and quartzites, travertine deposits	32°C	HCO_3 439.2 Na + 206.3 SiO_2 83.8 cl 76.6, SO_4^2 75.7, CA^2 + 22.4, K + 13.4, Mg^2 + 3.6, R_2O_3 0.3 NO_3 0.18
Gisenyi	Recent granites, micashists, pegmatites of volcanic origin	73°C	H_2S plus other unanalyzed materials
Cyabarauka	Metamorphic schists, Burundian Kaolinite; travertine deposits	20°C	K+ 168.7, NA+ 159.4 plus carbonic gas
Giterere	Burundian schists, traventine deposits	36°C	Unknown
Kunyu	Pegmatoid granite	22°C	Uncertain magnesium fraction plus carbonic gas
Munwa	Micashist with biotite	20°C	Same as Kunyu
Ntaresi	Staurolite schist	22°C	Same as Kunyu
Akagera	Unknown	Unknown	Same as Kunyu

Source: Bertossa. 1969.

Napoleonic code. In Rwanda, groundwater belongs to the owner of the land, except where such water is subject to legislation concerning mining or the protection of public drinking water. Surface waters are divided into two domains: private appropriation of small pools or streams is recognized, while running water is publicly appropriated. Navigable waters are part of the state domain of public waters.

Provision is made for fishing, navigation and industrial use of water in the statutes. While customary fishing rights are recognized, individual and industrial permits are granted. Fishing is curtailed in protected zones, e.g. the Ruzizi River and in the AKagera Park, and may be halted in areas considered saturated, or where fishing interferes with the potable water supply. Navigation on Lake Kivu and Lake Tanganyika is controlled by several international treaties.

Several items of legislation protect water quality. Water pollution is prohibited; persons are required to prevent the collection of stagnant water in settlements, and the license to discharge polluted effluent is regulated by a revokable ministerial decree.

Tanneries, shoe factories, and coffee processing mills are regulated with regard to water pollution; downstream litigants may be awarded damages and compensation.

A Ministerial decree is required when industrial water use involves machinery of more than 5000 hp, or the rate of water use is more than 25 cubic meters per second.

Enforcement of water quality legislation has not been effectively carried out in rural areas (White et al. 1972).

Several areas of legislation are unclear or incomplete. There are hardly any provisions concerning flood control, although erosion is subject to control under legislation concerning reforestation. Water quality legislation is incomplete as is that concerning groundwater management. In addition, the actual bearer of ministerial authority is left vague in most of the documents, although the Ministries of Natural Resources, Mines and Quarries, Public Health, Public Works, and Planning are all interested parties (Caponera 1976).

Current planning focuses upon the development of hydroelectric resources, fisheries, the energy potential of Lake Kivu, marshes, and possibly large-scale management of the water, power and mineral resources of the AKagera Basin, and development of the navigational potential of the major lakes. A hydroelectric station is located at Mururu on the Ruzizi and one is planned at Mukungwa (Lemarchand 1977). There are other installations at Ntaruka and Gisenyi. A list of key legislation concerning water resources is included in Appendix V.

3.4 Vegetation

Rwanda is divided into two major phytogeographic zones. One is the Sudano-Zambezian zone below 1800 m elevation. The other is the Afro-Alpine zone at elevations between 1800 m and 4500 m. The Sudano-Zambezian zone is sub-divided into secondary grassland mosaics, and East African bushlands. East African bushlands are, in turn, divided into shrub savannah with trees under 4 m tall, and acacia wooded savannah with trees over 4 m tall. The Sudano-Zambezian zone also contains swamp vegetation of several types. The Afro-Alpine phytogeographic zone may be subdivided into an African montane zone above 2000 m and an African submontane zone below 2000 m. Secondary forest mosaics produced by human activity have generally replaced the natural vegetation in the African submontane zone (IUCN 1979, Rattray 1960, Keay 1959, ORTPN n.d.).

The vegetation associations which exemplify the phytogeographic groupings have been described for the Virunga volcano region, the Rugege-Nyungwe forest on the Zaire-Nile summit, and the Akagera National Park in greatest detail (Spinage 1972, Bouxin 1975a, 1976, Troupin and Girardin 1975, Troupin 1966). Recent interest in the agricultural and energy potentials of peat in Rwanda's extensive bogs and swamps has led to detailed studies of the vegetation in them (Norconsult-Electrowatt 1976, Gaudet 1981). Determined collecting in Rwanda under the auspices of the Jardin Botanique de l'État, Brussels, Belgium and published in its Bulletin has resulted in detailed knowledge of the plants present throughout the country. Lists of major species recognized in each zone are contained in Appendix II.

3.4.1 Sudano-Zambezian Zone

Secondary Grassland Mosaics. The grasslands of Rwanda are part of the *Themeda triandra* zone of Africa (Rattray 1960) but locally dominant species vary with forest cover, soil, rainfall, and the degree of overgrazing and dry season burning which occurs (Bouxin 1975b).

About 24 percent of the land surface of Gisenyi, Kibuye, Ruhengeni and Cyangugu Prefectures between 1800 and 2500 m in elevation is covered with pastures Gotanegre et al. 1974). A small percentage of the area is dominated by *Pennisetum clandestinum*, a nutritious species, but the majority lies under *Escotheca abyssinica*, and other grasses such as *Hyparrhenia* spp.

In the central Prefectures of Kigali, Gitarama, Butare and Gikongoro at elevations between 1300 and 1500 m *Brachiaria platynota* and *Hyparrhenia filipendula*, a heliophilic species, are found. Pastures cover about 43 percent of the land area here, but due to overgrazing and soil erosion less nutritious grasses such as *Eragrostis* spp. now dominate in many areas.

The *Brachiaria* spp. are the most nutritious, containing 63 percent protein as a percentage of dry weight and remain nutritious throughout the year. *Hyparrhenia* spp., which contains 3.9-4.4 percent protein of dry weight, become woody and impalatable as they mature.

Byumba and Kibuye Prefectures are thought to hold great promise as future ranch lands; 30,700 ha have already been set aside for this use in the north of Byumba. Over 50 percent of the land is considered suitable for grazing here. There are two complimentary zones of middling quality savannah which could be grazed by cattle and small ruminants if trypansomiasis carried by the tsetse flies *Glossina palipides* and *G. morsitans* could be controlled. One zone is open *Themeda triandra* savannah on the cuirassed hill tops; the other is the low alluvial valleys where *Brachiaria* sp., *Setaria* sp., and *Panicum maximum* grow. *Themeda,* the forage potential of which is best when immature, contains 4.1 percent protein of dry weight. *Panicum maximum* on the other hand, is an excellent year-round fodder plant which contains 6.61 percent protein as a percentage of dry weight (Thornton 1968 vide Nordconsult-Electrowatt 1976).

East African Bushlands. The Acacia wooded grasslands of the eastern pediplain were once more extensive than they are at present. Most plant communities have been profoundly altered by grazing and cultivation. However, relatively pristine vegetation still exists in the northern Mutara (Fig. 24), in the southern Bugerera region between Lakes Mugesera and Rugwero. Studies of this area provide a detailed picture of shrub savannah and acacia wooded grasslands (van den Berghe and Lambrecht 1962, Troupin 1966, Bouxin 1974, 1975a, 1975b, Nordconsult-Electrowatt 1976). Overall, more than 50 percent of the vegetation of the eastern region consists of wooded savannah, over 30 percent consists of bushland and about 11 percent consists of the species-rich community called xerophilic thickets (Bouxin 1975a).

Akagera National Park. A complete study of the Akagera Park vegetation was carried out by Troupin (1966) who identified 823 species (Appendix III) and their pedological proclivities. These species were divided into the following groups:

234 species of large trees, taller than 4 m (28%)
249 species of woody shrubs (30%)
98 species of herbaceous perennials (12%)
161 species of annuals (20%)
57 species of bulbs and corms (0.7%)
16 species of hydrophilic plants (0.2%)

The species list is probably nearly complete for the eastern region as a whole. However, it does not include some of the

swamp and marsh species discussed in section 3.4.4. Flood communities in the Mutara and Bugesera regions will be described in greater detail as examples of the types found. As illustrated in Figure 24, eight plant communities have been isolated in the northeast of Rwanda:

1. Papyrus marsh occupies both banks of the Akagera River in almost pure stands of *Cyperus papyrus*.

2. Gallery forest parallels the papyrus marsh along the Akagera River and is found along the Kakitumba River as well in a narrow band dominated by *Acacia mildbraedii* assoc. with *Phoenix reclinata, Euphorbia dawei* and *Ficus* spp.

3. *Themeda triandra* herbaceous savannah is interspersed with Acacia savannahs. Scattered individuals of *Acacia seyal* var. *multijuga, A. hebecladoides, A. campylacantha, A. sieberiana* are found.

4. *Hyparrhenia lecomtei* herbaceous savannah occupies the rocky flanks of schistic slopes and grows in relatively pure stands.

5. Wooded *Combretum eleagnifolium* savannah separates association 3 and 4 and is found at the transition between schistic slopes and alluvial terrain. *Acacia hebecladoides* and *A. campylacantha* are found with occasional *Dombeya madiensis* and *Gardenia jovis-tonantis*.

6. Acacia savannah is made up of various species frequently joining dense stands. *A. seyal* often provides an understory and in order of abundance, the following are present: *A. seyal* var. *multijuga, A. hebecladoides, A. campylacantha, A. senegal, A. sieberiana*.

7. Tropophillic thickets are found at the heads of valleys cutting the hillsides and in some deep ravines, and are composed of numerous species. Typical species include: *Grewia bicolor, Dombeya quinqueseta, Combretum eleagnifolium, Bridelia scleroneura, Securidaca longepedunculata, Albizia adiantifolium, Ficus* spp. *Protea madiensis, Pterolobium exosus, Teclea nobilis, Allophyllus* spp., *Maytenus* spp., and *Euphorbia dawei*.

8. Xerophilic thickets. Curiously thick vegetation due apparently to edaphic conditions and characterized by *Grewia* spp., *Rhus* spp. various epiphytes and aloes (van den Berghe et al. 1956).

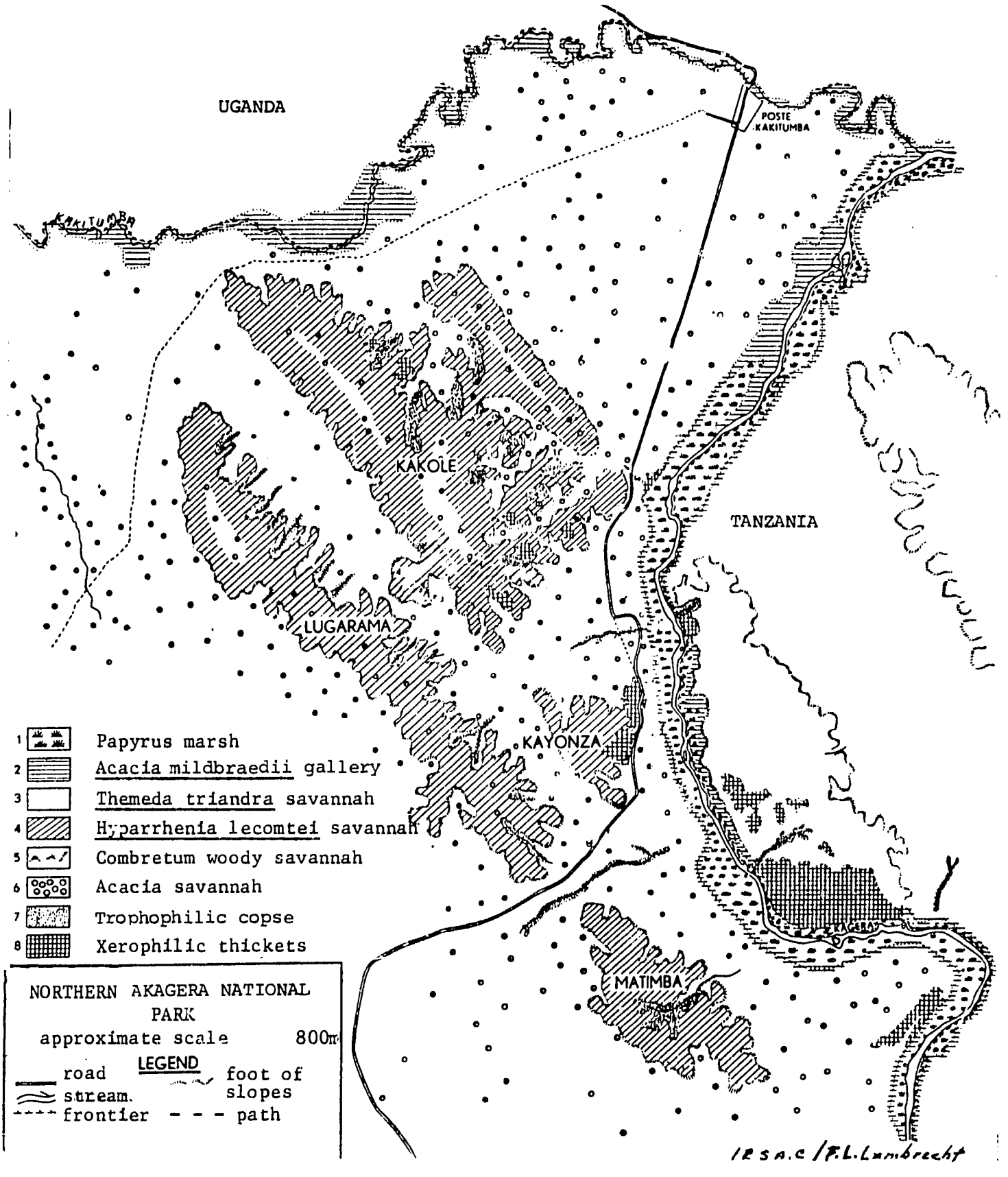


Figure 24. Plant Communities of Akagera National Park

Source: van den Berghe et al. 1956.

Other Shrub Savannah Associations. A slightly different set of communities is found in the Kagitumba Valley northwest of the Akagera Park. This area is suitable for irrigated agriculture because it is underlain by alluvial rather than mineral soils. Gallery Forest of *Phoenix reclinata, Sapium ellipticum, Triumfetta macrophylla, Acanthus arboreus* and *Afromonum sanguineus* is found in the upper reaches of the valley. There are also *Acacia sieberiana* forests with a *Themeda triandra* understory and small *Imperata cylindrica* swamps (Nordconsult - Electrowatt 1976).

Vegetation of the Bugesera region between lakes Mugesera and Rugwero, southwest of the Akagera Park is comprised of herbaceous and wooded savannahs and xerophilic thickets of the east African bushlands series (van den Berghe and Lambrecht 1962). Scattered specimens of *Gardenia jovis-tonantis* and *Ficus rupicola* occur.

The herbaceous community is differentiated between communities growing on dry vertisols and lithosols. *Bothriochloa insculpta* and *Themeda triandra* grasses dominate on the former. Both of these are of moderate protein value, but are unpalatable when mature. *Loudetia simplex* and *Heteropogon contortus* occurs on the latter; *Loudetia* has low nutrition value.

In an area south and southwest of Karama, *Loudetia simplex* and *Themeda triandra* are found as well as *Hyparrhenia* spp., *Cyperus submacropus, C. leptophylla,* and *Cymbopogon afronardus*. The latter is of moderate nutritional value (5.1 percent protein by dry weight) but is only palatable when very young (Nordconsult-Electrowatt 1976). Due to the lack of easily available water and low nutritional value of the dominant grasses, this area has been recommended for grazing by wild ungulates of the browsing species.

Van den Berghe and Lambrecht (1962) identified six types of bush savannah and five types of wooded savannah in the Bugesera region the latter containing trees over 4 meters tall. *Acacia gerrardii, A. hockii* and *Theeria insignia* are the commonest lignaceous species. A complete list of the associations they identified is contained in Appendix II).

A wooded hilltop near Rwizaka in the Bugesera region had *Ficus rupicola , Euphorbia candelabrum, Teclea nobilis* and *Securidaca virosa* overgrown by *Cissus* spp. On the lower slopes were found *Sporobolus pyramidalis* and *H. filipendula*. Just above the low swamp occur *Brachiaria* spp., *Panicum maximum,* usually found with *Acacia Siberiana* and *A. polycantha* subsp. *campylacantha* in this area, and *Kyllinga aurata* (Nordconsult-Electrowatt 1976). These associations were not noted by van den Berghe and Lambrecht (1962) in this study in the Bugesera region.

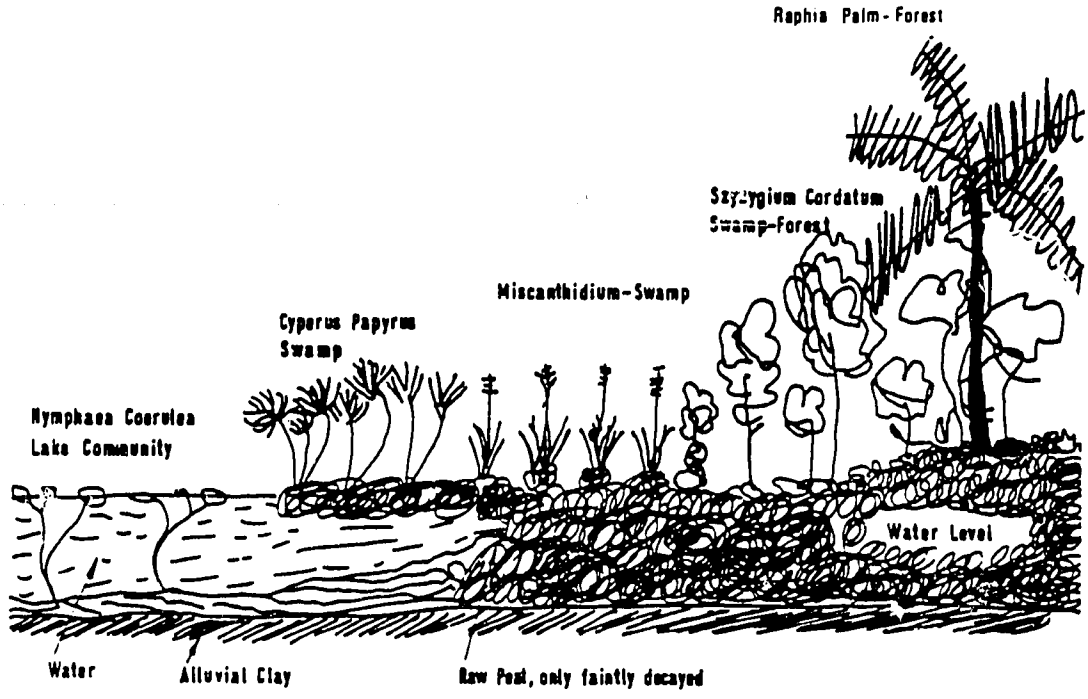
3.4.2 Swamp Vegetation

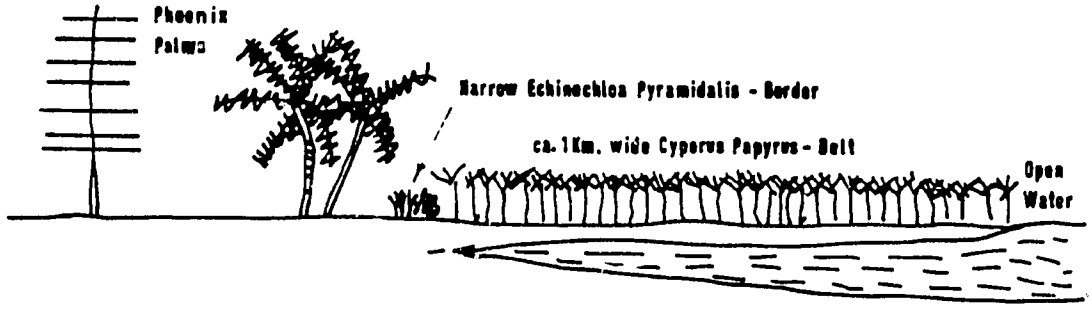
Extensive areas of Rwanda, about 48,000 ha, are covered by swamp and bog vegetation. Swamps contain less than 60 percent organic matter, bogs more than 60 percent (Gotanegre et al. 1974). Extensive reconnaissance has been made in the low altitude swamps of the Akagera National Park, in the Bugesera region around Busoro, and in the Grand Marais near the confluence of the Nyarabongo and Akagera Rivers (Norconsult-Electrowatt 1976, Gaudet 1981). Less detailed studies have been made elsewhere. Typical swamp vegetation associations in Rwanda are shown in examples from the Akagera Park in Figures 25a and 25 b.

Cyperus papyrus swamp is the most common type in Akagera Park, occurring in large stands along the river and in the lakes. In addition to papyrus, Rwandese swamps also contain stands of *Miscanthidium violaceum* and *Loudetia phragmatoides* on peaty soils. These plants are of little economic value. A large swamp along the Rugegi River in northern Rwanda contains both this association and stands of *Cyperus latifolius*. The swamps of the *C. latifolius* type is easily reclaimable for agriculture (Nordconsult-Electrowatt 1976).

In the accumulated drier sediments of *Miscanthidium* vegetation in the Akagera Park are stands of *Syzygium cordatum*, which is used as firewood; on still drier ground is found rarer *Raphia* palm forest which is valuable for firewood. *Raphia* also functions as a regulator of water level, and is a source of fiber for weaving. It is especially abundant in the Businia Forest. Associated species include *Afromonum* spp., *Pennisetum purpureum*, a nutritious grass, *Setaria chevalieri*, *Panicum* spp., and others. Other swamp associations of limited areas in the Akagera Park include: *Cyperus latifolius* and *Lipocarpha fuirenia* swamp edge vegetation and *Echinochloa pyramidalis* grasses found in wet swamps. The *Lipocarpha chinensis - Fuirenia stricta* community is species rich, and the grasses have an appreciable nutrient content. Associated species include *Laurembergia tetrandra, Ascolepis capensis, Eriocaulon gigantea* and *Eriochrysis brachypogon*. The *Echinochloa* swamp typical in the Nyamat area also contains *Dissotis macrocarpa* and climbers like *Aissampelos mucconatus* and *Ipomoea* spp.

In addition to the permanent swamps vegetation, there is also lake vegetation and vegetation of seasonal swamps throughout the eastern plains. Lake vegetation in the Akagera park is dominated by *Nymphaea coerulea*, and *Potamogeton richardii*.

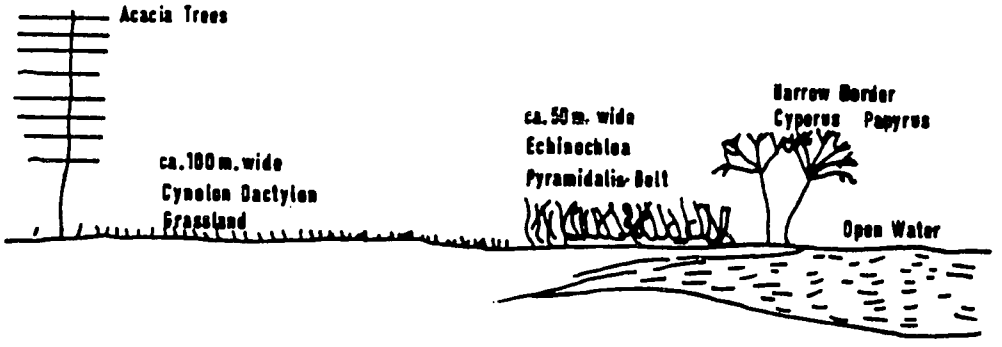




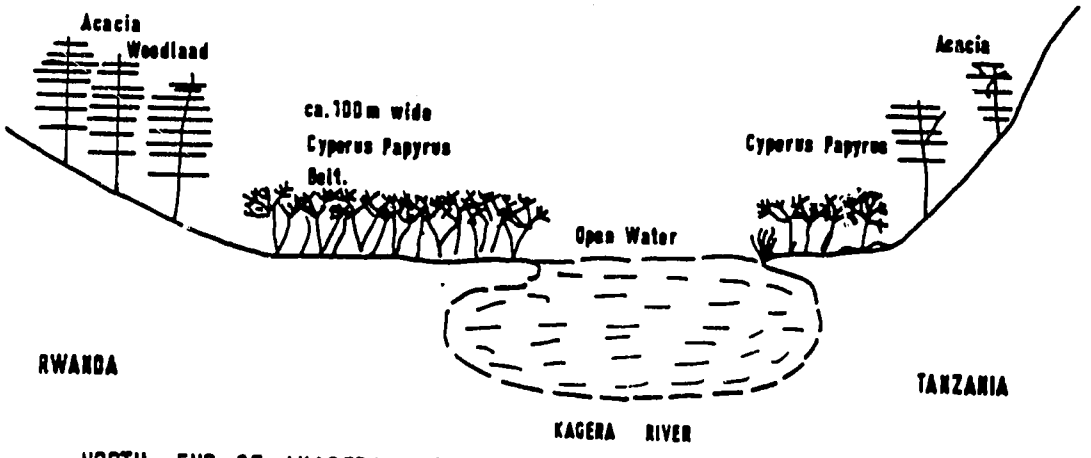
WEST BANK OF LAKE IHEMA

Figure 25a. Typical Swamp Floral Associations in Akagera National Park

Source: Nordconsult-Electrowatt. 1976.



WEST BANK OF LAKE HAGO



NORTH END OF AKAGERA NATIONAL PARK

Figure 25b. Typical Swamp Floral Associations in Akagera National Park

Source: Nordconsult-Electrowatt. 1976.

