

# BURUNDI



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## **PREFACE**

This environmental overview of Burundi was requested by the Commission of the European Communities — specifically the Directorate-General for Development (DG VIII A/1).

It was prepared on the basis of a desk-top study of information to hand as a briefing for CEC officials. Wherever possible the most recent figures and information were employed as sources<sup>1</sup>.

After the introductory Fact Sheet and outline of Key Issues, the report is divided into three chapters. The first deals with institutional infrastructure, especially related to environmental issues, together with national and international legislation and training opportunities. The second reviews the country's natural resources. The final chapter evaluates the nation's ecological heritage and considers its past, current and foreseeable environmental problems. Because the information changes so rapidly, no attempt has been made to provide a comprehensive survey of international organisations working in Burundi. Instead, the reader is advised to contact the organisations themselves for an up-to-date summary of activities.

The IUCN team responsible for the preparation of this Synopsis included: Jeremy Carew-Reid, Peter Sanders, R. David Stone, Nils Beaumont, Thérèse Lethu, Peter Hulm, Paul A. Driver, Claire Santer, John Watkin, and Brian Johnston. Additional editorial assistance was provided by Anthony J. Curnow, Adrienne Jackson, Paul E. Ress, Gamini Senevirate and Wendy Lubetkin.

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<sup>1</sup> A note on the data sources follows the detailed reference list. Within the text, individual sources are indicated by the number of the reference inside brackets, e.g. [24]. Metric weights and measurements are used throughout. A billion refers to 1,000,000,000.

# FACT SHEET

## Natural Resources

**Land area:** 27,834km<sup>2</sup> (excluding lakes 25,950km<sup>2</sup>)

**Climate:** Equatorial montane, with generally well-distributed rainfall, peaking in March and April, with a dry season during the summer. Average temperatures are 20°C on plateaux, 23°C in valleys

**Rainfall:** Average rainfall 1200mm on the plateaux, 750mm in the valley. Rain is occasionally irregular, and droughts have been known

**Ecological zones:** Predominantly Afromontane in the highlands and Lake Victoria Regional Mosaic in the lowlands, with a small Zambebian element along the border with Tanzania

**Languages:** French and Kirundi (official), Swahili, Bantu

**Main towns:** Bujumbura (capital) 226,628; Gitega 95,300; Ngozi 20,005 (1990 estimates)

**Measures:** Metric system

**Currency:** Burundi franc (BUF) = 100 centimes. Exchange rate December 1992: BUF216.37 = US\$1 and BUF343.5 = UK£1

**Land use:** Area under cultivation: 13,320km<sup>2</sup>; arable land 52%; permanent pasture 36%; woodland 3%; other land 10% (1984-1986)

**Protected areas:** Four categories of protected areas are recognised (forest reserves, nature reserves, national parks and national monuments) covering 1090km<sup>2</sup> (3.9% of the country)

**Agriculture:** The main food crops are cassava, sweet potatoes, bananas, plantains, pulses, maize, sorghum and rice. The main cash crops are coffee, tea, sugar and cotton

**Livestock:** Cattle 435,000; pigs 103,000; sheep 365,000; goats 930,000; chickens 4 million (1991)

**Fisheries:** 17,395 tonnes according to FAO (1990) (but see Fisheries)

**Mining:** Gold 35kg; peat 13,000 tonnes (1988)

## Demography

**Population size:** 5.41 million (1991)

**Population growth rate:** 2.51% per annum (1991)

**Projected population in 2025:** 11.81 million

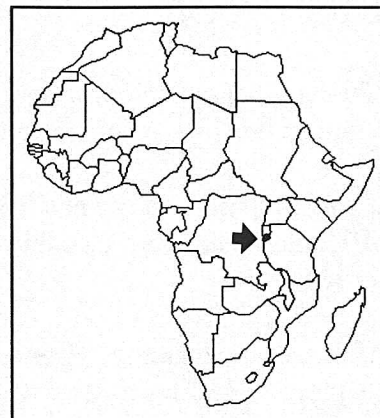
**Age distribution:** Under 15 years 45.3%; 15-65 years 51.6%; over 65 years 3.1% (1990 estimate)

**Fertility rate:** 6.8 (1990)

**Gender ratio:** Female 51%; male 49% (1990)

**Spatial distribution:** Urban 6%; rural 94% (1990)

**Urbanisation rate:** 5.5% of population a year (1980-1990); 6.1% (1990-2000)



## Health and Education

**Infant mortality (deaths/1000 live births):** 117 deaths/1000 live births (1985-1990)

**Mortality of under-5s (per 1000 live births):** 192 per 1000 live births (1987)

**Life expectancy:** 49 years; females 50.6; males 47.3 (1985-1990)

**Access to safe drinking water (% of population):** 92% of urban population; 48% of rural population (1991)

**Access to sanitation services (% of population):** 52% of total population; 90% of urban population; 25% of rural population (1983)

**Access to health service (% of population):** 61% (1985-1987)

**Enrolment in education:**

Level	Number enrolled	% male	% female
Primary (1987)	532,935	56	44
Secondary (1987)	31,413	63	37
Tertiary (1989)	3,080	74	26

## Industry and Pollution

**Main industries:** Processing of agricultural products, textiles and blankets, footwear, cigarettes, brewing, insecticides, cement

**Energy:** *Types* - hydro-electric, peat, fuelwood, thermal

**Pollution:** Limited water pollution from untreated sewage and agricultural runoff; industrial pollution negligible at present

## Economic Indicators

**GDP:** US\$1000 million (1990)

**GDP per capita:** US\$206 (1992)

**GDP growth rate:** 3.9% (1990)

**Agricultural % of GDP:** 49% (1992); 56% (1990)

**Exports at current market prices:** US\$489 million (1991)

**Imports at current market prices:** US\$682 million (1991)

**Total official development assistance:** US\$263 million (1990)

**Total external debt:** US\$898 million (1991)

**Sources:** [11, 18, 19, 20, 21, 22, 23, 24, 25 and 26] unless otherwise indicated

# KEY ISSUES

### Background

Burundi is a small landlocked country in the heart of central Africa. To the north, it borders Rwanda (with which it is affiliated culturally), to the west Zaïre, and to the south and east, along the shores of Lake Tanganyika, Tanzania.

Burundi is situated in the highlands along the eastern arm of the Western Rift Valley. The land surface only falls below the 1000m contour along the shores of Lake Tanganyika (773m). A mountain range, the Zaïre-Nile ridge reaching 2679m, runs roughly north-south along the western boundary, providing the highest land in the country. From its watershed western streams descend steeply to Lake Tanganyika. Most of the country is made up of fault plateaux and relatively low hills. The great variations in topography, soil and climate are responsible for the occurrence of a large number of vegetation types [1].

Key environmental issues in Burundi include: a high population density; soil erosion; deforestation; an inadequate protected area system; political context; and economic performance.

### High population density and growth

Most environmental problems in Burundi are related to the large population concentration within a small land area. With 208 persons per km<sup>2</sup>, Burundi has the second highest population density of continental Africa (surpassed only by Rwanda), and the annual growth rate of 5.1% is expected to rise in the next 20 years. This high concentration of people has already placed a strain on resources, particularly increasingly scarce land resources.

Soil erosion is the single most important environmental issue in Burundi. It is a direct result of the demands from a burgeoning, primarily agricultural population on limited cultivable land. While Burundi has been self-sufficient in food production for the last 20 years there are signs that the limit of these resources has been reached. For these reasons Burundi has been called "a conservationist's nightmare".

Efforts are being made to redistribute the population to alleviate the pressure on the over-populated hilly areas or the central plateau to less densely populated areas like the Ruzizi Valley. Family planning services are being encouraged. Since children are frequently seen as a form of wealth, however, the fertility rate remains high (6.8). Combined with longer life expectancy and a reduction of mortality rates, this has prevented any slowing of the growth rate.

### Soil erosion

Recent decades have witnessed a dramatic increase in agricultural activities in Burundi. These have resulted in some of the worst soil erosion problems in the world. Over-stocking, fire and an almost complete loss of fallow aggravate the problems. Subsistence crops are grown on increasingly marginal land where yields are low and soils are easily depleted of what little nutrients they possess. No immediate solution to these issues is forthcoming.

A range of activities and programmes have been initiated to combat soil erosion and nutrient depletion. Recommendations for easing the soil erosion problem have relied on improved technologies: use of mechanised techniques, selection of improved seeds, land reclamation (swamp development), burying of crop residues, contour line cultivation, alternating strip agriculture, agro-forestry techniques, improved animal husbandry, sustained regular crop protection, and irrigation. The need for a system to develop a better market infrastructure in the countryside has been recognised.

Promotion of these activities is constrained by a shortage of skilled personnel as well as limited funds. Uncontrolled population growth has placed a considerable burden on land resources. Agriculture and traditional practices have lost their effectiveness. Future development and environmental management programmes should be aware of the deeply rooted relationship between the people and their land.

### **Deforestation**

It is estimated that one-third to half of Burundi was originally montane forest. According to 1990 estimates forests comprise only 1.4% (360km<sup>2</sup>) of the country (some estimates are even lower). The annual deforestation rate is estimated at 2.7% a year for 1980-1990. The main threats to remaining forests are agricultural encroachment and the demands for fuel and construction wood from settlements adjacent to forests. Commercial extraction of timber is not a threat since montane forests harbour only low densities of valuable hardwoods. If the present rate of destruction continues, all forest will have disappeared within 90 years.

Action taken to improve the situation includes strengthening of protection for forested areas and reforestation efforts. The participation of local communities in management of these resources is actively encouraged. Agro-forestry activities have also been developed to assist rural communities and help ensure the integrity of remaining natural vegetation.

The country suffers from a lack of technical expertise and financial resources to achieve many of its objectives in natural resource management. Forest extension plans, including the provision of trees, encouraging woodlot management and tree care by farmers, remain underfunded and inadequately staffed.

### **Inadequately enforced protected area network**

Burundi straddles a major portion of the Zaïre-Nile Divide: a rugged mountainous region of the Rift Valley which is thought to have served as a refuge for moist forest species during glacial periods. Although interconnected in the past, the mountain forests of the region have become disconnected to form an archipelago of forest islands allowing for the separate evolution of species. These factors, in combination with a large range of topographic and climatic features, have resulted in montane forests of unusual species richness as well as high levels of local endemism and species rarity.

Protected areas were first established in 1933. In 1976 Burundi established a national nature conservation organisation, the National Institute for the Environment and the Conservation of Nature (INECN). The purpose of this institute was to overhaul Burundi's conservation legislation and establish a national system of protected areas.

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Conservation activities are having some positive effect on vegetation and wildlife populations in protected areas. But a gradual reduction of species and habitats in all the forests is continuing and the protected area system is still considered inadequate.

Protection of existing protected areas is known to be unsatisfactory. Rural populations frequently invade and exploit these areas for grazing access, collection of fuelwood, hunting of wildlife and exploitation of minerals such as gold. The lack of trained personnel, infrastructure and funding are of particular concern.

### **Political context**

Since independence from Belgium in 1962 Burundi has experienced a number of uprisings, coups and tribal unrest. Efforts have been made by the government to reduce inequalities and encourage national integration. One of the most far-reaching was the abolishment of the traditional land-holding system in 1976. For the first time proprietary rights over the land were transferred from Tutsi overlords to the hands of the (mainly Hutu) peasantry.

