

Chapter 4

BIOPHYSICAL ENVIRONMENT

4.1 Introduction

The purpose of this chapter is to outline the underlying information relevant to natural resource management (NRM) across the study area, and to indicate its utility and possible weaknesses. It is basically a description of what information is available and what it can deliver. As a background to the rest of the study, this chapter provides descriptive natural resources information on three provinces.

4.2 Physical and Biological Environment in South Africa

4.2.1 THE EASTERN CAPE

The Eastern Cape is one of the poorest provinces in South Africa. It is situated in the south east of the country and encompasses what is traditionally known as the Eastern Province, Border and north Eastern Cape areas, as well as the former "homelands" of Transkei and Ciskei. On the northern side, it borders the Kingdom of Lesotho and Free State, while the districts of Middelburg, Graaff-Reinet, Aberdeen, and Willowmore form its western borders. The Eastern Cape is spatially the second largest province, covering 170 616 km², or 13.9 per cent of the total surface area of South Africa.

4.2.1.1 Climate

According to the South African Weather Bureau classification, the Eastern Cape comprises five climatological regions, based on temperature and rainfall variations.

The climatological regions are as follows:

- **Arid to semi-arid (Southern Cape interior/Karoo)**

This area receives on average less than 250 mm rain per year although this figure rises to 400 mm in the east. It is only in the mountain ranges, such as the Sneeuberge, that the average rainfall exceeds 600 mm. Rain falls throughout the year. Thunderstorm frequency is between 10 - 20 per year, while hail occurs on one - three days per year. Snow falls about five times per year. Temperatures demonstrate a large diurnal and seasonal range. Contrasts of 28°C from night to day are common. Frost occurs from about 1 June to 31 August, but sometimes extends several weeks either way. Prevailing winds are light to moderate, varying from southeast and east in January to northwest in July. On occasion, high velocity winds have been recorded in this region.

- **Semi-arid (North-Eastern Cape interior)**

This area, also known as the Southern steppe, receives 250 – 600 mm rain per year, the wettest areas being in the east where rainfall can rise to 800 mm in the mountainous regions. Most rain is in the form of showers or thunderstorms in the summer months, with a peak in February/March, during which it may rain up to 10 days per month. In winter precipitation can be in the form of snow on the mountain ranges accompanied by intensely cold temperatures. Hail falls from two - six days per year, increasing in prevalence towards the northeast. This is largely a summer phenomenon. Air temperatures fluctuate widely on both diurnal and seasonal time scales. The average daily maximum temperature varies from 33°C in January to 17°C in July. In contrast, some average daily minimums are 15°C in January and 0°C in July. Frost occurs on about 150 days per year between May and September in the south of this region, which decreases to about 100 days per year towards the north. Prevailing winds in summer tend to be light southeasterly, becoming moderate northwesterly in winter. Stronger southwesterly winds are common in association with thunderstorms, but are generally of short duration.

- **Drakensberg region (North-Eastern highlands)**

Primarily its altitude shapes this highland region. Rainfall is high, ranging from 600 - 1500 mm. Most rain falls in summer, from November to March, with 12-13 days of

rain per month. In winter, this decreases to two or three days' per month. Most of the rain falls as intense thundershowers, occurring between 60 and 90 times per year. Mist and drizzle are common and hail occurs from three to seven times per year. Snow is fairly common, with falls about eight times a year – some of which do not melt for several days. Temperatures fluctuate widely on both a diurnal and seasonal basis. Average daily maximums are 27°C in January and 19°C in July, while average daily are 15°C in January and 3°C in July. Frost varies widely with the topography, but occurs on average from 90 to 150 days per year between April and September. Prevailing winds are moderate southerly in January, and change to slightly stronger northerly and northwesterly winds in autumn and winter.

- **Coast with evenly distributed rainfall (Eastern Cape)**

The entire region receives rain in more or less equal amounts throughout the year, but with slight increases in the autumn and spring months. Amounts vary between 400 mm on the inland plains to over 1 000 mm on some of the mountain ranges, where rain can be recorded for up to 12 days per month. Hail and snow are rare, both occurring on average twice a year. Temperatures are modified by proximity to the ocean and generally only exceed 38°C during 'berg winds conditions'. Average daily maximums are 26°C in January and 19°C in July. The average daily minimum values are 15°C in summer and 7°C in winter. Frost is uncommon, especially near the coast. Prevailing wind are generally strong, and range from southwest to northwest in winter and from southwest to southeast in summer.

- **Humid, summer rainfall coastal region (Ciskei to Transkei)**

This coastal region is warm and humid, with a summer rainy season peaking in March. The summer rainfall period produces about 12 rainy days per month, whereas winter will account for four days of rain per month. Rainfall increases steadily from 500 mm along the Great Fish River to over 1 200 mm at Port St Johns. Generally, the rainfall is showery, with about 20 to 30 thunderstorms per year, which are occasionally accompanied by hail. Average daily maximum temperatures are 28°C in January and 21°C in July. Average daily minimums are 17°C in January and 8°C in July. Frost usually only occurs on 30 to 40 days during July and August in the

interior valleys. Prevailing winds are northeasterly and southwesterly for much of the year along the coastline and can occasionally reach gale force. 'Berg winds' sometimes blow from the northwest in winter and bring hot, dry weather to the region.

In summary, the climate is characterised by extreme variability as regards both temperature and precipitation. This variability permits an unusually wide choice of production options in selected areas, but the area in which production can be intensified under suitable rainfall conditions is limited. The large desert and semi desert areas confine crop production mainly to the coastal strip and immediate hinterland, as well as the northern sector of the province.

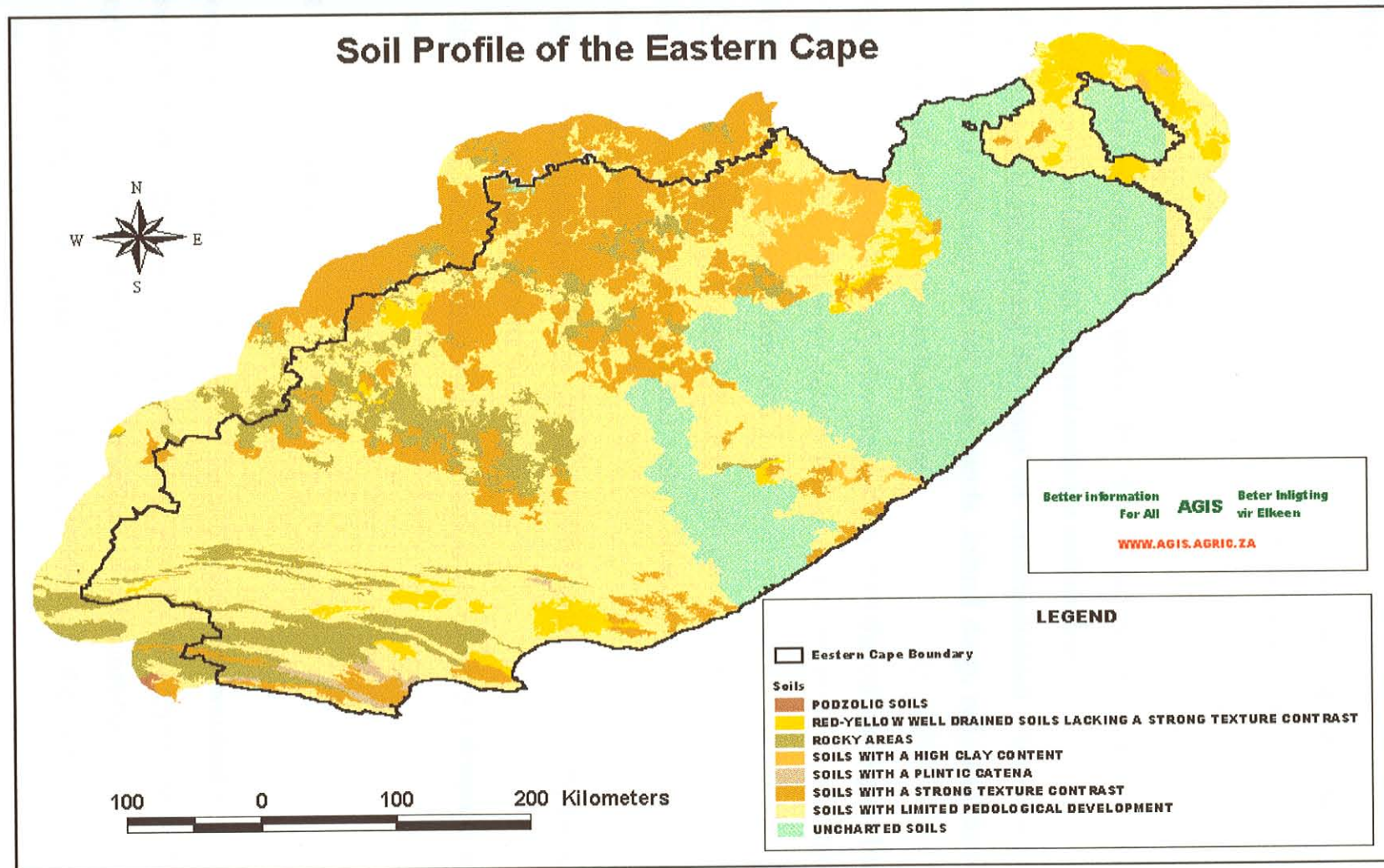
4.2.1.2 Topography

The topography is as variable as the climate, including flat plains, highland areas and stretches of beautiful coastline. This variability in itself does not serve as an impediment to appropriate agricultural production. It also provides an invaluable resource for nature-based tourism, enhanced by the climate and freedom from dangerous diseases such as bilharzia and malaria.