In a typical seasonal swamp of the wetter variety found in the Kanoboba Valley in the Akagera Park, *Mimosa nigra* and *Sesbania sesban* occur. The seasonal swamps of valley bottoms and river banks are important to local wildlife, but also serve as a breeding and feeding area for the *Tsetie* flies (van den Berghe and Lambrecht 1962). Wet hollows support *Hygrophilia auriculata* and *Cyperus articulatus* with *Cyperus* spp.

Bugesera Swamps. Some swampy areas in the Bugesera contain *Polygonum pulchrum* and *Cyperus auricomus*. This association is an indication of reclaimable soils. Drier seasonal swamps which are frequently brought into cultivation contain *Hyparrhenia filipendula, Sporobolus pyramidalis,* and *Themeda triandra*. Such dry swamps are an important agricultural resource in the Bugesera where low rainfall and extensive unreclaimable swamps place a premium upon cultivable land (Nordconsult-Electrowatt 1976).

In the more mountainous terrain of western Rwanda swamps and bogs are also found. Swamps typically support *Typha australis, Phragmites mauritanus, Cyperus papyrus, Phoenix reclinata* and *Syzygium cordata*. The medium altitude peat bogs, such as Kamiranzovu at 1970 m in the Gugege-Nyungwe Forest, contain *Cyperus papyrus, Cladium jamaicense, Miscanthidium violaceum, Syzygium cordatum* and *Myrica kandteana*. High altitude bogs contain *Cyperus denotatus, Xyris* spp. *Sphagnum* spp. *Erica rugegensis,* a tree fern, and *Syzygium cordatum* (IUCN 1979).

Diversity of opinion clouds the issue of the economic utility of *Cyperus papyrus* which crowds the rivers and lakes of Rwanda, and has created numerous peat bogs. It can be used to make paper and paper board, and as fertilizer. The peat is a good soil conditioner, source of biomass, and an excellent low BTU fuel source in the form of briquettes (UNDP 1978, Moore 1980, Gaudet 1980). A small paper mill turns out 200 tons of papyrus paper a year (Gotanegre et al. 1974). The Rwanda Peat Project has begun to produce peat for fuel. Reserves of peat could last well into the next century (Gaudet 1980). Problems with the use of papyrus include the dispersion of stands suitable for large scale paper production, and lack of modern paper production technologies for papyrus and the narrow cost advantage of papyrus relative to other papers. A problem associated with the use of papyrus peat for fuel is the lack of economic incentive for most households to switch from wood to peat (Gaudet 1980).

3.4.3 Afro-Alpine Vegetation

Major studies of alpine montane vegetation have been conducted in the Volcano National Park (Spinage 1969/70, 1972,)

and in the Rugege-Nyungwe forest in the south of Rwanda (Bouxin 1976).

Volcano National Park. The Volcano National Park covers 23,000 ha between 1800 and 4500 m elevation. As shown in Figure 26, sixteen percent of the park (roughly 4500 ha) consists of moist montane forest, dominated by *Pygmeum africanum* at elevations between 1800 and 2300 m, although the altitudinal limits of this, and other zones vary from peak to peak. Dense shrubbery, lianas, and epiphytes are found. Outside the forest boundaries, *Pygmeum* has been replaced by *Pteridium equilinum* and high altitude praries of *Pennisetum clandestinum* (ORTPN 1976).

Twenty-five to thirty-five percent of the park (6000 to 8200 ha) at elevations between 2300 and 3000 m is dominated by tall mountain bamboo *(Arundinaria alpina)* with *Erica arborea* (Fig. 27). Where the soils are shallow as on Muhavara volcano, *Myrica arborea* replaces *A. alpina*. *Hyparrhenia mobukensis* is a common grass, found particularly on Muhavura.

Another 20 to 30 percent of the area (4600 to 7000 ha) between 2300 and 3200 m in elevation comprises the *Hagenia* zone, dominated by *H. abyssinica*, a large tree 10-12 m tall. Here open forest alternates with grassy waterlogged clearings in which *Agrostis mildbraedii* is dominant.

Seventeen percent of the park (about 4200 ha) at an elevation of 3000 to 3700 m is in the sub-alpine zone. *Hypericum lanceolatum* occurs here in stunted form only. *Erica arborea* and *Philippia johnstonii* are characteristic. Giant lobelias and senecios such as *Lobelia wollastonii* and *Senecio erica-rosenii*, respectively, predominate on the acidic soils. Mosses such as *Braunia secunda* and epiphytes cover the shrubs. Swamps here are characterized by the presence of *Sphagnum planifolium*, a source of peat, the grass *Carex runssorensis* and *Alchemilla* spp.

Just 1900 ha or 6.8 percent of the area is in the alpine zone proper (Fig. 27). Here it ranges in elevation between 3600 m and 4500 m where most plant life ends. This zone is species poor and is characterized by *L. wollastonii, Senecio alticola* and *S. adnivalis*. Above 4200 m, *Alchemilla cryptantha*, and *A. johnstonii* predominate. In the swamps *Carex runssorensis, Luzula abyssinica* and *L. johnstonii occur* (Spinage 1972, ORTPN n.d.)

Rugege-Nyungwe Forest. In southwestern Rwanda, between 1500 and 3000 m in elevation, the vast (100,000 ha) Rugege-Nyungwe Forest is found. Along with the Virungo Park Forest, it is the principle climatological regulator in Rwanda, and contains the sources of the Nyarabongo and Akanyaru Rivers which flow into the Akagera.

The western zone of the forest, which extends south to the frontier with Burundi, lies between 1800 and 1900 m and is the latest disturbed by human activity. There *Podocarpus* spp. was once common, but has now been almost completely cut out.

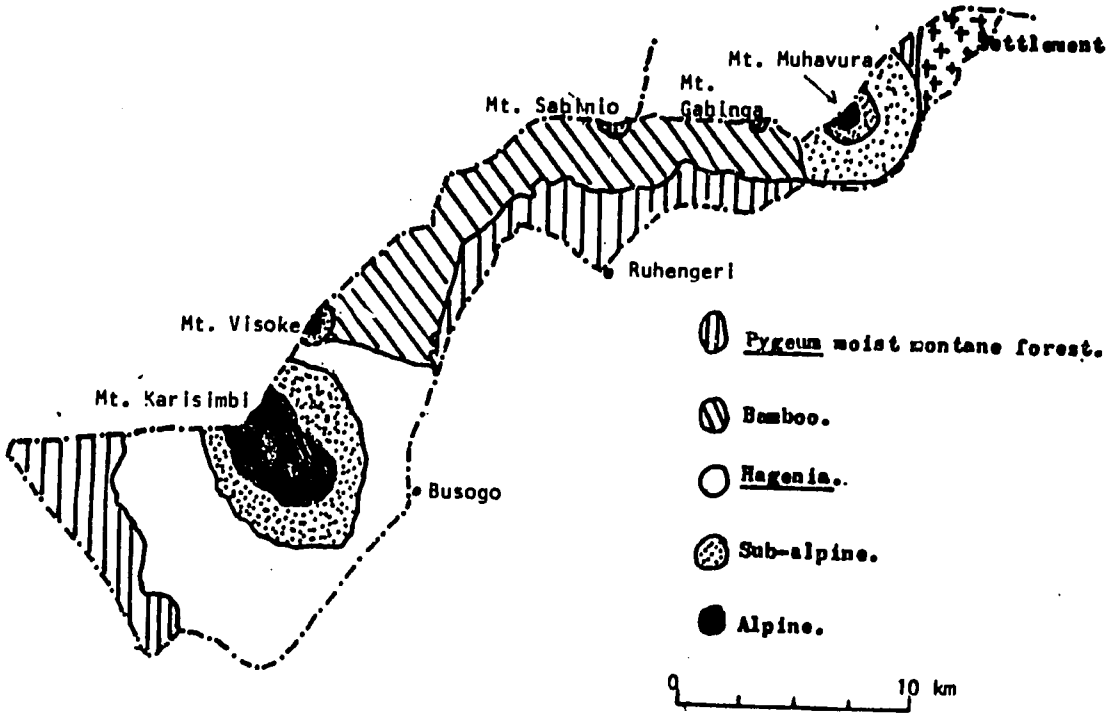


Figure 26. Vegetation Zones in the Virunga Mountain Park

Source: Spinage. 1969/1970.

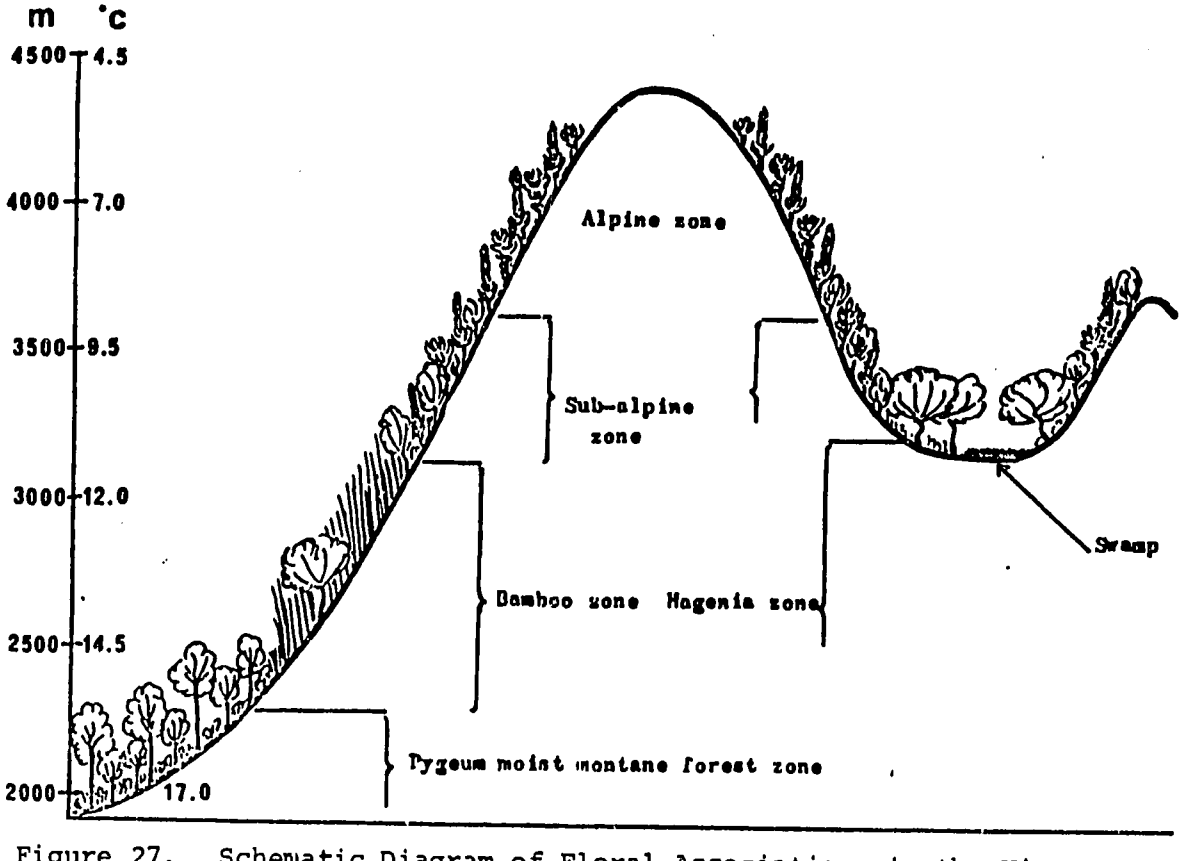


Figure 27. Schematic Diagram of Floral Associations in the Virunga Mountain Park.

Source: Spinage. 1969/1970.

Pantadesma reydersii, a tree unique to Rwanda, also grows here. *Entandrophragma excelsum* and *Ekebergia capensis* are among the rare and endangered species found.

In a detailed study at 1950 m in the western part of the forest, Bouxin (1976) isolated four vegetation associations.

The first grouping occurs on flat ground with standing water under the uppermost soil horizon, and has a tree density of 38 square m per ha. It is characterized by *Syzygium staudtii* and *Mamecylon beguesertii*.

A second grouping in standing water on level ground and characterized by a tree density of 19 square m per ha was dominated by *Asplenium friesioriens* and *Anthocleista grandiflora* at the most humid sites.

The third association was found on level ground with intermediate hydromorphy and tree densities of 47 square m per ha. *Syzygium staudtii* and *Balthaseria schiebrenii* var. *intermedia* predominates.

A fourth grouping was isolated on valley slopes of 17 percent without surface water and a light tree density of just 3 square m per ha. *Neubototonia macrocalyx* and *Sericortachys tomentosa* predominate.

The second zone of the forest lies on the eastern flank of the Zaire-Nile crest in Gikongo Prefecture. It is dominated by secondary species on poor soils such as *Polyscias fulva, Neobotonia macrocalyx, Dombeya goetzonii, Hagenia abyssinica,* etc. This part of the forest has been most affected by opportunistic cutting practices and there are expanses of open bush and grass (ORTPN 1976).

The value of these two Afro-Alpine vegetation zones as sources of wood is patent. The habitat they provide for rare fauna is an equally important function. Perhaps the greatest importance of the forests is their rainfall catchment function. The Virunga Mountains along account for 10.6 percent of the nation's effective catchment zone, but 35 square km of the high altitude vegetation cover has been cut back in the Virunga region since 1968 (Harcourt and Curry-Lindahl 1978). Further losses could have an extremely deleterious effect upon rainfall catchment and infiltration and increase flooding and erosion downstream (Spinage 1972).

3.5 Fauna and Conservation

3.5.1 Mammals

Most of the native terrestrial fauna is concentrated in

Akagera National Park, Virunga Volcano National Park, and in the Rugege-Nyungwe Forest, where it is either protected or isolated from human activities. Species are typical of East Africa. Close to thirty ungulates are found, including elephants, black rhinoceros, and hippopatamus, as well as numerous antelopes such as impala, Cape eland and Bushbuck. Four felid genera are represented as well as six primate species. Lists of the major species recognized are included in Appendix IV.

Final removal of all human occupants from the Akagera Park in 1969 was beneficial to many ungulates.

As illustrated by Table 8, population densities for most species except water buck (*Kobus defassa ugandae)* have increased (Nordconsult-Electrowatt 1976). Some endangered species have been reintroduced. An endangered population of elephants (*Loxodonta africana)* was successfully moved from the Bugesera region to the park in the mid-1970s (ORTPN 1976). Black rhinoceros *(Diceros bicornis)*, threatened by range reduction elsewhere (IUCN 1972), have also been reintroduced to the park.

Table 8. Density and Biomass in Savannas and Open Forest Environments in the Akagera Valley between Lake Mihindi and Githinga (area Surveyed - 4.2 km^2)

	Density (n/km^2)		
	1959/63	1969/70	1974
Zebra	2.1	18.5	4.2
Buffalo	1.4	1.4	2.6
Topi	1.6	7.9	3.8
Impala	20.2	114.3	281.6
Waterbuck	2.0	2.0	3.0
Warthog	0.9	?	5.3
	28.1	144.1	302.5
	Biomass (kg/km^2)		
Zebra	504	4440	1008
Buffalo	672	672	1248
Topi	192	948	696
Impala	808	4572	11264
Waterbuck	320	320	480
Warthog	45	?	265
	2541	10952	14961

Source: Nordconsult-Electrowatt. 1976.

Ungulate populations in the Akagera Park are most threatened by changes in vegetation due to frequent burning of the savannahs and to possible flooding from hydroelectric installations. Pastures suitable for migratory grazers like topi (*Damascus korrigum*), roan antelope *(Hippotragus equinus)*, and Cape Eland *(Taurotragus oryx)* have been reduced in favor of pasture preferred by mixed feeders like duikers and bushbuck (*Tragelaphus scriptus)* (Spinage 1969/70, Nordconsult-Electrowatt 1976). Flooding from damming of the Akagera and its tributaries could be beneficial to hippopotamus populations by increasing its habitat but would have negative effects on other ungulates. Poaching, and the encroachment of human settlement upon natural preserves are the most serious threats to the primates and felines. In contrast to the ungulates, the prospects of survival for the mountain gorilla *(Gorilla gorilla berengei)*, the rarest of the 3 subspecies of gorillas are guarded. It only occurs in the Virunga mountains where its numbers have been reduced from 600 to 150 individuals over the past 25 years (IUCN 1972, Spinage 1972, Harcourt and Curry Lindahl 1978). The chimpanzee *(Pan trogloydytes schweinfurthii)* and the leopard *(Pantherus panthera)* which occur in the Virunga and Akagera Parks, as well as in the Nyungwe forest, are also in danger (IUCN 1972). The African wild dog *(Hycaon pictus)* whose numbers have apparently been much reduced by canine distemper rather than by human intervention, completes the list of endangered terrestrial fauna in Rwanda listed by the International Union for Conservation of Nature and Natural Resources (IUCN). Small mammals, such as the "lava rat", and local races of non-endangered species such as *Cercopithecus magistratus* are also at risk in the shrinking protected reserves in Rwanda (ORTPM 1976).

3.5.2 Avifauna

Data concerning the avifauna of Rwanda have been summarized by Schouteden (1966). Kunkel and Kunkel (1969, 1970) and Prigogine (1972) provide supplementary information. Over 500 species have been found in the Akagera basin, 170 in the Nyungwe-Rugege forest and 99 in the Virunga mountains. For the most part the avifauna in these areas resembles that in similar biotopes in neighboring East African countries. However, the "bec-en-sabot" swan *(Balanenicaps rex)* is rare except in the swamps of the Akagera Park. In the Virungas, the most impressive species are the irridescently-plumed mountain touraco *(Ruwenzornis johnstonii)* and the francolin *(Francolinus nobilis)* (ORTPN 1976).

Populations of ibis on open lakes have been reduced by changes in water level, while forest clearance has favored granivorous species at the expense of frugivorous and tree and

shrub dwelling species (Curry-Lindahl 1974, Kunkel and Kunkel 1970). Further destruction of habitats by forest clearing and dam construction is sure to have a negative influence on bird populations in Rwanda.

3.5.3 Ichthyofauna and Fisheries

The inventory of Rwanda's freshwater fish is far from complete. Some 22 species have been reported from Lake Ihema (Appendix IV) in the Akagera Park, but a few other species are probably present (Kiss 1977). Eight of these 22 species are reported from Lakes Rugwaro and Mugesera (Marlier et al 1960, vide Kiss 1977). Individual species have been reported in half a dozen other lakes and rivers in the country. Four species of the genus *Tilapia*, cichlid, are the most common fish found in Lake Ihema, representing over 60 percent of the biomass. One of the species *T. nilotica eduardiana* was introduced by the Belgians between 1928 and 1936 and is now the most important commercial fish (Kiss 1977, Dunn 1977).

According to Kiss (1977) and Dunn (1977), fishermen employ simple but efficient net technologies in artisanal fishing. Four lakes are the most important to the industry: Kivu, Luhondo, Rugwero and Ihema. According to Kiss (1977) production on the latter was about 450 tons in 1968, but fell to just 75 tons as a result of displacement of fishermen under pressure from Akagera National Park authorities (Kiss 1977). Potential yield on the Lake Ihema is 1200 tons per year. Presently Lake Kivu produces about 452 tons per year, Lake Luhondo about 531 tons and Lake Rugwero about 232 tons for a total catch of some 1200 tons (U.S. AID 1980, Dunn 1977).

On Lake Rugwero, fishing provides higher than average income to fishermen. Minimal investments of some 65,000 Rwandese francs could be used to improve docking and cleaning facilities for a significant increase in production, according to Dunn (1977).

Pisiculture in household ponds has also been advocated for Rwanda. A government center in Butare-Kimbale breeds high yield species of *Tilapia, Serranochromis,* carps and other species for distribution to locally managed ponds in Butare Gikongoro, Gitarama and Kigali Prefecture (Gotanegre et al. 1974). Surveys of some of the 4000 ponds installed by 1977 indicate that post-installation follow-up, stocking and maintenance have not always been successful. Expansion and follow-up for the pisiculture program as a source of cheap, high quality protein is indicated (Afrique Agriculture 1978).

3.5.4 Conservation and Economic Uses of Wildlife

Rwanda's two National Parks (Table 9) were created by a

Table 9. Existing and Proposed National Parks

Name	Area	Remarks
Akagera National Park	251,000 ha	Dry lowlying savannah gallery forest, papyrus swamps, lakes. Extremely diverse terrestrial and avifauna.
Volcano (Albert) National Park	18,000- 23,000 ha	Volcanic terrain between 1800-4507 m. High cool rainforest, sparse alpine veg., alpine meadows, high alt. swamp. Last habitat of mountain gorilla (*G. gorilla berengei*).
Nyungwe National Forest	Proposed	1600-2500 m. Afro-Alpine Forest, high alt. swamp habitat of the rare Spadix (*Cephalophus spadix*).

Decree of November 26, 1934, which created the "Institut des Parcs Nationaux du Congo Belge." The modern Bureau of Tourism and National Parks (ORTPN) was created in 1973 to manage the parks and the Mutara Hunting Reserve. The Decree Law of April 26, 1974, and 18 separate ordinances protecting wildlife in Rwanda spell out its functions (Appendix V). Successful conservation efforts in the Parks are hampered by a lack of trained personnel, funds and infrastructure. Although receipts from tourism are increasing rapidly they still do not meet ORTPN expenses. Lack of funds has meant that the few dozen guards have been able to control neither poaching of gorilla and other endangered species, nor illegal cutting, and clearing of forests.

Under the current conditions of intense population pressure upon a limited land base, government policy makers question the wisdom of reserving nearly 11 percent of Rwanda's territory (270,000 ha) for parks. Although addition of new parks in the Rugege-Nyungwe forest to preserve unusual and unique species is desirable, prospects for creating it are uncertain under present circumstances (Spinage 1969/70, IUCN 1979).

In an effort to conserve species threatened with extinction in the existing parks, particularly the mountain gorilla, the World Wildlife Fund, the Belgian Government and ORTPN are collaborating to finance the infrastructure and training and equipment of guards necessary to place the parks upon a firmer footing (Harcourt and Curry-Lindahl 1978, Harcourt 1979, ORTPN 1976).

An alternative for combining economic productivity and conservation of wildlife is the ranching of wild ungulates on the eastern plains (Lambrecht 1966, Spinage 1969/70, Nordconsult-Electrowatt 1976). The advantages of cropping wild ungulates rather than domesticated animals in the eastern region include:

1. Decreased water dependence of wild ungulates
2. Greater diversity of forage plants exploited by wild ungulates
3. More rapid weight gain, earlier fecundity, and higher birth rates of wild ungulates
4. Decreased susceptibility of wild ungulates to animal trypanosomiasis
5. Absence of social and aesthetic values which inhibit optimum commercialization of domesticated livestock

Because of endemic trypanosomiasis, East Coast Fever, other illnesses, and the poor quality of fodder on the eastern plains, the biomass of small domesticated ruminants which could be supported there is about 900 to 1300 kg per square km. In contrast, the wild ungulate biomass in unspoiled areas of the Akagera Park is 15,000 to 28,000 km per square km, which is close to the maximum given the current state of pastures in the Mutara region (Lambrecht 1966, Spinage 1969/70). About 20 percent of the ungulate biomass could be harvested annually (3 to 5.3 tons of meat per square km). This figure is far superior to current harvesting of domesticated animals (Nordconsult-Electrowatt 1976). Wild animal ranching has proven successful elsewhere in East Africa (Lambrecht 1966).

Problems associated with wild ungulate ranching include construction of infrastructure and training of personnel, refrigeration and transport of butchered animals, creation of a demand for game within Rwanda and competition with other sources of supply on world markets.

For several reasons, preservation and further development of Rwanda's National Parks for research, ranching and tourism is desirable. First, the floral communities found in the parks are crucial regulators of climate and river flow. Second, a number of plant species and communities are unique to Rwanda and deserve preservation on scientific grounds. Third, this flora supports several vanishing species. Foremost among them is the mountain gorilla which is only known from Rwanda's Virunga National Park, and even less well protected zones in Zaire and Uganda. Fourth, wild ungulates could be more profitably managed on the natural vegetation of the pasture plains than domesticated animals could. Finally, tourism and research can become an important component of economic diversification and development in Rwanda. Within five years the ORTPN predicts that its operations will indeed become profitable.

4.0 Environmental Problems

In Rwanda, uncontrolled human pressure exerted on natural ecosystems currently threatens ecological balances and has initiated undesirable ecological successions. There is a diminishing diversity of species, particularly large mammals and useful plants, and lower overall systemic productivity (Nordconsult-Electrowatt 1976). However, the nation is faced with the difficult tasks of doubling agricultural production in the next twenty years to provide food for a projected 10 million persons, and of diversifying production to provide export earnings to fund non-agricultural development U.S. AID 1980, UNDP 1978, UNEP 1981). Intensification and diversification of agriculture are sure to increase pressure upon Rwanda's limited natural resources. A sober assessment of the human environmental problems is therefore a necessary component of national planning.

4.1 Agricultural Land Use

Rwanda's soils, although suitable for extensive cultivations with long fallowing, are extremely fragile. They are mineral-poor, have poor phosphorous-retention capacity and a propensity towards irreversible drying (Spinage 1969, Sys 1975, Andriesse et al 1976). These soils need fertilizer but because of the high relief, intensification and increased fertilizer use may cause downstream pollution. Remaining virgin soils are often located on slopes of over 30 degrees or in marshes. The former soils are highly subject to erosion, and can therefore be safely brought into cultivation only with large investments in erosion control (Bouxin 1970, Lemarchand 1979, Spinage 1969/70). The marsh soils must be drained and are frequently acidic. Heavy investments in drainage systems, and soil conditioners are necessary, but the necessity for high quality maintenance over time will require massive extension, credit and education efforts if they are to be successful.