Following the 1988 uprising and massacre, Burundi's President Buyoya created a commission for the formulation of national unity, comprising members of the major ethnic groups. A national unity profile was adopted by referendum in February 1991 after lengthy discussion. The new constitution of the Third Republic, approved by referendum in March 1992, ended a single party ruling system. A programme of economic and social development is now being prepared.

### **Economic performance**

The government's efforts to accelerate economic growth and social development during the 1980s failed to produce the anticipated results. This was the result of a decline in trade and particularly the fall of coffee prices, aggravated by very difficult climatic conditions in 1982 and 1984 and by ineffective financial and monetary policies. From 1986-1991 GDP dropped by an average of 3.4% a year. Inflation was 9% in 1991. The deficit of commercial trade rose from BUF4.9 million in 1988 to BUF28 million in 1991. The coverage rate, however, showed a strengthening in 1991 from 22% in 1990 to 73% in 1991. This was the consequence of an increased coffee harvest (+22%), an improvement in exchange rates and a better performance by the cotton industry which earned BUF243.6 million in 1991, compared with BUF19.6 in 1990. Debt increased to US\$886 million by the end of 1991 and debt-servicing represented 33.5% of export earnings. The third structural credit adjustment was approved by the World Bank in June 1992.

This is a difficult period for the government with rising prices, insufficient food, an unstable economy and increasing external indebtedness. As a result, funding for the protection and management of natural resources is scarce.



## **INSTITUTIONAL CONTEXT**

### **Environmental Institutions**

General environmental matters come under the Ministry of Equipment, Tourism and the Environment [3] which was established in 1989 and includes departments formerly attached to other Ministries. These are: the Department of Waters and Forestry; the Department of Rural Engineering; the Department of Land Development and Land Registry; the National Geographic Institute (IGEBU); and the National Environment and Nature Conservation Institute (l'Institut National pour l'Environment et la Conservation de la Nature - INECN)<sup>2</sup>.

INECN is responsible for wildlife management and protected areas including the creation and management of national parks and nature reserves. It is also responsible for organising scientific studies, encouraging diversification of tree and animal species, ensuring maximum use of tourist sites (in collaboration with the National Office of Tourism), training technicians in nature conservation and making proposals to the President for new sites to be established as parks or reserves.

The Forest Service is responsible for managing areas within the State forest domain. The Forest Code stipulates penalties (fines and prison sentences of six months to five years) for infractions within the forest domain. These penalties are doubled when the area involved is a protected forest or forest reserve. In the event that the land is classified as a protected forest the Forest Code also provides compensation to the owner for loss of earnings.

A National Institute for the Safety of Nature has been established to advance the more rational management of forest resources [1].

### **Environmental Policies and Standards**

General environmental policy has focused on the improvement of the protected area system. The government has begun to move people out of critical areas by offering them alternative places to settle. Of particular concern is Ruvubu National Park where 3000 families need to be resettled. This is expected to be an extremely costly exercise.

The Director of INECN has recognised the need to educate the general public in environmental matters. A National Committee on the Relative Problems of the Environment was initiated in 1982 to make people aware of environmental degradation and to encourage an appreciation of the need for protected areas. Proposals have been made to improve the protected areas system in the interest of tourism. No provisions are made, however, for the extension of the protected area system with regards to the large and expanding human population [1].

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<sup>2</sup> Until recently INECN was known as the National Institute for the Conservation of Nature (INCN).

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Regional coordination efforts were initiated at the first of an annual series of workshops on conservation and management of Afromontane forests of Rwanda, Burundi, eastern Zaïre and south-western Uganda. Future coordination is planned in the form of other meetings, site visit exchanges for reserve personnel, exchange of reports and information and a regional training programme [2].

### **National and International Organisations**

Support for forest conservation efforts has been provided by several international conservation organisations during the last five years in Burundi. These include: Wildlife Conservation International (part of the New York Zoological Society) (WCI/NYZS); the Fauna and Flora Preservation Society (FFPS); the World Wide Fund For Nature (WWF); the African Wildlife Foundation (AWF); and the US Peace Corps.

Financial and technical assistance is being received from Belgium and USAID. Renewals of support from USAID have recently been negotiated, allowing for a continuation and expansion of current conservation efforts [2].

### **Legislation Concerning Natural Resource Management and Environmental Protection**

At the international level, Burundi is a member of UNEP and the African Ministerial Conference on Environment Group for Central Africa.

Burundi is signatory to the following: the World Heritage Convention (although to date no sites have been inscribed); the (African) Convention on the Conservation of Nature and Natural Resources, which provides for strict nature reserves, national parks and national reserves; the final Act of the Conference of Plenipotentiaries on the Convention on the Control of Transboundary Movements of Hazardous Wastes; and the Bamako Convention on the prohibition of imports and the control of transboundary movements of hazardous wastes (since January 1991). Burundi is also a signatory of the (CITES) Convention on International Trade in Endangered Species of Wild Fauna and Flora. It is not party to the (Ramsar) Convention on Wetlands of International Importance especially as Waterfowl Habitat. No sites have yet been inscribed under the UNESCO Man and the Biosphere (MAB) Programme. An UNESCO mission in 1979 recommended the establishment of three biosphere reserves, but there has been no follow-up action [1, 12].

Burundi is one of the few African countries not to have had a national park established during the colonial era, although all forest land was established as official reserves by the Belgian colonial authorities in 1933. Until 1980 there was no legislation concerning protected areas. The situation has improved since then.

Decree-Law No. 1/6 of 3 March 1980 establishes national parks and nature reserves. It is an important piece of legislation in the effort to preserve fauna and flora. Activities prohibited within national parks and nature reserves, and penalties to be imposed for infractions are specified. The Decree-Law also states that both reserve boundaries and reserve management plans should be determined by decree.

The Forest Code of 25 March 1985 provides, among other things, for the establishment of protected forests, forest reserves and reforestation areas.

Decree No. 100/47 of 3 March 1980 concerned the creation and organisation of INCN.

### **Environmental Training Institutes**

There are no research training facilities for specialisation in environmental issues. General environmental matters are taught in faculties and institutes at the University of Burundi. Environmental research is also carried out at the Agricultural Research Institute (ISABU), the Ministry of Energy and Mines, and the University of Burundi [12].

### **Cultural Aspects of Resource Utilisation**

Land tenure in Burundi has undergone a major change during recent decades. Under agrarian land reforms introduced in 1976 and 1977, former Tutsi overlords were compelled to cede much of their titular land to Hutu peasants. A more privatised land tenure system now prevails in which each household is the effective owner of its land, even in the continuing absence of legal deeds. The limited data on holdings indicate that virtually all families in Burundi own land. This is normally passed on and sub-divided within families. The transfer of land through purchase and sale — now a more common event — is still an exception to the above [6].

Land ownership no longer reflects significant inequalities. Burundi is, for the most part, a mosaic of small private agricultural enterprises. There are no large-scale farming units except in newly developed areas where agro-industrial schemes have been launched. This system of individual ownership and familial inheritance is not, however, without its problems. Farms are often broken up into tiny plots. Inheritance rules (usually reserved for male descendants) lead to even greater fragmentation [12]. According to a survey undertaken in 1953 the average family farm in 11 regions (excluding Bweru) was more than 1ha. By 1991 farms of this size were only apparent in four regions and the average farm size was just 0.8ha, compared with an average of 1.3ha in 1982. This excessive subdivision, together with traditional agricultural techniques, has led to soil depletion and an acceleration of erosion in many regions [12].

As space becomes ever scarcer, conflicts arise between farmers and livestock herders, and between settlers in new settlements and conservation requirements.

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The role of women in Burundi has changed in recent decades. In general it has become more difficult. Traditionally food crop production was the chief responsibility of women, while stockraising, coffee and banana cultivation were the work of men. Several surveys have revealed that more and more women now participate in tasks traditionally reserved for men, including cash crop production. Such changes now preclude any opportunity for the advancement of the role of women in society. Women often depend on their daughters for help with the work thus jeopardising school attendance and putting the next generation of women at risk of being caught in the same vicious circle [12].

The Ministry of Families and the Advancement of Women is aiming at improving the situation of women by encouraging their organisation and training in specific associations and by building women's development centres [12].

In a general manner the relationship between man and the environment has also changed in recent decades. Rural life is deeply integrated with social, ethical and psychological values. Uncontrolled growth has led to a new type of land-use. Agricultural activities have been reduced with obvious consequences for the communities involved. Future environmental and development programmes should address these specific socio-cultural issues.

## **STATE OF THE ENVIRONMENT**

### **Inventory of Natural Resources**

#### **Ecological zones**

Four natural ecological regions have been identified: the Imbo lowlands and the areas around Lake Tanganyika; the Zaïre-Nile massif; the central plateau; and the eastern depression.

Biogeographic affinities are predominantly Afromontane in the highlands and Lake Victoria Regional Mosaic in the lowlands, with a small Zambebian element along the border with Tanzania [3].

The Imbo region, in the west, is a narrow subsidence plain extending along the Ruzizi River and the north bank of Lake Tanganyika at an altitude of 780-1000m. Remnant savannah and a small patch of Guineo-Congolian forest still occur. The area is covered by alluvial deposits and sediments. It is suitable for irrigation. Rice is grown in small-scale irrigation schemes.

The elongated, folded ridges of the Zaïre-Nile massif rise some 1500m above the Imbo plains before merging with the Central Plateau in the east at around 2100m. The divide runs parallel to the Ruzizi valley and Lake Tanganyika, some 20 to 30km to the west. There are four summits of over 2500m in the area. Lower montane rain forest remains along the highest reaches of the massif. A mild climate allows crops such as wheat, tea and potatoes to be grown. The topography makes the region susceptible to erosion because of the steep elevations and intensive agricultural practices.

The Central Plateau, a hilly region above 1500m, is considered Burundi's heartland. More than half of the population lives in this region. It is irrigated by a dense network of rivers and waterways carving the land into a multitude of hills. The eastern depression stretches from the north-eastern depressions in Bugesera around the northern lakes to the central valley of the Ruvubu river and is bordered by the Malagarazi and Mosso basins which contain extensive wetlands. Altitude varies between 1000m and 1500m. The climate did not allow early population settlements and these areas have only recently been populated [2, 12].

Altitudinal variations in Burundi have a strong bearing on the climate, resulting in several equatorial microclimates. The annual rainfall pattern is divided into a main and a shorter rainy period. Rainfall varies between 1200mm in the elevated areas and 750mm in the lowlands. The varied microclimates allow for a multitude of different crops to be grown. They are also a potential asset for the development of tourism [12].

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### Water

Water resources are unevenly distributed within Burundi. Some regions in the east, north-east, and in the Imbo plain are considered arid, whereas the western hilly regions have a plentiful water supply.

Two types of drainage predominate in Burundi. A dense network of torrential streams descend the Mirwa escarpment and the entire western slope of the Zaïre-Nile massif into the Ruzizi River (150km long) or into Lake Tanganyika (Fig. 2). River gorges follow the ancient fault lines. Major rivers include the Mwambe, Nyagama, Kagunuzi, Mpanda, Mwembwe, and Kaburantwa, many of which have hydro-electric potential.