4.2.1.3 Soils

Apart from the river valleys where deeper alluvial soils are found, soils are shallow and of agricultural potential. There are, however, two major exceptions, namely the substantial area of North Pondoland (the area around Lusikisiki and Flagstaff) and the 100km strip between Paterson and Port Alfred. North Pondoland, which is by far the larger area of the two, has deep, fertile soils and high rainfall. The agricultural potential of this area is considered to be amongst the highest in the country. Soil degradation in the region is mainly associated with agriculture on unsuitable soils. Vegetation changes due to heavy grazing pressures have occurred.

Figure 4.1



Soil composition is such that the potential for erosion for most of the region is fairly high and it is also subject to heavy erosive rainstorms. The soil types found in this region include:

- Poorly developed soils on rock with lime in the bottomlands. Soils are generally well drained. Further inland are undifferentiated rock and lithosols. Along the coast, windblown sand dunes provide littoral grey sands.
- Undifferentiated lithosols are primarily shallow and weakly developed with surface limestone and rocks. In the mountainous regions soils are undifferentiated lithosols. The red soils are well drained.
- Wind-blown dunes: along the coast are unconsolidated wind-blown dunes with littoral and near littoral grey sands. Inland deep, red, undifferentiated porous soils and lithosols on limestone.
- Solonetzic soils: with a high clay content occur in the central region but these become shallow and poorly developed on rock with some surface limestone tending to lithocutanic to the north.
- Deep, acidic sands or loams (latosols): with poor drainage. Solonetzic soils in the south and non-humic red and yellow latosols together with black clayey soils in the north.
- Deep, non-humic red/yellow latosols: with smaller areas comprising black clay with rocky land or acid latosols.
- Shallow black and red clays and solonetzic soils: with poor drainage in the B-horizon.

4.2.1.4 Vegetation

The topographic diversity and history of the sub-region has resulted in an equally diverse pattern of vegetation. Most major South African veld types can be found in this region, and four major different veld types can be distinguished:

- Coastal tropical forest: that occurs from Alexandria to the southwestern border of the Eastern Cape near Knysna.
- False bushveld: is found between the Kei and Keiskamma River valleys.

4.2.1.5 Water Resources

- Karoo and Karroid vegetation: covers most of the interior of the region and is subject to erosion, especially on the western side.
- Grasslands: are found north of the Great Fish River basin only, and are sensitive to overgrazing.

Veld conditions are under pressure throughout the region, owing to heavy stocking and poor land-management practices. Invasive plant species are on the increase, and altered species compositions of the rangelands have reduced their potential productivity. Of particular importance to conservation is the Tsitsikama Forest, the smaller forest along the former Transkei coast, and the Baviaanskloof mountain catchment area as well as the primary grasslands of the region. In the Eastern Cape, the interaction of climate, vegetation and geology has resulted in an infinitely varied landscape and environment. The diverse geology, climate and soils of the region provide for vegetation and flora, which has been noted for its fill-geographical complexity.

4.2.1.6 Agricultural potential

Because of its low rainfall and the nature of its topography and soils, most of the region is suitable only for grazing. Since about 90% of the total farming area is utilized for livestock production, the spread of undesirable veldtypes will require firm management. The introduction of exotic plant species, free of their natural controls, has brought about a slow but steadily accelerating deterioration of the indigenous vegetation. The region seems to have a large compliment of naturalized plants from Australia, such as the many *Acacia sp.* or Cactaceae from the Americans. These invasive plants may also affect water supplies and add to the danger of fires, reduce farming productivity and promote the loss of the biodiversity. Biological control of plant invaders has been successful for some species in the region and, ideally, land management procedures should be modified in conjunction with the use of selected natural enemies to best achieve control.

4.2.1.5 Water Resources

The province is deficient in water over most of its area. The data show that water demand in the East London-Berlin-King Williams Town area already exceeds the supply capacity, and it is apparent that the demand for water for urban and industrial use imposes a limitation on the development of large-scale irrigation schemes. The Port Elizabeth-Uitenhage area has been water deficient since 1988 and has relied on inter-catchment transfer from the Gariep River system (formerly the Orange River). Further expansion, particularly of irrigation, depends on the outcome of the current re-planning of the Gariep River system. The Queenstown-Ezibeleni-Sada area seems assured of water into the next century, and potential for further impoundment will permit growth for twenty years or longer. The limited potential and skewed distribution of water calls for careful spatial and strategic planning of future developments, particularly in the large-scale irrigation sector. The dispersed nature of the resource does, however, favour small-scale, low-cost irrigation schemes.

4.2.1.6 Agricultural potential

4.2.1.6.1 Land use patterns

Potential arable land in the province comprises about 1 172 901 ha or 7%, of which 155 000 ha is irrigated. The potential arable land is almost evenly distributed between large scale farming and subsistence agriculture, with 643 501 ha and 529 400 ha respectively. Grazing land comprises 81%, while forestry and nature conservation respectively comprise 1% and 4% of the total surface area. Little land is available for lateral expansion of the large scale farming areas of the province, while land available for expansion is of medium to low cropping potential. Agricultural production activity in the province is highly diversified, correlating strongly with the diverse natural resource base and especially the variance in climate. According to Kassier (1988), the province has extremely erratic and limited water resources. Average annual rainfall increases from west to east and varies from 300 – 400 mm in the lower rainfall of the west to 700 - 800 mm towards to the east. A few isolated areas on the

upper slopes of the Winterberg enjoy rainfall of over 900mm per annum. In the commercial farming areas irrigation is mostly undertaken by private farmers and in many cases they fall under the jurisdiction of Irrigation Boards or Associations. The most important rivers in the area from an irrigation point of view are the Gamtoos, Sundays and Fish Rivers. The most important source of water in this portion of the province is the Orange River Project, which is used to supplement water supplies in these river systems. The area under irrigation which could be linked to Irrigation Boards comprises about 43 820 ha and some 95 000 ha irrigated by farmers utilizing private water sources.

The river catchment of areas in former Ciskei include the Keiskamma, Kat/Fish, Swart Kei/Oxkraal/Klipplaat, Buffalo and Chalumna covering a total surface area of almost 8 170 km². According to Hill *et al.*, (1987) the area of potentially irrigable land in the former Ciskei is estimated at 9 930 ha which is highly recommended, 3 795 ha which is recommended and 102 060 ha which could be regarded as marginal. At that time about 4 294 ha was irrigated, which was expected to increase to 12 532 ha by year 2000. The existing storage facilities in the southwestern Transkei have the capability of providing water for some 17 877 ha of irrigation of which 6 295 ha were irrigated in 1987. Land under irrigation was expected to increase to 9 236 ha by the year 2000. The ratio of grazing land (82%) relative to potential cropland is much higher than the average for South Africa, indicating that livestock production is the most important and significant farming enterprise in the province. Forestry land occupies an estimated 133 520 ha or 0,8% of the land area of which more than 65% occurs in the high rainfall zone of the former Transkei.

4.2.1.6.2 Large scale agriculture

There are 6 429 large scale farming units in the province covering a surface of 10,0 million ha – which is equal to 12,3% of the total surface area of South Africa. In the period from about the mid 1980s drought, high interest rates and declining terms of trade resulted in lower net returns from farming and rising debts. According to the 1988 census, farms in the Central and Northern Cape subregion of the province

average about 1 400 ha in extent while those in the Coastal subregion of the province are significantly smaller, namely 586 ha. Although having the same or smaller areas under rainfed crops, coastal farms produce mainly higher-valued crops such as pineapples, chicory and wheat, while irrigated crops of importance include citrus and vegetables. The number of farming units and the farm income from animal products highlight the dominance of the livestock-production sector. Except for field crops and forestry, paid employment decreased significantly in other enterprises. The animal-production sector of the Eastern Cape and the gross income of this enterprise are almost three times that of horticulture, which lies second. The Eastern Cape has a comparative advantage in the production of mohair because of the abundance of high quality natural grazing compared to other provinces, which tend to rely on cultivated pastures.

4.2.1.6.3 Crop production

Field-crop production shows a declining trend, which correlates with the national trend. Trend analysis performed on maize and wheat production shows a significant decrease in the area cultivated. The area under maize in the large scale farming sector decreased from 38 000 ha in 1980-1 to only 29 000 ha in 1991-2, while production followed the same trend. The main cause for this phenomenon is the lower profitability of maize production, the deteriorating financial position of farmers and the withdrawal of marginal cropping land. The area under wheat decreased significantly from 80 000 ha to only 7 000 ha over the same period. This trend could be ascribed to the combined effects of low product prices, rising input costs and erratic rainfall patterns. There are strong indications that field crop production in the Eastern Cape is decreasing at an increasing rate as the establishment of pastures progresses. The production of maize, wheat, and fodder crops is the most important field-crop farming activity from a farm income perspective. The production of citrus and vegetables forms the backbone of the horticultural crop industry. The citrus industry is export-oriented, but the South African market is growing in importance. Production in the high rainfall coastal region seems to be expanding at a faster rate

than in the Eastern Cape Midlands. The availability of water could in the long run limit the expansion of this industry.