Another environmental problem associated with farming is the extremely small size of family plots which makes mixed cropping, rotation with leguminous nitrogen fixing crops, growing forage crops, etc., difficult due to competition with food crops (Nwafor 1979, Sys 1975). Complex, overlapping patterns of land tenure, and the nearly complete occupation of agricultural land make innovations in the structure of farming difficult to implement (Nordconsult-Electrowatt 1975, Meschi 1977). Nonetheless present practices have a deleterious effect on the agricultural environment. For example, the vertical system of landholding encourages soil erosion due to improper terracing, and along paths (U.S. AID 1980).

One response to this problem has been the creation of agricultural settlement zones for poor farmers where a rational system of land

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allocation is employed along with new techniques (Sylvestre 1974). Relocation of the poorest of the poor to marginal agricultural lands without extremely careful extension work may result in rapid degradation of the soils if traditional practices are employed (U.S. AID 1980). Reliance upon extension through the cooperative movement and the paysannats for the diversification and intensification of agriculture, and employment of volunteer labor for public works like erosion control provide only a partial answer to the over-exploitation of farm lands (Venneier 1978, Stauffer 1970, Bulletin Agricole du Rwanda 1979, Préfol and Delepierre 1975b).

Long-term plans call for a revolution in agriculture. A key component is development of irrigation facilities to reach some 200,000 ha employing point, aspersion, and continuous pumping systems, and the application of mineral fertilizers. Two-fold increases in yield have been demonstrated employing these techniques (Neel 1973, Welsh 1980). At Nkanga, 45 km south of Kigali, Rusono Falls, and Miogina and Mwago, favorable feasibility studies of irrigation have been conducted (UNDP 1978, Welsh 1980). The beneficial effects of irrigation include replenishment of the aquifer, facilitation of reforestation as marginal land is freed from use, growth of fodder crops and agricultural diversification (UNDP 1980).

Irrigation projects contain many unknowns. Successful irrigation requires a heavy input of education if rural farmers are to manage their plots (UNDP 1978, Welsh 1980). No research has been conducted to determine the ability of farmers to adapt to a high technology farming system, nor of the effects of relocation upon farming families. Such studies are necessary since failure to adequately manage irrigation and fertilizer applications can result in crop loss, and/or downstream dumping of fertilizers and insecticides. Irrigation also extends environments favorable to vectors responsible for schistosomiasis and dysentery, which are already health problems (Lambrecht 1981).

4.2 Pastures and Animal Husbandry

The pastures of Rwanda are managed by local townships (communes). They are generally degraded due to overgrazing in the central prefectures, where *Eragrostis* has succeeded *Themeda* grasslands despite local *Panicum* reseeding programs. Pastures in the western prefectures are fragile on account of slope and soils, and they are dry and too often burned in the eastern prefectures (Gotanegre et al. 1974, Rattray 1960, Nordconsult-Electrowatt 1976). Good grasses are grazed before they have a chance to get established which encourages the growth of hardier and less nutritious species (May 1965, Deschuytener 1974, Préfol and Delepierre 1975b). Overgrazing, overstocking and under-harvesting of livestock results in severe pressures upon the grasslands.

Burning is a more severe problem than overgrazing in the east. Savannah ecologists generally agree that fire damages the most nutritious grasses and favors the proliferation of species of less value to both wild and domesticated ungulates (Nordconsult-Electrowatt 1976). Pastures in the eastern plains, including the Mutara Hunting Preserve and Akagera National Park are burned as often as four times a year. Burning of hill tops at the end of May favors reforestation and the extension of habitats favorable to animal and human trypanosomiasis vectors (Lambrecht 1963). Burning of wet lowlands in July and August retards the growth of woody vegetation and stabilizes open, woody grass species (Bouxin 1975). Extension of short grass savannah is prejudicial to the survival of gregarious wild grazers like topi and zebra, forcing them into more restricted grazing zones. Woody grasses are also unsuitable for cattle.

Rural range management practices such as burning, overstocking, and restriction of livestock to rocky pastures more suited for afforestation are detrimental to the environment and to the livestock itself. Kiltz (1974) found that many animals examined in Rwanda were so undernourished, and plagued by so many pathogens picked up in the bush that dipping and spraying against East Coast Fever was hardly cost effective. This conclusion is particularly discouraging in light of the fact that losses due to the latter disease are estimated at 15 percent of live offspring (Thomas 1980).

From a technical standpoint, effective measures to restore pastures and improve livestock health include programs of more efficient marketing, replacement of Ankole with Ankole-Jersey and Ankole-Sahivale hybrids, forced grazing on undesirable grass species to promote nutritious grass stands, diversification of the ungulate population with wild animals foraging on diverse species, eradication of tsetse fly, and development of ranching programs which incorporate range management and livestock health control measures (Thomas 1980, Spinage 1969/70, Lambrecht 1956, Nordconsult-Electrowatt 1976). Such changes are predicated upon a vigorous program both to educate farmers about improved practices and to replace livestock as the main symbol of prestige in rural life. Such a program has yet to be inaugurated (Thomas 1980).

4.3 Forest Resources

Rwanda's forest resources of some 325,000 ha are under intense pressure and could be exhausted in the near future. By 1985 national needs will reach 6.2 million cubic meters of wood per year,

and by 2000 8.2 million cubic meters will be needed. Even using a harvest strategy of cutting 10 cubic meters per hectare of eucalyptus plantation, 4 cubic meters per hectare of pine in the forests, and some sort of control of cutting on the wooded savannahs, Rwanda's firewood deficit will reach 6.0 million cubic meters by the year 2000 (UNDP 1978).

The effects of continued uncontrolled cutting include the loss of the important water catchment effects of the forests, increasing rainfall runoff by 50 percent, aggrevation of ravine formation and mudslides which carry off the soils, transport of sterile sediments to valley bottoms where better soils are covered, and aggravation of the danger of flooding (Bittig 1976, vide Stauffer 1980, Gotanegre et al. 1974, Spinage 1972, Kourzoun et al 1977).

The forest resources of the Akagera National Park are also in potential danger from flooding should the proposed hydroelectric and irrigation projects by constructed. Flooding of gallery forest wooded savannah there will change them to open grass or swamp vegetation. Other forests there may assume the various aspects of swamp edge vegetation which are of limited economic utility (Nordconsult-Electrowatt 1976).

In Kibuye Prefecture, Swiss foreign aid is currently working on the creation of hamlet and household woodlots developed in conjunction with erosion control measures such as terracing and planting of living hedges. These projects, begun in 1967, have promoted reforestation by both the public and the private sector. Woodlots have been instituted on a number of 50-250 ha plots, and 94 nurseries established in the nine communes of the Prefecture. Between 1977 and 1979, 1270 km were reforested, with an additional 600 ha reforested in 1979. Extension services and cooperative labor have contributed to the success of the program. Woodlots, however, are subject to theft and the communes are insufficiently aware of the importance of management and surveillance of the lots (Stauffer 1980). The technicians believe far more funds are necessary to meet the staggering wood deficits in Kibuye.

There is an urgent need for more projects such as the Kibuye one. The German Agency for Technical Cooperation for example, expanded the original FAO-sponsored reseeding project in Nyabisindu into an ecofarming scheme in which reforestation is a principal component. Over 133 nurseries providing *Grevillea, Cupressus, Pinus patula,* and *Eucalyptus* seedlings have been established, and 1000 ha per year replanted (Soltner 1979, Freeman and Fricke 1980).

Most authorities have called for the rapid development of Rwanda's peat and methane resources to take some of the pressure off of the forests. Service wood used for drying crops, fish and for brick and tile manufacture, and for institutional cooking, amounts to a yearly need of 55,000 cubic meters which could be replaced with peat or low BTU gas produced from it (UNDP 1978). However, these projects are still in the planning and pilot project phase (Gaudet 1980).

4.4 Water and Hydroelectric Resources

In the year 2000, 4 million cubic meters of water will be needed every day by the eight million inhabitants of Rwanda for drinking, irrigation, and other purposes (UNDP 1978). If plans to irrigate between 20000 and 97000 hectares of cropland go forward, additional water reserves of some 2.2 to 10 million cubic meters will be called for (UNDP 1978, Nzamurambaho 1972). Reservoirs will be constructed on the major rivers of Rwanda, especially the Akagera where the largest projects are planned, and the Ruzizi, where two smaller projects are planned (Nordconsult-Electrowatt 1976, UNDP 1978).

Rwanda's rivers may also be called upon to generate power to irrigate family farms (1,700 million KWH), irrigate massive projects (400 million KWH) and run one or more fertilizer factories (10 MW) (UNDP 1978). By the year 2000, power output will total 240 GWH in contrast to 61.3 GWH today (Kloch 1980). Prefeasibility studies indicate that at least 4000 ha of land can be irrigated without much difficulty and that planned hydroelectric projects can generate more than enough electricity to meet projected demand (Kloch 1980, UNDP 1978).

A major unknown of these projects is the effect of diverting Akagera River water from Lake Victoria and ultimately from the Nile. Because Lake Victoria has risen in recent years, and the Akagera is higher than pre-1960 levels, the idea that river water could be diverted without negative effects in an attractive one. However, the causes of changes in river depth are not known, nor have the effects of a possible decline in water level upon either irrigation schemes or the Nile system been researched (UNDP 1978).

The environmental health effects of water resources development should also be considered. Hydroelectric development in the Akagera River Basin would lead to an increase in schistosomiasis and malaria (Kloch 1980). The vectors responsible for these diseases are extremely difficult to eradicate. In addition, irrigation requires the use of urea or calcium nitrate fertilizers because of the increased demand of the plant on the soils and lengthening of the growing season. Without fertilizer, fertility declines on irrigated plots (Welsh 1980).

The effects of fertilizer runoff into Akagera basin waters and upon plant communities there has not been evaluated. Use of water to cool the fertilizer plants at Rusomo and at the Amashyuga cement plant may result in downstream heat pollution or pollution with potasium hydroxide and calcium. The latter substance improves conditions for shell formation of schistosomiasis-bearing snails. Gotanegre et al. 1974, Nordconsult-Electrowatt 1976, Lambrecht 1981).

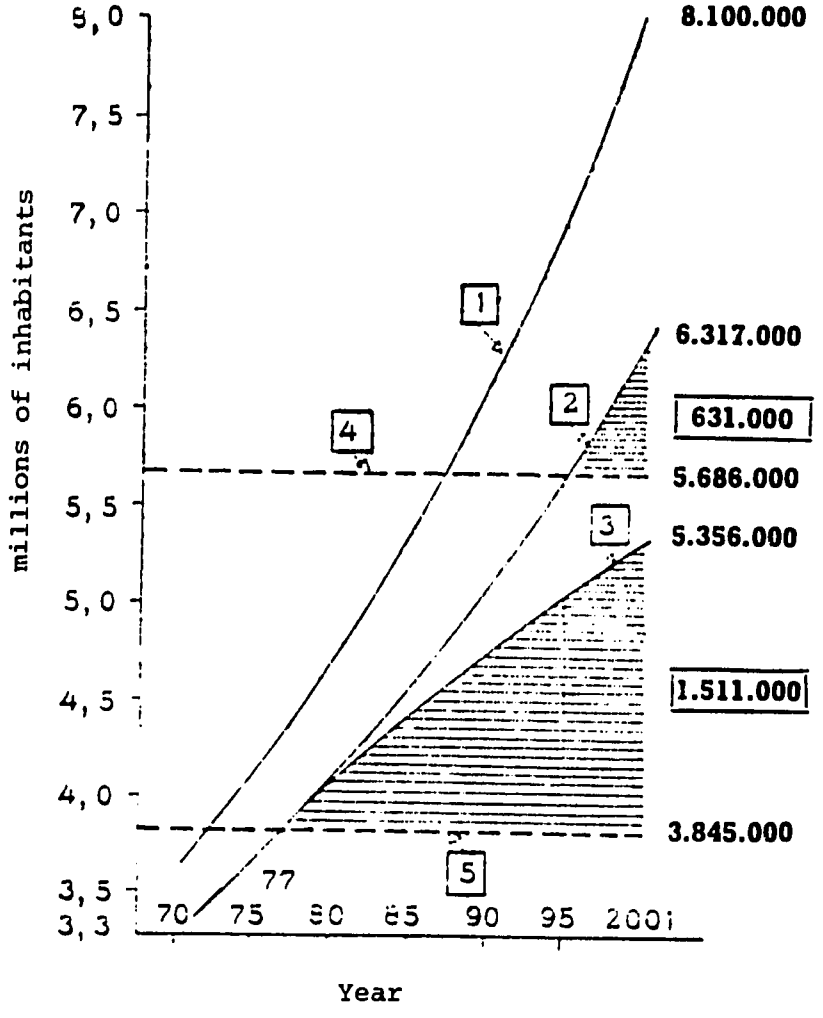
4.5 Fauna

Uncontrolled poaching and unauthorized cultivation in the two National Parks and in marshes are the causes of alarming declines in the population of primates, particularly the mountain Gorilla *(Gorilla gorilla berengei)*, as well as numerous birds (Harcourt and Curry-Lindahl 1978, Curry-Lindahl 1974, Harcourt 1979). Wild ungulates have held up well under competition from domesticated animals, particularly since the cessation of human occupation in Akagera National Park (Spinage 1969/70, Nordconsult-Electrowatt 1976). Plans and proposals to reduce the size and change the ecology of the parks will have a negative impact on wildlife, while development of the tourist and research potential of the parks and preservation of the water catchment effects of the forests compensate for any lost agricultural revenues on the marginal agricultural lands in the parks (Harcourt and Curry-Lindahl 1978, Spinage 1969/70, 1972)

4.6 Environmental Quality and Human Productivity

Rapid population growth is not necessarily an environmental problem. However, when an economic infrastructure cannot make productive use of a growing population, causing productivity to fall behind the increasing demand, population growth does cause a decline in the quality of life. This is the situation in Rwanda, where an annual population growth rate of 3 percent is a direct cause of loss of environmental quality (Gotanegre et al. 1974, Nwafor 1977, U.S. AID 1980).

Figure 28 from Préfol and Delepierre (1975b) shows growth projections to the year 2001 for the entire population of Rwanda and for the farming population only. Assuming that the farming population grows at the same rate as the entire population, and assuming that farms remain the same average size as they are now (1.1 ha), Rwanda's farmland will be entirely saturated by the year 1995, with a farming population of about 5.7 million people (level 4, Fig. 28). However, Préfol and Delepierre (1975b) consider the current average farm size to be too small to permit vigorous, self-sustaining economic growth, or economic "take-off." To achieve economic take off, farm size should be increased to 1.8 ha. Under these conditions, Rwanda's farmland is already saturated by the year 1977 at a farming population of about 3.8 million (level 5, Fig. 28). With every passing year, Rwanda's expanding population limits the possibilities for healthy economic growth and increases the potential for loss of environmental quality.



1) Population of Rwanda.
2) Population which could live on farming given a linear projection of population growth in relation to farm size of 110 ares.
3) Population which could live on farming under "take off" conditions: farm sizes of 180 ares.
4) Population which should live on farming given a linear projection of the status quo (110 ares/household).
5) Population which should live on farming given "take off" conditions (180 ares/household).

Figure 28. Population and Farming Growth Projections

Source: Préfol and Delepierre. 1975b.

Population growth has an equally important impact upon human productivity by affecting human health. Chronic malnutrition, particularly among women and children is already a problem in Rwanda and becomes severe at peak agricultural periods. Certain dietary practices could be modified to improve nutrition. For example, most food is boiled, which does away with many nutrients. Consumption of bananas as beer results in a 50 percent loss in food value. Diluting it with polluted ditch or spring water contributes to the spread of debilitating parasites and dysentery (May 1965, UNDP 1978, White et al. 1972).

Human intervention in the natural ecosystem has contributed to the deterioration of health. Trypanosomiasis and malaria vectors have been spread through forest clearance and irrigation. They can only be controlled through vigorous management and education efforts (van den Berghe and Lambrecht 1956, UNDP 1978, Walsh 1981). The emphasis of the current Five Year Plan (1977-81) upon preventive medicine and improved nutrition are important first steps in improving environmental and human health (U.S. AID 1980). Such improvements are a precondition for intensified use of human resources in Rwanda during the next two decades.

4.7 Environmental Impacts of Development Projects

Rwanda is a member of two regional organizations which have set in motion some large scale projects with profound environmental significance. One organization is the Akagera River Basin Commission (Tanzania, Burundi, Rwanda). Its primary focus has been a massive hydroelectric project with a high dam at Rusomo Falls on the Akagera River in southeastern Rwanda and smaller dams downstream at Kishanda and Kakona. A 175,000 ton calcium nitrate fertilizer plant is proposed near the high dam using power from the dam and limestone from Tanzania or Burundi in its operations. The dams are to produce not only power for the region but also irrigation water for hundreds of thousands of hectares of land, primarily in Tanzania, but also on the dry eastern plains of Rwanda (Nordconsult-Electrowatt 1976).

According to U.S. AID (1980), "The importance of the dam to Rwanda is being questioned by the GOR.* Since the country's electrical power needs are reasonably assured into the next century, serious reservations are being expressed over the inundation of up to 40,000 hectares (depending on the height finally agreed upon) of Rwandan agricultural land which will result from construction of the dam. The possibility of movement of a large segment of the population from Rwanda to Tanzania (1 million people is the figure used) would be a major undertaking clearly fraught with possibility of disaster."

Only one volume of the 13 volume Rusomo Falls Project feasibility

* This project has since been approved by GOR.

study deals with the environmental consequences of the dam and fertilizer plant. It evaluates only the effects of changing water levels upon Akagera National Park lands, and concludes that the park might be sacrificed for "more productive uses." There is an acute lack of information concerning the effects of the disposal of pesticide and fertilizer-loaded irrigation tail waters on fish and fisheries; the effects of the installation of large transmission lines and new roads; farming and wildlife; the degree to which habitats suitable for mosquitos, tsetse fly and shistosome-bearing snails will be extended; and changes in river dynamics, especially sediment transport and deposition rates behind and below the dams.

The second major regional organization to which Rwanda belongs is the Economic Community of the Great Lakes (CEPGL) (Rwanda, Burundi, Zaire). Activities of the CEPGL include economic and development cooperation such as plans for a regional investment bank, free movement of goods and people across borders and a major transport plan to ease the high costs of import and export (U.S. AID 1980). According to the intraregional transportation plan, a seven-highway network covering Rwanda, Burundi and western Tanzania is to be constructed in conjunction with hydroelectric schemes in southeastern Rwanda.* One of the three proposed railroads will wind through Rwanda and Burundi, taking off from the Kigoma, Zaire-Dar Es Salaam, Tanzania line. A new track will be also laid from the shores of Lake Kivu to Lake Victoria passing through Kigali (Africa News 3/30/81). U.S. AID is considering funding portions of this system (U.S. AID 1980). The environmental impact of this multimillion dollar project, which is likely to be considerable, has not yet been assessed.

Other current U.S. AID projects are summarized in Appendix VII. Environmental effects of small-scale development projects already discussed in the text include the Rwanda Peat Project (Section 3.1.3), Swiss and German agro-forestry projects (Section 4.3), a Lake Kivu methane extraction project (Section 3.1.2) and a Cyangugu limestone project (Section 4.4).

* The hydroelectric scheme and interrelated highway network come under the Kagera Basin Organization.

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Appendix I

Climatic Data for Rubona

CLIMATIC TABLE FOR RUBONA, RWANDA
Latitude 02°29'S, longitude 29°46'E, elevation 1,706 m

Month	Temperature (°C)				Relat. humid. (%)	Precipitation				Wind			Averages			
	mean		extreme			mean (mm)	max. (mm)	min. (mm)	days ≥ 0.1 mm	max. 24 h (mm)	aver. speed (km/h)	preval. direct	cloud-iness (oktas)	sun-shine (h)	radi-ation (Ly/day)	evap. (mm)
	max.	min.	max.	min.												
Jan	25	14	27	13	79	111	241	17	15	66	6	NE	4	177	460	134
Feb.	25	13	27	13	78	156	215	48	15	79	6	NE	4	160	470	124
Mar.	25	14	27	13	78	140	249	53	18	76	6	NE	4	184	481	141
Apr.	25	14	26	13	83	183	319	92	22	80	7	SE	4	162	453	125
May	24	14	26	13	72	164	367	38	18	73	6	SE	4	164	463	136
June	24	13	26	11	70	23	117	0	4	68	7	SE	3	220	454	128
July	26	12	27	11	59	7	37	0	2	19	7	SE	3	236	449	134
Aug.	27	13	28	12	60	37	95	0	5	74	8	SE	3	226	471	147
Sept.	27	14	28	13	60	63	176	1	11	45	8	SE	3	204	490	146
Oct.	26	14	28	13	71	102	171	48	16	63	7	SE	4	193	475	140
Nov.	25	14	26	13	76	110	199	55	20	47	7	NE	4	175	469	131
Dec.	25	14	28	13	80	93	213	7	17	65	6	NE	4	177	460	133
Annual	25	13	28	11	73	1,139	1,408	904	163	79	7	—	4	2,278	466	1,619
Rec. (yrs.)	10	10	10	10	3	30	30	30	30	30	3		5	5	2	2

APPENDIX II

Major Plant Associations

1. African Montane
2. African Sub-montane
3. Savanna
4. Xerophilic Thickets

Sources: Bouxin. 1975.
IUCN. 1979.
Liben. 1973.
Nordconsult-Electrowatt. 1976.
Spinage. 1972.
van den Berghe and Lambrecht. 1956, 1962.

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1. African Montane

Pygmeum Moist montane forest, 1800-2300 m.

Pygmeum africanum, Podocarpus milanjianus, Hagenia abyssinica, Albizia gummifera

Bamboo zone, 2300-3000 m.

Arundinaria alpina, Hypericum lanceolatum, Erica arborea, Hagenia abyssinica, Laportea alotipes, Clematis hirsuta, Viola abyssinica, Myrica arborea, Agauria salicifolia, Rhamnus prinoides, Calamagrostis epigejos var. capensis, Helictotrichon lacnanthum, Festuca spp., Hyparrhenia mobukensis, Kniphofia thomsonii

Hagenia zone, 2300-3200 m.

Hagenia abyssinica, Polystachia sp., Rumex ruwenzoriensis, Germanium aculeolatum, Stachys aculeolata var. afromontana, Vernonia adolfi-friderici, Anthriscus sylvestus, Peucedanum kerstenii, Agrostis mildbraedii, Deschampsia flexuosa var. afromontana, Poa annua, Festuca abyssinica var. abyssinica, Parietaria debilis, Cyperus denudatus, Xyris sp. Sphagnum sp., Syzygium cordatum, Erica rugensis.

Subalpine zone, 3000-3700 m.

Hypericum lanceolatum, Erica aborea, Philippia johnstonii, Lobelia wollastonii, Senecio erica-rosenii, Braunia secunda, Polytrichum hoehnelli, Philippia piliferu, Rha comitrium hypnoides, Rubus runssorensis, Rubus kirungensis var. glabrescens, Helichrysum newii, H. spp., Sphagnum planifolium, Carex runssorensis, Alchemilla spp., Andropogon amethystinus

Afro-alpine zone, 3600-4500 m.

Senecio alticola, S. adnivalis var. adnivalis, Lobelia wollastonii, Helichrysum newii, Alchemilla cryptantha, A johnstonii, Festuca abyssinica, Deschampsia flexuosa var. afromontana, Hypnum cupressiforme, Brewtelia subgnaphalea, Carex runssorensis, Luzula abyssinica

2. African Sub-Montane Associations

Sub-Montane Forest Associations, 1950 m.

Syzygium staudtii group I.

Syzygium staudtii, Memecylon bequertii, Impatiens bequertii, Caropa grandiflora, Carcinea volkensii, Galiniera coffeoides, Isoglossa runssorica, Psychotria chalconema var. montana

Anthodeista grandiflora group.

Asplenium friesorium, Anthocleista grandiflora, Syzygium staudtii, Olea welwitschii, Isoglossa runssorica, Elatostema monticolum Asplenium mildbraedii, Begonia meyeri-johannis

Syzygium staudtii group II.

S. staudtii, Batthasaria schliebenii var. intermedia, Carapa grandiflora, Galineria coffeoides, Impatiens beguertii, Isoglossa sthulmanii, Isoglossa runssorica, Begonia meyeri-johannis, Blotiella globra, Afromomun sp.

Neuboutonia macrocalyx group.

N. macrocalyx, Sericortachys tomentosa, Triumfetta cordiflora, Hypoestes verticullaris, Boglossa runssorica, Pilea bambuseti

African Transitional Rainforest Association, 1300-2000 m.

Primary Forest

Podocarpus usambarensis, Symphonia globulifera, Carapa grandiflora, Strombosia scheffleri, Syzygium parvifolium, Galineria coffeoides

Forest Regrowth, 1300-2000 m.

Podocarpus usambarensis, Symphonia globulifera, Carapa grandiflora, Strombosia scheffleri, Syzygium parvifolium, Galineria coffeoides, Polysciae fulva, Haungana madagascariensis, Bridelia brideliifolia, Pteridium agilinium, Hagenia abyssinica, Arundinaria alpina, Alinia rochetiana

3. Savanna

Grass-savannas with discontinuous scattered trees and/or shrubs.

Heeria-type common on hilltops.

Higher trees (A-stratum) dominated by *Heeria insignis* and *Combretum guenzii*, stratum B by *Maytenus senegalensis* and *Combretum guenzii*

Combretum-type: common.

Stratum A: *Combretum guenzii*
Heeria insignis
Stratum B: *Acacia hockii*
Lanea humilis

Acacia senegal type.