Throughout the eastern half of the country a series of slow-moving streams flow through the valley beds. The gradual slopes of these rivers frequently cause alluvial blockages, some of which have led to the formation of Lakes Cohoha and Rweru along the Kanyaru River. Streams in the north and centre of the country flow into the Ruvubu, the Kanyaru or the Kagera on their way to Lake Victoria. The Ruvironza is the most southerly source of the Nile. Streams in the south-east flow into the Murogarazi (475 km long) which enters into Tanzania, eventually returning to Lake Tanganyika. Streams reach their maximum levels during the long rainy season (October to April).

Data concerning groundwater in Burundi is limited. It is thought, however, that water supplies are adequate, as in neighbouring Rwanda. Most rural residents draw water from locally managed springs, located along lower hillslopes, and seeps located in valley beds. Water from these sources is of good quality although lower, unprotected slopes are frequently contaminated from human and animal wastes [5]. In the early 1990s there were 338 connections supplying 2765 fountains and 1921 private connections, 11,000 protected springs and 97 boreholes [12].

Wetlands comprise four large lakes, including Lake Tanganyika, as well as a number of smaller mountain lakes. In total there are 2184km<sup>2</sup> of lakes in Burundi. The part of Lake Tanganyika which lies within the country covers 2000km<sup>2</sup>, is 700m deep, and is the largest body of water in the country. It is also, after Lake Baikal in the former Soviet Union, the deepest lake in the world [12]. The level of the lake fluctuates several metres each year. Other important lakes include Lake Rweru (Rugwero), which covers about 80km<sup>2</sup>, and Lake Cohoha, which extends over 59km<sup>2</sup>.

Floodplains and permanent swamps occur along many of the rivers, especially at the headwaters and on the lower plateaux [1, 5]. *Ceratophyllum demersum* is abundant at many river mouths, while *Azolla pinnata* forms immense floating mats in many deltas. Extensive submerged beds of *Myriophyllum spicatum*, *Najas marina*, *N. pectinata*, *Ottelia ulvifolia*, *Potamogeton pectinatus* and *P. schweinfurthii* also occur. *Potamogeton* spp. are the predominant macrophytes around much of the shoreline, with occasional rafts of *Nymphaea caerulea* and *N. capensis* in shallow sheltered bays. *Cyperus papyrus*, *Phragmites mauritianus* and *Typha domingensis* dominate delta swamps.

### Forest

Montane forest is thought to have originally covered between one-third and half of Burundi, mostly in the western highlands of the Zaïre-Nile massif and the slopes leading to Lake Tanganyika and Kivu (Fig. 3). At present, however, only 1.4% (360km<sup>2</sup>) of the country remains forested, most of which is in the highest reaches of the Zaïre-Nile massif. But even this is fragmented. Apart from these, one very small patch (a few km<sup>2</sup>) of lower altitude closed forest survives at Kigwena, along the banks of Lake Tanganyika [2].

Bururi forest (see Fig. 4) is located at the southern tip of the Zaïre-Nile divide. It contains a unique assemblage of species, some more typically found in the savannah regions to the east, some from the lowland forests of Zaïre and others common to other montane forests of the region. More than 90 tree species are present, six of which are deciduous. The lowest-lying regions are dominated by *Anthonotha pynaertii*, *Albizia gummifera*, *Parinari excelsa*, *Newtonia buchananii*, *Croton macrostachyus*, and *Tabernaemontana stapfiana*. Epiphytes and ferns are numerous. The upper regions include *Albizia* spp. and *Tabernaemontana* spp. but are characterised by *Chrysophyllum gorungosanum*, *Symphonia globulifera*, and *Entandrophragma excelsum*.

Kibira forest (Fig. 4), along the divide to the north, is at a higher altitude and is more humid. It is contiguous with the Rwanda's Nyungwe forest. Primary forest constitutes about 20% of these areas; the rest is secondary as a result of human disturbances (fire, tree-felling, cattle raising). The primary forest is tall closed canopy forest dominated by species such as *Parinari excelsa*, *Entandrophragma excelsum*, *Cassipourea ndando*, *Albizia gummifera*, and *Syzygium guineense*. Secondary forest stages include the tree species *Macaranga kilimandscharica*, *Neoboutonia macrocalyx*, *Polyscias fulva*, and *Hagenia abyssinica*. Bamboo (*Arundinaria alpina*) is mixed with both the primary and secondary forests. This forest was previously used as a royal hunting ground. Some areas still hold magical qualities for the local people and are therefore left undisturbed.

The small patch of evergreen forest at Kigwena contains exceptionally large and spectacular *Dracaena steudnesi* plants (some of which are over 10m), along with a wide variety of other trees including *Maesopsis eminii*, *Newtonia buchananii* and *Pycnathus angolensis* [2].

Forests are too scarce and contain too little hardwood to support logging at any economic scale. Efforts have been made, however, to enhance forest productivity for local subsistence needs. In 1985 the International Development Agency (IDA) provided US\$12.8 million to help to increase the use of trees for wood supply and agricultural use. IDA is helping finance a long-term programme to develop basic forestry services and to promote tree-planting to supply wood for fuel, construction poles and timber. The project will benefit an estimated 60,000 rural families [4].

## Burundi

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### Agriculture

Like most African countries, Burundi's economy is predominantly agricultural. Almost 90% of the labour force is involved in this sector, cultivating 64% of the arable land, mainly at a subsistence level. In 1991 the agricultural sector provided 55% of GDP [4, 5].

Two types of agricultural land-use prevail. The first concerns the vast majority of farmers who live in dispersed homesteads (*rugo*) and each cultivates an average of 0.8ha of hillside. Simple handtools and green manuring techniques are employed. Cooperation is generally restricted to members of the extended family household. These small farms (about 900,000) are characterised by low productivity, vulnerability to land degradation and low levels of input. The production system is based on mixed cropping practices. Crops grown are primarily intended for the family homestead, leaving little for sale. Food products represent 78% of agricultural activities and account for 92% of the total cultivated area. Agriculture is the single most important activity in Burundi, contributing 44% of GDP. Current agricultural productivity ensures self-sufficiency. Subsistence crops include cassava, sweet potatoes, bananas, pulses, maize and sorghum [4].

The second major use of land is industrial coffee and tea plantations, comprising 2% of the total area. Burundi's dominant cash crop and economic mainstay is coffee. In the past the overwhelming dependence on coffee (it provided more than 80% of total export earnings in the 1980s [12]) caused economic difficulties in times of falling world prices. A scheme introduced in 1975 under the Lomé Convention to stabilise export earnings has, however, helped to relieve this problem. All green coffee is processed in factories at Bujumbura and Gitega. Production increased from 20,000 tonnes in 1977, to 35,000 tonnes in 1987, but a slight decrease was recorded once again in 1991 (33,700 tonnes) [4, 12].

Tea is a distant second in export commodities. Production of tea (green leaves) has shown a steady increase in recent years: 19,000 tonnes in 1990 and 25,000 tonnes in 1991. Quality remains high and 95% of dried tea (5300 tonnes) was exported in 1991. Foreign assistance has aided several agricultural development schemes. France has financed a tea project in Buhoro and the European Development Fund (EDF) has provided funding to extend five other tea plantations [4].

Other cash crops of lesser importance include cotton, rice, and sugar. Following a major decline in the production of cotton seed in 1990 (5500 tonnes), production increased again in 1991 to 7200 tonnes.

Given the large population, food demands are increasing while available land is steadily declining. The current system has been able to feed the population but there are signs that it has reached its limits. Cultivated land has gradually risen higher on hillsides and taken over marsh land and valleys formerly used as pastures. Livestock is now confined to the periphery. Farmers have had to multiply certain crops; some are grown up to three times a year, first in September, again in February and a third time in July-August. In some regions there are three distinct cultivation seasons: two on the hill slopes and one in marsh lands. Fallow land has almost



entirely disappeared. These developments, combined with growing scarcity of cattle manure as fertilizer, have resulted in a rapid decline of soil quality [12].

Agricultural development is further limited by the restricted potential for irrigation, mechanisation, or intensive use of land. Food production also remains vulnerable to the vagaries of the weather. Crop extension on new plots is practiced on marginal land to increase production, but the resulting output is low as a result of soil infertility and primitive production techniques.

Although food production rates and nutrition levels are not yet alarming, the situation remains precarious. There is a risk that this could seriously deteriorate in coming years. Priority objectives for the government are rural development, continuing food self-sufficiency and an improvement of the nutritional status of the population [12].

Details of land distribution and its use in Burundi are given in Table 1. As this shows, the proportion of available land in Burundi is 50.4%. Despite these details, natural resource planners do not have much to rely on, for the following reasons: the portion reserved for pastures is difficult to calculate, and all empty space is grazed; intrinsic value of available land is marginal at best. More than half of it is barren and unsuitable for food crops. Other areas are without water or inaccessible because of topography [12].

Table 1. Land distribution and its use in Burundi [12]

	Area (ha)	Percentage
Total land area	2,783,400	100.0
Permanent water (lakes & rivers)	215,133	7.7
Regional land	2,568,267	92.3
of which: non-arable land	167,730	6.0
arable land	2,400,537	86.3
Land available for agriculture, pastures and woodlots		
Hillside cultivation	786,955	28.3
Industrial plots	5,650	0.2
Man-made forests	79,743	2.9
Marshlands	125,991	4.5
Available land (incl pasture)	1,402,198	50.4

## Burundi

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### Livestock

Livestock represented 6.8% of GDP in 1991. This sector has stagnated because it has not been modernised. It now represents less than 10% of the GDP and the traditional values that once made it a source of prestige are disappearing [12]. Livestock are generally underused (large numbers are kept although productivity is low). Stock-raising is also a source of harmful practices such as bushfires and overgrazing in return for mediocre yields in milk and meat (milk production amounts to only 600 litres per cow per year, half of it consumed by the calf. Meat consumption is about 3kg per person annually). Calf mortality is high, and malnutrition is a common problem among cattle, particularly during the dry season. A substantial drop in livestock fodder in 1991 has seriously aggravated this situation [9]. The sale of hides has, however, increased. In 1989 this was the fourth largest source of export earnings [4].

Pressure from the agricultural sector on marsh lands and other marginal lands (which were traditionally pasture lands) has been the prime cause for the decline of the livestock industry. The availability of animal manure has also declined which has had a deleterious effect on farmland. Decreases in livestock numbers have also lowered the protein levels in the national diet. Efforts to improve the livestock situation are planned, although they face enormous odds with the scarcity of grazing land [12].

### Fisheries

Burundi's fish catch comes almost entirely from Lake Tanganyika which, because of its depth, has many characteristics of a sea (it differs from most African lakes in that its principal resources are to be found in the pelagic zone). Ndagala (*Stolothrissa tanganyicae* and *Limnothrissa miodon*), mukeke (*Lates strappersii*) and sangala (*Lates* spp.) are the main species taken.

The fisheries of Lake Tanganyika are divided into industrial, artisanal and traditional operations. In 1989 the industrial fisheries consisted of 17 Greek-style purse-seine units, each employing 25-35 fishermen. The average annual catch per vessel decreased from 400 tonnes in the mid-1970s to 200 tonnes in 1981, with a further fall to 90 tonnes (according to official figures) in 1988. These figures are, however, probably considerable underestimates of the true catch. Several factors account for this decline, mainly an increase in predators. Since the early 1980s, the northern part of the lake has become gradually impoverished and the main fisheries have moved southwards. Total catch of the industrial fisheries is around 1500 tonnes a year (according to official figures), although other sources put it between 3500 and 6000 tonnes [8], while FAO estimates the catch was over 17,000 tonnes in 1990.