4.2.1.6.4 Livestock production

Livestock is important throughout the region. The distribution of beef cattle, sheep and goats generally coincides with the suitability of the vegetation, while dairy cattle, pigs and poultry are found in the Coastal region nearer the larger population concentrations. An analysis of livestock numbers in both commercial farming areas and subsistence farming regions shows that cattle numbers in the former homelands almost equal those of large scale agriculture, namely 882 000 commercial versus 970 000 subsistence. On average, cattle numbers comprise nearly 22% of total South African stock numbers. Sheep numbers total nearly 8 million, or 28% of South Africa's in total. Declining profitability in the grain industry has resulted in a steady increase in stock numbers. The existing stocking densities exceed recommended stocking densities. Overstocking has led to severe deterioration of the veld's condition in most parts of the former homelands.

4.2.1.6.5 Forestry and forestry production

The commercial plantations in the Eastern Cape comprise about 121 923 ha of which more than 87% is owned by the State. The surface under commercial forestry in the former Transkei currently comprises 55,6% of the total forestry area of the province. Lateral expansion of plantation areas is expected to serve an estimated doubling of the demand for timber over the next 30 years. Commercial plantations mainly consist of pines and other softwood for the production of pulpwood for sawlogs and veneer. The production of veneer totaled 91 288m³ in 1992-3.

4.2.1.6.6 Mineral

The Eastern Cape is the poorest of all provinces in terms of mineral resources in South Africa. Clay, limestone, sand, salt, heavy mineral sands and low-grade kaolin

are the main products. Several stone-quarrying sites exist, as well as a granite mine in the former Transkei. Even when taking all these into account, the province produces only 0% of South Africa's total mineral sales.

4.2.1.6.7 Ecotourism

The principal tourist potential is found in one of the world's most renowned coastal stretches, its primary attractions being its relatively unspoiled landscape and rich cultural heritage. There are two distinct areas of tourism attraction in the Eastern Cape, namely the coastal zone and the mountains. It is one of the world's regions of highest biodiversity, and supports many endemic plants and animals. The Eastern Cape has three national parks (Mountain Zebra, Addo Elephant, and Tsitsikamma Coastal), several provincial parks, and several private game reserves.

4.2.2 KWAZULU NATAL

KwaZulu Natal is situated on the eastern seaboard between latitudes 27°S and 31°S and longitudes 29°E and 33°E. The Indian Ocean to the east, the Drakensberg range to the west, Mpumalanga Province, Swaziland and Mozambique border the province to the north and – west, and the Eastern Cape Province to the south. A portion of the Eastern Cape, 269 900 ha in extent, is enclosed within the Province in the south. KwaZulu Natal is approximately 300 km long and 300 km wide, has a surface area of 92 100km² of which 13,1% is potential arable and 61,7% suitable for grazing.

Forestland currently occupies 5,1% of the total surface area. These high potential indicators have to be related to the population of 9,1 million which gives a density of 100,1 people per km², that is well above the average for the country. Of the total, 47,1% live in the rural areas and depend heavily on natural resources for their survival. The HDI value is 0,602 which is higher than for the other two provinces, but is still below the South African national average.

4.2.2.1 Climate

The climate of KwaZulu Natal is geographically highly variable as a consequence of the influence of the coast, the Drakensberg range, and its broken topography. It has consequently been categorized into 11 bio-climatic zones, based mainly on precipitation. Some degree of uniformity is found within each of these.

Group 1 – Coastal lowlands

Rainfall is well distributed and varies between 850 and 1 500 mm per annum, with an average of 970 mm. Mean annual temperatures are mostly between 22^oC and 23^oC. There are no ecologically dry months (less than 25 mm of rain), but dry spells of several weeks' duration are common, and can reduce growth. Rare to occasional heavy flooding is also experienced. Frost is non-existent to very rare, but may occasionally be locally severe. Lightning and hail are rare. Windy conditions considerably enhance evapotranspiration and, together with high temperatures, reduce the effective rainfall along the coast. Humid heat from October to March is also not conducive to working comfort.

Group 2 – Coastal hinterland

There is considerable variation among the subregion. Annual rainfall varies between 850 mm and 1 300 mm, with an average for the area of approximately 954 mm and that encompasses not more than two ecologically dry months. Mean annual temperature ranges from 17,5^oC to 20^oC, the average for all stations in the group being 18,3^oC. Climatic hazards include occasional drought and light frosts.

Group 3 – Midlands mist belt

The climate is mostly humid to sub-humid, but may vary considerably among subregions. Annual rainfall ranges from 800 mm to 1 600 mm, with an average of over 1 000 mm. Mist is a common phenomenon. Mean annual temperature range between 16^oC, and 18^oC with an average of 17,1^oC. Climatic hazards include occasional dry spells of short duration in summer, excessive cloudiness in early

summer, slight to sometimes severe frosts, occasional hail and hot “berg” winds in early spring, sometimes followed by sudden cold snaps.

Group 4 – Highland sourveld

The annual rainfall is between 800 and 1 500 mm, with an average of 920 mm. There are usually two to three ecologically dry months. Mean temperatures are between 13°C and 15°C. Cool summer conditions are followed by regular to very severe frosts, with snow being experienced locally. The major climatic hazards include a relatively short growing season, severe frosts, sporadic hail, and hot “berg” winds.

Group 5 – Montane

In this area, annual rainfall exceeds 1 500 mm, mean annual temperature is less than 13°C, and severe frosts and snowfalls occur regularly. It comprises magnificent mountain scenery, and its importance resides in the fact that it is the source of a number of the most important rivers, which flow through the Province.

Group 6 – Moist tall grassveld

Mean annual rainfall is between 800 and 1 000 mm, with an average of 848 mm. There are three to four ecologically dry months. Mean annual temperature is between 16°C and 18°C. Climatic hazards include occasional periods of drought during the rainy season, moderate to severe frosts for several months in winter, and occasional hailstorms.

Group 7 – Valley thornveld (Tugela)

Annual rainfall is between 600 and 800 mm, with an average of 716 mm. There are four to five ecologically dry months, and generally, the rainfall is not as reliable as that of group 6. Mean annual temperatures are between 17°C and 18°C. The low and rather erratic rainfall pattern is the primary limitation.

Group 8 – Dry tall grassveld

Annual rainfall is between 600 and 800 mm, with an average of 716 mm. There are four to five ecologically dry months, and generally, the rainfall is not as reliable as

that of group 6. Mean annual temperatures are between 16°C and 18°C. The main climatic hazards are erratic rainfall, frequent periods of moisture stress and moderate to severe frosts in winter.

Group 9 – Zululand bush thornveld

Annual rainfall is between 700 and 850 mm, with four ecologically dry months. Mean annual temperature range from 21°C to 22°C. Frosts are very rare. Uncertain dry spells during the rainy season constitute the main climatic hazard.

Group 10 – Interior and valley thornveld

Annual rainfall varies between 600 and 700 mm, with four to five ecologically dry months (three nearer the coast). Rain shadow effects are particularly marked in this area. Mean annual temperatures are between 16°C and 18°C locally. Significant climatic hazards include frequent periods of drought, moderate to locally and seasonally severe frosts, especially in the riverine faciation (excluding the north eastern and coastal sectors), considerable heat during summer in the north-eastern sectors, lightning and hail. Hail may cause heavy losses to horticultural crops under irrigation.

Group 11 – Arid lowveld

This is the most arid area, receiving an annual rainfall of only 320 to 600 mm and experiencing six or more ecologically dry months. Mean annual temperatures are between 21°C and 23°C, but may be considerably higher locally. Evaporation (Symmons Tank) exceeds 1 524 mm per annum. The major climatic hazards include low and erratic rainfall, high temperatures, and excessive evaporation.

4.2.2.2 Topography

KwaZulu Natal is noted for its variation in scenery resulting from altering topography, ranging from impressive mountains to plateaux, upland areas, basin plainlands, deeply incised river valleys, and picturesque coastal hinterland and

lowlands. In 1967, Turner identified 43 physiographic regions, which Phillips (1973) grouped into seven broad categories, namely:

- **Mountain ranges**

Found along the Great Escarpment of the High and Low Drakensberg they form the boundary between KwaZulu Natal, Lesotho and Free State to the west, Mpumalanga to the north, and the Eastern Cape Province to the south.

- **Elevated plateau**

These are found around Msinga and Qhudeni, and project the Drakensberg range.

- **Upland regions**

These lie to the west of the Intermediate Regions (see below), and typically range in altitude from 1 200m in the Natal Midlands to as much as 1 900m in East Griqualand.

- **Basin plainlands**

These dominate the upper reaches of uThukela catchment area, and the extreme west of southern KwaZulu Natal.

- **Intermediate regions**

These are located along a north-south axis through the centre of KwaZulu Natal between the interior uplands and the coastal lowlands, at the Kranskop Divide; the Melmoth-Nkandla Block; the middleveld of Zululand; the Ixopo-Highflats Benchland and the Harding Benchland. The Intermediate Regions generally are characterised by undulating terrain and steep slopes.

- **Low-lying regions**

These include the cleft made by the Lower Thukela River; the Pomeroy Bench; the Valley of Thousand Hills; the uMvoti River Valley; and the Lowveld of Zululand.