Very common and most typical.
Stratum A: *A. senegal*
A. gerrardii
Stratum B: *A. senegal*
A. hockii

A. gerrardii-type common.

A. gerrardii-Dichrostachys type commonly found on larger plains.

Stratum A: *A. sieberiana*
Stratum B: *Dichrostachys cinerea*
A. gerrardii

A.hockii-A. gerrardii type.

Common in Mutara. Dichrostachys position is replaced by *A. gerrardii*.

Combretum type found in the valley of Kuiteko.

Woody vegetation is dominated by *Combretum binderianum*.

Savannas with Continuous Scattered Trees and/or Shrubs.

This vegetation type does not exist on hilltops and is very rarely found on slopes, but it is commonly found on piedmonts and vertisols.

Panicum - A. senegal-type common.

The only actual dominating species of the woody vegetation is *A. senegal*. The two most prominent species of grasses are *Panicum maximum* and *Chloris gayana*.

Cynodon-type.

Most commonly found in the Kagera depression where *Cynodon dactylon* shows little dominance over other grasses such as *Setaria kageriensis, Asystasia gangeticus* and *Brachiaria eminii*. The woody vegetation is dominated by *A. polycantha, A. sieberiana* and locally by *A. gerrardii*.

Cynodon-A. polycantha-A. gerrardii-type.

This type is found in the northern Kagera Valley. *A. polycantha* and *A. gerrardii* are the most prominent woody species.

Cynodon-A. sieberiana-type.

This type covers the zones bordering the Kagera depression. *A. sieberiana* is the prominent woody species.

Grass-savannas of the Pediplain.

Grass-savannas on hilltops.

Loudetia-type found on very shallow soils in the quartzitic hill zone.

Uncovered stones and rocks do not allow a continuous grass-cover. Most common species are *Loudetia simplex* and *Andropogon dümmeri*.

Themeda-type found on deeper soils on argilo-schistic peaks Mubari.

Common species are *Themeda triandra* and *Hyparrhenia filipendula*.

Grass-savannas on slopes.

Themeda-Hyparrhenia type commonly found on all hill slopes in hill zone. Most common species are *Themeda triandra* and *Hyparrhenia filipendula*.

Grass-savannas on piedmonts.

Rarely found as most zones feature savanna vegetation with discontinuous, scattered shrubs and/or trees. Most common species are *Pennisetum polystachio* and *Hyparrhenia dissoluta*.

Pennisetum-type along the lakes and the Kagera River.

Hyparrhenia-type in the interior where *Pennisetum* shows lower performance.

Savannas on plains.

Most common grasses of this abundant vegetation are *Bothriochloa insculpta*, *Themeda triandra*, *Sporobolus pyramidalis* and *Hyparrhenia filipendula*. Grass savannas in plains appear in two type, dominated either by *Bothriochloa* or *Sporobolus*.

Bothriochloa-type in all larger plains in the center and north of the park.

Sporobolus-type strictly limited to plains of the south, especially Nyarahuru, and Gyisitire.

4. Xerophilic Thicket

Usnea spp., Aloe spp., Sanseveria guineensis, Asparagus subfalctus. Acacia pennata, Oromocarpum trichocarpum, Dichrostachys glomerata, Haplocoelum foliosum, Rhus incana, Rhus metalensis, Grewia bicolor, Grewia similis, Terminalis glandulosa, Capparis spp., Maerua sp., Dodonaea viscosa, Commiphora africana, Jasminum sp.,Olea chrysophylla, Carrisa edulis, Cissus quadrangularis, Rhipsalis carsytha, Sarcostemma viminalis, Cynanchum sarcostemmoides, Kalanchoe sp., Anagraecum spp., Acacia fascicularis, Olea africana, Teclea nobilis, Setaria verticulata, Acacia brevispica, Tarenna graveoleus, Euphorbia calycina, E. candelabrum.

Appendix III

Soil and Plant Associations of Akagera National Park

Legend

Soils

Lithosols:	G-G - granite-gneiss derived S-Q - schist-quartz derived P-SL - plinthite (dalle)--stone line
Arenoferrals:	ferralitic soils with high mineral content, high degree of migration of iron oxydes
Kaolisols:	correspond to the undifferentiated red and yellow ferrisols of the more general classification schemes and include red soils near slope tops, and yellow soils below them which have been leached. These yellow soils are equivalent to the kaolisols lessivés of this classification.
Vertisols:	Below the kaolisols are the black tropical vertisols with poor drainage characteristics, enriched with soluable elements and with little organic matter.

Habitat

A = preforests and forest formations
B = wooded savannahs
C = shrubby savannah or savannah with thickets
D = herbaceous or grassy savannahs

X = Species is present

Source: Troupin. 1966.

I. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
DICOTYLÉDONES																																
Acanthaceae																																
Acanthus arboreus Forsk.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Acanthus pubescens (Oliv.) Engl.																																
Asystasia gangetica (L.) T. Anders.	·	×	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	×	·	·	·	×	·	·	·	·	·	·	×	·	·	·
Asystasia schimperi T. Anders.	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Asystasia rostrata (Hochst.) Somls-Laub.																																
Asystasia somalensis (Franch.) Lebrun et Toussaint	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Barleria grandicalyx Lindau	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Barleria ventricosa Hochst. ex Nees	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Blepharis cristata S. Moore	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Blepharis integrifolia (L. f.) E. Mey.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Blepharis maderaspatensis (L.) Heine ex Roth.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Crabbea velutina S. Moore	·	×	·	·	×	×	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·	×	·	·	·
Dyschoriste radicans (Hochst.) Nees	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	·	·	·	×	×
Dychoriste trichocalyx (Oliv.) Lindau	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Hypoestes verticillaris (L. f.) R. Br.	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hypoestes paniculata (Forsk.) Schw.																																
Hygrophila auriculata (Schum.) Heine	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Asteracantha longifolia (L.) Nees																																
Justicia engleriana Lindau	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Justicia flava Vahl.	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Justicia sp. nov. aff. matammensis (Schum.) Oliv.	·	·	×	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Justicia anselliana Auct. non T. Anders.																																
Justicia sp. nov. aff. extensa T. Anders.	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Justicia striata (Klotzsch) Bullock	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Justicia uncinulata Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Lepidagathis andersoniana Lindau	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Monechma debile (Forsk.) Nees forma	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Monechma bracteatum Hochst.																																
Monechma scabrinerve C. B. Cl.	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Monechma subsessile (Oliv.) C. B. Cl.	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Monothecium glandulosum Hochst.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Phaulopsis imbricata (Forsk.) Sweet	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Ruellia patula Jacq.	·	·	×	×	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×
Thunbergia alata Boj. ex Sims	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·
Whitfieldia elongata (Beauv.) De Wild. et Th. Dur.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Aizoaceae																																
Glinus oppositifolius (L.) A. DC.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Mollugo nudicaulis Lam.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·
Zaleya pentandra (L.) Jeffrey	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×
Trianthema pentandra L.																																
Amarantaceae																																
Achyranthes aspera L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Achyranthes aspera L. var. sicula L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·
Achyranthes aspera L. var. *argentea* (Lam.) C. B. Cl.																																
Aerva lanata (L.) Juss. ex Schult.	·	·	·	×	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Aerva leucera Auct. nov. (L.) Moq.																																
Aerva leucera (L.) Moq.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Alternanthera sessilis (L.) R. Br.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

BEST AVAILABLE DOCUMENT

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Arénoferrals				c. Kaolisols								d
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Amarantaceae (*suite*)																																
Amaranthus hybridus L. ssp. cruentus (L.) Thell.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Amaranthus caudatus Auct. non L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Celosia stuhlmanniana Schinz	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Celosia trigyna L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Cyathula uncinulata (Schrav.) Schinz	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×
Gomphrena globosa L.	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Psilotrichum elliotii Bak.	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Psilotrichum ovatum Auct. non Moq.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Psilotrichum camporum Lebrun et Toussaint	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	×	·
Puppalea lappacea (L.) Juss.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·
Anacardiaceae																																
Heeria insignis (Del.) O. Ktze var. reticulata Bak. f.	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Heeria insignis Auct. non (Del.) O. Ktze	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	×	×	×	·	·	·	·
Lannea edulis (Sond.) Engl.	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Lannea fulva (Engl.) Engl.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Lannea humilis Engl.	·	·	·	·	×	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·
Lannea schimperi (Hochst. ex A. Rich.) Engl.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	×	×	×	·	·	·	·
Lannea barteri Auct. non (Oliv.) Engl.	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Lannea stuhlmannii (Engl.) Engl.	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhus longipes Engl.	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	×	×	·	·	×	×	·
Rhus incana P. Mill. var. *grandifoliola* Robyns et Lawalrée	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhus incana P. Mill. var. *cuneifoliolata* Auct. non (Engl.) Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhus natalensis Bernh. ex Krausse	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhus natalensis Bernh. ex Krausse var. *elliptica* (Engl.) Engl.	·	×	×	·	·	×	×	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	×	·
Rhus vulgaris Meikle	·	×	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhus incana P. Mill. var. *tomentosa* Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Annonaceae																																
Annona chrysophylla Boj.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Apocynaceae																																
Acokanthera schimperi (A. DC.) Benth.	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	×	×	·	·
Carissa oppositifolia (Lam.) Pichon	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ancylobotrip amoena Hua	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Landolphia nitida Lebrun et Taton	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Landolphia caniniana Hall. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Carissa edulis Vahl.	×	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	×	·	·	×	×	·	·
Araliaceae																																
Cussonia arborea Hochst. ex A. Rich.	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cussonia holstii Engl.	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	×	×	·	·	·	×	·
Asclepiadaceae																																
Asclepias sp. aff. glaucophylla Schult.	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·
Caralluma dümmeri (N.E.Br.) E. A. Bruce	·	·	×	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Stapelia kagerensis Lebrun	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Caralluma schweinfurthii Auct. non Berger	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ceropegia stenantha K. Schum.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·
Cynanchum sarcostemmoides K. Schum.	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·
Cynanchum schistoglossum Schltr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cynanchum tetrapterum (Turcz.) R. A. Dyer	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

BEST AVAILABLE DOCUMENT

1. Genres et Espèces	5. Habitat																			
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Asclepiadaceae (*suite*)																																
Ectadiopsis oblongifolia (Meisn.) Schltr.	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Cryptolepis oblongifolia (Meisn.) Schltr.																																
Gomphocarpus physocarpus E. Mey.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×
Asclepias semilunata R. Br.																																
Gymnema sylvestre (Retz.) Schultes	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Gongronema angolense (N.E.Br.) Bullock	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Marsdenia angolensis N.E.Br.																																
Pachycarpus schweinfurthii (Decne) Bullock	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Asclepias lineolata Auct. non Schltr.																																
Pentarrhinum insipidum E. Ney.	·	×	×	·	×	·	·	×	×	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Raphionacme madiensis S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Sarcostemma viminale N. E. Br.	×	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	×	·	·	×	·	·	·	·	·	·	·
Secamone africana (K. Schum.)Bullock	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Secamone stuhlmannii K. Schum.	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	×	·	·	·	×	·	·	·
Stathmostelma pedunculatum (Decne) K. Schum.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×
Asclepias macrantha Hochst.																																
Tenaris tubella E. Ney.	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Tenaris rostrata N. E. Br.																																
Tylophora sp. aff. conspicuum N.E.Br.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Tylophera sylvatica Decne	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Basellaceae																																
Basella alba L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Bignoniaceae																																
Kigelia aethiopum (Fenzl.) Dandy	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Markhamia obtusifolia (Bak.) Sprague	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·
Markhamia platycalyx Sprague	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Boraginaceae																																
Ehretia cymosa Thonn.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×
Trichodesma zeylanica (L.) R. Br.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Burseraceae																																
Commiphora africana Engl.	·	·	×	×	·	×	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Commiphora madagascariensis Jacq.	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Commiphora habessinica (Berg.) Engl.																																
Cactaceae																																
Rhipsalis baccifera (J. G. Mill.) Stearn	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·
Rhipsalis cassytha Gaertn.																																
Campanulaceae																																
Lightfootia napiformis A. DC.	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Capparidaceae																																
Boscia corymbosa Gilg	·	·	·	·	·	·	×	·	·	×	×	·	·	·	·	×	·	·	·	·	×	×	×	·	×	×	×	·	·	·	·	·
Boscia caloneura Gilg																																
Cadaba farinosa Forsk. ssp. adenotricha (Gilg et Bened.) R. A. Graham	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cadaba farinosa Auct. non Forsk.																																
Capparis erythrocarpos Isert	×	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	×	·	·	×	×	·	·	×	·	·	·
Capparis fascicularis DC var. fascicularis	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	·	·	·	×	×	·	·	×	×	·	·	×	·	·	·

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Arénoferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Capparidaceae (*suite*)																																
Capparis fascicularis DC var. elaeagnoides (Gilg) Dewolf					×	×							×	×			×	×														
Capparis elaeagnoides Gilg																																
Capparis bangueolensis R. E. Fries																																
Capparis mildbraedii Auct. non Gilg																																
Capparis sepiaria L. s. l.					×	×								×															×			
Capparis mildbraedii Gilg																																
Capparis tomentosa Lam.	×	×			×								×				×															
Capparis subtomentosa De Wild.																																
Cleome hirta (Klotzsch) Oliv.				×											×																	
Cleome monophylla L.															×	×																
Maerua angolensis DC					×																											
Maerua triphylla A. Rich. var. johannis (Volk. et Gilg) De Wolf	×				×				×								×	×														
Maerua triphylla Auct. non A. Rich.																																
Maerua johannis Volk. et Gilg																																
Maerua becquetii Wilczek																																
Maerua campicola Gilg et Ben.																																
Maerua cfr campicola Gilg et Bened.																																
Caryophyllaceae																																
Drymaria cordata (L.) Willd.				×																												
Silene burchellii Otth. var. burchellii															×	×																
Celastraceae																																
Cassine aethiopica Thunb.	×				×												×				×				×				×			
Mystroxylon aethiopicum (Thund.) Loes.																																
Cassine buchananii Loes.					×																											
Maytenus arbutifolius (Hochst. ex A. Rich.) Wilczek																													×			
Gymnosporia engleriana Loes. var. *macrantha* Loes.																																
Maytenus buchananii (Loes.) Wilczek					×	×			×								×												×			
Maytenus cymosus (Soland.) Exell	×				×				×	×											×	×			×				×			
Gymnosporia marangensis Loes.																																
Gymnosporia beniensis Robyns et Lawalrée																																
Maytenus serratus (Hochst. ex A. Rich.) Wilczek var. argutus (Loes.) Wilczek																																
Gymnosporia gracilipes (Welw. ex Oliv.) Loes. *var. arguta* Loes.																																
Gymnosporia serrata (Hochst. ex A. Rich.) Loes. var. *niansaica* Loes.																																
Maytenus senegalensis (Lam.) Exell			×		×	×																										
Gymnosporia senegalensis Lam.																																
Gymnosporia senegalensis Lam. var. *spinosa* Engl.																																
Maytenus undatus (Thunb.) Blakelock					×				×																							
Maytenus lancifolius (Schum. et Thonn.) Loes.																																
Chenopodiaceae																																
Chenopodium ambrosioides L.																			×													
Chenopodium opulifolium Schrad.																			×													
Chenopodium procerum Hochst. ex Moq.																			×													
Chenopodium botrys Auct. non Schrad.																																
Combretaceae																																
Combretum binderianum Kotschy			×			×	×			×	×							×	×													
Combretum elaeagnifolium Planch.																																
Combretum gueinzii Sond. ssp. splendens (Engl.) Exell		×	×				×																			×						
Combretum splendens Engl.																																
Terminalia mollis Laws.																																
Terminalia glandulosa De Wild.																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Compositae																																
Ageratum conyzoides L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	·	·	·	·	·	·	·	·	×	·	×	×
Aspilia africana (Pers.) C. A. Adams	·	·	×	×	·	·	×	·	·	·	×	×	·	·	·	×	·	·	×	×	·	·	×	×	·	·	·	×	·	·	·	·
Aspilia asperifolia O. Hoffm.																																
Aspilia kotschyi (Schip.-Bip.) Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Anisopappus africanus (Hook.) Oliv. et Hiern	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Berkheya spekeana Oliv.	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×
Bidens pilosa L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	×	·	·	×	×
Bidens steppia (Steetz) Scherff.	·	·	×	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	×	·	·	×	×
Blepharispermum pubescens S. Moore	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Blumea lacera (Burm. f.) DC	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	×	×	·	·
Conyza aegyptiaca (L.) Ait.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Conyza hochstetteri Schip.-Bip.	·	·	·	×	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Crassocephalum bojeri (DC) Robyns	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	×	·	·	·
Crassocephalum bumbense S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Crassocephalum picridifolium (DC) S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Crassocephalum rubens (Juss.) S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Crassocephalum vitellinum (Benth.) S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Dicoma anomala Sond.	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dicrocephala integrifolia (L. f.) O. Ktze	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dicrocephala bicolor (Roth.) Schlechtend.																																
Echinops amplexicaulis Oliv.	·	·	·	·	·	·	×	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Echinops bequaertii De Wild.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Echinops eryngiifolius K. Hoffm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Echinops hoehnelii Schweinf.	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eclipta prostata (L.) L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eclipta alba (L.) Hassk.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	×
Elephantopus scaber L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Elephantopus scaber L. var. brevisetus Philipson	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Emilia coccinea (Sims) G. Don	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Emilia juncea Robyns	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Emilia humbertii Robyns	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Erigeron floribundus (H.B.K.) Sch.-Bip.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	×	×	·	·
Erigeron grantii Oliv. et Hiern ex Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	×	·	·	·
Nidorella pratensis Auct. non S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	×	·	·	·	·
Erlangea cordifolia S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Erlangea marginata (Oliv. et Hiern) S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Erlangea spissa S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Ethulia conyzoides L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Galinsoga parviflora Cav.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	×
Gerbera abyssinica Sch.-Bip.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	×
Gnaphalium declinatum L.f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	·
Gnaphalium unionis Sch.-Bip.																			×	×									·	·	×	×
Gnaphalium luteo-album Auct. non L.																																
Guizotia scabra (Vis.) Chiov.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·
Gynura ruwenzoriensis (S. Moore) S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Helichrysum gerberaefolium Sch. Bip. ex A. Rich.	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	×	·	·	·
Helichrysum velatum Moeser																																
Helichrysum odoratissimum (L.) Less.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×
Helichrysum hochstetteri Hook. f.																																
Helichrysum schimperi (Sch.-Bip.) Moes.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Helichrysum undatum Less.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Helichrysum globosum Sch.-Bip.																																
Inula glomerata O. Hoffm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×

1. Genres et Espèces	5. Habitat																			
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d.			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Compositae (*suite*)																																
Kleinia grantii Hook. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	×	·	·	·	·	·	·	·	·	×	×	·	·
Notonia grantii Oliv. et Hiern																																
Notonia bequaertii De Wild.																																
Lactuca sp. cfr. intibus L.	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Lactuca kenyaensis Stebbins	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Lactuca leptocephala Stebbins	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Laggera alata Sch.-Bip. ex Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Laggera brevipes Oliv. et Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Laggera crassifolia Sch.-Bip.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Melanthera scandens (Schum. et Thonn.) Rob.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Melanthera brownii (DC) Schip.-Bip.																																
Microglossa angolensis Oliv. et Hiern	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Microglossa pyrifolia (Lam.) O. Ktze	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·
Nidorella spartioides (O. Hoffm.) Cronquist	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Polycline psyllioides Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	?	·	·	·	·	·	·	·	·
Senecio adolfi-frederici Muschl.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·
Senecio chlorocephalus Muschl.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Senecio discifolius Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	×
Senecio karaguensis O. Hoffm.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Senecio petitianus A. Rich.	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Senecio ruwenzoriensis S. Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·
Senecio stuhlmannii Klatt	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Sonchus exauriculatus (Oliv. et Hiern) O. Hoffm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Sonchus oleraceus L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Spilanthes africana DC	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Spilanthes acmella (L.) Murr.																																
Spilanthes oleracea L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Sphaeophyllum lastii O. Hoffm.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Tagetes minuta L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Tolpis ephemera R. E. Fries	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Vernonia aemulans Vatke	·	·	×	×	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Vernonia amygdalina Del.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Vernonia brachycalyx O. Hoffm	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	×	·	×	·
Vernonia sp. aff. cistifolia O. Hoffm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·
Vernonia congolensis De Wild et Th. Dur.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vernonia grantii Oliv.	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	×	·	·	×	·	·	·	·	·	·	×	·	·
Vernonia karaguensis Oliv. et Hiern	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	×	·	·
Vernonia sp. aff. lasiopus O. Hoffm.	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Vernonia perrottetii Schip.-Bip.	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vernonia petersii Oliv. et Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Vernonia purpurea Schip.-Bip.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×
Vernonia schweinfurthii Oliv. et Hiern	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vernonia smithiana Less.	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Vernonia undulata Oliv. et Hiern	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Wedelia menotriche Oliv. et Hiern	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Convolvulaceae																																
Astripomoea grantii (Rendle) Verdc.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×
Astripomoea malvacea (Klotzsch) Hall. f. var. volkensii (Dammer) Verdc.	·	·	×	×	·	·	×	·	·	·	·	×	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×
Astrochlaena volkensii Dammer																																
Convolvulus sagittatus Thunb, var. ulopetalus (Hall. f.) Verdc.	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Evalvulus alsinioides (L.) L.	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d.
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Convolvulaceae (*suite*)																																
Evolvulus nummularius L.																			×	×												
Falkia oblonga Bernh. ex Krauss.																															×	
Hewittia sublobata (L.) O. Ktze							×				×		×				×						×	×							×	×
Ipomoea blepharophylla Hall. f.																																×
Ipomoea cairica (L.) Sweet																													×			
Ipomoea sinensis (Desr.) Choisy ssp. blepharosepala (A. Rich.) Meeuse																			×	×												
I. cardiosepala Hochst.																																
Ipomoea eriocarpa R. Br.																				×												
Ipomoea hispida (Vahl) Roem. et Schult.																																×
Ipomoea involucrata Beauv. var. operosa (Hall. f.) Verdc.																								×								
Ipomoea operosa Hall f.																																
Ipomoea lepidophora Lebrun et Taton																								×								
Ipomoea obscura (L.) Ker.-Gawl.																			×	×												
Ipomoea ochracea (Lindl.) G. Don var. ochracea				×															×	×												
Ipomoea kentrocarpa Hochst. ex A. Rich.																																
Ipomoea oenotherae (Vatke) Hall f.																								?								
Ipomoea temnophylla Lebrun et Taton																																
Ipomoea rubens Choisy																																
Ipomoea fragrans Choisy																																
Ipomoea tenuirostris Steud. ex Choisy ssp. tenuirostris																																
Ipomoea wightii (Wall.) Choisy var. wightii																																
Crassulaceae																																
Kalanchoe beniensis De Wild.					×																											
Kalanchoe laciniata (L.) DC.					×																											
Kalanchoe lateritia Engl.																			×					×								
Kalanchoe marmorata Bak.																								?								
Cruciferae																																
Erucastrum arabicum Fish. et Mey.																			×													
Rorippa madagascariensis (DC) Hara																																×
Rorippa indica Auct. non (L.) Hiern																																
Cucurbitaceae																																
Cucumis aculeatus Cogn.																	×	×	×													
Cucumis ficifolius A. Rich.			×																													
Diplocycles palmatus (L.) Jeffrey																															×	×
Bryonopsis laciniosa Auct. non (L.) Naud.																																
Melothria punctata (Thunb.) Cogn.																													×	×	×	
Momordica foetida Schum. et Thonn.																			×	×												
Sphaerosycios sphaericus (E. Mey.) Hook. f.																	×		×													
Trochomaeria macrocarpa (Sond.) Hook. f.																								×								
Zehneria minutiflora (Cogn.) Jeffrey																																×
Melothria cognauxiana De Wild.																																
Ebenaceae																																
Euclea divinorum Hiern																													×			
Euclea schimperi (DC) Dandy	×	×			×	×			×	×			×	×			×	×			×				×	×						
Euclea kellau Auct. non Hochst.																																
Euphorbiaceae																																
Acalypha bipartita Muell.-Arg.					×																								×	×	×	×
Acalypha villicaulis Hochst. ex A. Rich.			×	×															×	×							×	×			×	×