The artisanal sector consists of about 600 wooden catamarans. Each unit employs five or six fishermen. The average catch from such boats is 15-20 tonnes a year. Official figures which estimate total artisanal catches at 5000 tonnes per year, may reflect real figures of 9000-12,000 tonnes.

The traditional sector, using dugout canoes and conical dip nets in shallow water, have largely been replaced by catamarans. In recent years, however, traditional methods have made something of a comeback; the number of boats has more than doubled since 1982, to 94 in 1988.

Rural fish-farming schemes were inaugurated in 1985 with the help of the US Peace Corps and with funds from USAID. The programme demonstrated a simple technique for rearing *Tilapia* in rural communities. Several NGOs are also involved in fish-farming extension. UN-funded projects are also taking place on Lake Tanganyika [8].

Lake Tanganyika fisheries make an important contribution to the economy of Burundi as a food source. At the national level fish represents about one-third of the total available animal protein. In many other areas fish is of great importance. The fishing industry also plays a considerable socio-economic role in lake-side communities as a source of employment. Fishermen, whether engaged in the industrial fishery or self-employed, are said to be among the highest income earners of the rural population.

Although fish consumption in Burundi is relatively low, both by world standards and in comparison with other Central African countries, it is unlikely, given the present state of the resources, that landings can be significantly increased in the immediate future. Problems of supply rather than demand restrict growth of the industry. Nevertheless, continued development of the fishing industry is being actively encouraged by the government.

Environmental problems related to the fishing industry include overfishing, unsanitary drying and packing facilities, lack of fuel to permit fish smoking, and high concentrations of pesticides in the tissues of the fish [5, 8].

### **Protected areas and wildlife**

Unlike most African countries with a colonial past, Burundi established no national forests or parks in the early part of this century. It was only in 1980 that a decree allowed for the establishment of national parks and nature reserves in Burundi. By then, however, the high population density had ensured that most natural habitats had already been destroyed. Those that survived were small and fragmented. Hence the urgent need to protect remnant habitats.

Two national parks now dominate the system: Ruvubu National Park (436km<sup>2</sup>) an important site for large mammals, which stretches along the Ruvubu River in the north-east (Fig. 4); and Kibira National Park (377km<sup>2</sup>), in the north-central region, which represents the largest area of montane forest vegetation in Burundi. The latter is also a major water catchment area [3]. The Ruzizi Managed Nature Reserve and Bururi Natural Forest Reserve are also important areas of floodplain habitat and forest respectively. The protected area system currently comprises 10 areas covering 1090km<sup>2</sup> (3.9% of the country) most of which is montane habitat.

## **Burundi**

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In 1983 a management plan for Bururi Natural Forest Reserve was developed under the direction of INECN with assistance from USAID. Much of this plan, which involved protection of the remaining forest, natural reforestation, development of woodlots and agroforestry plots around the reserve, and a preliminary study of tourist potential, has now been implemented.

Protection activities for Kibira National Park have included extensive planting of exotic tree plantations on the eastern border, organisation of park patrols, and a detailed study of resident chimpanzees (*Pan troglodytes*) to assess their conservation status and the possibility of chimp-focused tourism. Although the area has National Park status, enrichment planting has been attempted in the forest to support economic self-sufficiency in park management [2].

Ever-present threats to the protected area system include human settlements, uncontrolled fires, pollution and overfishing in Lake Tanganyika, and the trade in illegal wildlife products, especially ivory and rhino horn. Wetlands are also poorly protected and managed. Important biological resources in these ecosystems could easily be lost through clearance and over-use.

Management of the protected area system suffers from a range of deficiencies, notably insufficient resources and expertise. Management plans are urgently needed, especially in Ruvubu National Park (where existing human settlements should be relocated to buffer zones) and Kibira National Park (where forests are being cleared illegally). The Bururi Natural Forest Reserve should be upgraded since full protection and management is essential to its survival. The management and protection of wetlands also needs improving throughout the country, particularly the papyrus swamps near Karuzi and the Ndurama Valley [3]. Enforcement capability is constrained by insufficient trained professionals, including biologists, wardens, foresters, and managers [2]. This is a major handicap for promoting the need for conservation and building a strong environmental awareness in the country.

### **Non-renewable resources**

Significant mineral resources are believed to exist in Burundi, but mining has remained a small operation. Bastnaesite and cassiterite mining, significant in the 1970s, has decreased to negligible outputs. Gold, tungsten and colombo-tantalite are mined in small quantities. Important deposits of vanadium, believed to be the richest resources in the world, and uranium are being surveyed. Petroleum has been detected beneath Lake Tanganyika and in the Ruzizi Valley.

Large nickel deposits — estimated at 5% of world reserves — were discovered in 1973 near Musongati. In 1981 the IDA provided a loan of US\$3.9 million to assist financing an assessment of the ores' commercial potential. Ore-processing could include the recovery of copper, cobalt and platinum, as well as nickel. An evaluation of the economic feasibility of exploiting identified deposits of phosphate was under way in 1991 [4].

### Industry

#### Main industrial sectors

Industrial activity in Burundi is limited, concentrated on the processing of agricultural products such as cotton, coffee, tea and vegetable oil, and small-scale wood mills. It accounted for about 24% of GDP in 1991. Development of industry suffers from the country's land-locked position, the shortage of trained personnel, as well as market restrictions. In other respects, successive devaluation of the BUF has led to a price increase in basic materials and increased debt among businesses.

Beginning in 1978 a series of Five-Year Plans were launched to revitalise the stagnant economy by increasing and diversifying production, both for export and for import-substitution, and by encouraging businesses in unfavourable areas. By 1983 several small enterprises (including cement, footwear and insecticide factories) had been established. A brewery was completed in Gitega. A textile industry was developed with aid from China and, by 1986, one-third of total textile production was exported, earning BUF400 million. In 1991 cotton exports experienced a major increase earning BUF243.6 million, compared with BUF19.6 million in 1990.

Recent industrial development has been characterised by an effort to provide substitutes for imports and by the promotion of exports. An investment programme has been published and large undertakings in the public sector are being gradually replaced by competitive bodies. Prices have been freed and the devaluation of the Burundi franc ensures better competitiveness [7]. The pattern of goods importation slowed in 1991 following a strong increase (+34%) in 1990 and stagnation in 1989. Apart from petroleum products, which did not register an increase (-1%), other imports increased by 12%.

Handicrafts, which are of particular economic importance in rural areas, have created 16,000 new jobs. Their development potential is, however, limited [7].

Industrial development in general is hampered by Burundi's land-locked position (seaward access is about 1400km via Dar-es-Salaam and 2000km from Mombassa). This means that only products capable of bearing the high costs of transport can be developed [4].

#### Location of industry

Nearly all industry is located in Bujumbura, the capital and largest city. It is the country's only port. Most export trade is conducted along Lake Tanganyika between Bujumbura and Tanzania and Zaire. Soap, textiles and cigarette factories, slaughterhouse facilities, dairies and a brewery are all located in the city [4, 12].

A brewery is also located at Gitega, the second largest urban centre [4].

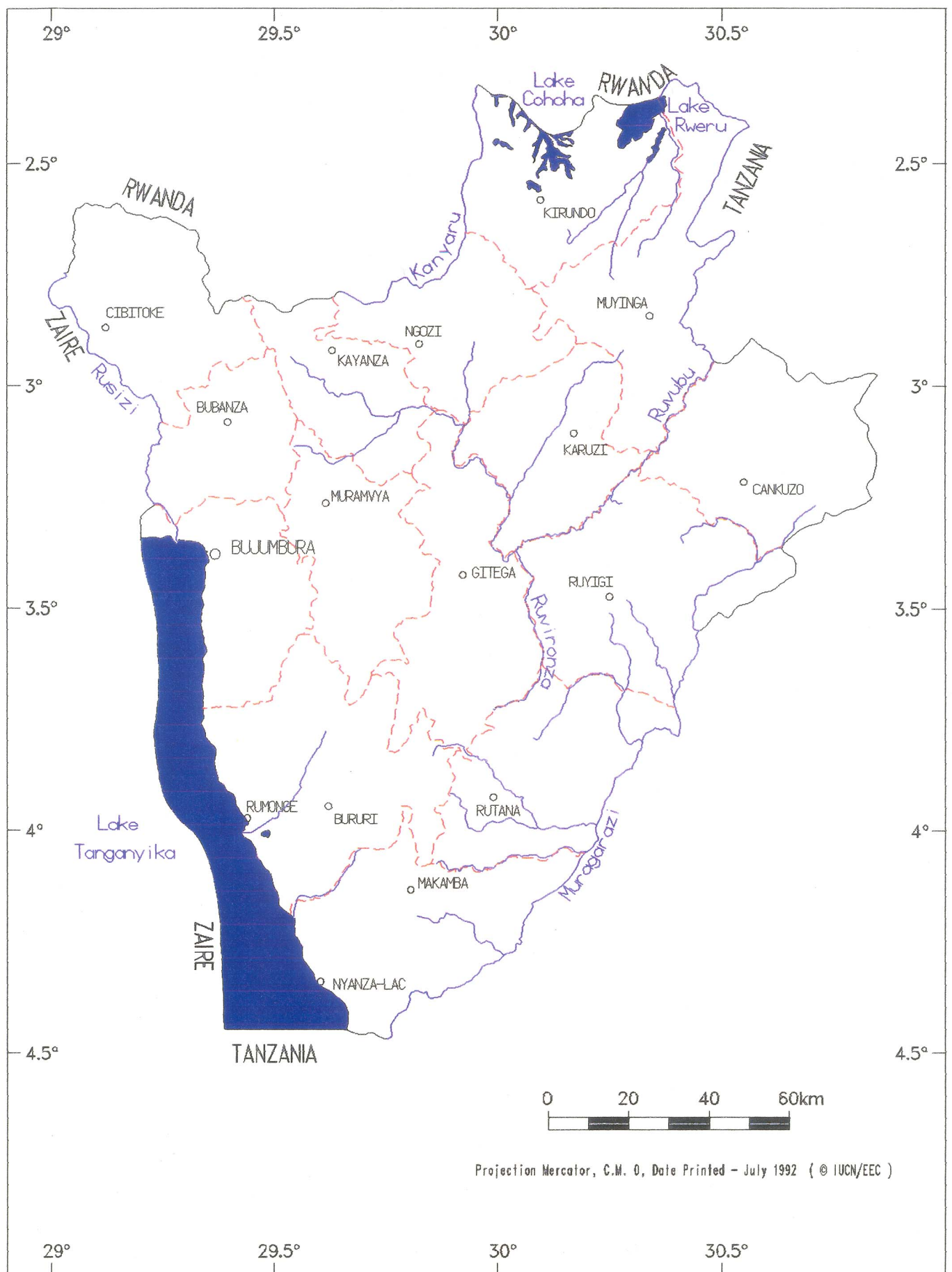


Figure 1. Administrative Boundaries , Rivers  and major towns of Burundi.