Coastal regions

This coastal area extends from the south of the province, widening considerably in the north across the Zululand Coastal Plain, and including the incised river valleys of the province. Lowveld areas form the interior of central Zululand as well as significant areas of Thukela Valley and the Valley of Thousand Hills to the northwest of Durban. In general, the topography of the province is extremely rugged in the south, but moderates north of Thukela Valley. The area to the northeast of the Lebombo range up to the uSuthu River on the northern border is flat and largely featureless. The uplands are flat or undulating, and relief is provided by deep valleys and gorges cut by rivers, e.g. Thukela Valley, which is 1 000 metres deep only 50km from its mouth. The rivers run from west to east. The High Drakensberg reaches an altitude of 3 300 metres only 120 km from the coast. The sharp drop in altitude enhances the hydroelectric potential of many rivers. Rainfall diminishes from the escarpment eastwards, and from south to north.

4.2.2.3 Soils

The environmental diversity in KwaZulu Natal results largely from the variety of parent rock [for example granite, sandstone, shales and tillite (diamicite)] and a range of interactions between geology and climate have resulted in a large number of different kinds of soils, which are best described in association with the geology of KwaZulu Natal (Anon., 1986a).

Recent sands cover most of the Maputaland plains in northeastern KwaZulu Natal and these occur, as a narrowing band, down the coast of the province. In the north the upland sites are mainly covered by grey Fernwood soils and, to a lesser extent, sandy Clovelly soils. Red sands are found on the prominent dune ridges. Along the south coast the sandy Shepstone form is encountered in places. In depressions, soil types consist of the Champagne form and, in places, the deep well-drained sands of the Fernwood form. On the Coastal Lowlands and in the southern hinterland of the province, granite has weathered into shallow medium- and coarse-textured Glenrosa soils. In the drier valleys of the northern interior, exposed granite has given rise to

similar Glenrosa soils, with duplex soils found frequently in bottomland sites. The Natal Group Sandstone (NGS) is often exposed on moist upland plateau remnants, and here humic Inanda and Nomanci forms are common. On the slopes, common soils are shallow: Cartref and Glenrosa forms and occasional red sandy-clay Hutton forms.

Extensive areas of Dwyka tillite are exposed in the river valleys of the Lowland areas and in the basin of the Thukela River. In the dry interior valleys fine- and medium-grained sandy-loam soils of the Mispah and Glenrosa forms are widespread, while shallow plinthic soils such as Westleigh and Longlands forms are also found. In bottomland areas, severely eroded calcareous duplex soils of the Swartland and Valsrivier forms are common. In the moderately moist Lowland areas, Swartland and Valsrivier forms are dominant on Dwyka tillite, while in the Moist Mistbelt areas of inland KwaZulu Natal, deep, highly weathered Griffin forms are common.

Sandstones and shales of the Ecca and Beaufort Groups comprise much of the bedrock over the interior of the province and these produce a variety of soil patterns. In relatively dry areas, the dominant soil on shale is Mispah, but it may occur in association with plinthic and duplex. Margalitic soils are also found. In cool, moist upland landscapes, however, the Clovelly form is widespread on shale. A wider spectrum of soils is found on sandstone. The Ecca Group is dominantly medium-grained, while the Beaufort Group commonly has finer sand fractions. In the interior valleys of the Province, the dominant soil types may be found together with the Longlands form in the moister upland sites of these valleys. Where dolerite has intruded into sandstone, heavier textured soils of the Shortlands, Bonheim, Arcadia and Rensburg forms are common and in the moist interior basins Avalon and Longlands forms predominate. In the cool, Moist Mistbelt and Highland areas above 900 m a.s.l., dystrophic clays and sandy clays of the Clovelly, Griffin, Hutton and Katspruit forms are common.

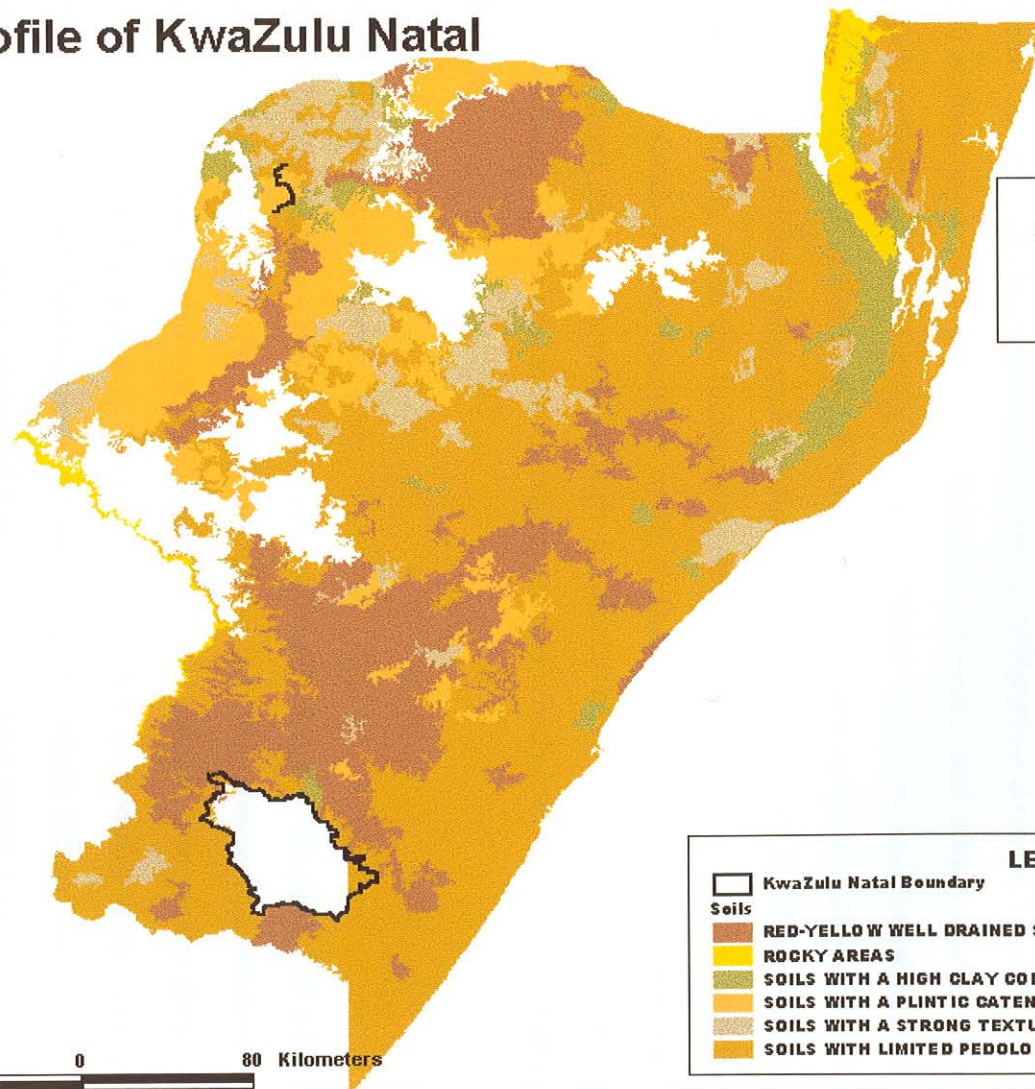
In general, dystrophic soils have developed where the rainfall exceeds 900 mm per annum, and leaching has resulted in fertility problems. With a decrease in rainfall less

leaching of nutrients takes place, giving rise to mesotrophic and eutroc soil types that tend to have problems of a physical nature. Work done by Edwards and Scotney (1978), Fitzpatrick (1978) and Schulze (1982) resulted in a soil potential rating for the province. It is estimated that 26% of the region has very high potential soils, 12% high, 60% moderate and 2%, low potential soils. The highest potential soils occur along the Drakensberg escarpment, including the upper reaches of the Thukela catchment area and considerable portions of the Natal Midlands. High potential soils are also found in the western parts of Zululand. The coastal regions are generally characterised by moderate potential soils. However, regional representation of soil potential may vary significantly at a finer scale due to the influence of local geology, topography and climate and local conditions will determine the extent and quality of soils available.



Figure 4.2

Soil Profile of KwaZulu Natal



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LEGEND

- KwaZulu Natal Boundary
- Soils**
- RED-YELLOW WELL DRAINED SOILS LACKING A STRONG TEXTURE CONTRAST
- ROCKY AREAS
- SOILS WITH A HIGH CLAY CONTENT
- SOILS WITH A PLINTIC CATENA
- SOILS WITH A STRONG TEXTURE CONTRAST
- SOILS WITH LIMITED PEDOLOGICAL DEVELOPMENT

4.2.2.4 Geology

The variety of different geological materials underlying KwaZulu Natal contributes with the variation of climate, to the marked ecological diversity encountered. The various geological formations and their distributions in the Province as described by Phillips (1973) are illustrated.

- **The Metamorphic Basement Complex**

The Basement Complex rocks, which according to radioactive datings, were formed about 1 100 million years ago, consist of granites, gneisses, and schists and contain minerals such as feldspar, hornblende and mica. Where there has been crustal uplift, these rocks are exposed at the surface, such as the domed granite outcrops in the Valley of a Thousand Hills. These rocks, which were formed within the Earth's crust, tend to weather rapidly, with the feldspar crystals breaking down to clays, and the quartz crystals to sand. These Basement rocks, in their many variations, are exposed mainly in the deep river valleys, although in places have they been uplifted to prominent positions, e.g. the east west crustal fractures which from the Ngoye Range near Empangeni.