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Arénoferrals				c. Kaolisols								d.
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Euphorbiaceae (*suite*)																																
Argomuellera macrophylla Pax	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Bridelia micrantha (Hochst.) Baill.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Bridelia scleroneura Muell.-Arg.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Bridelia scleroneuroides Pax																																
Clutia abyssinica Jaub. et Spach. var. pedicellaris (Pax)	×	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Clutia abyssinica Auct. non Jaub. et Spach. p. p.																																
Croton dichogamus Del.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Croton macrostachyus Hochst. ex Del.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Drypetes gerrardii Hutch.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·
Erythrococca bongensis Pax	×	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Euphorbia bongensis Kotschy et Peyr.	·	·	×	×	·	·	×	·	·	·	·	×	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	×	·	·	·	·
Euphorbia candelabrum Trem. ex Hotschy	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	×	×	·	×	·	·
Euphorbia calycina N.E.Br.																																
Euphorbia dawei N.E.Br.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Euphorbia grantii Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Euphorbia hirta L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Euphorbia inaequilatera Sond.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Euphorbia prostrata Ait.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Euphorbia zambesiaca Benth. var. villosula (Pax) N.E. Br.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Phyllanthus capillaris Schum. et Thonn.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Phyllanthus maderaspatensis L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Phyllanthus lebrunii Robyns et Lawalrée	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Sapium ellipticum (Hochst.) Pax	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Securinega virosa (Roxb. ex Willd.) Pax et K. Hoffm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Synadenium grantii Hook. f.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Tragia sp. aff. brevipes Pax	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Flacourtiaceae																																
Dovyalis macrocalyx Warb.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Flacourtia indica (Burm. f.) Merrill	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Scolopia zeyheri (Nees) Szysz.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Scolopia rigida R. E. Fries ...																																
Trimeria tropica Burkill	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Geraniaceae																																
Monsonia biflora DC	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Guttiferae																																
Psorospermum febrifugum Spach.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Psorospermum rotundifolium Spirlet																																
Hydnoraceae																																
Hydnora johannis Beccari	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	?	·	·	·
Icacinaceae																																
Apodytes dimidiata E. Mey. ex Bernh. var. acutifolia (Hochst. ex A. Rich.) Bout.	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Labiatae																																
Aeolanthus repens Oliv.	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Basilicum polystachyon (L.) Moench.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Becium obovatum (E. Mey. ex Benth.) N. E. Br.	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×
Ocimum elskensii Robyns et Lebrun																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								e.
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Labiatae (*suite*)																																
Coleus barbatus Benth.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Coleus claessensii De Wild.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Coleus edulis Vatke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Coleus flavo-virens Gürke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·
Coleus kilimansdchari Gürke	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Coleus lanuginosus Hochst. ex Benth.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Coleus kiruensis Lebrun et Toussaint																																
Coleus stachyodes (Oliv.) Bruce	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Coleus thyrsiflorus Lebrun et Toussaint	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Haumaniastrum galeopsifolium (Bak.) Duvign. et Plancke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Acrocephalus galeopsifolius Bak.																																
Hoslundia opposita Vahl	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Leonotis mollissima Gürke	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Leonotis kagerensis Lebrun et Toussaint																																
Leonotis nepetaefolia R. Br.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Leucas glabrata R. Br.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Leucas biglomerulata Lebrun et Toussaint																																
Leucas martinicensis R. Br.	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Leucas descampsii Briquet																																
Leucas deflexa Auct. non Hook.																																
Leucas microphylla Vatke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Leucas calostachys Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Leucas spicigera Lebrun et Toussaint																																
Ocimum kilimandscharicum Gürke	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ocimum suave Willd.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Orthosiphon suffrutescens (Thonn.) J. K. Morton	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Orthosiphon australis Vatke																																
Plectranthus cyclindraceus Hochst. ex Benth.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×
Plectranthus longipes Bak.	×	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Pycnostachys coerulea Hook.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Leguminosae-Mimosoideae																																
Acacia abyssinica Hochst. ex A. Rich. ssp. calophylla Brenan	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·
Acacia abyssinica Auct. non Hochst. ex A. Rich.																																
Acacia brevispica Harms	·	·	·	·	·	×	×	·	·	×	×	·	·	×	·	·	×	×	·	·	·	×	·	·	×	·	·	·	·	·	·	·
Acacia pennata Auct. non (L.) Willd.																																
Acacia gerrardii Benth. var. gerrardii	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	×	·	·	·	×	·
Acacia hebecladoides Harms																																
Acacia hockii De Wild.	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Acacia seyal Auct. non Del.																																
Acacia kirkii Oliv ssp. mildbraedii (Harms) Brenan	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Acacia mildbraedii Harms																																
Acacia polyacantha Willd. ssp. campylacantha (Hochst. ex A. Rich.) Brenan	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·
Acacia campylacantha Hochst. ex A Rich.																																
Acacia caffra Willd. var. *campylacantha* (Hochst. ex A. Rich.) Aubréville																																
Acacia senegal (L.) Willd. var. senegal	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	×	×	·	·	·	×	·
Acacia sieberiana DC var. orientalis Troupin	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·
Acacia nefasia Auct. non Schweinf.																																
Acacia sieberiana Auct. non DC																																
Acacia sieberiana DC var. vermoesenii (De Wild.) Keay et Brenan	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Acacia nefasia Schweinf.																																
Acacia sieberiana Auct. non DC																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Arénoferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Leguminosae-Mimosoideae (*suite*)																																
Albizia adianthifolia (Schum.) W. F. Wright	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Albizia amara (Willd.) Beauv. ssp. sericocephala (Benth.) Brenan	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	·	·	·	·	·	·
Albizia amara Auct. non (Willd.) Beauv.																																
Albizia antunesiana Harms	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Albizia grandibracteata Taub. gummifera (J. F. Gmel.) C. A. Smith	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Albizia grandibracteata Auct. non Taub. p. p.																																
Albizia petersiana (Bolle) Oliv.	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·
Albizia versicolor Welw. ex Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Dichrostachys cinerea Wight et Arn. ssp. cinerea	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·
Dichrostachys glomerata (Forsk.) Chiov.																																
Dichrostachys platycarpa Welw. ex Oliv.																																
Dichrostachys cinerea Wight et Arn. ssp nyassana (Taub.) Brenan	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Dichrostachys nyassana Taub.																																
Entada abyssinica Steud. ex A. Rich.	·	×	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Entadopsis abyssinica (Steud. ex A. Rich.) Gilbert et Boutique																																
Mimosa pigra L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Leguminosae-Caesalpinioideae																																
Caesalpinia dichapetala (Roth.) Alston	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cassia absus L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cassia didymobotrya L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cassia falcinella Oliv.	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cassia hildebrandtii Vatke	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cassia grantii Oliv. var. *pilosula* Oliv.																																
Cassia kirkii Oliv. var. guineensis Steyaert	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cassia kirkii Auct. non Oliv.																																
Cassia laevigata Willd.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Cassia mimosoides L.	·	·	·	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Cassia cfr. siamea Lam.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Erythrophleum africanum (Welw.) Harms	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Piliostigma thonningii (Schum.) Milne-Redhead	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Bauhinia thonningii Schum.																																
Leguminosae-Papilionoideae																																
Aeschynomene elaphroxylon (Guill. et Perr.) Taub.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Aeschynomene schimperi Hochst. ex A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Alysicarpus glumaceus (Vahl) DC	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Alysicarpus rugosus (Willd.) DC ssp. perennirufus J. Léonard	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×
Alysicarpus glumaceus Auct. non (Vahl) DC																																
Astragalus abyssinicus Steud. ex A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·
Crotalaria cf alexanderi Bak. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Crotalaria chrysochlora Bak. ex Harmms	·	·	×	·	·	·	×	×	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Crotalaria glauca Willd. var. elliotii Bak. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	×	·	·	·	·	·	·	·	·	·
Crotalaria goreensis Guill. et Perr.	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Crotalaria incana L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Crotalaria intermedia Kotschy	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×
Crotalaria kikangaensis De Wild.	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×
Crotalaria laburnifolia L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	×	·	·	·	·
Crotalaria lachnophora Hochst. ex A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Crotalaria natalitia Meissn.	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Crotalaria recta Steud. ex A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×
Crotalaria spinosa Hochst.	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

1. Genres et Espèces	5. Habitat																			
	a. Lithosols - Sols récents												c. Kaolisols								d.
	G-G				S-Q				P-Sl.				b. Aréno-ferrals				Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Legumineosae-Papilionoideae (*suite*)																																
Crotalaria vallicola Bak. f.																		×	×													
Dalbergia nitidula Welw. ex Bak.						×	×																									
Desmodium barbatum (L.) Benth. var. procumbens Schubert																			×													
Desmodium dimorphum Welw.																																
Dolichos axillaris E. Mey. s. s.														×	×																	
Dolichos biflorus Auct. non L. p.p.																																
Dolichos formosus A. Rich.																		×														
Dolichos taubertii Bak. f.																			×													
Dolichos biflorus Auct. non L. p.p.																																
Eriosema erici-rosenii R. E. Fries							×	×																								
Eriosema montanum Bak. f.																														×		
Eriosema pauciflorum Klotzsch																×			×	×								×	×			
Eriosema buchananii Bak. f. f. *ellipticum* (St. et Decr.) Staner																																
Eriosema parviflorum Auct. non E. Mey.																																
Eriosema psoraleoides Don var. grandiflorum Staner et Decraene																		×														
Eriosema shirense Bak. f. ex Harms				×																							×	×				×
Erythrina abyssinica Lam. ex A. Rich.															×																	
Erythrina tomentosa R. Br.																																
Glycine javanica L. var. claessensii (De Wild.) Hauman																		×	×	×			×							×	×	
Glycine javanica Auct. non L.																																
Glycine schliebenii Harms var. rufescens Hauman																															×	×
Indigofera ambelacensis Schweinf.																			×	×												×
Indigofera wildemanii Bak. f.																																
Indigofera arrecta Hochst. ex A. Rich.																			×	×											×	×
Indigofera brevicalyx Bak. f.								×												×												
Indigofera circinella Bak. f.																							×									
Indigofera colutea (Burm. f.) Merrill																															×	×
Indigofera multifoliolata De Wild.																																
Indigofera zenkeri Harms ex Baker f.																																
Indigofera zenkeri Harms var. *brevifoliolata* De Wild.																																
Indigofera viscosa Lam.																																
Indigofera congesta Welw. ex Bak.														×				×	×													
Indigofera dendroides Jacq.																		×	×													
Indigofera drepanocarpa Taub.								×																×								
Indigofera emarginella Steud. ex A. Rich.																																
Indigofera garckeana Vatke				×	×														×					×	×					×		
Indigofera tetragona Lebrun et Taton																																
Indigofera spicata Forsk.																								×	×							
Indigofera parvula Del.																																
Indigofera endecaphylla Jacq.																																
Indigofera vicioides Jaub. et Spach.				×																×												
Indigofera semlikiensis Robyns et Boutique																																
Indigofera phyllanthoides Auct. non Bak.																																
Lablab niger Medik.																														×	×	
Dolichos lablab L.																																
Mucuna stans Welw. ex Bak.																														×	×	
Ormocarpum trichocarpum (Taub.) Harms							×	×										×					×	×			×	×		×	×	
Phaseolus schimperi Taub.																			×	×											×	
Vigna macrorrhyncha (Harms) Milne-Redhead																																
Pseudarthria hookeri Wight et Arn.							×												×	×			×	×							×	×
Pycnospora lutescens (Poir.) Schindl.							×												×				×									
Rhynchosia albiflora (Sims) Alston					×				×																							
Rhynchosia cyanosperma Benth.																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Leguminosae-Papilionoideae (*suite*)																																
Rhynchosia aureovillosa Hauman var. humbertii Hauman	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	?	·	·	·	·	·	·	·	·	·	·	·	·
Rhynchosia breviracemosa Hauman	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhynchosia caribaea Auct. non (Jacq.) DC p.p.																																
Rhynchosia goetzei Harms	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhynchosia minima (L.) DC var. prostrata (Harv.) Meikle	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	×	·	·	×	×	·	·	·	·
Rhynchosia hockii De Wild.																																
Rhynchosia nyasica Bak. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·
Rhynchosia resinosa (Hochst. ex A. Rich.) Baker	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhynchosia sublobata (Schum.) Meikle	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhynchosia caribaea Auct. non (Jacq.) DC p.p.																																
Rhynchosia verdickii De Wild.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Sesbania sesban (L.) Merrill	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Stylosanthes mucronata De Wild.	·	·	·	·	·	·	·	?	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	?	·	·	·	·	·	·	·	·
Tephrosia linearis (Wild.) Pers.	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Tephrosia linearis (Wild.) Pers. ssp. discolor (E. Mey.) Gillett	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Tephrosia discolor E. Mey.																																
Tephrosia linearis Auct. non (Wild.) Pers.																																
Tephrosia bracteolata Guill. et Perr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Tephrosia heckmaniana Harms	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Tephrosia bequaertii De Wild.																																
Tephrosia nana Kotschy ex Schweinf.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Tephrosia barbigera Welw. ex Bak.																																
Tephrosia purpurea (L.) Pers. var. pubescens Bak.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Tephrosia purpurea Auct. non (L.) Pers.																																
Tephrosia purpurea (L.) Pers. var. pumila (Lam.) Bak.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	?	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·
Tephrosia vogelii Hook. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Teramnus andongensis (Welw. ex Bak.) Bak. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	×	·	·	·	·	·
Vigna esculenta (De Wild.) De Wild.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vigna fragrans Bak. f.																																
Vigna gracilis (Guill. et Perr.) Hook. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Vigna ulugurensis Harms	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Vigna friesiorum Auct. non Harms																																
Vigna vexillata (L.) Benth.	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Zornia pratensis Milne-Redhead	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Zornia diphylla Auct. non (L.) Pers.																																
Zornia setosa Bak. f. ssp. obovata (Bak. f.) J. Léonard et Milne-Redh.	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Zornia tetraphylla Auct. non Michaux																																
Loganiaceae																																
Strychnos innocua Del. s.s.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Strychnos lucens Baker	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Strychnos spinosa Lam. s.s.	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Strychnos usambarensis Gilg.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·
Loranthaceae																																
Phragmanthera rufescens (DC) Balle	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	×	·	·
Loranthus rufescens DC																																
Viscum hildebrandtii Engl.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Viscum tuberculatum Engl.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Lythraceae																																
Ammania baccifera L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Nesea schinzii Koehne	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols												d.			
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Malvaceae																																
Abutilon angulatum (Guill. et Perr.) Mast.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·
Abutilon asiaticum (L.) G. Don	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Abutilon cabrae Auct. non De Wild. et Th. Dur. p.p.																																
Abutilon hirtum (Lam.) Sweet	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Abutilon cabrae Auct. non De Wild. et Th. Dur. p.p.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Abutilon mauritianum (Jacq.) Medic.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Abutilon cabrae Auct. non De Wild. et th. Dur. p.p.																																
Abutilon indicum (L.) Sweet var. *wittei* Hochr.																																
Hibiscus aethiopicus L. var. helvolus Harv.	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·
Hibiscus aponeurus Sprague et Hutch.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hibiscus calyphyllus Cav.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hibiscus cannabinus L. s.s.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Hibiscus diversifolius Jacq.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Hibiscus fuscus Garcke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hibiscus ferrugineus Auct. non Cav.																																
Hibiscus ludwigii Eckl. et Zeyh.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Hibiscus pycnostemon Hochr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hibiscus vitifolius L. ssp. vulgaris Brenan et Exell.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Kosteletzkya adoensis (Hochst. ex A. Rich.) Mast.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pavonia burchellii (DC) R. A. Dyer	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	×	·	·	·
Pavonia urens Cav. var. variabilis (De Wild.) Hauman	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·
Pavonia urens Auct. non Cav.																																
Sida cordifolia L.	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	×	·	·	·	·	·	·	·	·
Sida ovata Forsk.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Sida rhombifolia L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Melastomataceae																																
Dissotis brazzae Cogn.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Dissotis canescens (E. Mey. et Graham) Hook.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dissotis irvingiana Hook. var. irvingiana f. abyssinica (Gilg) R. et E. Fernandes	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	×	×	·	·
Meliaceae																																
Ekebergia capensis Sparrm.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Ekebergia rueppelliana (Fres.) A. Rich.																																
Melianthaceae																																
Bersama abyssinica Fres s.s.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Menispermaceae																																
Cissampelos mucronata A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	×
Stephania abyssinica (Dill. et Rich.) Walp. var. tomentella (Oliv.) Diels	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Stephania cyanantha Welw. ex Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Tinospora caffra (Miers) Troupin	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Moraceae																																
Dorstenia benguellensis Welw.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Dorstenia schlechteri Engl.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus burkei Miq.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Ficus rupicola Lebrun et Toussaint																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Moraceae (*suite*)																																
Ficus cfr bussei Warb.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus calotropis Lebrun et Toussaint	·	·	·	·	×	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus dekdekena (Miq.) A. Rich.	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus kageensis Lebrun et Toussaint																																
Ficus neurocarpa Lebrun et Toussaint																																
Ficus glumosa Del.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·
Ficus gnaphalocarpa (Miq.) Steud. ex A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus ingens (Miq.) Miq.	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus aff. ingentoides Hutch.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus ovata Vahl	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ficus thonningii Blume	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·
Ficus tropophyton Lebrun et Toussaint	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Myrtaceae																																
Syzygium guineense DC	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·
Nyctaginaceae																																
Boerhavia diffusa L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	·	·	·	×	×	·	·
Commicarpus plumbagineus (Cav.) Standl.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Commicarpus plumbagineus (Cav.) Standl. var. viscosus (Ehr.) Robyns	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Mirabilis jalapa L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Nymphaeaceae																																
Nymphaea lotus L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Nymphaea nouchalii Burm. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Nymphaea coerulea Sav.																																
Nymphaea callianha Conard																																
Nymphaea mildbraedii Gilg.																																
Nymphaea muschleriana Gilg.																																
Ochnaceae																																
Ochna schweinfurthiana F. Hoffm.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Olacaceae																																
Ximenia caffra Sond.	·	·	·	×	·	·	·	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	×	·
Oleaceae																																
Jasminum dichotomum Vahl.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·
Jasminum eminii Gilg.	·	·	·	·	×	×	·	·	×	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·
Jasminum fluminense Vell. s.l.	·	·	·	·	×	·	·	·	×	×	·	·	×	·	·	·	×	×	·	·	×	·	·	·	×	·	·	·	×	·	·	·
Jasminum mauritianum Boj. ex DC																																
Olea africana Mill.	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	·	·	·	·	·	·	·
Olea chrysophylla Lam.																																
Onagraceae																																
Epilobium salignum Hausskn.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×
Epilobium stercophyllum Fres. var. kiwuense (Loes) Brenan	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×
Ludwigia abyssinica A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×
Jussiaea abyssinica (A. Rich.) Brenan																																
Ludwigia prostata Auct. non Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×
Ludwigia adscendens (L.) var. diffusa (Forsk.) Hara	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×
Jussiaea repens L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×
Ludwigia leptocarpa (Nutt.) Hara	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×
Jussiaea leptocarpa Nutt.																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Opiliaceae																																
Opilia celtidifolia (Guill. et Perr.) Engl. ex Walp.	×	·	·	·	×	×	·	·	×	·	·	·	·	·	·	·	×	×	·	·	×	·	·	·	·	·	·	·	·	·	·	·
Oxalidaceae																																
Biophytum petersianum Klotzsch	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	×	·	·	×	×
Oxalis corniculata L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×
Pedaliaceae																																
Sesamum angustifolium (Oliv.) Engl.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	×	×	·	·	·	·	·	·	·	×	·	·	·	×
Phytolaccaceae																																
Phytolacca dodecandra L'Hérit.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	×
Piperaceae																																
Peperomia arabica Miq. var. parvifolia C. DC	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pittosporaceae																																
Pittosporum spathicalyx De Wild.	·	·	·	·	×	×	·	·	×	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·
Plumbaginaceae																																
Plumbago zeylanica L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Polygalaceae																																
Polygala albida Schinz var. angustifolia (Chodat) Exell	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Polygala stanleyana Chodat																																
Polygala petitiana A. Rich.	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×
Polygala sphenoptera Fres. var. sphenoptera																																
Polygala sphenoptera Fres. var. fisheri (Gürke) Petit	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×
Polygala kagerensis Lebrun et Taton	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Securidaca longepedunculata Fres.	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Polygonaceae																																
Oxygonum sinuatum (Hochst. et Steud. ex Meisn.) Dammer	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·
Polygonum pulchrum Blume	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Polygonum salicifolium Brouss. ex Willd.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Polygonum senegalense Meissn. s.l.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Polygonum setosulum A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Polygonum acuminatum H.B.K. p.p.																																
Polygonum quarrei De Wild.																																
Rumex abyssinicus Jacq.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Rumex bequaertii De Wild.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	·
Portulacaceae																																
Portulaca kermesina N.E.Br.	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Portulaca foliola Auct. non Ker.																																
Portulaca oleracea L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×
Talinum caffrum (Thunb.) Eckl. et Zeyh.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Talinum triangulare (Jacq.) Willd.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	×	×	·	·	×	×	·	·	×	×	·	·	·	×
Proteaceae																																
Faurea speciosa Welw.	·	·	·	×	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Protea madiensis Oliv.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols												d. Vertisols			
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Ranunculaceae																																
Clematis hirsuta Perr. et Guill.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Clematis wightiana Auct. non Wall. ex Wight et Arn.																																
Clematis orientalis ssp. *wightiana* Auct. non (W. ex W. et A.) Ktze																																
Clematopsis scabiosifolia (DC) Hu[illegible]	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Clematopsis stuhlmannii (Hie[illegible] Hutch.																																
Rhamnaceae																																
Helinus mystacinus (Ait.) [illegible]ey. ex Steud.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Rhamnus staddo A. Rich.	·	·	·	·	×	·	·	·	×	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Scutia myrtina (Burm. f.) Kurz	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Ziziphus mucronata Willd.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·
Rosaceae																																
Parinari curatellifolia Planch. ex Benth. ssp. mobola (Oliv.) R. A. Graham	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Parinari mobola Oliv.																																
Rubus rigidus Sol.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rubus inedulis Rolfe																																
Rubus inedulis Rolfe var. *discolor* Hauman																																
Rubus pinnatus Willd. var. pinnatus	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rubiaceae																																
Agathisanthemum globosum (Hochst. ex A. Rich) Kl. ex Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	?	·	·	·	?	·	·	·	·
Oldenlandia globosa Hochst. ex A. Rich.																																
Borreria dibracteata (Oliv.) K. Schum.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Borreria stricta (L. f.) C.F.W. Mey.	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Borreria subvulgata K. Schum.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	×	·	·	·	·
Canthium lactescens Hiern	×	×	·	·	×	×	·	·	×	×	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	×	·	·	×	·	·	·
Canthium schimperianum A. Rich.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	×	·	·	×	·	·	·	·	·	·	?
Canthium euryoides Bullock ex Hutch. et Dalz.																																
Canthium vulgare (K. Schum.) Bullock	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Canthium zanzibaricum Klotzsch	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Diodia sarmentosa Swartz	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Crossopteryx febrifuga Benth.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Gardenia jovis-tonantis (Welw.) Hiern	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hymenodyction floribundum (Hochst. ex Steud.) B. L. Robinson	×	×	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Kohautia coccinea Royle	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Oldenlandia abyssinica Hiern	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Mitragyna rubrostipulata (K. Schum.) Hav.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Oldenlandia caespitosa Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Oldenlandia cladens Brem. f. dolichostyla Brem.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·
Oldenlandia scopulorum Bullock																																
Oldenlandia herbacea (L.) Roxb.	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pavetta assimilis Sond.	×	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pavetta rhodesiaca Brem. var. *pubescens* Brem.																																
Pavetta oliveriana Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pavetta ternifolia (L. f.) Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Psychotria lauracea (K. Schum.) E. Petit	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Gramilea bequaertii De Wild.																																
Rubia cordifolia L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Rytigynia beniensis (De Wild.) Robyns	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rytigynia castanea Robyns	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	?	·	·	·	?	·	·	·	·	·	·
Tarenna graveolens (S. Moore) Brem.	×	×	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·
Temnocalyx obovata (N.E.Br.) Robyns	·	·	·	·	·	·	×	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Arénoferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Rubiaceae (*suite*)																																
Tricalysia congesta Oliv. ex Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	·	·	·	×	·	·	·	×	·	·	·
Tricalysia ruandensis Brem.																																
Uragoga suaveolens (Schweinf.) K. Schum.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Vangueria tomentosa Hochst.	×	×	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rutaceae																																
Clausena anisata (Willd.) Hook. f. ex Benth.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Fagara chalybea (Engl.) Engl.	·	·	·	·	×	·	·	·	×	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Teelea nobilis Delile	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Teelea trichocarpa Engl.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Toddalia asiatica (L.) Lam.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Salvadoraceae																																
Salvadora persica L.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Santalaceae																																
Osyris wightiana Wall. ex Wight	×	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·
Osyris arborea Wall.																																
Thesium caespitosum Robyns et Lawalrée	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Sapindaceae																																
Allophylus africanus Beauv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Allophylus alnifolius (Bak.) Radlk.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Allophylus ferrugineus Taub.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Allophylus fulvo-tomentosus Gilg	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·
Allophylus macrobotrys Gilg	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Allophylus orcophilus Gilg	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Allophylus subcoriaceus Bak. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Allophylus africanus Auct. non Beauv.																																
Cardiospermum halicacabum L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·
Haplocoelum gallaense (Engl.) Radlk.	·	·	·	·	×	×	·	·	×	·	·	·	×	·	·	·	×	×	·	·	×	×	·	·	×	·	·	·	×	·	·	·
Pappea ugandensis Bak. f.	×	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Paullinia pinnata L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Scrophulariaceae																																
Buchnera hispida Buch.-Ham. ex D. Don	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Buchnera nuttii Skan	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Craterostigma lanceolatum (Engl.) Skan	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	×	×	·	·	·	×	·	·	×	·
Craterostigma nanum (E. Mey.) Benth.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	×	×	·	·	·	×	·	·	×	×
Dopatrium cfr. dortmanna S. Moore	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hebenstreitia dentata L.	·	·	×	×	·	·	×	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hebenstreitia beauertii De Wild.																																
Hysanthes pulchella Skan	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hysanthes trichotoma Urban	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhamphicarpa hersfeldiana Vatke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·
Rhamphicarpa heuglinii Hochst.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×
Rhamphicarpa brevifolia (De Wild.) Staner	·	·	·	·	·	·	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Sopubia ramosa Hochst.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×
Striga asiatica O. Ktze	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	×	×	·	·	·	×	·	·	·	×	·	·	·	×
Striga bilabiata (Thunb.) O. Ktze	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·
Striga forbesii Benth.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Striga glandulifera Engl.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	×
Striga hermonthica (Del.) Benth.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d.
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Scrophulariaceae (*suite*)																																
Torenia thouarsii (Cham. et Schltr.) O. Ktze	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Torenia parviflora Buch. Ham. ex Wall.																																
Simaroubaceae																																
Harrisonia abyssinica Oliv.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·
Harrisonia occidentalis Engl.																																
Solanaceae																																
Physalis micrantha Link.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·
Physalis divaricata D. Don.																																
Solanum dasyphyllum Thonn.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Solanum indicum L. ssp. indicum (Thonn.) Bitter s.l.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	×	·	·	·
Solanum beniense De Wild.																																
Solanum delagoense Dunal																																
Solanum renschii Vatke	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	·	·	·	×	·	·	·	·	·	·	·
Solanum wittei Robyns																																
Solanum taitense Vatke	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	·	·	·	×	·	·	·
Solanum cyano-purpureum De Wild.																																
Solanum terminale Forsk. ssp. terminale	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·
Solanum bifurcatum A. Rich.																																
Withania somnifera (L.) Dunal	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·
Sterculiaceae																																
Dombeya bagshawei Bak. f.	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dombeya claessensii De Wild.																																
Dombeya burgessiae Gerr. ex Harv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dombeya kirkii Mast.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dombeya rotundifolia (Hochst.) Planch.	·	·	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Dombeya quinqueseta Auct. non (Del.) Exell.																																
Melhania velutina Forsk.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Melhania ferruginea A. Rich.																																
Waltheria indica L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	·
Waltheria americana L.																																
Tiliaceae																																
Corchorus trilocularis L.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	×	·
Grewia similis K. Schum.	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Grewia mollis Juss. var. trichocarpa (Hoscht. ex A. Rich.) Burrett	×	×	·	·	×	×	·	·	×	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Grewia trichocarpa Hochst. ex A. Rich.																																
Grewia bicolor Auct. non Juss.																																
Triumfetta annua L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Triumfetta cordifolia Guill. et Perr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Triumfetta rhomboidea Jacq.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×
Triumfetta bartrania Auct. non L.																																
Ulmaceae																																
Trema orientalis Blume	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Trema guineense (Schum.) Figalho																																
Umbelliferae																																
Diplolophium abyssinicum (Hochst.) Benth.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·
Heteromorpha arborescens Cham. et Schltr	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Umbelliferae (*suite*)																																
Lefebvra cfr benguellensis Welw. ex Hiern	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Lefebvra stuhlmannii Auct. non Engl.																																
Urticaceae																																
Fleurya ovalifolia (Schumach.) Dandy	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Fleurya podocarpa Wedd.																																
Obetia pinnatifida Bak.	·	·	·	·	×	×	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Verbenaceae																																
Clerodendrum myricoides (Hochst.) Vatke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·
Clerodendrum myricoides (Hochst.) Vatke var. *grosserratum* Gürke																																
Clerodendrum rotundifolium Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	·
Lantana rhodesiensis Moldenke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Lantana trifolia L.	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	×	×	×	×
Lantana mearnsii Moldenke s.l.																																
Lantana salviifolia Auct. non Jacq.	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×
Lippia grandifolia Hochst. ex A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Lippia adoensis R. E. Fries																																
Lippia wilmsii H. H. W. Pearson	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	×	·	·	·
Verbena officinalis L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Vitaceae																																
Cissus adenocaulis Steud. var. adenocaulis	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	×	·	·	·	·
Cissus adenocaulis Steud. var. eglandulosa Dewit	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×
Cissus adenocaulis Steud. var. pubescens Dewit	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	×	·	·	·	·	×	·	×	×
Cissus adenocaulis Steud. var. eglanduloso-pubescens Dewit	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Cissus cyphopetala Fres.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cissus quadrangularis L. B.	×	×	·	·	×	·	·	·	×	×	·	·	×	·	·	·	×	·	·	·	×	×	·	·	×	·	·	·	×	×	·	·
Cissus mildbraedii Gilg et Brandt	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Cissus petiolata Hook. f. s.l.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhoicissus erythrodes (Fres.) Planch.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Rhoicissus revoilii Planch.	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	×	·	·	·
Zygophyllaceae																																
Tribulus terrestris L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
MONOCOTYLÉDONES																																
Alismataceae																																
Burnattia enneandra Micheli	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Caldesia reniformis (D. Don) Makino	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Limnophyton obtusifolium (L.) Miq.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Amaryllidaceae																																
Ammocharis tinneana (Kotschy et Peyr.) M.-R. et Schweickerdt	·	·	·	·	·	·	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·
Haemanthus multiflorus Martyn	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Hypoxis angustifolia Lam.	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Hypoxis urceolata Nel.	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·
Hypoxis bequaertii De Wild.																																

I. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Aponogetonaceae																																
Aponogeton abyssinicum Hochst. ex A. Rich.																																
Commelinaceae																																
Aneilema sp. nov. aff. A. nicholsonii C. B. Cl.																																
Aneilema speke C. B. Cl.																																
Commelina benghalensis L.							×																									
Commelina bracteosa Hassk.					×												×	×														
Commelina diffusa Burm. f.							×																									
Commelina erkloniana Kunth																																
Commelina echinulata Lebrun et Taton																																
Commelina sp. nov. aff. C. elgonensis Bullock															×			×	×													
Commelina latifolia Hochst. ex A. Rich.																																
Commelina livingstonii C. B. Cl.																																
Commelina kagerensis Lebrun et Taton																																
Commelina purpurea C. B. Cl. ex Rendle					×	×																										
Commelina ruandensis De Wild.																																
Cyanotis caespitosa Kotschy et Peyr.																																
Cyanotis foecunda DC ex Hassk.																																
Cyanotis somalensis C. B. Cl. s.l.																																
Cyanotis lanata Benth.																	×															
Cyanotis longifolia Benth.																																
Murdannia simplex (Vahl.) Brenan																																
Cyperaceae																																
Bulbostylis atrosanguinea (Boeck.) C. B. Cl.																																
Bulbostylis metralis Cherm.																																
Bulbostylis boeckleriana (Schw.) Beetle							×	×																								
Bulbostylis collina Kunth																																
Bulbostylis densa (Wall.) Hand.-Mazz.							×																									
Bulbostylis filamentosa (Vahl.) C. B. Cl.																																
Bulbostylis cardiocarpa (Ridley) C. B. Cl.																																
§ Eucyperus																																
Cyperus articulatus L.																																
Cyperus auricomus Sieber																																
Cyperus distans L. f.																																
Cyperus dives Del.																																
Cyperus esculentus L.																																
Cyperus latifolius Poir.																																
Cyperus papyrus L. s.l.																																
Cyperus rigidifolius Steud.																																
§ Kyllinga																																
Cyperus brevifolius Rottb.																																
Cyperus purpureo-glandulosus Matte. et Kük.																																
§ Mariscus																																
Cyperus assimilis Steud.																																
Courtoisia assimilis (Steud.) C. B. Cl.																																
Cyperus bequaertii (Cherm.) Robyns et Tournay																																
Cyperus cyperoides (L.) O. Ktze																																
Cyperus dubius Rottb. var. coloratus (L.) Kük.																																
Cyperus leptophyllus Hoschst. ex Krauss																																
Mariscus leptophyllus (H. ex K.) C. B. Cl.																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Aréno-ferrals				c. Kaolsols								d. Vertisols			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol.less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Cyperaceae (*suite*)																																
§ Mariscus (*suite*)																																
Cyperus leptophyllus H. ex K. var. friesii Kük.																			×	×							×					
Cyperus longibracteatus (Cherm.) Kük.																				×												
Cyperus macrocarpus (Kunth.) Boeck.	×		×	×				×			×												×	×								
Cyperus mollipes (C.B.Cl.) K. Schum.																																
Cyperus psilostachys (C.B.Cl.) Kük.				×			×	×																								
Cyperus submacropus Kük.							×	×			×	×							×												×	×
Mariscus macropus (Boeck.) C. B. Cl. var. *abbreviatus* (Kük.) Cherm.																							×				×	×			×	
Cyperus vestitus (Hochst.) C. B. Cl.							×	×			×																					
§ Pycreus																																
Cyperus tremulus Poir.																																×
Fimbristylis dichotoma (L.) Vahl																															×	×
Fimbristylis monostachyos (L.) Hassk.																							×				×	×				
Fimbristylis exilis (O. Ktze) Roem. et Schult. var. brachyphylla (Cherm.) Robyns et Tournay																			×	×												
Fuirena leptostachya Oliv.																																
Fuirena pubescens (Lam.) Kunth																																
Scirpus inclinatus (Del.) Asch. et Schweinf.																																
Dioscoreaceae																																
Dioscorea quartiniana A. Rich.																	×															
Gramineae																																
Andropogon canaliculatus Schum.			×	×			×	×																								
Andropogon dümmeri Stapf																																
Andropogon schirense Auct. non Hochst.											×	×							×	×			×	×								
Aristida adoensis Hochst.												×							×	×												
Aristida adscensionis L. var. guineensis (Trin. et Rupr.) Hubb.																×			×												×	
Beckeropsis uniseta (Nees) Stapf ex Robyns												×							×												×	
Botriochloa insculpta (Hochst. ex A. Rich.) Camus												×																			×	
Brachiaria bovonei (Chiov.) Robyns							×																									
Brachiaria fulva Auct. non Stapf																			×	×												
Brachiaria brizantha (Hochst. ex A. Rich.) Stapf							×																									
Brachiaria dictyoneura (Fig. et De Not.). Stapf							×	×				×																				
Brachiara eminii (Mez.) Robyns																			×	×											×	×
Brachiaria decumbens Stapf																																
Brachiaria platynota (K. Schum.) Robyns																			×	×												
Brachiaria semiundulata (Hochst. ex A. Rich.) Stapf																				×												
Cenchrus ciliaris L.																							×									
Chloris gayana Kunth																			×	×												
Chloris pycnothrix Swartz																															×	×
Chloris virgata Swartz																							×				×					
Ctenium concinnum Pilger var. indutum Pilger																																
Cymbopogon afronardus Stapf							×																									
Cynodon dactylon (L.) Pers.							×	×											×	×							×	×				
Dactyloctenium aegyptium (L.) Beauv.																				×											×	×
Dactyloctenium aegyptiacum (L.) Willd.																																
Digitaria longiflora (Retz.) Pers.			×	×																												
Digitaria maitlandii Stapf et Hubb.							×	×											×	×												
Digitaria maitlandii Stapf et Hubb. var. glabra Van der Veken																				×												
Digitaria velutina (Forsk) Beauv.																																
Digitaria horizontalis Auct. non Willd.																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Arénoferrals				c. Kaolisols								d. Vertisol			
	G-G				S-Q				P-Sl.								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Gramineae (*suite*)																																
Digitaria vestita Fig. et De Not. var. scalarum (Schw.) Henrard	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×
Echinochloa aristifera (Peter) Robyns et Tournay	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Echinochloa colonum (L.) Link.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Echinochloa crus-pavonis (Kunth.) Schultes	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Echinochloa equitans (Hochst. ex A. Rich.) C. E. Hubb.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Echinochloa pyramidalis (Lam.) Hitch. et Chase	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Echinochloa stagnina (Retz.) Beauv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Eleusine africana Kennedy O'Byrne	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×
Elyonurus argenteus Nees	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	×	·	·	·	×
Eragrostis atrovirens (Desv.) Trin. ex Steud.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis chapelieri (Kunth) Nees	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis cilianensis (All.) F. T. Hubb.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis hispida K. Schum.	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis paniciformis (R. Br.) Steud.	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis patens Oliv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis racemosa (Thunb.) Steud.	·	·	·	·	·	·	×	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis chalcantha Trin.																																
Eragrostis schweinfurthii Chiov.	·	·	·	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis cfr squamata (Lam.) Steud.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eragrostis tenuifolia (A. Rich.) Hochst. ex Steud.	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×
Eragrostis sp. nov.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Eulalia geniculata Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Eustachys paspaloides (Vahl) Lanza et Mattei	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Harpachne schimperi Hochst. ex A. Rich.	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Heteropogon contortus (L.) Roem. et Schult.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hyparrhenia collina (Pilger) Stapf	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×
Hyparrhenia cymbaria (L.) Stapf	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hyparrhenia diplandra (Hack.) Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Hyparrhenia dissoluta (Nees ex Steud.) C. E. Hubb ex Hutch.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hyparrhenia filipendula (Hochst.) Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	×	·	·	·	·	·	·	·	·	×
Hyparrhenia filipendula (Hocsth. Stapf var. pilosa (Hack.) Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	×	·	·	·	·	·	·	·	·	×
Hyparrhenia gazensis (Rendle) Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hyparrhenia lecomtei (Franch.) Stapf	·	·	×	×	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hyparrhenia rufa (Nees) Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Hyparrhenia variabilis Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Imperata cylindrica Beauv. var. africana C.E. Hubb.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Leersia hexandra Sw.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Loudetia simplex (Nees) C. E. Hubb.	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·
Loudetia arundinacea Auct. non (Hochst.) Steud.																																
Melinis minutiflora Beauv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Melinis tenuissima Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Microchloa kundtii Desv.	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Microchloa indica Auct. non (L.) Beauv.																																
Miscanthidium (K.Schum.) Robyns	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Oplismenus compositus (L.) Beauv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Oryza barthii Chev..	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Panicum atrosanguineum Hochst.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Panicum brevifolium L.	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	·	·	·	·	·	·	·	·	·	·	·
Panicum deustum Thunb.	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·
Panicum massaiense Mez.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Panicum maximum Jacq.	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	×	×	·	·	×	×	·
Panicum repens L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Panicum trichocladum Hack. ex K. Schum.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Arénoferrals				c. Kaolisols								d. Vertisols			
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.							
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Gramineae (*suite*)																																
Panicum sp.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Paspalum commersonii Lam.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Paspalum polystachyon R. Br.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Pennisetum polystachyon (L.) Schultes	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	·
Pennisetum purpureum Schum.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Pennisetum trisetum Leeke	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·
Perotis patens Gandoger var. parvispiculata C. E. Hubb.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Rhynchelytrum repens (Willd.) C. E. Hubb.	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·
Setaria anceps Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	×
Setaria kagerensis Mez.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·
Setaria kiabaensi Vanderyst	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Setaria longiseta Beauv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·
Setaria plicatilis (Hochst.) Hack.	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Setaria sphacelata (Schum.) Stapf et Hubb.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×
Setaria splendida Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
Setaria thollonii (Franch.) Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Setaria trinervia Stapf	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Setaria verticillata (L.) Beauv.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Sorghum verticilliflorum (Steud.) Stapf	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Sporobolus marginatus Hochst. ex A. Rich.	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Sporobolus pyramidalis Beauv.	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Sporobolus stapfianus Gandoger	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	·
Sporobolus festivus Hochst. var. *fibrosus* Auct. non Stapf																																
Themeda triandra Forsk. s.l.	·	·	·	×	·	·	×	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·
Tragus berteronianus Schultes	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·
Trachypogon plumosus Nees	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Trachypogon cfr planifolius Stapf	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Trachypogon sp. nov.	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Iridaceae																																
Gladiolus psittacinus Hook.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·
Gladiolus quartinianus A. Rich.																																
Liliaceae																																
Albuca angustibracteata De Wild.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	×	×
Albuca fibrillosa De Wild.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·
Albuca katangensis De Wild.	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·
Albuca nigritana (Baker) Troupin	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	×	·
Aloe lateritia Engl.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	×	·	·	·
Aloe angiensis De Wild.																																
Aloe macrosiphon Baker	·	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	×	·	·
Aloe sp. 2																																
Aloe myriacantha Schult.	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Aloe graminifolia Auct. non Berger																																
Aloe volkensii Engl.	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·
Aloe sp. 1																																
Anthericum elgonense Bullock	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Anthericum oatesii Baker	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·
Anthericum malosanum Auct. non Baker	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	×	×	·
Anthericum subpetiolatum Baker	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	·	·	·	×	×	·	·	×	×
Anthericum uyuiense Rendle	·	·	·	·	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	×	·	·	×	×	·	·	·	·
Anthericum speciosum Rendle																																
Asparagus abyssinicus Hochst. ex A. Rich.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	×	·	·	×	·
Asparagus falcatus L.	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	×	·	·	·	×	×	·	·	×	·	·	·
Asparagus subfalcatus De Wild.																																

1. Genres et Espèces	5. Habitat																							
	a. Lithosols - Sols récents												b. Arénoferrals				c. Kaolisols								d.
	G-G				S-Q				P-SL								Ferrisols				Ferralsols				Kaol. less.				Vertisols			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Liliaceae (*suite*)																																
Asparagus mitis A. Rich.	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Asparagus racemosus Willd.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	×	×	·	·	·	×	·	·	×	×
Bulbine asphodeloides (L.) Spreng	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	×	·	·	·	·	·	·	·	·
Chlorophytum bequaertii De Wild.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Chlorophytum beniense De Wild.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·
Chlorophytum blepharophyllum Schw. ex Baker	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Delesia minor (De Wild.) Robyns et Tournay	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dipcadi longifolium Baker	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Gloriosa simplex L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	×	·	·	·	·	·	·	·	·	·	×	·	·	·
Sansevieria gracilis N. E. Br.	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·
Sansevieria parva N. E. Br.	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Urginea altissima (L. f.) Baker	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Orchidaceae																																
Aerangis bilola (Lindl.) Schltr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Ansellia gigantea Rchb. f. var. nilotica (Baker) Summerh.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Cyrtorchis ringens (Rchb. f.) Summerh.	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Diaphananthe fragrantissima (Rchb. f.) Schltr.	·	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eulophia cucullata (Afz.) Lindl. ex Steud.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Eulophia livingstoniana (Rchb. f.) Schltr.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Eulophia orthoplectra (Rchb. f.) Summerh.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Eulophia parvula (Rendle) Summerh.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·
Eulophia pyrophila (Rchb. f.) Summerh.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·
Eulophia subulata Rendle	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Eulophia zeyheri Hook. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	×	×	·	·	·	·
Microcoelia guyoniana (Schb. f.) Summerh.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Polystachya modesta Rchb. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pteroglossaspis eustachya Rchb. f.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Palmaceae																																
Phoenix reclinata Jacq.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Typhaceae																																
Typha angustifolia L.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Zingiberaceae																																
Aframomum sanguineum K. Schum.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×
PTÉRIDOPHYTES																																
Adiantaceae																																
Pellaea leucomelas (Matt.) Bak.	×	×	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Pellaea hastata (Thunb.) Prantl																																
Aspleniaceae																																
Asplenium stuhlmannii Hieron.	·	·	×	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Asplenium praemorsum Auct.																																
Loxoscaphe theciferum (Hook. et Bak.) Moore	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	·	·	·
Asplenium cornutum Alston																																
Davalliaceae																																
Arthrapteris orientalis (Gmel.) Postil.	·	·	·	×	·	·	·	×	·	·	·	×	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Dennstaedtiaceae																																
Pteridium aquilinum (L.) Kuntl	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	×	×	·	·	·	·	·	·	·	·	·	·	·	·
Pteridium aquilinum (L.) Kuntl var. *lanuginosum* (Bory) Hook.																																

APPENDIX IV

Faunal Surveys

1. Fish of Lake Ihema
2. Reptiles of Akagera National Park
3. Birds of Akagera National Park and Mutara Hunting Reserve
4. Birds of the Lake Kivu Region
5. Birds of the Rugege-Nyungwe Forest
6. Mammals of Akagera National Park
7. Mammals of Volcano National Park
8. Mammals of Rugege-Nyungwe Forest

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1. Fish of Lake Ihema

Classe des *TELEOSTOMI*.

Sous-classe des ACTINOPTERYGII.

— Ordre des CLUPEIFORMES (ISOSPONDYLI).

Famille des MORMYRIDAE.

Genre : *Mormyrus* Linne, 1758.

1. *Mormyrus kannume* Forskall, 1775.
   Gnathonemus Gill, 1862.
2. *Gnathonemus longibarbis* Hilgendorf, 1888.
   Marcusenius Gill, 1862.
3. *Marcusenius cyprinoides* (L., 1758).
4. *Marcusenius victoriae* (Worthington, 1929).
   Hippopotamyrus Pappenheim, 1906.
5. *Hippopotamyrus grohami* (Norman, 1928).

— Ordre des CYPRINIFORMES (OSTARIOPHYSI).

Sous-ordre des CYPRINI.

Famille des CHARACIDAE.

Genre : *Alestes* Muller et Troschel, 1846.

6. *Alestes nurse* (Ruppell, 1832).
7. *Alestes sadleri* BLGR, 1906.

Famille des CYPRINIDAE.

Genre : *Barbus* Cuvier et Cloquet, 1816.

8. *Barbus aff. altianalis* BLGR., 1900.
9. *Barbus acuticeps* Matthes, 1959.
10. *Barbus aff. somereni* BLGR, 1911.

Genre : *Labeo* Cuvier, 1817.

11. *Labeo victorianus* BLGR., 1901.

Sous-ordre des SILURI.

Famille des CLARIIDAE.

Genre : *Clarias* Scopoli, 1777.

12. *Clarias mossambicus* Peters, 1852.

Famille des SCHILBEIDAE.

Genre : *Schilbe* Cuvier, 1817.

13. *Schilbe mystus* (L., 1758).

Famille des MOCHOCIDAE.

Genre : *Synodontis* Cuvier, 1817.

14. *Synodontis afro-fischeri* Hilgendorf, 1888.

— Ordre des CYPRINODONTIFORMES (MICROCYPRINI).

Famille des CYPRINODONTIDAE

Genre : *Aplocheilichthys* Bleeker, 1863.

15. *Aplocheilichthys pumilus* (BLGR., 1906).

— Ordre des PERCIFORMES (PERCOMORPHES).

Famille des CICHLIDAE.

Genre : *Tilapia* A. Smith, 1840.

16. *Tilapia nilotica* (Linné) *eduardiana* Poll, 1932.
17. *Tilapia variabilis* BLGR., 1906.
18. *Tilapia esculenta* Graham, 1928.
19. *Tilapia rendalli* BLGR., 1896.

Genre : *Haplochromis* Hilgendorf, 1888.

20. *Haplochromis nubilus* (BLGR.. 1906).
21. *Haplochromis aff. pellegrini* Regan.

— Ordre des MASTACEMBELIFORMES (OPISTHOMI).

Famille des MASTACEMBELIDAE.

Genre : *Mastacembelus* Scopoli, 1777.

22. *Mastacembelus frenatus* BLGR., 1901.

Source: Kiss. 1977.

2. Reptiles of Kagera National Park

Latin Name	English Name
Naja nigricollis nigricollis	spitting cobra
Dendroaspis angusticeps	black mamba
Python sebae	python
Psammophis sibilans	beauty snake
Chlorophis heterodermus	green tree snake
Typhlops blanfordii	boot lace snake
Varnus niloticus	Nile monitor lizard
Crocodylus niloticus	Nile crocodile
Boulengezina annulata	?

Source: IUCN.. 1977.
Nordconsult-Electrowatt. 1976.
Spinage. 1969/70.

3. Birds of Akagera National Park and Mutara Hunting Reserve

Hagedashia hagedash
Excalfactoria adansoni
Turtur afer
Stimatopelia senegalensis
Streptopelia capicola
S. semitorquata
Teron calva
Chrysococcyx caprius
C. Klass
Gymnoschizornis pereonata
Melittophagus pusillus
Apus apus
Colius striatus
Urocolius macrourus
Tricholaema lacrymosum
Pogonornis bidentatus
Indicator minor
I. indicator
I. variegater
Thriapus namaquus
Macronyx croceus
Pymonotus tricolor
Phyllastrephus fischeri
Campephaga phoenicea
Erythropygia hartlauki
Cossypha heuglini
Cercomela familiaris
Phoenicurus phoenicurus
Eminia lepida
Camaroptera brevicaudata
Asticola woosmani
Cisticola cantars
C. robusta
Prinia subflava
Schoenicola brevirostis
Sylvia borin
S. communis
Acrocephalus scirpaceus
Phylloscopus trochilus
Melaenornis pammeliana
Batis molitor
Platysteira cyanea
Terpsiphone viridis
Riparia cincta
Hirundo rustica
Cecropis daurica
Dicruris adsimilis
Nilous afer
Tschagra senegala
Chlorophoneus sulfureopectch
Lamiarius ferrugineus
Lanius collurio
Oriolus larvatus
Creotophora cinerea
Cyanomitra verticalis
Cinnylis cupresus
C. bifasciatus
Othyphantes baglafecht
Textor cucullatus
T. intermedius
T. melanocephalus
T. xanthops
Hyphanturgus nigricollis
Quelea cardinalis
Quelea quelea
Euplectes ardens
Euplectes hordaceus
E. azix
E. axillaris
E. albonolatus
Lagonosticta rubricata
Uraenginthus bengalus
Pytilia melba
Estrilda astrild
Estrilda preludicola
Spermestes bicolor
S. cucullatus
Ochrospiza citrinelloides
O. mozambica
Crithogna sulphurata
Emberiza flavientus

Source: Kunkel and Kunkel. 1970.

4. Birds of the Lake Kivu Regio

Tauraco schüttii
Corythornis picta
Melittophagus gularis
Colius striatus
Pogoniulus rubsulphureus
Smithornis sharpsi
Andropadus latirostris
Pycnonotus barbatus
Phyllastrephus xavieri
Nicator chloris
Malococinda rufipennis
Muscicapa adusta
Camaroptera brevicaudata
Cisticola anonyma
C. chubbi
C. erythrops
Prinia leucopogon
Bathmocercus rufus
Chloroptera natalensis
Cossypha nieicapilla
Erannornis albicauda
Terpsiphone bedfordi
T. viridis
Poliospiza striolata
Parus funereus
Nectarinia alinae
N. batesi
N. cyanolaema
N. olivacea
N. verticalis
N. chloropygia
N. minulla
N. preussi
N. superba
N. purpureiventris
Ploceus melanocephalus
P. nigerrimus
Malimbus nitens
Euplectes hordaceus
Pirenestes astrinus
Estrilda atricapilla

Source: Prigogine. 1972.