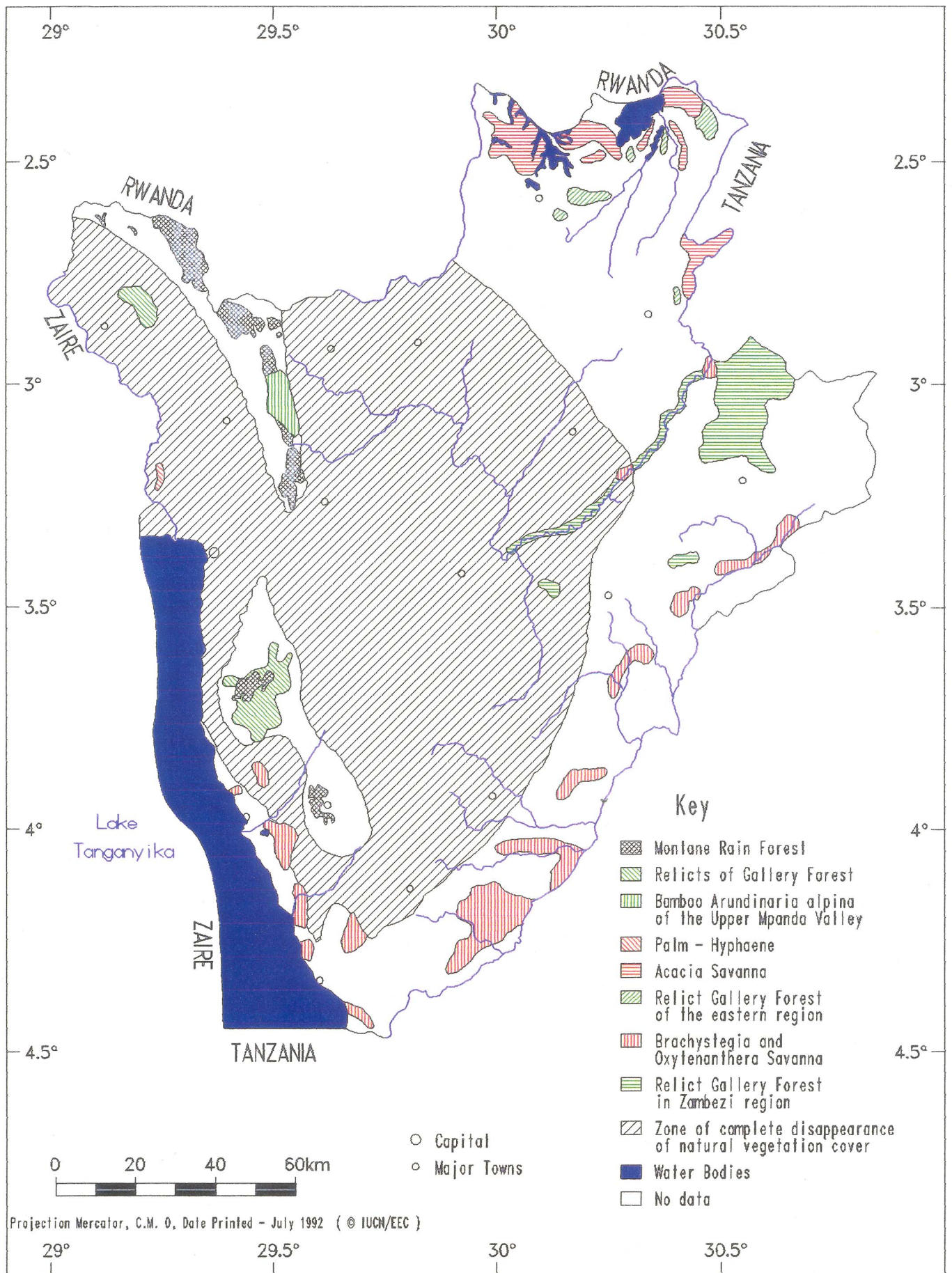


Figure 3. Vegetation pattern of Burundi  
See text and Annex I for further details.

## **Burundi**

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### **Energy sources and consumption**

Burundi is a very low consumer of energy with poorly developed energy resources. Energy consumption per person was 21 kgoe (kilogrammes of oil equivalent) in 1989. Total energy consumption increased by 7.3% from 1980 to 1989.

The dominant share of energy consumption (95%) is covered by wood and charcoal, used primarily for domestic purposes. Wood is the main source of energy consumed in rural areas while urban households use mostly charcoal. Total annual consumption of wood and charcoal is estimated at five million tonnes. Since about 2,425,000 tonnes of wood are produced every year, this represents a deficit of 2,575,000 tonnes each year [12].

Although wood and charcoal represent 95% of total energy consumption, they account for only 25.6% of commercial energy. This portion is generally consumed by various institutions (including secondary schools, prisons and army barracks).

Although Burundi has the capacity to produce its own power, most of its electricity is imported (mainly from Zaïre). Hydropower potential is estimated at some 400MW primarily on the Ruvubu and other rivers falling from the Zaïre-Nile crest into the Ruzizi River and Lake Tanganyika. Two power plants with a combined capacity of 9725kW are in operation, and nine additional smaller stations were brought into production in the late 1980s, practically doubling electricity production within a decade. Various parts of the network have been interconnected and many rural centres are supplied with energy through micro-power stations. Ten of the 15 provincial capitals now have a permanent electricity supply [7]. Present hydro-electric and thermal plants can supply a guaranteed 180GWh per year. Electric power generation is currently estimated at 120GWh per year, 67% of the annual potential.

The share of thermal-electric plants is very low, only 0.5% of total demand [12]. The production of thermal plants in general has been declining over the years and there are plans to phase them out gradually in view of their high operating costs, compared to small hydropower plants [12].

Petroleum products provide 60% of commercial energy needs. This represents about 3.65% of the country's total energy consumption, which reflects the low level of development in the modern sector of the economy. Burundi imports all of its petroleum products. These make up 20% of imports and absorb 40% of export earnings, placing a serious constraint on industrial development plans [5, 12].

The annual total of imported petroleum products — 60,000 tonnes — is modest in absolute terms. Consumption per inhabitant, around 11kg/year, is one of the lowest in Africa (average consumption in sub-Saharan Africa in 1986 was 116kg/inhabitant/year [12]).

Peat reserves are estimated at 42,584,000 tonnes, with a moisture content of 30%. These are located in highland bogs in the central and southern regions (Ryansoro, Matana, Gisozi) in the



Nyamuswaga valley and in the valleys of the tributaries of the Kanyaru (Buyongwe, Ndurumu, Nyavyamo). Currently less than 3km<sup>2</sup> of bog is mined, and production stands at 11,500 tonnes a year [12].

Plans are under way to develop the use of plant wastes as well as solar and wind energy under the auspices of the Burundi Centre for Studies of Alternative Sources of Power [7].

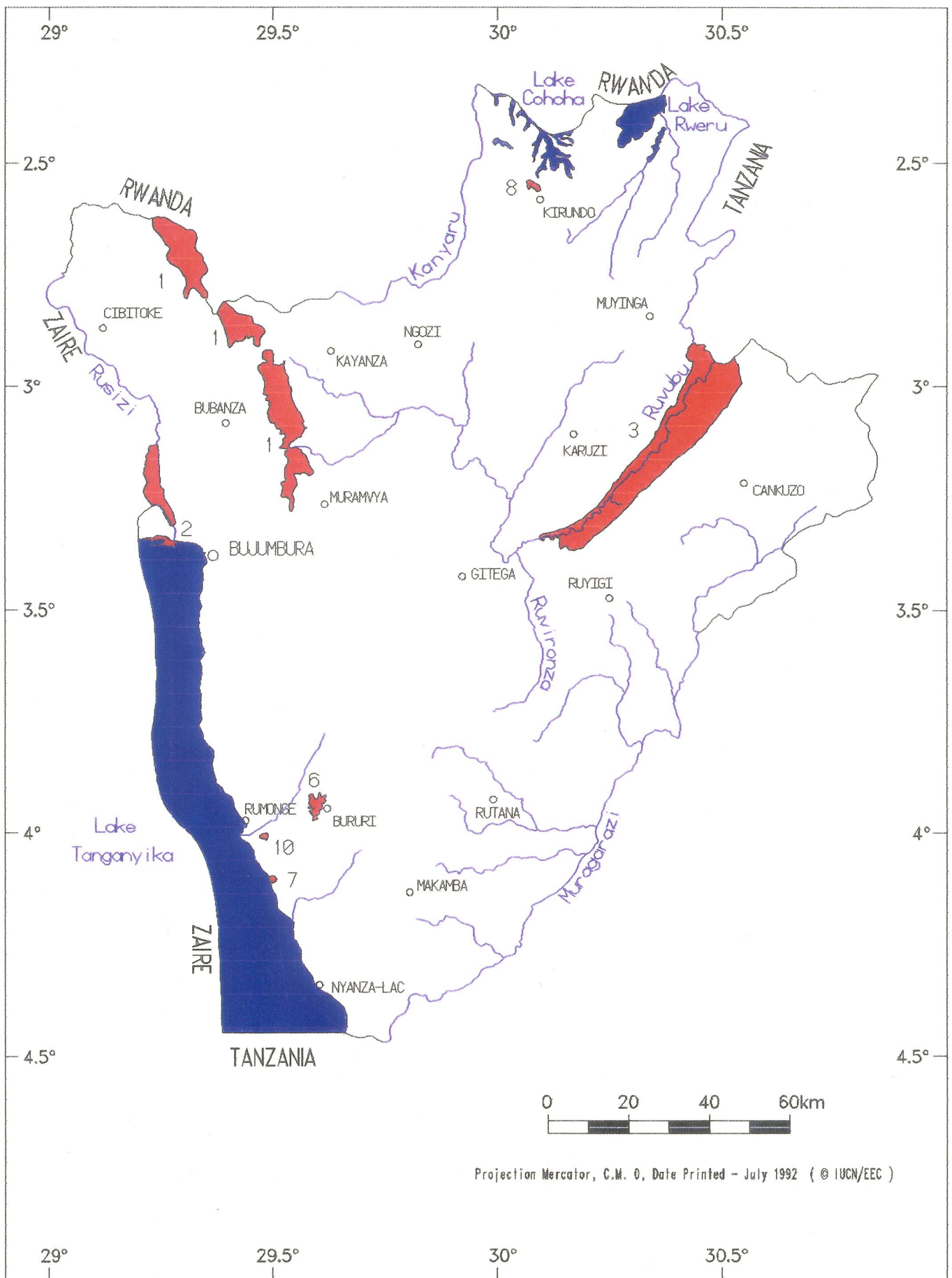


Figure 4. Protected Areas of Burundi  
 See text and Annex II for further details.