- **The Natal Group Sandstone**

A sequence of rock strata lies above the basement Complex rocks, the oldest of which is the Natal Group Sandstone (NGS). This forms some of the spectacular scenery of vertical cliffs in the central and southern part of the Province. The sandy material which formed these strata, was laid down as sediments and varies from layer to layer, with the basal layers having been derived from the older formation on which they lie, that is, the weathered granite and quartzites. The thick upper part of the NGS consists of micaceous, sandy beds of various grain sizes. It is considered that some sediment may have originated in northern KwaZulu Natal and moved southwards (King, 1972). With transport, the particles became finer, resulting in maroon shales speckled with mica flakes. A second zone of orthoquartzite of the NGS, some 15-m to 18,5 m thick, had a source in the west. A washing back and forth, possibly by the sea, left a dominance of uniform, rounded quartz grains that, over a period of time,

formed the orthoquartzite rock. The pebble beds found in the Dalton area may also have come from the west (King, 1972). The NGS forms the impressive cliff faces of the Kloof Gorge and the Hillcrest plateau and extends northwards to Ndwedwe, Glendale and Maphumulo. In the Thukela River valley, the cliff faces are most impressive, especially to the east of the village of Kranskop, "the Kop" being a well-known view site. North of the Thukela River, the NGS forms the Melmoth and Eshowe plateau and part of the steep country in the vicinity of Nkandla. Beyond Eshowe, the NGS is absent. Orthoquartzite cliffs surround many plateaus and in southern KwaZulu Natal, Oribi Gorge and the Mthavuna Gorge are formed where the rivers have cut their way through the NGS. Above the NGS is a series of sedimentary strata, which covers the larger part of the province.

- **The Dwyka Group**

The Dwyka is exposed only in the eastern part of the province and its composition indicates its origin. Laid down during a glacial period, the original "mud" that was dragged along by the glaciers has a green-blue matrix and is studded with boulders and pebbles that vary considerably in size. These boulders and pebbles are of differing origins, representing samples of the rock rubble that was once beneath the ice. Rock types include granite, gneiss, quartzite, sandstone and orthoquartzite. This accumulation of rock rubble was then hardened and cemented together by the pressure of overlying material. Below this hardened rock, striated glacial pavements may be found, polished by the glacier as it moved over the rock surface. In the northern parts of the province, the striations indicate that the ice moved in from the north, whereas along the coast, indications are that the movement was from the northeast, i.e. from the direction where the Indian Ocean lies today.

- **The Ecca Group**

The Ecca Group has a total thickness of about 700 metres. Laid down in extensive bodies of fresh water during a cold temperature period, the Ecca shales and sandstone lie above the Dwyka. Sand stones of the Ecca Group crown the prominent escarpment that extends from the Thukela River to the west of the towns of Greytown, Pietermaritzburg and Ixopo as far as the Mzimkhulu River. These

sandstones have a coarser grain size and crumble more easily than the NGS. In the northern part of the province, coal seams are found within the sandstones of this Group, which also form the many minor escarpments in that area. The shales of the Ecca Group tend to be dark and are exposed in the midlands and coastal areas Bricks of good quality are made from Ecca shales which, because of a high iron content, burn red.

- **The Beaufort Group**

The Beaufort Group was originally alluvial flats laid down during a warm temperature period and consists of grey-blue sandstones, which weather rapidly when exposed, and shales, which are even less resistant to weathering. Layers of these two materials can be seen as ledges on hillsides in the western part of the Province. Formations of the Beaufort Group extend from the foothills of the Drakensberg eastwards towards the towns of Donnybrook, Howick, Weenen and Ladysmith. North of Ladysmith, they are narrow to a strip along the western and northern border of the province. The shales of this Group are exposed in many dongas and are red, green or maroon in colour.

- **The Stormberg Series**

The Stormberg Series, which form the entire face of the Drakensberg, consists of the Molteno, Red Beds, Cave Sandstone and Basalt formations. Material and Molteno stage consists of shales and sandstones. Thickest in the south, where sandstone and shale bands are intermixed, it is widest in the Drakensberg Gardens area. It then becomes less apparent towards the north where, in the Loteni River valley, terraces are less prominent. The Red Beds and the Clarens sandstone (Cave Sandstone) are found along the whole length of the Drakensberg. The Clarens Sandstones, which are approximately 100 metres thick, are well known for their extent (Little Berg). A lack of bedding in the cliff faces and size grading of the particles, indicate that the sandstone was laid down as wind-blown sands under hot desert conditions. The Red Beds lie immediately below the Clarens Sandstone and are apparent as unstable slopes of red, crumbly shale and red micaceous sandstone, providing the name for this geological layer. After sedimentary accumulations of the Karroo system had

been laid down, an outpouring of lava, which covered extensive areas with solidified lava hundreds of meters thick, disrupted them. At Mont-aux-Sources the basalt layer is 1 350 meters thick. The Ubombo Mountains in northeastern KwaZulu Natal were developed by ejecta of basalt and silica, forming rhyolite. North of Empangeni and west of the Ubombo Mountains, a large area of basalt extends northwards to Phongola. Lava that reached the surface solidified into basalt. However, much of the lava never reached the surface but intruded into fissures and passageways in the sediments of the Ecca and Beaufort Groups, the Natal Group Sandstone, and into the Basement rock. This lava, which cooled slowly compared with the surface lava, is known as dolerite and is harder and has finer crystals than the basalt. The material in the fissures formed dolerite dykes, and on exposure these dolerite ridges form a common feature in the landscape. The passageways, or sills, are sub-horizontal and are exposed to the surface following erosion, where they form hard caps to hills. Examples can be seen at Griffin's Hill near Estcourt and Mt. Gilboa, in the Karkloof.

Natal is a province of South Africa (Department of Water

- **Later geological formations**

After the period of geological build up, the African Surface was subjected to a series of uplifts and the splitting of Gondwanaland. This initiated a series of erosion cycles, which have led to the physiography and surface geology of KwaZulu Natal as it is today. New geological formations developed when alluvia were deposited on the coastal belt. This coastal belt underwent periods of submergence, when the sea land re-emerged, exposing sandy flats with marine shell deposits. Depressions remained forming lakes and lagoons such as Lake St. Lucia and Lake Sibaya. This coastal plain is widest in the north in Maputaland, where it is approximately 75 km wide, narrowing in the vicinity of Mthunzini, where it forms a narrow strip stretching down the north and south coasts of the Province. It consists of Quaternary, beach derived aeolian sands, which cover most of Maputaland and which are underlain by calcareous Cretaceous sediments.

such as Thukela, highlighting the fact that it is not

- **Faulting and Erosion**

The whole landscape described above underwent changes when faulting uplifted parts of the strata in relation to adjacent strata. Submergence also occurred. Then the

river systems, flowing largely from west to east, cut through the geological layers, exposing fresh faces in the deeply incised valleys. This exposed material was then subjected to a wide range of climatic conditions, with the resultant wide diversity of soils in KwaZulu. Extensive coal deposits are found throughout the KwaZulu Natal Midlands, which apart from mining for coal also forms the basis for heavy industrialisation, such as iron smelting. Kaolin, lithium mineral fluxes, and dolomites also have economic potential. The province provides 3% of the country's total mineral sales.

4.2.2.5 Water Resources

KwaZulu Natal is situated in the highest rainfall zone, and has one of the highest runoff: rainfall ratios in South Africa. Although the province comprises only 14% of the land surface area of the country, mean annual runoff from rivers in KwaZulu Natal accounts for 39% of runoff from all rivers in South Africa (Department of Water Affairs, 1986). The Province forms part of two hydrological drainage areas, namely the Eastern Escarpment (including drainage regions U, V and W) and parts of the Eastern Cape (including drainage region T). Some of the major rivers include the uSuthu, Phongola, Mkhuze and Umfolozi in drainage region W, Thukela in V, uMkhomazi and uMngeni in U, uMzimkhulu and uMthavuna in drainage region T.

Effluents as well as minerals from rocks and soils adversely affect the quality of surface water in the province. In northern KwaZulu Natal, the development of coalfields has contributed to pollution of the ecologically sensitive Black Umfolozi and Mkhuze Rivers, while groundwater near the coast is affected by salinity. The water balance is such that the region not only has the potential to meet future demands, but also the capacity to export water. However, export of water is only possible in a few catchment areas such as Thukela, highlighting the fact that it is not the lack of water, which might limit development in KwaZulu Natal, but rather its distribution within the province. Further, the sub-region is affected by periodic prolonged droughts, which are often terminated by severe floods (Department of

Water Affairs, 1986). Basically, sufficient water is either impounded or can be developed to suffice well into the next century. Availability of water does not constitute an impediment to development; KwaZulu Natal is more fortunate than the other provinces in this regard.

4.2.2.6 Vegetation

Several invaluable studies on the vegetation of KwaZulu Natal have been undertaken, providing a sound understanding of its nature and distribution. Climate, altitude, topography and distance from the sea largely determine the distribution of vegetation. Approximately 80% of the province is still under natural vegetation and this plays a vital role in both the agricultural economy and in the conservation of soil and water resources. Acocks (1975) classified the vegetation of KwaZulu Natal into eight major types, with several sub-types, namely:

- coastal tropical forests;
- inland tropical bushland savanna;
- tropical bushland savanna;
- karroo and karroid;
- temperate and transitional forest;
- pure grassveld; and
- false grassveld.