5. Birds of the Rugege-Nyungwe Forest

Accipiter rufiventris
Francolinus nobilus
Tympanistria tympanistria
Columba arquatrix
Coythaeola cristata
Ruwenzornis johnstonii
Melittophagus oreobates
Phoeniculus bollei
Tockus alboterminatus
Bycanistes subcylindricus
Coleus striatus
Pogoniulus billineatus
P. leucolaema
Campethero taeniolaema
Andropadus latirostris
Arizelocichla tephroloema
Pymonotus tricolor
Phyllastrephus flaviostriatus
Malacocincla poliothorax
Pseudalcippe atriceps
Alethe poliophrys
Sheppardia aequatoriallis
Bessonomis archeri
Pogonocichla stellata
Saxicola torquata
Geokichla piagqiae
Turdus abyssinicus
Sylvietta leucophrys
Apalis binotata personata
A. porphyrolaema
A. ruwenzorii
Cisticola chubbi
Prinia bairdi
Bradypterus cinnamomus
Bradypterus lopezi
Sylvia borin
Seicerus laetus
Chloropeta sinilis
Dioptornis fischeri
Alseonax adustus
Batis diops
Terpsiphone viridis
Delichon urbica
Psalidoprogne holomelaena
Telophorus dohertyi
Laniarius poensis
Dryoscopus gambensis
Parus fasciventer
Couris albicollis
Onychognathus tenuirostris
Zosterops senegalensis
Anthreptes collaris
Nectarinia alinae
N. verticalis
N. olivacea
N. purpureiventis
Cinnyris after
C. reichenowi
C. regius
Othyphantes baglafecht
Hyphanturgus allenus
Cryptospiza jacksonii
Estrilda atricapilla
Nigrita canicapilla
Ochrospiza citrinelloides
Poliospiza burtoni
P. streolata

Source: Kunkel and Kunkel. 1969.

6. Mammals of Kagera National Park

Cercopithecus aethiops
C. mites
Papio doguera
Lycaon pictus

Crocuta crocuta

Felis serval
Pantherapardus
Panthera leo

Loxodonta africana

Dendrohyrax brucei

Diceros bicornis
Equus burchelli
Potamochoerus porcus
Hylochoerus meinertzhageni
Phacochoerus aethiopicus
Hippopatamus amphibius
Ourebia ourebi
Oreotragus oreotragus
Redunduca redunduca
Kobus defassa
Aepyceros melampus

Taurotragus oryx
Tragelaphus spekei
Tragelaphus scriptus
Hippotragus equinus
Damaliscus korrigum
Sylvicapra grimmia
Cephalophus nigrifrons
Syncerus caffer

Hydrictis maculicollis
Attilox poludinosis

Source: Spinage. 1969.
Nordconsult-Electrowatt. 1976. v.5
IUCN. 1977.

7. Mammals of Volcano National Park

Gorilla gorilla berengei
Pan troglodytes
Cercopithecus ascanius
C. mitis

Poecigale albinucha
Crocuta crocuta
Laphuromys woosmani
Cricetomys gambianus

Suncus ruandae

Chlorotalpa leucorhina

Herpestes ichnuemon

Felis serval
Panthera pardus
Felis aurata
Genetta tigrius

Loxodonta africana

Dendrohyrax arboeus

Potamchoerus porcus

Hylochoerus meinertzhageni

Tragelaphus scriptus
Boocerus euryceros
Cephalophus nigrifrons
Cephalophus sylvicultor
Syncerus caffer

Source: Spinage. 1970, 1972.

8. Mammals of Rugege-Nyungwe Forest

Pan troglodytes
Cercopithecus mitis
Cercopithecus lohestis
Cercopithecus monus
Colobus magistratus

Cephalophus sylvicultor
Cephalophus nigrifrons
Cephalophus spadix
Loxodonta africana
Syncerus caffer
Tragelaphus scriptus

Panthera pardus
Civettictis civetta
Felis serval

Source: ORTPN. 1976.

Appendix V

Environmental Law

1. Water Law
2. Soils Law
3. Flora Law
4. Fauna Law
5. Objectives of the Rwandese Office of Tourism and National Parks
6. Suggested National Parks Law, 1970

1. Water Law

1. Agreement between the Belgian Government and the Government of the United Kingdom of Great Britain and Northern Ireland regarding Water Rights and the Boundary between Tanganyika and Rwanda-Urundi, signed at London, 22 November 1934, C.L.B. 699 1/

2. Civil Code, Livre II, ss. 16-20, 26, 27, C.L.B. 53

3. Criminal Code, s. 144, C.L.B. 180

4. Judiciary Code, ss. 137, 149, C.L.B. 221

5. Legislative Ordinance 409/TP/U.N., 30 November 1943, Inquiry Commission on Rivers and Lakes Navigation, C.L.B. 832.

6. Decree-Law 1/196, 2 October 1968, Regideso, C.L.B. 703.

7. Order of 9 August 1893, Sale and Renting of Public Ownership, s. 7, C.L.B. 953.

8. Order of 12 July 1932, Fishing Grants Regulations, c. I, III, C.L.B. 616.

9. Order of 21 April 1937, Hunting and Fishing, c. II, III, C.L.B. 606.

10. Order of 5 January 1949, Sales Taxes, ss. D., C.L.B. 939.

11. Order of 6 May 1952, Servitudes on Ground Waters, Rivers and Lakes, and Respecting Their Uses, C.L.B. 694.

12. Order of 6 May 1952, Rivers and Lakes Waters Administration and Grants, C.L.B. 697.

13. Ordinance, 17 October 1911, Packaging, Preparation and Manufacture of Foods, C.L.B. 548.

14. Ordinance 127/6, 15 June 1913, Regulation Respecting Buildings in Urban Areas, C.L.B. 629, ss. 7-16, 31.

15. Ordinance of 1 July 1914, Rivers, Lakes, Sources Pollution and Contamination, C.L.B. 698.

16. Ordinance 5/TP of 25 December 1924, Lakes Navigation Policy and Survey, C.L.B. 836.

17. Ordinance 79/A.E. of 2 October 1930, Mineral Waters, Lemonades, Extracts or Syrups for Drinking or to be mixed with Waters in order to produce Lemonades, C.L.B. 700.

18. Ordinance 375/Hyg. of 10 October 1940, Health, C.L.B. 741.

19. Ordinance 52/442 of 21 December 1952, Local Associations provided for in Decree of 6 May 1952 dealing with Servitudes respecting Rivers, Lakes and Underground Waters, C.L.B. 696.

20. Ordinance 52/443, 21 December 1952, Provisions in order to preserve Sources, Aquifers, Lakes and Rivers, to prevent Water Waste and Pollution, to control Use Rights and Granted Occupancy Rights, C.L.B. 699.

21. Ordinance 64/560 of 22 December 1958, Navigation Policy and Survey - Measures of Waterways, Works and Harbour Structures Conservation, C.L.B. 839.

22. Ordinance 44/139 of 11 March 1959, Rates respecting Lands, Mines, Water-flow, and Registry of Land Titles, C.L.B. 102, s. V.

23. Ordinance 42/12 of 9 January 1950, Private Properties Measure and Marking out, C.L.B. 98.

24. Ordinance 74/335 of 28 June 1959, Public Health in Urban Communities, C.L.B. 738 annexe.

25. Rwanda-Urundi Ordinance 41/78 of 28 May 1956, respecting Unhealthy and Dangerous Buildings, C.L.B. 716.

26. Rwanda-Urundi Ordinance 5520/186, Ruzizi Fishing Regulation, C.L.B. 619.

27. Rwanda-Urundi Ordinance 221/259 of 13 December 1958, Water Sports Regulation, C.L.B. 843.

28. Rwanda-Urundi Ordinance 111/23 of 18 January 1961, Drinking Water Supply Restrictions, C.L.B. 741.

2. Soils Law

1. Decree Law No. 1/72, 1967. Abrogates Ordinance No. 551/254, 1959 which created a Rwanda-Burundi Soil Committee and institution instead a national soil committee.

2. Decree, 1958. Conservation and Utilization of Soils.

Johnson et al. 1977.

3. Flora Law

1. Ord. 52/175, 1953. Bush fires.

2. Decree 1930. Regulates cutting of wood.

3. Decree 1926. Protection of *Elaeis* palms.

4. Leg. Ord. 29/129, 1923. Protection of *Santal*.

5. Ord. 53/15, 1915. Rule for conservation and preservation of trees.

Source: Johnson et al. 1977.

4. Fauna Law

1. Ord. 52/82, 1965. Protection of Zebra and Black Buffalo.

2. Ord. 52/67, 1954. Protection of Tendunca arundinum Antelope.

3. Ord. 52/88, 1951. Protection of Cheetah.

4. Ord. 35/Agri., 1942. Protection of *Francolinus camerunensis*.

5. Ord. 33/Agri., 1939. Protection of the "*Rouanne*" Antelope.

6. Ord. 050/139, 1969. Regulation of hunting and protection of specific species.

7. Decree 1937. Hunting and fishing.

8. Ministerial Decree 050/348, 1964. Closing of hunting in the Ruzizi Plain.

9. Ord. 5520/237, 1958. Closing of hunting.

10. Ord. 52/111, 1956. Prohibition of bird hunting, on Rwihinda Lake.

11. Ord. 52/79, 1955. Prohibition of use of certain hunting implements.

12. Ord. 103/Agri., 1937. Hunting, fishing and protected animals Decree 1937.

13. Ord. 53/Agri., 1934. Fight against invasions of locusts.

14. Ord. 52/160, 1955. Regulates fishing in certain lakes.

15. Ord. 52/25, 1955. Prohibition of fishing in a certain manner.

16. Ord. 326/Agri., 1947. Prohibition of introduction of strange fish species to local fauna. Ord. 18/Agri., 1944.

Source: Johnson et al. 1977.

5. Objectives of the Rwandese Office of Tourism and National Parks

1. To promote tourism and to use all means likely to contribute to the development of tourism, including:

   a) To promote and make known, the natural beauty and folkoristic interest of Rwanda

   b) To collaborate with, and coordinate the efforts of public and private groups, business, artisan's and folklore associations, etc. which are active in the domain of tourism

   c) To establish contact with tourist offices and travel agencies on other countries, particularly those neighboring to Rwanda

   d) To collaborate with the information services to promote awareness of the country

   e) To seek out aid to encourage investments in tourism, particularly in hostelry, by aiding syndicates and individuals, public and private groups, in their dealings with local authorities.

2. To assure the conservation of nature, particularly flora and fauna, to promote scientific research and to encourage tourism, to the degree that these two activities are compatible with the protection of the environment.

3. To manage the buildings and equipment placed in service of its objectives.

4. To propose to the Government, the negotiation of accords or convention directly or indirectly concerned with the protection of nature and with tourism.

5. To determine the sites or structures of historic scientific, archaeological or touristic value and to propose they be so classified.

Two Presidential decrees have further clarified the objectives of the ORTPN.

1. It is forbidden to possess, transfer or offer for sale any trophy which is not accompanied by a certificate of legitimate possession which only the office may issue.

   Under the terms of this decree, the poaching of leopard, zebra, colobus monkey and lava rats have been slowed.

2. The office shall annually fix a hunting quota for each species and for each hunting territory in light of an annual census of the species in question.

Source: ORTPN. 1976.

6. Suggested National Parks Law, 1970

The following national park laws was suggested by C.A. Spinage (Spinage 1969/70), a consultant employed by the Government of Rwanda to report on the ecology of Rwanda's national parks and make recommendations for their management. This law is a suggestion only; it is not known to have been implemented.

Definition

The National Parks of Rwanda are those areas set aside for the preservation of the natural environment; its geology, soils, waters, flora and fauna, and which is held in trust by the people of Rwanda for the benefit of the people of Rwanda and for all mankind, who pledge themselves to conserve these areas for posterity with all means at their disposal.

1. The Government of Rwanda is charged with protecting the flora and fauna of its parks, encouraging scientific research in them and encouraging tourism in so far as it is compatible with the protection of nature.

2. The areas set aside as National Parks shall be those shown in sections 12 and 13 of this law. Their limits, fixed by law, can only be amended by another law.

3. All areas designated as national parks will be areas in which all human habitation, animal husbandry, agriculture or any other human activity is forbidden, excepting where such habitation or human activity concerns the administration of the parks or the furtherance of their aims as specified in section 1.

4. The administration of the National Parks will be the responsibility of the Ministère de l'Information et du Tourisme (or the Ministère de l'Agriculture et de l'Elevage).

5. In the National Parks it is forbidden:

a. to chase, hunt, capture, destroy, frighten or annoy, in any fashion whatsoever, all species of wild animals and even, except in the case of legitimate defence, animals classed as vermin.

In the case of an animal being wounded or killed in legitimate defence a declaration must be made, without delay, to the competent authority. It is incumbent upon the party concerned to establish proof that it was a case of legitimate defence and that there was no provocation, either directly or indirectly, for the aggression of which the party claims to have been victim of. In default of satisfactory proof the party will be guilty of an offence under this present law. Animals wounded outside of the parks, whether classified as dangerous or not, may not be pursued into a park without the prior consent of the park authorities.

b. To take or destroy eggs or nests.

c. To fell, destroy, uproot or pull up plants or uncultivated trees.

d. To introduce any species of animal or plant unless authorised to do so.

e. To make ditches, banks, borings, samplings of materials and all other works of a nature to modify the aspect of the terrain or the vegetation except in connection with the aims of section 1.

f. To introduce dogs, spears, bows and arrows or firearms.

g. To drive or walk except in such places as specified by the authorities.

h. To camp or stay except in such places as authorised by the authorities.

i. To catch fish unless authorised by the authorities.

6. "The authorities" will be the Director of the National Parks of Rwanda, appointed by the Minister responsible for administering the national parks; or the conservator in charge of a park when so deputed to act by the Director.

7. Requests for scientific studies to be carried out within a national park shall be made in writing to the Director who will convene a twice-yearly committee to consider such applications. Such committee should comprise the Director of National Parks, the Director of the Institut National de Recherche Scientifique, the Principal of the University of Butare, the Director of Tourism and two other responsible members. It shall be the duty of such committee to assist the Director in arriving at his decision. Should an application be refused the applicant shall have the right of appeal to each member of the committee.

8. If an approved application for scientific research is in the interests of the National Parks then the Director has the right to waive all or such fees as he thinks fit.

9. Visitors to the national parks are required to pay a statutory entrance fee and any other fees as may from time to time be decreed by an order of the Minister. Visitors must be in possession of an authorised receipt for such fees.

10. The statutory fees shall be as follows:.....

Fees may be waived at the discretion of the Director.

11. It is forbidden for visitors to:

a. lodge in the park except in authorised places and upon payment of the statutory fees.

b. To light fires except in authorised places.

c. To drive in the park between 1830 hours and 0600 hours.

d. To leave any rubbish whatsoever.

e. To cause fires through carelessness, or to throw away lighted cigarette ends.

f. To damage or misplace signs or any other park property whatsoever.

g. To ignore such rules and directions as may from time to time be instituted by the conservator or his representative.

12. The limits of the Akagera National Park shall be as follows: (to be determined and to constitute one category, ie no territoire annexe).

13. The limits of the Volcano National Park shall be as follows: (to be re-surveyed).

14. This law shall be deemed to supersede any other law in so far as the capture or hunting of animals within the National Parks of Rwanda is concerned, and any other laws dealing with the delimitation, organisation and administration of the national parks.

15. Any infringement of this law shall constitute an infringement of the laws of Rwanda and shall render the person or persons liable to .....

Except in the case of section 11 d. concerning the casting of litter where the conservator or such persons within the parks' employ as authorised by the conservator, shall be entitled to demand and receive payment of a 1,000 RwFr fine on the spot, for which an official receipt shall be issued.

Source: Spinage 1969/70.

Appendix VI

Organizations Concerned with Development and Environmental Policy

1. Association Rwandaise des Compagnons Batisseurs. B.P. 454, Kijali.

   Interested in alternative cements and building materials, devising applications for papyrus, and glue manufacture from animal waste.

2. Centre d'Études et d'Applications de l'Energie au Rwanda (CEAER) Départment de Physique, Université Nationale du Rwanda, Butare

   Studies of solar energy applications of Girardier solar pump, construction of Pelton Wheel for small-scale power production, distillation, irrigation chambers and water heaters.

3. L'Institut des Sciences Agronomiques du Rwanda (ISAR). B.P. 138, Butare.

   Research and development of subsistence and export crops.

4. Office de Cultures Industrielles du Rwanda (OCIR). B.P. 104-1344, Kigali.

   Concerned with control of existing production and development of new industrial cultigens.

5. Office Rwandaise du Tourisme et des Parcs Nationaux (ORTPN). B.P. 905, Kigali.

Sources: Europa. 1977.
UNEP. 1979.

Appendix VII

Current U.S. AID Projects

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PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: RWANDA
PROJECT TITLE: REDUCTION OF FOOD WASTAGE

PROJECT: 69A0101 SUB-PROJECT: 00
INITIAL FY: 75 FINAL FY: 76

PROBLEM: 25% WASTAGE OF FOOD DURING STORAGE, WIDE PRICE FLUCTUATION, AND THE HIGHEST DEMOGRAPHIC DENSITY IN AFRICA PRODUCE NEED FOR BETTER CONSERVATION OF FOOD.

STRATEGY: PROVIDE TECHNICAL ASSISTANCE AND TRAINING. DESIGN, CONSTRUCT, AND EQUIP 4 SMAL. STORAGE UNITS AND RELATED FACILITIES IN 6 LOCATIONS. PROVIDE WORKING AND OPERATING CAPITAL FOR MARKET INTERVENTION SYSTEM.

SUMMARY: 50% OF HARVESTED CROPS ARE SUN-DRIED AND HELD IN MUD AND THATCH HUTS WHERE DEPREDATIONS OF HUMIDITY, RODENTS AND INSECTS CONSTITUTE A 25% LOSS. CATHOLIC RELIEF SERVICES CONTRACTED TO CONSTRUCT MORE VIABLE SILOS AT 4 OF ITS MISSIONS. LOCAL TECHNICAL EXPERTISE WAS OBTAINED, THE SILOS CONSTRUCTED AND A SEASONAL IMPLEMENTATION FOR THE PURCHASE OF BEANS AND SORGHUM CONCEIVED. AN OPERATIONAL FUND OF $7000 WAS ALLOTED TO EACH MISSION WHICH WAS RECOUPED AT TIME OF SALE. THE PROFITS OF EACH SALE WERE HELD TO A SPECIFIED AMOUNT WHICH REDUCED SPECULATION BY TRADERS.

GOAL: INCREASE THE AVAILABILITY OF AGRICULTURAL FOOD PRODUCTS AT A RATE FASTER THAN THE RAPID POPULATION GROWTH AND THUS RAISE AVERAGE NUTRITIONAL LEVELS IN RWANDA.

PURPOSE: DEVELOP AN ECONOMICALLY EFFICIENT PRICE STABILIZATION SYSTEM FOR MAJOR FOOD CROPS, PARTICULARLY IN AREAS OF PROJECT OPERATION BUT WITH NATION-WIDE EFFECTS AS WELL. SYSTEM SHOULD BE SUITABLE FOR EXPANSION TO OTHER FOOD CROPS.

OUTPUTS: 1.WAREHOUSES. 2.TRAINED STAFF. 3.OFFICE IN RWANDAN DEVELOPMENT BANK CAPABLE OF ADMINISTERING FOOD STORAGE AND MARKETING PROGRAM. 4.OPERATING PROCEDURES AND METHODS OF FINANCIAL CONTROL. 5.SYSTEM OF WAREHOUSE MANAGEMENT. 6.WORKING CAPITAL ACCOUNT.

This project was completed in 1976.

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: RWANDA
PROJECT TITLE: COOPERATIVE Grain Storage

PROJECT: 696010B SUB-PROJECT: 00
INITIAL FY: 78 FINAL FY: 80

PROBLEM: IN RWANDA, WHATEVER SLIGHT INCREASES IN AGRICULTURAL PRODUCTION WHICH ARE ACHIEVED ARE FREQUENTLY LOST DURING STORAGE. THE MINISTRY OF AGRICULTURAL ESTIMATES THAT THE LOSS OF POST HARVEST BEANS AND GRAINS DUE TO INSECT INFESTATION, RODENTS, AND EXCESSIVE HUMIDITY CONTINUALLY BURDENS ON 25%. A STUDY IN 1969 REVEALED THAT STORAGE LOSSES FOR THAT YR AMOUNTED TO 760,000,000RF OR 9% OF THE GROSS NATL PRODUCT. AS A RESULT, RURAL INCOMES REMAIN LOW, AND THE LIKELIHOOD OF KEEPING FOOD PRODUCTN IN STEP WITH RWANDA'S GROWING POPULATN IS LESSENED.

STRATEGY: THREE-YEAR PROJECT CONSISTS OF A GRANT TO THE COOPERATIVE LEAGUE OF THE USA (CLUSA) TO PROVIDE TECHNICAL ASSISTANCE AND COMMODITY SUPPORT IN THE DEVELOPMENT OF GRAIN STORAGE COOPERATIVES IN SELECTED AREAS OF RWANDA. THE HOST-COUNTRY WILL PROVIDE FINANCIAL & INSTITUTIONAL SUPPORT.

SUMMARY: GRANT IS PROVIDED TO THE COOPERATIVE LEAGUE OF THE USA (CLUSA) TO ASSIST IN DEVELOPING FARMER-OWNED GRAIN STORAGE COOPERATIVES IN SELECTED AREAS OF RWANDA. THE PROJECT WILL BE IMPLEMENTED IN COOPERATION WITH THE MINISTRY OF SOCIAL AFFAIRS & COOPERATIVE MOVEMENT WITH ADDITIONAL GRANT-FUNDING PROVIDED THRU THE UN CAPITAL DEVEL FUND (UNCDF). THE USAID GRANT WILL FINANCE THE SERVICES OF A PROJ MANAGER FOR 24 PERSON-MOS AS WELL AS SUPPORT TRNG & PROCUREMENT OF COMMODITIES. THE UNCDF GRANT WILL FINANCE THE CONSTRUCTION OF SEVEN STORAGE CENTERS & RELATED FACILITIES. IN ADDITION, AN OPERATING FUND WILL BE ESTABLISHED FOR THE NEW CENTERS. THE PARTICIPATING CO-OP'S & STORAGE SITES WILL BE SELECTED BY THE CLUSA PROJ MANAGER IN COOPERATION WITH THE MINISTRY. TRNG MATERIALS & SHORT COURSES WILL BE DEVELOPED FOR LEADERS, MANAGERS, AND OPERATING PERSONNEL OF THE CO-OP'S & STORAGE CENTERS. THE TRNG WILL FOCUS ON ACCTG, REPORTING SYSTEMS, AND CONTROL OF OPERATIONS. LATER, THE PROJ MANAGER WILL DIRECT EFFORTS TOWARD INCREASING THE EFFECTIVENESS OF LOCAL BOARDS OF DIRECTORS AND IMPROVING RELATIONSHIPS BETWEEN THE BOARD MEMBERS & VARIOUS CO-OP'S. FOUR TO SIX MINISTRY STAFF MEMBERS WILL RECEIVE IN-DEPTH INSTRUCTION IN MGMT, ACCTG, CO-OP OPERATIONS, AND MEMBER RULES. SOME MINISTRY & CO-OP PERSONNEL MAY RECEIVE SHORT-TERM MGMT TRNG AT THE PAN-AFRICAN INSTITUTE OF DEVELPMNT IN CAMEROON & AT OTHER INSTITUTES OUTSIDE RWANDA. THE MAJOR EMPHASIS WILL BE PLACED UPON IN-COUNTRY TRNG IN MGMT, ACCTG, REPORTING, AND THE TECHNOLOGICAL ASPECTS OF GRAIN STORAGE, FUMIGATN, AND HANDLING. THE CLUSA PROJ MANAGER WILL DESIGN THE ACCTG, RECORDKEEPING, AND REPORTING SYSTEMS FOR EACH PARTICIPATING CO-OP. CLUSA WILL BE RESPONSIBLE FOR GATHERING PHYSICAL & FINANCIAL DATA ON MARKETING & STORAGE OF BEANS & GRAIN, MEMBERSHIP PARTICPATION, VOLUME OF COMMODITIES HANDLED, STORAGE LOSSES, PRICINGDATA, GERMINATION PERCENTAGES OF SEED STOCK, AND OTHER DATA NECESSARY FOR EVALUATION OF THE COOPERATIVES & THEIR MGMT. DIRECT BENEFICIARIES INCLUDE 4400 FAMILIES WHO WILL UTILIZE THE STORAGE CENTERS. ANOTHER 13,500 FAMILIES WILL BENEFIT THROUGH INCREASED LOCAL FOOD SPPLY & MORE STABLE PRICES.

GOAL: 1.INCREASED SUPPLY OF BEANS AND GRAINS IN PROJECT AREAS. 2.GREATER SERVICES OFFERED BY COOPERATIVES TO LOCAL AREAS.

PURPOSE: 1.REDUCTION IN STORAGE LOSSES FOR FARM FAMILIES. 2.INCREASED FARM FAMILY INCOME. 3.IMPROVED COOPERATIVE SERVICES AND OPERATIONS.