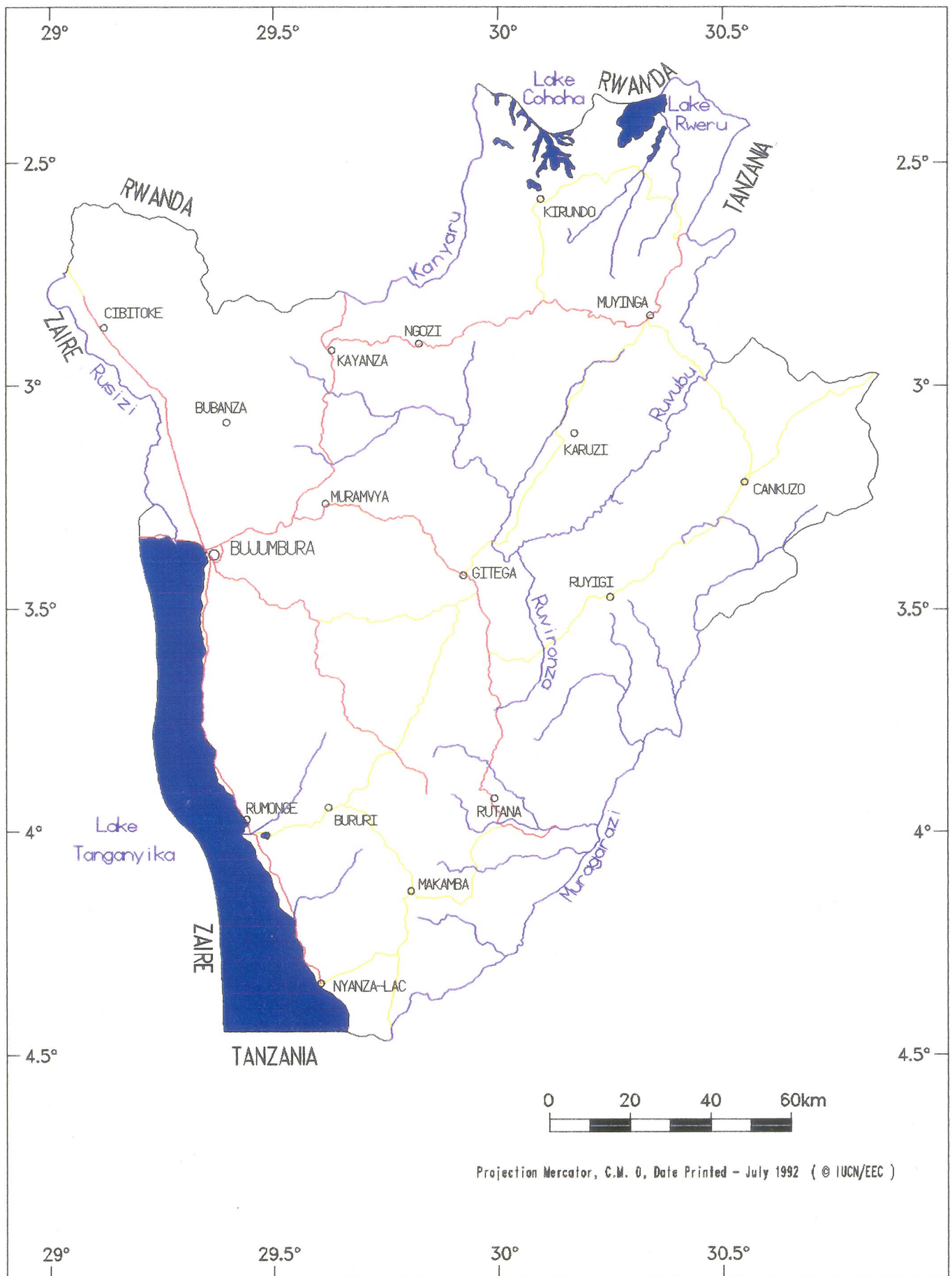


Figure 2. Major Communication routes in Burundi:

Major Roads , Secondary Roads , Railways , Rivers .

### Demography and Urbanisation

#### Demographic pattern

In July 1991 the population was estimated at 5.4 million and overall population density was 208 persons/km<sup>2</sup>.

The country's diverse topography has led to an unequal distribution of population, with drier regions having up to 450 persons/km<sup>2</sup>. This concentration of population in the steep-sloped highlands increases the vulnerability of the landscape to soil erosion.

The northern portion of the central plateau has the highest density (over 250 persons/km<sup>2</sup>). This is the traditional heartland of Burundi, comprising the provinces of Ngozi, Gitega and Muramvya (Fig. 1). There is also a high population density around Bujumbura, at the top of Lake Tanganyika. Density rates are lower in the area south of the central plateau (144-250 persons/km<sup>2</sup>). The outlying counties along the eastern borders and in the far north-west have densities ranging from 80-144 persons per km<sup>2</sup> [5].

Linguistically the population is homogeneous: all three ethnic groups speak Kirundi as their mother tongue. French is the official language of Burundi [6]. More than 60% of the population are Christians, mostly Roman Catholics. There are 200,000 Protestants, of whom some 160,000 are Pentecostals. Fewer than 40% of the population adhere to traditional beliefs, and about 1% are Muslims. The Baha'i Faith is also active in Burundi [4].

Ethnically, the population is divided between the Hutu majority (85% of the population), and the politically dominant Tutsi minority (14%). The pygmy Twa group constitute the remaining 1%.

The domination of the majority by a minority has caused numerous clashes and uprisings in the post-colonial period. Gradually, however, more liberal and equitable policies have evolved. Land reforms in 1976-1977 transferred land from Tutsi overlords to the peasant farmers. Today nearly all families own their farms. Fierce clashes and reprisals still occur occasionally, but the country seems to be moving, albeit slowly, towards a more democratic structure.

The majority of environmental problems are directly tied to the concentration of population in a small area. Current population densities already impose severe pressure on natural resources, especially soil. Soil erosion is a major environmental problem in Burundi. It results directly from excessive demands of the population which is heavily dependent on agriculture. Agricultural potential has now, however, reached its upper limits.

#### Population growth

Nowhere has population growth in Africa been more dramatic than in Burundi and Rwanda, two of the smallest countries on the continent. The population of Burundi was thought to be around 1.7-2 million in 1950. Since then the population has jumped to 3.6 million in 1970 and 5.47

million in mid-1990. The population density has risen from 134 persons per km<sup>2</sup> in 1970 to 193 persons per km<sup>2</sup> in 1990 [5].

Burundi's population density is the second highest in Africa and the rate of growth, which is estimated at 3% per annum, is likely to speed up in the next two decades. At that rate the population would increase to seven or eight million by the year 2000. An active policy has been adopted to stem this expansion by providing family planning services as part of maternal and child health programmes, but the use of contraceptives is not widespread and fertility rates are high while mortality rates are declining [11].

### **Internal and external migration**

There is little internal migration in Burundi. Most people are attached to that portion of the countryside over which they exert usufructuary rights. Nevertheless, two types of migration have been identified: rural-rural and rural-urban. Efforts are being made to move people from the overpopulated hilly areas to the Ruzizi valley [4]. There is also a slow, but steady, immigration in the Kumoso lowlands, and also to Rumonge. Apart from this rural movement there is a steady influx of people to Bujumbura seeking employment in the port and the city's few industries. The extent of this rural to urban shift is, however, much less than in most African countries. Official policy is to reduce migration by creating rural employment, constructing schools, hospitals and health centres in rural areas, as well as improving infrastructure and transportation.

The pressure on fertile land by the large population has resulted in extensive external migration, mainly to Tanzania, Zaïre and Uganda. Measures taken in these countries to restrict employment to nationals are, however, closing the outlets for such migrations. Burundi also has plans to regulate the entry and residency of migrant workers and their families, as well as refugees [4].

The three member states of the Economic Community of the Countries of the Great Lakes — Burundi, Rwanda and Zaïre — adopted a convention in 1985 which would allow nationals and their family members to have the right to enter, reside and engage in economic activities in other member states [11].

Several projects are under way to improve conditions for immigrants in certain regions. In Mosso, for example, a project is seeking new ways for developing and improving farming techniques on steep ground. Results will be incorporated in an economic development programme for the region. This work mainly concerns the communities of Kinyinya and Nyabitsinda, comprising about 50,000 people and 9-10,000 farms. The French Ministry of Cooperation provided FF5 million for this development in 1991. Administered by the Minister of Agriculture and Livestock, this is the first integrated development project to take place in Burundi. It could therefore serve as a valuable reference for future international assistance programmes.

## **Burundi**

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Another project was launched in 1987 on the Nyanzalac plain, covering an area of 300km<sup>2</sup>. Preliminary research in 1991 emphasised the need for controlling erosion and the distribution of disease and insect-resistant crops varieties. The potential for selling crops on the local and national markets was also examined. The Centre for Cooperation in Agricultural Research for Development (CIRAD), which is an active participant in this project, has already conducted a survey of the physical environment (including mapping) and agricultural possibilities (100 case studies have been examined).

Finally, with the same objective an evaluation of arable land in the provinces of Kayanza and Ngozi, benefitted in February 1993 from FF31.5 million from the Caisse Française de Développement (CFD). This project, concerned with improving food production in this heavily populated area, will be centred around the management of some 16km<sup>2</sup> of marshland.

### **Extent, density and distribution of urbanisation**

Only 6% of the population is urban, the lowest percentage of urban dwellers on the continent. Despite high densities, the countryside lacks small towns [12].

Inhabitants of Bujumbura, the capital, represented 5% of the total population in 1990 and 82% of urban dwellers. In 1965 the city's population was just 71,000. Its annual rate of expansion was 5.5% between 1980 and 1990. Apart from the capital most external trade is conducted along Lake Tanganyika between Bujumbura and Tanzania and Zaïre.

The other urban centre is Gitega in the southern part of the central plateau (Fig. 2). Smaller settlements act as markets for farmers to sell their goods and as administrative capitals for provinces.

### **Health issues**

Basic health conditions in Burundi vary between regions. On the Imbo plain, malaria and schistosomiasis are common due to the hot, wet climate and poorly developed sanitation system. Intestinal parasites and dysentery are frequently transmitted by polluted water. At higher altitudes, such as the central plateau, where water sources are generally better maintained, these diseases are less of a problem. Endemic environmentally-based illnesses are prevalent, however, including exanthematic typhus, pulmonary ailments, and articular rheumatism [12].

It is estimated that 80% of endemic diseases in Burundi are due to unclean and scarce water [12]. The main cause of mortality for the years 1986-1988 was bacillary dysentery [12]. This was closely followed by malaria, which is now gradually spreading to higher parts of the country. The disease has developed resistance to most drugs used to combat it [12]. Concerted efforts to control malaria through spraying and epidemiological surveillance have now been instigated [10]. In spite of an intensification of immunisation campaigns there are also still many cases of tuberculosis, a situation aggravated by a generally inadequate diet.

The main causes of infant mortality are infectious and parasitic diseases (measles is a leading cause), nutritional diseases, prenatal mortality, pregnancy and child birth complications.

A growing number of AIDS cases have been reported. As of March 1992, WHO had recorded 6052 cases [39].

In 1985 Burundi and Rwanda announced plans to adopt a joint strategy to combat communicable diseases and control epidemics. In the same year the government initiated a rural water supply project and a programme of sanitary education to make the population more aware of the need for clean drinking water. The current five-year health plan outlines goals for combating hunger and malnutrition [11]. Main health policy objectives in the next few years are to improve the delivery of preventive medicine, the sanitary infrastructure, health and nutrition conditions, and to lower infant mortality. Given the low level of household income, the government covers most of the health costs as well as health personnel and infrastructures. At present there is one medical doctor for every 17,000 inhabitants and one nurse for 4410 inhabitants.