The coastal regions were initially covered by a form of forest of which little has survived. This was largely replaced by thornveld, which stretches inland up the river valleys. The current distribution of vegetation types in the province is markedly affected by altitude: the hotter, lower-lying areas being predominantly bush or dry woodland and the higher areas mainly grassland. The highland sourveld is found in the high rainfall areas of the Drakensberg foothills. The numerous valleys are clothed with tall grassveld, while pure grassveld is found in the level upland areas. This veld is palatable and permits intensification of production in a number of ways. A considerable proportion of the natural vegetation will give way to cropping, afforestation and urbanisation in the future. Phillips (1973) maintained that before

humans had a major influence on the vegetation, climate, soil and natural fire would have had an influence on the development of vegetation in its progress towards one of several climaxes in the province. More recently, however, humans and their livestock have had a considerable influence on indicating the various cycles of succession. For the purposes of this study we are going to focus on the agro ecological zones defined by Pentz (1945). These are as follows:

- **Coast and Coastal Hinterland**

Most of the natural vegetation along the Coast and Coastal Hinterland has been destroyed and replaced by crops, for example sugarcane. The remaining vegetation consists of relict forest communities, which indicate the past and potential distribution of this vegetation type and patches of scrub and palm clumps. The remaining grasslands are generally in a degraded condition (Anon, 1972).

- **Mistbelt**

Crops and commercial timber plantations have largely replaced the vegetation of the Mistbelt zone. Isolated patches of relict forest are found mainly on south-facing aspects in areas where they are protected from fire. The grassland, as a result of excessive burning and selective overgrazing, has deteriorated to a sward dominated by unpalatable Ngongoni grass (*Aristida junciformis*).

- **Highland and Montane**

In the Highland and Montane zone, the vegetation remains relatively undisturbed and the veld is in a relatively good condition. Isolated relict forests occur mainly on steep, rocky, south-facing aspects, where fires are usually of low intensity because of the rocky nature and moist conditions, which prevail on these slopes. The Montane area of the Drakensberg is mainly under the protection of conservation bodies and forests are thus fairly extensive.

- **Tall Grassveld**

The Tall Grassveld zone covers most of the interior basin of the Thukela River. Erosion is a serious problem in this area and the veld varies in condition from good to

poor quality, the latter being found mainly on erodible, duplex soil forms. The invasion of thorn scrub (*Acacia sp.*) poses a threat to stock farmers.

- **Thornveld**

The Thornveld zone is found around the upper perimeter of most of the river valleys. This is a secondary veld dominated by *Acacia sp.*, which invades the grasslands from the river valley vegetation. The condition of the veld ranges from a highly productive condition to very poor quality with low productivity and basal cover dominated by pioneer species.

- **Bushveld**

Bushveld is found in northeastern KwaZulu Natal and in the valleys of most of the rivers. The vegetation is dominated by a wide variety of trees and the grassland is highly palatable, carrying stock effectively throughout the winter without a requirement for supplementary feed.

4.2.2.7 Agricultural Land Use

Details such as area, altitude range, soil, mean annual precipitation (MAP), and mean annual temperature (MAT) of each land zone are provided in *Table 4.1*. Soil data were adapted from Phillips (1973) and climate data from the Cedara Research Station.

Table 4.1: Details of area, altitude, soil, MAP and MAT of the land use zones (LUZ) in KwaZulu Natal

LUZ	Area (ha)	Altitude m. s. l	Arable %	High Potential Soil %	MAP mm	MAT °C
Coast and Hinterland	1924 026	<900	35	12	740 -1423	17.6-22.0
Mistbelt	1418 612	901-1400	45	37	738 -1280	16.7-17.0
Highlands & Montane	1539 405	1401-1800	22	7	620 -1400	11.5-14.3
Tall Grassveld	1664 562	451-1400	33	14	645 -1000	16.0-19.5
Thornveld	785 901	320-1200	16	7	644 -846	17.1-21.1
Bushveld	1528 744	<450	51	17	587 -800	19.0-22.0

- **Coast and Coastal Hinterland**

Sugarcane is the most important crop of this zone and covers approximately 35% of the cultivated land in KwaZulu Natal. Its contribution to the province's agricultural production is about 40% and the zone produces almost 90% of the national cane crop. Timber, mainly from *Eucalyptus*, has become increasingly important, particularly in the northern areas. Subtropical fruits produced include bananas, litchis and papaws, and vegetable production is also important.

- **Mistbelt**

The Mistbelt, with favourable climate and good soils, is an area of high agricultural potential. Most of it is afforested and commercial timber production, including *Eucalyptus*, Pine, Wattle and Poplar, is the most important form of land use. Sugarcane is grown at lower altitudes in the central and southern areas on frost-free slopes. The potential for maize production is high, particularly in the Greytown area. It is an important milk producing area.

- **Highlands and Montane**

Found mainly in the western areas of the province, this zone has cold winters with frequent severe frost. Snowfalls are experienced in the high-lying areas. It carries close to one third of the province's cattle and sheep and it has considerable potential for increased livestock farming. Maize and potatoes are the most important crops grown, and a considerable area of land is devoted to fodder production to carry livestock through the cold winters. The Drakensberg has spectacular scenery and has been set aside for water yield, nature conservation and tourism.

- **Tall Grassveld**

The largest portion of this zone lies in the interior of the Thukela River basin. Livestock farming, mainly cattle, is the most important source of income. Soil has to be carefully selected for cultivation, particularly because deep soils are required in an area where rainfall during the growing season is unreliable. Crops are irrigated on suitable soils adjacent to the main rivers.

- **Thornveld**

This zone lies on the upper perimeter of the major river valleys and on the western boundary of the bushveld. It is an extensive farming zone suited mainly to cattle, goat and game farming, with the density of bush dictating the balance of animal types, or species, in the case of game animals.

- **Bushveld**

The Bushveld is situated mainly on Lowland areas in northeastern KwaZulu Natal and in the valleys of the major river systems. Summers are hot and winters warm, although in the upper river valleys in the south, severe frosts do occur. The relatively high percentage of arable land in this zone has limited cropping potential unless it is situated adjacent to a reliable source of water for irrigation, because the rainfall is too low for crop production. On selected sites along rivers such as the Thukela and Phongola, there is good potential for cropping under irrigation. In the north, crops such as sugar cane, cotton and vegetables can be grown, but in the south, frost-sensitive crops such as sugarcane cannot be grown due to low winter temperatures. Because of climatic factors the major portion of this area is suitable only for stock and game farming. Production is relatively cheap because of the high quality of the winter grazing, so that winter supplementation is not required. Tourism is a very important industry and game reserves such as Mkhuze, Hluhluwe – Umfolozi Park, Phinda and Ndumu, are situated in this zone.

4.2.2.8 Ecotourism

The division of KwaZulu Natal into five areas by Nicholson (1995) can be used to broadly define the tourism attractions of the Province. The five areas are: (a) The Drakensberg and battlefields; (b) Game reserves and Zulu culture; (c) South coast beach resorts; (d) Durban and North Coast; (e) and the Midlands. The natural resources of KwaZulu Natal provide many opportunities for resource-based or resource-linked recreation. These are focused along the coast, on the major towns, the major Zululand nature reserves, and the Drakensberg. In many instances, the use of natural resources is linked to recreational activities such as game viewing,

swimming, hiking, or fishing. The protected areas of KwaZulu Natal cover 6 752 km², which represent 8,36% of the terrestrial area, and 28% of the coastline (Nicholson, 1995).

4.2.3 NORTHERN PROVINCE

The Northern Province straddles the Tropic of Capricorn and forms a narrow small landmass in the north widening gradually southwards. Broadly speaking, there are two climatic zones, namely sub-tropical and temperate, with significant variations within these zones. Spatially, the Northern Province covers 116 824 km² or 9,6% of the total surface area of South Africa. The province is poor compared to the eight other provinces. This is reflected in the low human development index value discussed later in this study. It has a larger population with substantial growth momentum. However, the population is poorly educated, impoverished and has limited access to health services.

4.2.3.1 Climate

According to De Villiers (1985), four climatological regions are found in the Northern Province, which are determined primarily by precipitation. The far north is an arid region, followed by an arid to semi-arid region in the north, a semi-arid region on the highveld and a sub-humid region in the lowveld. The demarcation of these regions has been based on total annual rainfall and average annual statistics for day and night temperatures.

- **The arid region**

This area is generally frost free and has an average rainfall of 300 – 360 mm north of the Soutpansberg, which is lower than the minimum of 800 mm required for dryland crop production. The mean annual evaporation of 2 500 mm indicates how desiccated the area is. The mean monthly minimum in the coldest month of the year is 2,5^oC, with a mean monthly maximum of 37,5^oC in the hottest month. Hail occurs on average less than 1 day per year. Prevailing winds are light to moderate, blowing

in a predominantly northeasterly direction, changing to southwesterly during thunderstorms. The region is very hot and dry, and cropping is only possible with irrigation.