OUTPUTS: 1.SEVEN STORAGE CENTERS CONSTRUCTED AND IN OPERATION. 2.OPERATING FUND IN PLACE AND BEING UTILIZED. 3.MANAGERS AND ACCOUNTANTS TRAINED IN STORAGE CENTER OPERATIONS. 4.ACCOUNTING AND REPORTING SYSTEMS IN PLACE AND FUNCTIONING. 5.GOR PERSONNEL RECEIVE APPROPRIATE TRAINING AS ESTABLISHED BY MANAGEMENT AND MINISTRY OF SOCIAL AFFAIRS.

DESIGN AND EVALUATION DOCUMENTS IN DEVELOPMENT INFORMATION CENTER

DOCUMENT TYPE	DATE	DOCUMENT TITLE	PAGES	DIC CALL NO	PUB NO
PROJECT PROPOSAL	07/12/77	A PROPOSAL FOR A COOPERATIVE GRAIN STORAGE PROJECT RWANDA PREPARED AND PRESENTED BY THE COOPERATIVE LEAGUE OF THE USA IN CONJUNCTION WITH THE GOVERNMENT OF RWANDA	46P		

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: RWANDA — PROJECT: 6960100 SUB-PROJECT: 00

PROJECT TITLE: FOOD STORAGE AND MARKETING — INITIAL FY: 75 FINAL FY: 79

PROBLEM: LACK OF AN EFFECTIVE PRICE STABILIZATION PROGRAM FOR FOOD PRODUCTS PERMITS WIDE FLUCTUATIONS IN FOOD PRICES FROM HARVEST TO HARVEST AND BETWEEN REGIONS.

STRATEGY: CONTROL THE PRICE FLUCTUATIONS BY INSTITUTING A PRICE STABILIZATION PROGRAM THROUGH MARKET INTERVENTION FOR THREE MAJOR FOOD CROPS (BEANS, PEAS AND SORGHUM). THE GOR WILL PURCHASE DURING HARVEST TIME THEN BY A PROGRAMMED SELLING PROGRAM WILL DISTRIBUTE THE FOOD ACCORDING TO DEMAND.

SUMMARY: THE GOR WILL BEGIN A COMPLETE PROGRAM FOR PRODUCTION, BUYING, STORAGE AND DISTRIBUTION OF THREE MAJOR FOOD CROPS. AS PRICES ARE RAISED TO PRODUCERS IT IS EXPECTED THAT PRODUCTION WILL BE STIMULATED. WAREHOUSES WILL BE CONSTRUCTED TO STORE EXCESS PRODUCTION WHICH WILL BE RELEASED AT A CONTROLLED PRICE WHEN SHORTAGES OCCUR.

GOAL: AVAILABILITY OF FOOD PRODUCTS INCREASES AT A RATE FASTER THAN THAT OF POPULATION GROWTH. PRICE STABILIZATION SYSTEM ESTABLISHED FOR MAJOR FOOD CROPS.

PURPOSE: RWANDAN GOVERNMENT HAS STORAGE FACILITIES AND PRICE STABILIZATION POLICIES TO DAMPEN THE WIDE FLUCTUATIONS IN FOOD PRICES.

OUTPUTS: WAREHOUSES; TRAINED STAFF; OFFICE IN RWANDAN DEVELOPMENT BANK ADMINISTERING FOOD STORAGE AND MARKETING PROGRAM; OPERATING PROCEDURES AND METHODS OF FINANCIAL CONTROL; SYSTEM OF WAREHOUSE MANAGEMENT; WORKING CAPITAL ACCOUNT.

DESIGN AND EVALUATION DOCUMENTS IN DEVELOPMENT INFORMATION CENTER

DOCUMENT TYPE	DATE	DOCUMENT TITLE	PAGES	DIC CALL NO	PUB NO
PROJECT EVALUATION SUMMARY	02/20/79	EVALUATION REPORT: RWANDA FOOD STORAGE AND MARKETING PROJECT	98P		

DOCUMENT TYPE: PROJECT EVALUATION SUMMARY — PUBLICATION DATE: 02/20/79

DOCUMENT TITLE: EVALUATION REPORT: RWANDA FOOD STORAGE AND MARKETING PROJECT — CALL NUMBER:

AUTHOR(S): MORTON, STEPHEN T; PATTERSON, JOHN A; PATTINSON, IAN — ORGANIZATION: REDSO/EAST AFRICA

CONTRACT: — OTHER ID:

PROJECT(S): 696010000 — PUBLICATION NO:

ABSTRACT: AID-REQUESTED EVALUATION EXAMINES STATUS OF RWANDA FOOD STORAGE AND MARKETING PROJECT(FSM) IN RESPONSE TO PERCEIVED FSM DIFFICULTIES IN BEAN MARKETING,PRICING POLICY,FINANCIAL SELF-SUFFICIENCY,AND IN RELATING PROJ PURPOSE TO RWANDAN GOVT(ROG)ORGANIZATIONAL FRAMEWORK. PROJ ASSISTS ROG TO DEVELOP STORAGE FACILS & PRICE STABILIZATION POLICIES TO DAMPEN WIDE FLUCTUATIONS IN PRILES. EVALUATORS EXAMINED PROJ-GENERATED REPORTS AND DATA, INTERVIEWED AFFILIATED PERSONNEL,AND MADE ON-SITE INSPECTIONS OF FSM WAREHOUSES.
PROJ FOUND TO HAVE INFLUENCED CONSUMER PRICES AND PROVIDED CONTACT BASE WITH CONSUMER AND CO-OP ORGANIZATIONS. PRODUCER PRICE STABILIZATION HAS NOT YET BEEN DEMONSTRATED,AS GRAIN USED FOR CONSUMER PRICE STABILIZATION HAS COME CHIEFLY FROM COMMERCIAL SOURCES. DEFICIENCIES IN GOR STATISTICS RENDER VERIFICATION OF PROJ GOALS QUESTIONABLE. GRENARWA(GRENIER NATIONAL DU RWANDA),THE INSTITUTIONAL FRAMEWORK FOR FSM,HAS STILL NOT BEEN INTEGRATED INTO OPROVIA,THE STATE MARKETING AGENCY. EVAL FINDS GRENARWA MGMT INFRASTRUCTURE TOO WEAK TO SUPPORT PLANNED EXPANSION OF WAREHOUSE CAPACITY;REC PROJ CHANGE TO STRESS PERIOD OF CONSOLIDATION & TRNG PRIOR TO FURTHER EXPANSION.
EVAL ALSO RECOMMENDS PROJ ACQUIRE IMMEDIATE FINANCIAL & MARKETING TECH ASSISTANCE;THAT GOR ABANDON FIXED PRICING ON BEANS AND, INSTEAD, BASE PRICES ON THE FREE MARKET DELIVERED PRICE TO GRENARWA WAREHOUSES;THAT SACK WEIGHT STANDARDIZATION SHOULD BE INTRODUCED TO PERMIT INVENTORY CONTROL;THAT MARKET DATA INFO BE REFINED & FULLY UTILIZED;THAT GRENARWA BE PROVIDED WITH CENTRAL OFFICE FACILITIES TO COMPLEMENT ITS NECESSARY DVLP;THAT WAREHOUSE STAFF BE TRAINED IN-COUNTRY;THAT GOR SEEK INCREASED DONOR SUPPORT TO SUPPLEMENT WORKING CAPITAL;THAT ADDITIONAL VEHICLES BE SECURED;THAT GRENARWA INCREASE ITS MARKETING OF SORGHUM TO BALANCE OPERATIONS WITH BEANS AND EVEN-OUT EXPENDITURE AND REVENUE;AND THAT PROJ CO-DIRECTOR RECEIVE OVERSEAS FINANCIAL MGMT TRNG. EVAL WARNS PROJ CONSOLIDATION NOW NECESSARY;GRENARWA OTHERWISE FACES INSOLVENCY.
REDSO REC PROJ DESIGN REVISION,PROAG AMENDMENT;URGES GOR READJUSTMENT OF BEAN-PRICING POLICY.

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: RWANDA
PROJECT TITLE: FARM HAND TOOLS

PROJECT: 6960103 SUB-PROJECT: 00
INITIAL FY: 78 FINAL FY: 81

PROBLEM: WHILE 90% OF RWANDA'S EMPLOYED WORKERS ARE INVOLVED IN AGRICLUTURE,EMPLOYMENT OPPORTUNITIES IN THE AGR SECTOR ARE RESTRICTED DUE TO THE HIGH RURAL POPULATION DENSITY. THE COUNTRY'S NEED FOR BLACKSMITHS SKILLED IN THE REPAIR,MAINT & MANUFACTURE OF HANDTOOLS IS ONE VERY PLAUSIBLE SOURCE FOR ADDITIONAL AGR SECTOR EMPLOYMENT. RWANDA'S EXISTING BLACKSMITH TRNG INSTITUTION (EG,THE NYABISINDU BLACKSMITH TRNG CENTER),HOWEVER,LACK THE FACILITIES & TECH EXPERTISE NECESSARY TO ACCOMODATE ADDITIONAL ENROLLMENT & TO ENSURE PERMANENT OPERATION.

STRATEGY: FOUR-YEAR PROJECT CONSISTS OF A GRANT PROVIDING TECHNICAL ADVISORY ASSISTANCE,FACILITIES CONSTRUCTION,AND TRAINING EXPENSES TO TRAIN BLACKSMITHS AND DEVELOP AN OPERATIONAL BLACKSMITH TRAINING FACILITY. HOST COUNTRY PROVIDES EXISTING FACILITIES AND OPERATIONAL STAFF.

SUMMARY: GRANT TO THE GOVT OF RWANDA TO: 1)TRAIN 60 BLACKSMITHS AT THE NYABISINDU BLACKSMITH TRAINING CENTER(NBTC)IN THE REPAIR,MAINTENANCE & MANUFACTURE OF COMMON FARM IMPLEMENTS & UTENSILS; AND 2)UPGRADE THE NBTS'S BLACKSMITH TRAINING PROGRAM TO ENABLE A STEADY OUTPUT OF 20 TRAINED BLACKSMITHS PER YEAR. PROJ IS A FOLLOW-UP TO A SWISS-SUPPORTED PROGRAM WHICH DEVELOPED A BLACKSMITH TRNG CURRICULUM FOR NBTC AND TRAINED 66 PARTICIPANTS.
PRIMARY COMPONENT OF THIS PROJ WILL BE THE TRAINING OF 60 PARTICIPANTS IN THREE,9-MO TRNG COURSES(20 PARTIC/COURSE). PARTICIPANTS WILL BE RECRUITED THRU ANNOUNCEMENTS FOR EACH COURSE PUBLISHED IN THE PREFECTURES & COMMUNES OF RWANDA. AN EXAM WILL BE GIVEN BY THE NBTC'S ADMIN STAFF TO DETERMINE QUALIFIED CANDIDATES WITH FINAL SELECTION MADE BY THE FORGE CENTER DIRECTOR. THE NBTC 5-MAN TRNG STAFF WILL BE COMPRISED OF SELECTED GRADUATES OF THE FORMER SWISS PROG. THE CURRIC & MATRLS DEVELOPED BY THE FORMER PROG WILL FORM THE BASIS FOR THE INSTRUCTION PROVIDED UNDER THIS PROJ. ONE TECHNICIAN WILL BE ASSIGNED TO DEVELOP THE EXISTING CURRIC, TRAIN TEACHERS IN EXISTING BLACKSMITH TECHNOLOGY AND USE OF THE REVISED CURRIC,MONITOR SUPPORT & GRADUATE FOLLOW-UP ACTIVITIES,AND ASSIST WITH FULL-SCALE EVALUATIONS. PARTICIPANTS' IN-COUNTRY TRANSPORTATION & LIVING EXPENSES DURING TRNG WILL BE FUNDED UNDER THE PROJ,AS WILL TOOL KITS WHICH WILL BE USED FOR "TAKE-HOME" ASSIGNMENTS AND POST-TRNG EMPLOYMENT. A RESEARCH & TRNG BOARD,COMPOSED OF THE US TECH & THE NBTC ADMIN & TEACHING STAFF,WILL PROCURE SAMPLE AGRICULTURAL IMPLEMENTS,DISASSEMBLE AND THEN REFABRICATE THEM,MAKING ADAPTATIONS APPROPRIATE TO RWANDA'S ENVIRONMENT. RESULTS OF THIS ACTIVITY WILL BE INCORPORATED IN THE TRNG COURSES. IN SUPPORT OF THE NBTC'S CONTINUED OPERATIONS,IE,THE FUTURE TRAINING OF 20 BLACKSMITHS/YR,PROJ WILL FINANCE DESIGN & CONSTRUCTION SERVICES FOR RENOVATIONS/EXTENSIONS TO THE NBTC'S FORGES,CLASSROOM,ADMINISTRATIVE OFFICE,DORMITORY,AND DINING HALL. TWO VEHICLES,WORKSHOP EQUIPMENT,RAW MATERIALS,AND FURNITURE WILL ALSO BE PROVIDED.

GOAL: IMPROVED TECHNICAL AND VOCATIONAL SKILLS APPROPRIATE TO RWANDA'S RURAL DEVELOPMENT NEEDS.

PURPOSE: TO TRAIN BLACKSMITHS WHO CAN MANUFACTURE AND REPAIR COMMON RURAL IMPLEMENTS AND UTENSILS.

OUTPUTS: TRAINED BLACKSMITHS WITH UPDATED SKILLS AND TOOL KITS.

DESIGN AND EVALUATION DOCUMENTS IN DEVELOPMENT INFORMATION CENTER

DOCUMENT TYPE	DATE	DOCUMENT TITLE	PAGES	DIC CALL NO	PUB NO
PROJECT PAPER	09/01/77	FARM HAND TOOLS	58P		

PROJECT DESIGN INFORMATION

COUNTRY/BUREAU: RWANDA
PROJECT TITLE: LOCAL CROP STORAGE

PROJECT: 6960107 SUB-PROJECT: 00
INITIAL FY: 79 FINAL FY: 79

PROBLEM: RWANDA IS ONE OF THE FIVE POOREST COUNTRIES IN THE WORLD AND HAS THE HIGHEST POPULATION DENSITY IN AFRICA WHICH IS INCREASING AT 3.2% PER YEAR. FINANCIAL RESOURCES ARE INSUFFICIENT FOR THE PURCHASE OF NECESSARY FACILITIES AND EQUIPMENT TO ADEQUATELY STORE AND MARKET PRODUCE TO MEET THE FOOD DEMANDS IMPOSED BY THE GROWING POPULATION. AS A RESULT, RWANDA IS FACED WITH A SEVERE FOOD SHORTAGE PROBLEM.

STRATEGY: FIVE-YEAR PROJECT CONSISTS OF TRAINING, COMMODITIES, TECHNICAL ASSISTANCE, RESEARCH AND CONSTRUCTION COSTS TO THE GOVERNMENT OF RWANDA TO DEVELOP LOCAL FOOD STORAGE AND MARKETING SYSTEMS EQUITABLE TO SMALL FARMERS AND TO REDUCE FOOD STORAGE LOSSES IN COMMUNE AND ON-FARM SILOS. HOST COUNTRY WILL CONTRIBUTE LAND FOR WAREHOUSE CONSTRUCTION SITES AND SALARIES OF RESEARCHERS AND IMPLEMENTING AGENCY PERSONNEL. THE PEACE CORPS WILL SUPERVISE ACTUAL CONSTRUCTION.

SUMMARY: GRANT PROVIDED TO THE GOVERNMENT OF RWANDA (GOR) TO DEVELOP LOCAL LEVEL FOOD STORAGE AND MARKETING SYSTEMS AND TO REDUCE FOOD CROP LOSS IN COMMUNE AND ON-FARM SILOS. PROJECT MANAGEMENT WILL BE INFLUENCED HEAVILY BY THE EARLY RESULTS OF A PREVIOUS UPG VERY SIMILAR TO THIS UNDERTAKEN BY THE COOPERATIVE LEAGUE OF THE USA FINANCED JOINTLY BY AID AND THE UNITED NATIONS CAPITAL DEVELOPMENT FUND.
PROJECT COMPONENTS INCLUDE CONSTRUCTION, TRAINING, RESEARCH, AND THE DEVELOPMENT AND OPERATION OF COOPERATIVES WHERE THEY ARE NOT ALREADY ESTABLISHED. ONE HANGAR-TYPE, 100-TON CAPACITY GRAIN WAREHOUSE WILL BE CONSTRUCTED AT EACH OF 40 COMMUNES TO BE SELECTED BY THE IMPLEMENTING AGENCY, THE DEPT. OF COOPERATIVE PROMOTION (DCP). SIX SATELLITE GRAIN WAREHOUSES WILL OPERATE ON A PILOT BASIS EXTENDING STORAGE FACILITIES TO A GREATER NUMBER OF COMMUNE FARMERS. WEIGHING SCALES, CLEANING SCREENS, AND RELATED EQUIPMENT WILL BE PURCHASED FOR THESE FACILITIES. TEN DCP OFFICIALS AND 10 PREFECTORY PERSONNEL WILL BE INSTRUCTED IN COOP PLANNING, FINANCIAL AND OPERATIONAL MANAGEMENT; 40 COMMUNE PERSONNEL WILL BE TRAINED IN WAREHOUSE AND STORAGE METHODS, GRAIN MARKETING, AND COOP MANAGEMENT. A ONE-DAY DEMONSTRATION WILL BE CONDUCTED ON THE USE OF PESTICIDES AND STORAGE TECHNIQUES TO 1500 EXTENSION AGENTS ALREADY WORKING AT COMMUNES.
RESEARCH STUDIES WILL BE CONDUCTED BY 2 RWANDAN SCIENCE INSTITUTES AND 3 EXPATRIATE RESEARCH ASSISTANTS. THE SUBJECTS OF THESE STUDIES INCLUDE INDIGENOUS CROP STORAGE; INVENTORY OF BEAN VARIETIES; RESISTANCE OF BEAN VARIETIES TO PEST ATTACKS IN STORAGE; EFFECT OF STORAGE BEANS UNDER DIFFERENT CONDITIONS ON COOKABILITY; ESTIMATION OF CROP YIELDS; AND SOCIO-ECONOMIC EFFECTS. FORTY PER CENT OF THE RESEARCH BUDGET IS RESERVED FOR SOCIO-ECONOMIC STUDIES. NEW MARKETING AND PRODUCTION-TYPE COOPS WILL BE DESIGNED TO FACILITATE TRADING OF GRAIN AND PULSES, TO PROVIDE FARMERS WITH A SOURCE OF TECHNICAL ASSISTANCE, AND TO SUPPLY AGRICULTURE INPUTS, PARTICULARLY INSECTICIDES. A REVOLVING CREDIT FUND WILL BE ESTABLISHED TO PROVIDE THE COOPS WITH WORKING CAPITAL FOR THE PURCHASE OF CEREALS, PULSES, AND AGRICULTURAL INPUTS.

GOAL: 1. FARM FAMILY INCOME INCREASED IN REAL TERMS BY OFFERING FAIR MARKET VALUE FOR BOTH SALES AND PURCHASES. 2. CEREAL AND PULSE AVAILABILITY TO SMALL FARMERS AT MORE STABLE PRICES IMPROVED.

PURPOSE: 1. FOOD STORAGE AND MARKETING SYSTEM MORE FAVORABLE TO SMALL FARMERS ESTABLISHED AT THE LOCAL LEVEL FOR CEREALS AND PULSES. 2. SEASONAL AND REGIONAL PRICE FLUCTUATIONS REDUCED TO LEVELS WHICH APPROXIMATE OFFICIAL PRICES (ENSURING FAIR WEIGHTS). 3. STORAGE LOSSES REDUCED BOTH ON-FARM AND IN COMMUNE SILOS.

OUTPUTS: 1. STORAGE CAPACITY EXPANDED THROUGH COOPS. 2. PCP AND COOP PERSONNEL TRAINED. 3. ON-FARM STORAGE AND SALES OF CHEMICALS IMPROVED. 4. DATA ON STORAGE/MARKETING RELATED ISSUES RESEARCHED.

DESIGN AND EVALUATION DOCUMENTS IN DEVELOPMENT INFORMATION CENTER

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PROJECT PAPER	03/09/79	LOCAL CROP STORAGE	50P&AN NX		

A.I.D. Program

Current Status: Within the agricultural sector, in 1975 A.I.D. began a long-range program in Rwanda to improve grain storage and marketing, starting with the Food Storage and Marketing project (GRENARWA, 696-0100) aimed at creating an efficient national grain marketing institution, with purchasing and storage centers located in strategic areas of the country. The project has proved successful, within a limited area, in stabilizing the prices of beans and sorghum through selective intervention in the market. In addition it has served regional marketing needs.

The national focus of the GRENARWA project gave rise to the need for a separate activity to deal with the problems of grain storage at the local level. Under an A.I.D. grant to the Catholic Relief Services (CRS), a program of construction of local grain silos began in selected communes in Rwanda. To date, 16 of 26 silos have been completed, four of which are financed by A.I.D., the remainder by UNICEF and CRS.

As a next step in assisting the government in developing a systematic program for local grain storage and marketing, A.I.D. is financing, through the Cooperative League of the United States of America (CLUSA), a cooperative grain storage project (696-0108), undertaken jointly with the U.N. Capital Development Fund, to construct storage centers in seven communes where cooperatives already exist and to develop a local storage and marketing mechanism which will increase income of participating farmers, reduce storage losses, and strengthen rural institutions to provide new services to the local population.

The CRS and CLUSA projects were preliminary phases of the Local Crop Storage project (696-0107), begun in 1979. This project is constructing 40 storage facilities, is training personnel in cooperative management as well as in warehouse management, and has an important research component to examine the technical and economic aspects of bean production and storage.

FY 1981 Program: The development of the cooperative movement is a GOR priority strongly supported by A.I.D. To reinforce present programs in cooperative development A.I.D. is financing, in collaboration with the Swiss, a cooperative training center in Kigali. CLUSA will provide technical assistance to the center early in 1981.

The Agriculture Sector Survey and Analysis project, (695-0115), begun in FY 1981, is establishing an office

in the Ministry of Agriculture with the capacity to collect essential agricultural data, to analyze them, and to use them as a tool for long-term agricultural planning. A second project, Fish Culture (696-0112), begun in 1981 will support fish culture at the cooperative and farm level. Fingerling production and demonstration centers will be established in each of the 10 prefectures in Rwanda. The principal emphasis of the project will be in strengthening the fish culture extension service.

In the health sector, a Family Planning Initiative pilot project (698-0662.01) has begun, which will train personnel and provide equipment to assist the GOR to prepare for nationwide availability of maternal and child health care and family planning information and services. The follow-on project for major support to a GOR Maternal and Child Health/Family Planning project (696-0113) includes support to rural dispensaries and clinics as well as assistance to family planning education, information, and services provided through rural health and social services installations. An agreement for an expanded program for immunization to assist the Ministry of Public Health to provide immunizations against more prevalent contagious diseases was recently signed.

Through CRS and the Seventh-Day Adventist World Service (SAWS), A.I.D. is providing Title II food imports for child feeding and school lunch programs and through the ASHA program, A.I.D. has grant [redacted] to SAWS for enlargement of a hospital in rural Rwanda. A.I.D. has also begun a modest Title II, Section 206 program, with 250 tons of oil imported in FY 80. Following an evaluation of the import program, and the use of the generated currencies, the program will increase and form an important element of the Food for Development program in Rwanda.

An Agricultural Education project (696-0109) is providing funds for the construction of 30 integrated rural and artisan learning centers (CERAI's), development of curricula to be used in the CERAI's, the introduction of adult education in the centers, and the expansion of the Nyagahanga Agricultural School for Women. A.I.D. is also giving assistance to the Ministry of Education for Planning and Analysis in the education sector. This program supplements other A.I.D. training programs, artisan training through the Farm Hand Tools project (696-0103), training components of other projects, and the African Manpower Development Training Program (698-0364.23) for training in the U.S. and elsewhere in Africa. Research in renewed and improved traditional energy will continue with a pilot project with the Energy Research Center of the University of Rwanda.

Requested Year Program

Most of the [redacted] requested in FY 1982 will be directed to the agricultural sector. The program will continue the focus on developing the institutional systems and the human resources needed to increase rural production. The development of rural-oriented curricula for post- primary schools, the systematic collection and analysis of basic agricultural data, and support to the fish culture extension service will receive financing.

There are three new program starts planned for FY 1982. A.I.D. will extend its activity as the major donor working in the food storage and marketing sector with a second phase of the GRENARWA project (696-0116), for which [redacted] is requested. The establishment of a security stock and strengthening the capacity of the GOR to coordinate food grain transfers among regions and between national storage facilities and cooperative facilities will be the principal elements of this effort. A.I.D. will also assist the government's agricultural intensification program through an Area Agricultural Production project (696-0110), for which [redacted] is requested. These will reinforce the linkage between research and extension services in basic food crops and will also test the feasibility of irrigating the Ny Valley lands of Rwanda which are available

for intensive cultivation practices. The third new project is Rural Works (696-0117), for which is requested. This will provide assistance to local communities in their efforts in soil conservation and village reforestation, in rural water supplies, and in improvement of farm-to-market roads.

P.L. 480 Title II programs, through both CRS and SAWS, and through the Government-to-Government Section 206 program, will continue to serve as a valuable incentive for nutrition education to mothers and will provide essential food supplements for school children, in hospitals and in Food-for-Work programs.

Appendix VIII

Bibliography

1. Agriculture
2. Anthropology and Sociology
3. Climate
4. Ecology, Conservation and Development
5. Economy
6. Fauna and Fisheries
7. Flora and Forestry
8. Geology and Soils
9. Health
10. Water Resources

1. Agriculture

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