Life expectancy at birth was estimated at 47.3 years for males and 50.6 years for females (1990), an increase from 35 years for males and 38.5 years for females in 1965 [12]. The mortality rate declined from 26 to 24.4 per thousand between 1965 and 1971. The infant mortality rate also declined from 150 per thousand births in 1977 to 117 per thousand in 1989 [12]. Maternal mortality rate was eight per thousand live births between 1980 and 1987.

## **ANALYSIS OF POLLUTION AND DEGRADATION PROCESSES**

### **Water Pollution and Water Shortage**

Groundwater — the source of drinking water for 90% of the population — is abundant in rural areas in Burundi. Its quality and the ease of access, however, is not uniform. The hilly topography, dispersed habitat and the traditional system of building settlements and dwellings on hilltops often make water supplies hard to reach and financially costly to develop. Unprotected downslope water points are frequently contaminated from human and animal wastes. Less than half of the rural population has access to a safe water supply. It is estimated that 80% of endemic diseases are due to unclean and scarce water [12].

Action has been taken to improve water supply for both urban and rural populations. A national water and power commission was set up in February 1990 to coordinate activities [10]. In rural areas, the coverage rate for clean water has increased from 22% in 1982 to 43% by the end of 1989, and to 48% during 1991. About 92% of the urban population has access to water, 17% by individual connections and 75% by communal fountains. Piped water conditions were improved considerably in Bujumbura following a cholera outbreak in the late 1970s. The objective for Burundi is to achieve a 100% coverage rate by the year 2000. By then the distance to water for each household in the rural areas should not exceed 500m [12].

Water pollution in surface waters in Burundi is not common aside from contamination of the area of Lake Tanganyika around Bujumbura. Pollution of lake waters is mainly caused by solid waste accompanying natural effluents and by direct discharge of the city's waste water. Bacteriological tests have revealed a very high contamination level [12]. Some industrial effluent is also discharged into the lake, but no data are available on the extent or effect of these wastes.

The use of urea or calcium nitrate fertilizers is also a cause of river pollution. Once again, however, the extent of this problem is unknown [5].

Future water improvements will benefit from financial assistance by the World Bank (US\$32 million in 1992). This project will permit the construction of reserves in nine provinces and will protect about 3000 sources. It will also reinforce the capacity of the Department of Rural Water Resources through provision of materials and training. Co-financing of this project is expected from the Belgian (US\$12.6 million) and German (US\$6.2 million) Development Agencies.

### **Soil Erosion and Degradation**

Soil erosion and degradation are the most serious environmental problems in Burundi. Intensive hillside farming, the use of primitive farming techniques, highly erosive soils, and frequent violent rains have combined to create one of the worst soil erosion problems in the world [1].



## **Analysis of Pollution and Degradation Processes**

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The sensitivity of these soils to erosion is further increased by their low mineral and organic content. Burundi's soils need regular inputs of nitrogen, have poor phosphorus-retention and water-retention capacities, and frequently dry out. Hence the soils are highly subject to erosion. This is exacerbated by widespread farming on steep slopes where runoff is a constant threat.

Another problem is the extremely small size of family plots. This makes mixed cropping, rotation and growing forage crops difficult because of competition with food crops. Areas exploited on a family basis now cover an average of 0.8ha, compared with 1.3ha 10 years ago. To keep pace with the country's needs three crops are grown each year with little rotation of crops and an almost complete disappearance of fallow. Complex overlapping patterns of land tenure and the almost complete occupation of agricultural land make it difficult to implement innovations in the structure of farming. Improper terracing also encourages soil erosion.

The pastures of Burundi are generally degraded as a result of overgrazing and burning. Poor management of livestock (particularly over-stocking) has meant that high quality grass is consumed before it has a chance to get established. This, in turn, encourages growth of hardier and less nutritious species. Burning is an even more serious problem. Fire damages the most nutritious grasses and favours proliferation of species of less value to both wild and domesticated ungulates. The outcome in both cases is a gradual degradation of soils [5]. Since the 1970s higher levels of inorganic fertilizers have been applied to compensate for the lack of animal manure on agricultural land. At the same time loss of tree cover has led to a reduction of organic materials and a breakdown of soil structure.

A number of solutions to soil erosion have been suggested. Cultivation of marginal lands (especially marshes and pastures) would alleviate the pressure on existing cultivated land. Substantial areas of marsh must be drained, however, leading to loss of habitat. These soils are also frequently acidic and unsuitable for agriculture. Heavy investments in drainage systems and soil conditioners are necessary and maintenance will require massive extension, credit and education if it is to be successful. In the Ngozi region, for example, such investment in small areas was not found to be cost-effective [12]. In addition to the loss of important wetland habitat, development of Burundi's peat bogs for agriculture poses the potential problem of nutrient loading of Burundi's sluggish eastern rivers [5].

Agricultural settlement zones have been created for poor farmers in some regions where an organised system of land allocation (including erosion control measures) is employed along with new techniques.

Planned development of irrigation facilities and increased use of fertilizers would certainly increase yields and allow more diversification, growth of fodder crops and reforestation of marginal land freed from agricultural usage. The cost of such initiatives, however, is immense. Failure to manage irrigation and fertilizer application can result in crop loss and downstream

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deposition of fertilizers. Irrigation schemes also create conditions favourable to schistosomiasis, dysentery and other infectious diseases.

Expansion of tea plantations would also alleviate the soil problem. Tea crops preserve and protect the soil and help control erosion while making relatively few demands of soil quality.

Other recommended measures for soil restoration and alleviation include the introduction of mechanisation (although its use is limited in steep-sloped areas), burying of crop residues, contour line cultivation, alternating strip cultivation, agro-forestry techniques and the use of improved seeds and fertilizers. If better market information were available, supplies between regions could improve in response to supply and demand. Prices could then be stabilised and a surplus ensured for national food security.

In general, activities and programmes under way to combat soil erosion and depletion are considered insufficient in view of the damage being inflicted [5, 12]. The shortage of financial resources and technical training, together with the political and economic situation previously described, prevent desired action from taking place.

Although a number of anti-erosion and reforestation projects have been implemented in the past, many are hampered by poor planning and lack of foresight. To overcome these weaknesses a research programme on environmental protection has been initiated. It is intended to design reforestation and anti-erosion projects which will attract international funding, equipment and assistance that is required. This programme, operated by the Agricultural Institute of Burundi (ISABU) is part of the Environmental Action Programme (PAE). In 1991 French Ministry of Cooperation provided FF5.5 million in support of this programme.

## **Deforestation**

Although deforestation began more than 2000 years ago it was not until the first half of this century that the destruction became significant. During the 1920s the forest edge was pushed back at the rate of nearly 1km a year along the entire Zaïre-Nile Divide. Remaining forests resemble islands surrounded by a sea of intensive agriculture. The main threats to these forests include clearance for agricultural land and clearance for firewood and construction materials. Settlements around the edges of remaining forest patches constitute the main worry. Commercial extraction of timber is not a threat since remaining forests no longer contain species of economic importance. By 1990 just 1.4% of the country (360km<sup>2</sup>) was covered in natural forest. The deforestation rate was thought to be 7% (4km<sup>2</sup> of forest a year) in 1988. Details of roundwood removal from Burundi are given in Table 2.

Table 2. Roundwood removals from Burundi ('000m<sup>3</sup>) [4]

	1986	1987*	1988
Sawlogs, veneer logs and logs for sleepers	6	6	6
Other industrial wood*	39	41	42
Fuel wood*	3,702	3,810	3,918
<b>Total</b>	<b>3,747</b>	<b>3,857</b>	<b>3,966</b>

\* FAO estimates

In 1990 tree cover (including plantations and reforested areas) represented about 2020km<sup>2</sup> (7.22% of the area), distributed as shown in Table 3.

Table 3. Distribution of tree cover [12]

Development	Area (ha)
Village woodlots	29,952
Reforestation	45,842
Regional development organisations	8,502
Private plantations	61,000
Natural forest and reserves	56,730
<b>Total</b>	<b>202,026</b>

Since the late 1970s the importance of remaining forests has been recognised. Their role in the regulation of the region's hydrological system, prevention of soil erosion and reduction of flooding downstream are now better appreciated by the public. In recognition of this, various management strategies have been implemented to strengthen forest protection. During the past decade the borders of the forests have been actively patrolled and trees planted around the edge of the forest to act as a buffer. Replanting schemes are also in progress, especially in areas considered marginal for agricultural land. Local people are encouraged to participate in these developments as well as in the future protection of the replanted areas. Controls are, however, often irregular and lax. The lack of financial and technical assistance to operate these patrols is a major shortcoming.

Cattle have been effectively excluded from Kibira National Park, for instance, although problems of small-scale hunting and tree-felling continue. A comparatively new threat in Kibira forest is the invasion of thousands of gold miners who clear the forest to establish camps and strip vegetation from stream banks in search of alluvial deposits. Protection efforts show promise but the historical result has been a great reduction of large mammals in all forests.

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In addition to the reforestation programmes, a number of agro-forestry schemes have been introduced in areas traditionally reserved for agriculture. These are considered as a priority in view of their anti-erosion action and their cumulative impact on agriculture. The overall cost of the substitution and reforestation programmes is enormous, considering the country's potential. The 1988-1992 Five-Year Plan had allocated more than BUF1 billion (over US\$6 million), but this will only solve a minute portion of the problem. The potential for using alternative energy sources (turf, hydro-electricity and biogas) have been examined in an effort to reduce current demand for wood.

## Biodiversity

Until recently Burundi had a large and diverse collection of native terrestrial fauna and bird life. Much of this is concentrated in the Imbo region, the Zaïre-Nile massif, the Ruvubu River Valley and the Kumoso lowlands. The shortage of protected areas, non-enforcement of hunting and poaching laws, and rapid population growth have greatly diminished areas available for wildlife. Most of the country's natural habitat has been destroyed. Much of what remains is often small and fragmented. Consequently certain species face a significant risk of extinction [2, 5].

Although much of the fauna has not been catalogued, there are thought to be 633 bird and 103 mammal species in Burundi [2]. Endemicity is undoubtedly low given the country's size. The montane forests are, however, home to many species endemic to the Central African Highlands which border Uganda, Zaïre, Rwanda, and Burundi.

The combination of species richness, the high proportion of species endemic to the Central African Highlands and the significant numbers of rare and threatened species has led IUCN to rank these forests in the highest priority grouping for conservation in Africa [2].

The best known Afromontane species are certainly the primates, a number of which are threatened. Rare or threatened species include the golden monkey (*Cercopithecus mitis kandt*), l'Hoest's monkey (*C. l'hoesti*), the Rwenzori black and white colobus (*Colobus angolensis ruwenzori*), chimpanzee and the red colobus (*Procolobus rufomitratu tephrosceles*). Other primates on the Zaïre-Nile massif include Bosman's potto (*Perodicticus potto*), thick-tailed bushbaby (*Galago crassicaudatus*) and yellow baboon (*Papio cynocephalus*). Buffalo (*Synercus caffer*), elephant (*Loxodonta africana*), giant forest hog (*Hylochoerus meinertzhageni*), and serval (*Felis serval*) are also present in the massif region, although in steadily declining numbers [2, 3, 5].