- **The arid to semi-arid region**

Temperatures range from $-2,5^{\circ}\text{C}$ to 40°C , the river valleys being particularly hot. The climate is cooler and more humid towards the Waterberg plateau and the Soutpansberg. The area east of the Drakensberg is mostly frost-free, but frost does occur west of the range. The average annual rainfall (mainly thunderstorms) ranges from 360 – 600 mm in the Lowveld to 360 – 540 mm in the northwest, north of the Soutpansberg. Parts of the Waterberg receive up to 700 mm of rain. Wind directions are predominantly northeasterly, becoming southwesterly during thunderstorms.

- **The semi-arid region**

The average rainfall of the region varies from 520-650 mm and in the Lowveld portion from 600-720 mm, with annual evaporation of 1 750 – 2 500 mm. This region has the coolest climate of all the regions, with the lowest minimum temperatures being recorded. East of the Drakensberg escarpment it is mainly frost-free, but frost does occur to the west. In general, light winds prevail, except during thunderstorms, and frequent tornadoes may occur. Hail occurs on average between one and three days per year.

- **The semi-humid region**

Annual rainfall in the low-lying areas varies from 500-700 mm from north to south, increasing considerably at higher altitudes to a maximum of 200 mm in certain parts. The balance of the climatic variables is similar to the other regions. A large section of the Northern Province is part of a global drought belt receiving less than 500 mm rain annually, which is usually regarded as the minimum for successful dryland farming. Furthermore, the average annual rainfall, which affects surface runoff from rainfall significantly and causes high evaporative losses of water stored in dams. The low rainfall and adapted vegetation of a large portion of the province are, therefore, only suited to extensive livestock farming.

4.2.3.2 Topography

In the west of the province, the landform is flat to undulating, broken by river valleys and occasional mountain ranges such as the Waterberg. The further east, the more broken the topography, until the northern outliers of the Drakensberg range are reached. Because of the latitude, this area is typically subtropical and moister than the more westerly portions of the province. The eastern region contains extensive and spectacular mountain and gorge scenery, constituting highly attractive tourist resources.

4.2.3.3 Soils

- **Dystrophic, red and yellow, well-drained clay soils**

These highly leached, clay-like, acidic soils are found in the high rainfall areas of the Drakensberg and Soutpansberg ranges. The arable use of these soils is limited because of low fertility, steep slopes, and rockiness. However, the soils support excellent sites for afforestation.

- **Red, yellow and grey soils in catenary association**

Eutrophic (unleached, slightly acidic to neutral) mostly sandy and loam soils are found in the 300 – 600 mm summer rainfall belt to the west and north-western parts of former Transvaal. Eutrophic soils are dominantly red, yellow, or grey, with varying amounts of rock and lithosols. These soils are the most arable in the Northern Province, but only occur in the low rainfall area, west to north of Thabazimbi, Vaalwater, Ellisras and Pietersburg.

- **Black and red clay soils**

These soils are characterised by black or red clay, with varying amounts of rock and lithosols, and in the Northern Province occur along a narrow strip of land parallel to the eastern border, the Springbok Flats (Warmbaths, Settlers and Roedtan) and the south-western border area near Dwaalpoort. Although highly erodible and being

drought prone, these soils are utilized extensively for dryland cropping like cotton and winter cereals.

- **Duplex and paraduplex soils**

Duplex soils are characterised by a duplex morphology; that is, a topsoil that differs distinctly from subsoil with regard to texture, structure and consistency. Major occurrences of these soils are found in the Sekhukhuni district of the former Lebowa and in an area south to south-west of Ellisras in the Waterberg district, as well as in an area between Louis Trichardt and Tshipise, passing through a large section of the former Venda near the eastern border. These soils are not generally utilised as arable because of their erodibility.

- **Weakly developed soils on rock**

Soils within this category consist of topsoil overlying rock or weathered rock, which could be ascribed to low rainfall, steep topography, resistant rocks or youthful landscapes. A fairly large portion of the province to the east of the Drakensberg, including a large section of the former Gazankulu, could be described as sand and loam, with lime being common in bottomland sites, but absent in upland sites. The area to the west and east of Messina could be described as having sandy and loam soils, with lime in upland and bottomland sites together with the general occurrence of rocky outcrops. Arable utilisation is generally not advised, owing to the shallowness of these soils and their occurrence mainly in dry areas.

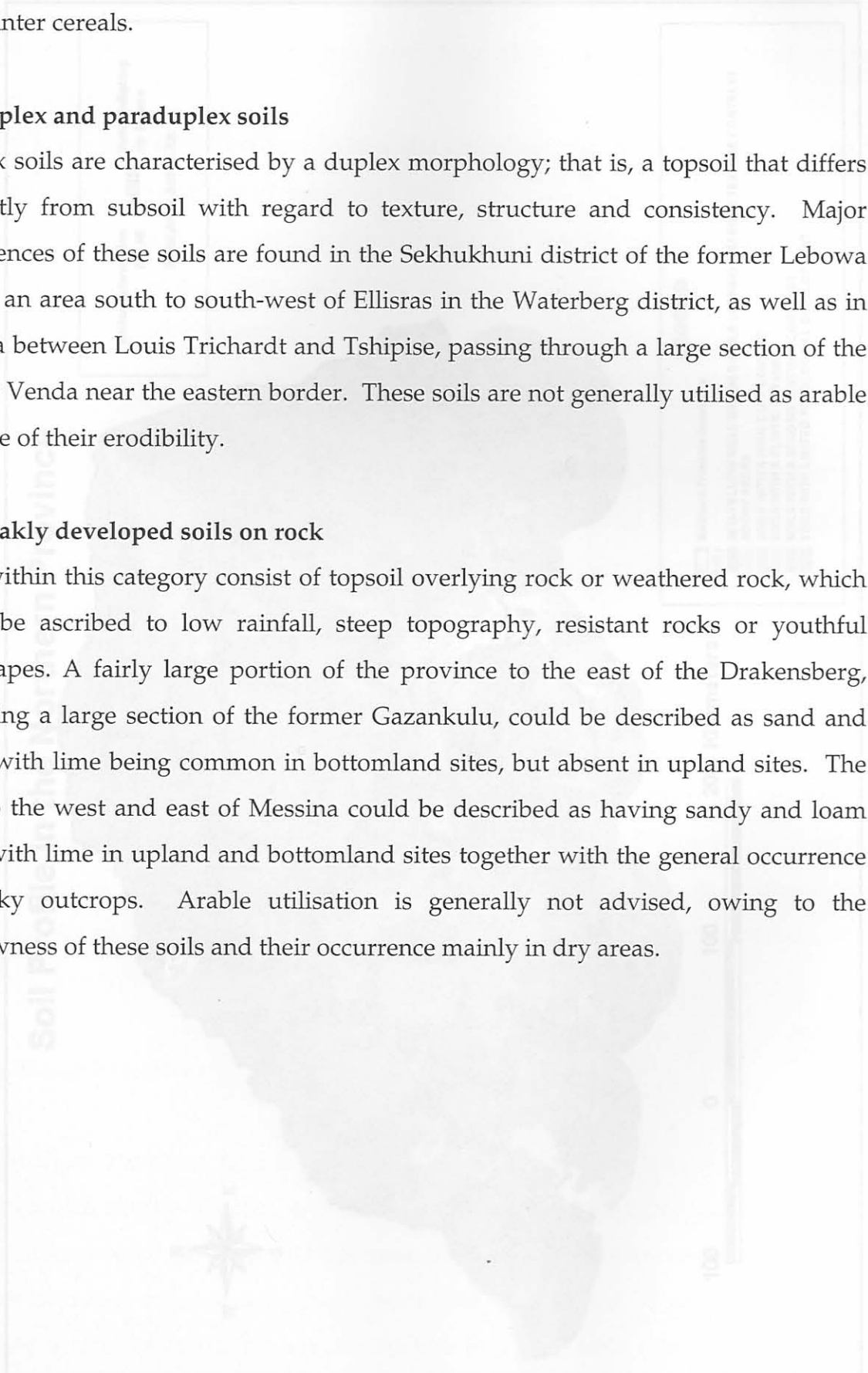
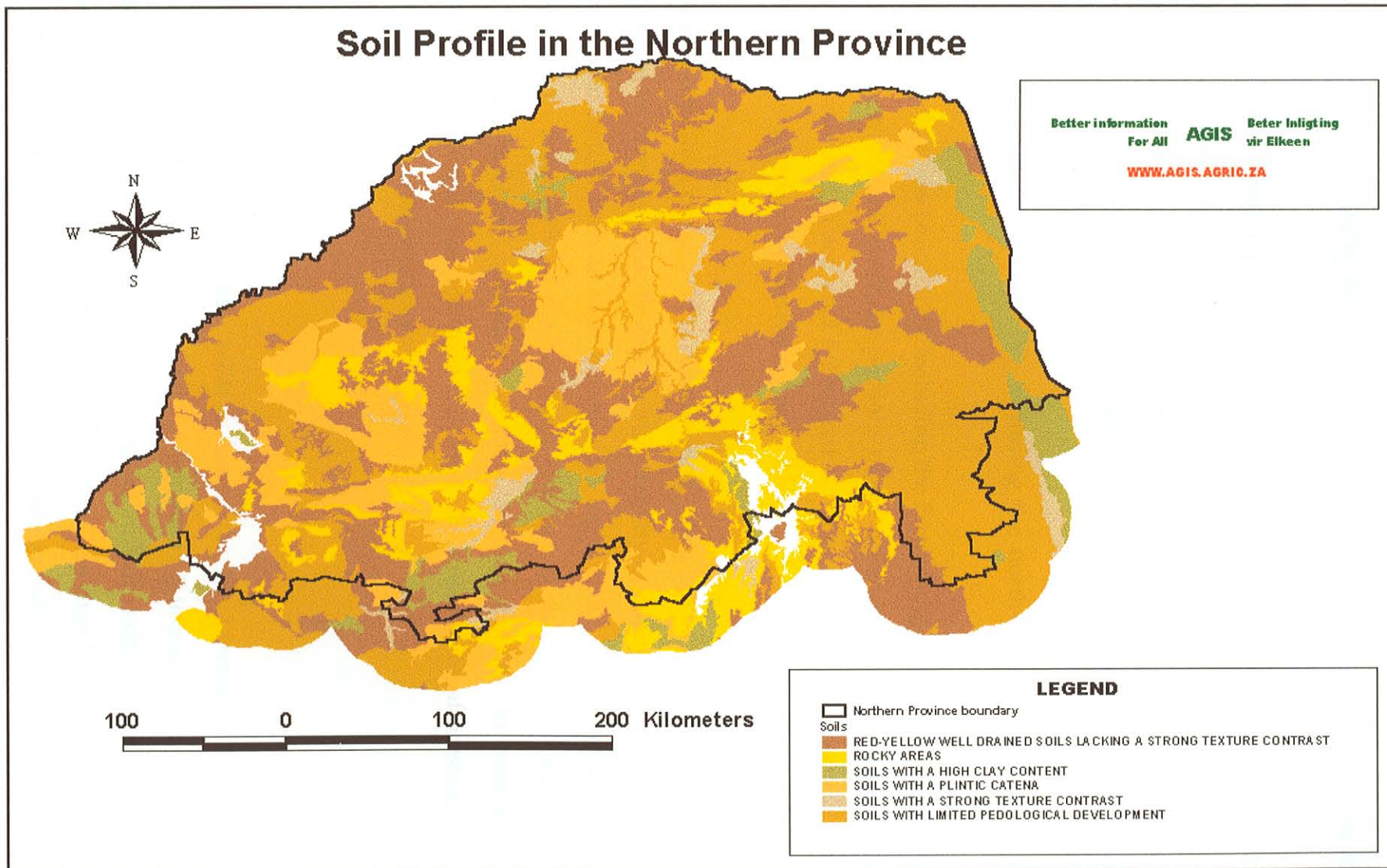


Figure 4.3



4.2.3.4 Vegetation

According to Acocks (1975), the following four different veld types occur in the Northern Province:

- inland tropical forest types (Acocks II), including the north-eastern mountain sourveld and Lowveld sour bushveld types;
- tropical bush and savannah types (Acocks III), including the Lowveld, arid Lowveld, Springbok Flats turf thornveld, other turf thornveld, arid sweet bushveld, mopani veld types;
- pure grassveld types (Acocks IV), including the north-eastern sandy highveld type; and
- false grassveld types (Acocks VI, including the Pietersburg plateau false grassveld type. The central and southern portions of the portions of the province consist mainly of sour and mixed veld types, that is the pure and false grassveld types, with a carrying capacity of between 7 and 12 ha/LSU.

The general condition of the veld is deteriorating. This can be attributed to an over-estimation of its carrying capacity and the vulnerability of different veld types, due to environmental factors such as soils, climate and topography, which are not always acknowledged. Some 78% of the Northern Province is suitable only for grazing. Cattle farming, therefore, constitute the main farming activity. In contrast, the mountain sourveld and lowveld sour bushveld are suitable for afforestation, and constitute important water catchment regions.

4.2.3.5 Water Resources

The Northern Province falls into what is known as the Limpopo-Olifants River system, which can be divided into drainage regions A (Limpopo) and B (Olifants); and small section of the Komati River system, region X. It is characterised by a large number of rivers, tributaries of those above, and no less than 72 named dams. The latter are a form of assurance against the low and unreliable rainfall of the region. Many rivers have peak flows during January and February and low flows during

August and September. Only the Limpopo, east of the confluence with the Shashi River, and the Nzhelele, Levuvhu, Nwanedzi, Mutale, Letaba, Olifants, and Sabie Rivers are perennial. The region has substantial underground water supplies. Three important dolomitic aquifers are:

- an area southeast of Pietersburg;
- areas to the southwest of Pietersburg on the boundary of drainage regions A and B; and
- areas to the north and southwest of Thabazimbi.

It is estimated that 500 Mm³ and 440 Mm³ groundwater could be extracted annually from the main drainage regions respectively. Large areas, which consist of sand and alluvial deposits (e.g. the Springbok Flats and the Crocodile, Sand and Limpopo Rivers), could be utilised for irrigation purposes. Large quantities of groundwater are available in the Nyl River valley, approximately three kilometers east of Naboomspruit. Known sources also occur on the farms Haakdoring, De Hoop and Soetdoring near Potgietersrus. A pump scheme near Naboomspruit extracts some 526 Mm³ water per annum. The quality of groundwater in the main drainage regions ranges from 200 to 1 500 mg/l total dissolved solids, thus falling within international standards for domestic consumption. An area of concern in the province is pollution of its water resources. The Limpopo River system is polluted by effluent discharged into its tributary, the Crocodile, by Gauteng (a province to the south of Northern Province) industrial area. The high concentration of dissolved solids in the Hartebeespoort Dam on the Crocodile (situated in the NorthWest Province) has created heavy metal and salinity problems which, in turn, have had negative economic impacts on irrigation. The Olifants River water system is affected by high acidity, largely the result of pollution by mining activities in the Witbank catchment area. High acidity in water has a detrimental effect on the fauna and flora, especially in ecologically sensitive areas like the Kruger National Park.

4.2.3.5 Ecolourism

The relative scarcity and unreliable water resources seriously hamper the development potential of the province. An important issue to be dealt with in planning water usage in the province is equitable allocation of available water

amongst competing users. Demand arises from rural communities, agriculture, industry, mining and urban development in the province, as well as from various users in the neighbouring states of Botswana, Zimbabwe and Mozambique.

4.2.3.6 Agriculture

More than 73% of the total surface area of the Northern Province can be regarded as grazing land, while only 14% is arable land. Of this, dryland and irrigated land comprise 11,5% and 24,5% respectively. More than 2,7% of the total arable land can be classified as being marginal, with a low soil and production potential. Warmbaths and Potgietersrus have a relatively large proportion of the high potential arable dryland. According to cropping patterns for cereals, fibre crops and oilseeds, the most important irrigation areas are found in the Northern and Lowveld Regions and the cultivation of horticultural crops including citrus fruits, subtropical fruit, nuts and vegetables predominate. Arable land is almost entirely utilised, with lateral expansion of cropping land being possible only in the southern and, to a lesser extent, in the central regions. An expansion of planted pastures could be expected in the low potential or marginal cropping regions, which comprise almost 2,4% of the total surface area.

4.2.3.7 Mining

The Northern Province is the best endowed of the three provinces included in the study (Eastern Cape and KwaZulu Natal), but nonetheless it supplies only 10,2% of the country's total mineral sales compared to Gauteng, North West and Mpumalanga, each of which produce over 20%. The major minerals found are platinum and chromite, while there is potential for developing titaniferous magnetite and vanadium.

4.2.3.8 Ecotourism

The Northern Province is known for the diversity of its countryside, which ranges from mountains to extensive grasslands, bushveld, wetlands and the Lowveld. It is

claimed that the tourism potential of the province is based on experiencing the 'real Africa' by exploring its historic/cultural heritage and engaging in nature related leisure activities. Resource based tourism consists mainly of mountaineering and hunting. Several famous nature parks, notably the northern section of the Kruger National Park, are situated in this Province. Further opportunities exist for the sustainable use of natural resources for tourism development.

The aim of this chapter is to provide an overview of human settlement, poverty and poverty related joblessness in South Africa. It first focuses on South Africa, and then focuses on the study area, the Eastern Cape, KwaZulu Natal and the Northern Provinces. Although the data are available at district level the study did not utilise it at that level in this chapter. Descriptions cover the demographics of a province; income poverty and human development; access to social and economic services, and labour force and employment conditions. A composite indicator of needs is included to facilitate identification of the poorest districts. Any review of poverty in South Africa has to take cognisance of the multifaceted nature of poverty, the socio-economic conditions that support it and the processes that perpetuate it. At a national level, data to support such an analysis are available from several sources, of which an understanding of local level poverty across different provinces is crucial. Due to a lack of disaggregated and comparable information at the district level, given the lack of appropriate data, descriptions in this chapter are essentially static.

Table 5.1: Population of South Africa by Province

Province	Eastern Cape	Free State	Gauteng	KZN/Natal	Mpumalanga	Northern Cape	Northern Province	North West	Western Cape
Population	4 324 224	2 933 994	7 248 423	4 417 321	2 800 711	2 493 321	4 923 355	3 034 822	3 933 473

Source: Census 96, 1994

5.2 Poverty in South Africa

The World Bank and the United Nations Development Programme (UNDP) classify South Africa as a middle income-developing country. However, the quality of life of its population compares unfavourably with conditions in other middle income countries in terms of general social indicators like life expectancy, literacy and infant