Hundreds of elephants had been recorded in the lowlands (particularly the Ibo region) until the 1950s. These have now disappeared. Prominent species include bushbuck (*Tragelaphus scriptus*), sitatunga (*T. spekei*), wild hogs (*Phacocherus aethiopicus*) and baboons. Lions (*Panthera leo*), jackals, hyenas, warthogs and wild dogs may be found in small numbers along the Ruvubu valley. Defassa's waterbuck, roan antelope, impala and buffalo are also still to be

seen within Burundi's borders. A large colony of fruit bats (*Eidolon helvum*) live in Bujumbura [5].

Aquatic wildlife has generally survived better than terrestrial fauna. The hippopotamus (*Hippopotamus amphibius*), for example, is extremely successful and is found both along the shoreline near Bujumbura and in the Ruvubu River Valley. There is also a large number of reptilian genera. Both the African Slender-snouted crocodile (*Crocodylus cataphractus*), which inhabits Lake Tanganyika, and the Nile crocodile (*C. niloticus*), which occur on the Kanyaru and Kagera Rivers, are endangered [5].

Threatened birds include Grauer's swamp warbler (*Bradypterus graueri*), the papyrus yellow warbler (*Chloropeta gracilirostris*) and the Kungwe apalis (*Apalis argentea*).

Lake Tanganyika contains a large fish fauna comprising some 193 species from 13 families, suggesting that the lake has been isolated for a long time. Eight endemic genera have been recorded. Species of scientific interest include *Protopterus aethiopicus*, *Polypterus congicus* and *P. ornatipinnis*. These are ancient fish which have probably been present since the Malagarasi River flowed directly into the Zaïre basin, before the faulting which led to the development of the Rift Valley and its lakes.

There are two aquatic piscivorous (fish-eating) snakes in the lake. *Boulengerina annulata* shelters in the rocks during the day and fishes at night, while *Glypholycus bicolor* hunts pelagic fish, chiefly shoals of *Stolothrissa tanganicae*.

There are approximately 2600 plant species in Burundi [3].

INECN has attempted to improve and extend the system of protected areas to safeguard biodiversity. Effective protection of these sites has suffered from the presence of settlers, together with an overall lack of technical training and financial resources. Demographic pressure has caused the population to develop agriculture and promote grazing, fishing and timber exploitation in all protected areas. It is obvious that recent conservation efforts have led to a positive effect on the natural vegetation and wildlife populations in protected areas. But this is only a beginning. The continuing loss of species and habitats in all forests and protected areas is recognised as being unsatisfactory.

## Urban Environment

Burundi's small urban population means that environmental problems linked to urbanisation are not of major concern. Bujumbura has, however, experienced many of the difficulties of other African urban agglomerations which have undergone rapid growth. Problems caused by poor living conditions along with unemployment, delinquency, poor sanitation and unhygienic living conditions, as well as the development of shanty towns, are now obvious in the capital.

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Bujumbura's waste water disposal and treatment facilities are inadequate. Sewage is either directed into simple pits, septic tanks and cesspits or, alternatively, into the lake. As a result, the area of Lake Tanganyika adjacent to Bujumbura is now seriously polluted.

Bujumbura's housing is largely of poor quality with inadequate services. The housing market also suffers from a three-tiered system which re-inforces unequal levels of services and facilities in different parts of the city and increases the division between the various socio-economic levels in the city [15].

A project is under way to examine dwelling conditions in Bujumbura and its surroundings. Within the scope of this project action is being taken to look at building sites, drainage and the result of two earlier operations in the northern part of the city. The French Ministry of Cooperation, through FAC, had provided FF8.5 million by the end of 1991 for this operation. This assistance made the development and later evaluation of urban activities possible.

### **Energy Issues**

A range of problems exists in the energy sector. The most important is the increasing scarcity of fuelwood and charcoal. Almost all of Burundi's population depend on these sources for cooking and other basic energy needs. Reforestation cannot compensate for current demands. There is a shortage of trained foresters in the country, and current forestry extension programs have suffered from a lack of funds. Trained extension workers can teach not only tree care and woodlot management, but promote fuel conservation strategies. Charcoal production outputs are very low and more efficient kilns are needed. National data on the household use of firewood and agricultural wastes should be made available to allow an evaluation of each sub-sector's resources [12, 13].

The second most pressing problem is the high cost of petroleum imports. Even with Burundi's modest consumption, oil products take up 40% of total export earnings. Transport and handling costs are high. Consequently, many installations and industries are being encouraged to convert to electricity or peat [12, 13].

Electricity is potentially abundant in Burundi but most of what is currently consumed is imported from Zaïre. Although a number of hydropower stations have been constructed in the last decade, the potential remains largely untapped. A power sector development plan is needed to set priorities and to determine when and how available sites should be developed. At present domestic electricity use requires potential consumers to purchase equipment (all of it imported and therefore costly) and to change their traditional cooking methods. Both are constraints to wider application [12,13].

Burundi's peat resources are a potential substitute for fuelwood for small industries and rural institutions and eventually for urban households. Peat provides a low cost, low pollutant (0.23-0.40% sulphur) alternative fuel to wood and charcoal for heating and cooking. Peat can be

burned in its natural state or transformed into briquettes. One of the major constraints to employing peat for domestic use, however, is that its price per calorific unit is greater than that of firewood gathered around the homestead [5]. Peat is slowly replacing fuel oil and wood among industrial consumers [12,13]. Desiccation of bogs and nutrient dumping are potential environmental problems that could arise from peat cutting. These problems could, however, be resolved with minimal safeguards.

Biogas was introduced in 1981. Eight years later there were 141 digesters in operation, producing about 540,417m<sup>3</sup> per year (351 tonnes of oil equivalent). Beneficiaries of digesters are mostly institutions (schools, army barracks, hospitals, prisons) and a few private individuals [12]. Environmental impact from the use of biogas is generally negligible. In a number of existing biogas installations, hygienic improvements have taken place as a result of organic matter digestion (improved sanitation) together with soil improvement due to the production of fertilizer. Environmental risks are slight and limited to leakage of gas and explosion. Biogas is a potential alternative for firewood for domestic use, but the technology and equipment still need to be refined before they can be widely used [13].

Burundi is relatively well endowed with solar radiation, with an average horizontal influx of 5kW/m<sup>2</sup> per day. But use is limited to solar water heaters, photovoltaic equipment and crop dryers. Annual production is estimated at 17.119kWh.

### **Industry**

Given the present state of industrial development in Burundi, there is no real evidence to suggest that industrial pollution has a serious impact on the population's health. Pollution by chemical agents, for instance, is still considered negligible [12].

Most industries are concentrated in the capital and awareness of the need to use technologies that meet accepted anti-pollution standards is growing. The very fact of urban concentration, however, poses a minimal threat.

The government has expressed interest in monitoring the pollution load of effluents from dairies, soap factories and breweries, reducing the use of non-biodegradable or toxic products in industrial plants and improving slaughterhouse sanitation. Prohibiting the washing of trucks on lake and river shores has also been recommended [12].

A serious study of industrial pollution is needed to assess dangers and make considered proposals for clean-up.

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## **NOTE ON DATA SOURCES**

Every effort has been made to ensure that the information in this Environmental Synopsis is as detailed and accurate as possible. Wherever possible, original data sources have been used as a reference or, failing that, data have been checked against several other sources.

A number of publications are recommended for further in-depth reading on a particular topic. These include the regular country reports of the Economist Intelligence Unit [9, 16] which provide a well-balanced review of the political (historical and present) and economic situations as does the Europa Handbook [4]. A wide selection of useful statistical data are to be found in [1, 4, 6, 8, 9, 11, 12, 16, 18, 19, 20, 21, 22, 23, 24, 25, 26, 32, 35, 36, 37]. Information on biodiversity, deforestation and wildlife issues have been obtained from a number of publications [1, 2, 3, 5, 6, 12, 13, 14, 17, 28, 29, 30]. Demographic, health and similar data have been taken from a wide range of sources within the United Nations (including WHO and UNICEF).

One of the prime objectives of this overview has been to highlight gaps in current information in the hope that government and development agencies alike will take the need for fuller information into consideration when planning and implementing future projects.

## **ANNEX I**

### ***Vegetation pattern of Burundi (See also Fig. 3)***

Vegetation of Burundi was digitised from *Plate 8* of the *Atlas du Burundi - Le Tapis Végétal*, published by the Ministère de la Coopération Française (1979). Plantation forests, mapped in the source material, have not be included in Figure 3. Conservation areas for Burundi were taken from a tourist map *Burundi* (1984), at a 1:250,000 scale, prepared by the Institut Géographique National-France, Paris, in collaboration with the Institut Géographique du Burundi, Bujumbura. The map was financed by Fonds d'Aide et de Coopération de la République Française. The 'Forêt' category and 'Limite de parc ou réserve' were digitised from this map.

Digitised data are held at the *WCMC Biodiversity Map Library*, WCMC, 219 Huntingdon Road, Cambridge, CB3 0DL, UK.

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## ANNEX II

### *Protected Areas of Burundi (See also Fig. 4)*

<b>Map Reference</b>	<b>Name</b>
1	Kibira National Park
2	Rusizi Managed Nature Reserve
3	Ruvubu National Park
4	Chutes de Karera Natural Monument *
5	Nyakazu Gorge Natural Monument *
6	Bururi Forest Nature Reserve
7	Kigwena Forest Nature Reserve
8	Lac Rwihinda Nature Reserve
9	Monge Forest Nature Reserve Nature Reserve *
10	Rumonge-Vyanda Forest Nature Reserve
*	not mapped

## ACRONYMS

ADF	Forestry Development Authority (Autorité du développement forestier)
AWF	African Wildlife Foundation
BUF	Burundi francs
CBFK	Kagera River Basin Commission (Commission du Bassin du Fleuve Kagera)
CEPGL	Economic Community of the Great Lakes (Communauté économique pour les Grands Lacs)
CEC	Commission of the European Communities
CITES	Convention on International Trade in ENdangered Species of Wild Fauna and Flora
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
EDF	European Development Fund
FAC	Fonds d'Aide et de Coopération
FAO	Food and Agriculture Organization of the United Nations
FF	French Francs
FFPS	Fauna and Flora Preservation Society
GDP	Gross Domestic Product
GNP	Gross National Product
gWh	Gigawatt-hour(s)
ha	hectare(s)
IDA	International Development Agency
IFAD	International Fund for Agricultural Development
IGEBU	National Geographic Institute
IIED	International Institute for Environment and Development
INECN	National Institute for the Environment and the Conservation of Nature (l'Institut National pour l'Environnement et la Conservation de la Nature)
ISABU	Burundi Institute of Agricultural Science (Institut des Sciences Agronomiques du Burundi)
IUCN	The World Conservation Union
km	kilometre(s)
kw	kilowatt(s)
MAB	Man and the Biosphere Programme (of UNESCO)
MW	Megawatt(s)
NGO	non-governmental organisation
NYZS	New York Zoological Society
ODA	Overseas Development Administration (UK)
PAE	Environmental Action Programme (Programme d'Action Environmental)
UNCED	United Nations Conference on the Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
USAID	United States Assistance for International Development
WCI	Wildlife Conservation International
WCMC	World Conservation Monitoring Centre
WHO	World Health Organization
WWF	World Wide Fund For Nature

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