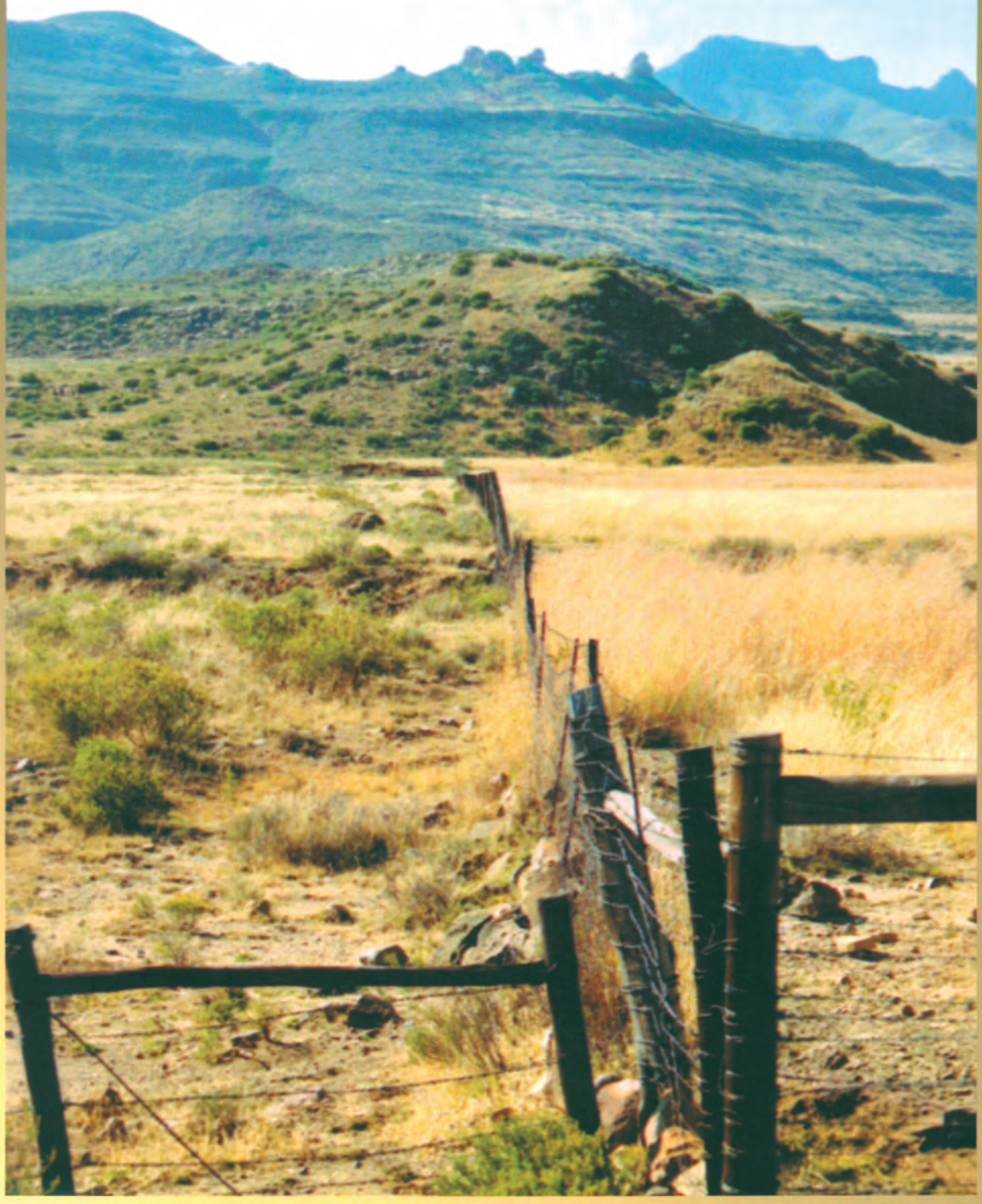

NATURE DIVIDED

LAND DEGRADATION IN SOUTH AFRICA

TIMM HOFFMAN
ALLY ASHWELL

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Preface

In the same way that South Africa's population has been divided along racial lines in the past, so too have its landscapes. The land of the former homelands and self-governing territories has been used very differently from that of the commercial areas of the former Republic of South Africa. This division of nature has had important implications for land degradation in the country as a whole.

This book is a more accessible summary of a technical report on land degradation in South Africa which was completed in 1999. The original study was commissioned by the Department of Environmental Affairs and Tourism (DEA&T) and funded in part by the International Development Research Centre (IDRC), Ottawa, Canada. It arose as a result of South Africa's commitment to the United Nations Convention to Combat Desertification, which requires participating countries to develop a National Action Programme to combat desertification.

A programme of action must be based on the most up-to-date information, and a thorough assessment of the land degradation problem in South Africa has been long overdue. The results of the study summarised in this book provide just such a review and are meant to raise awareness of and galvanise action around land degradation issues. South Africa has a long tradition of environmental concern and we can only hope that this small addition to the literature adds to the momentum already achieved. The technical report, together with an accompanying directory of contact addresses, a literature database and 'fact sheets', can all be found at the following website address: http://www.nbi.ac.za/landdeg.

The more comprehensive technical report is the product of the work of several authors, whose information we have paraphrased here. Simon Todd, Zolile Ntshona and Stephen Turner were all co-authors of the original report, which contains additional contributions from Gerry Garland, Dave le Maitre, Catherine Snaddon, K.O. Bang and Chris Stimie. We hope that we have represented their work accurately here and we take full responsibility for any errors. William Bond's and Coleen Vogel's comments on this report also significantly influenced our thinking.

Many other people contributed greatly to the original study as well as to this, its 'little sister' – the popular book. Indeed, it would not have been completed without Roben Penny and the generous support of Wilma Lutsch of DEA&T, Wardie Leppan from IDRC, Lehman Lindeque from the National Department of Agriculture, as well as all the directors in the nine Provincial Departments of Agriculture. This work is a tribute to the many 'foot soldiers' in the Department of Agriculture, in particular the agricultural extension officers and resource conservation technicians who provided the information for the consensus maps of land degradation in South Africa. Brian Huntley and Mike Rutherford from the National Botanical Institute were supportive throughout, as was Ben Cousins from the Programme for Land and Agrarian Studies (PLAAS) at the University of the Western Cape. We would also like to thank Stephen Law, Noel Oettlé and Adele Arendse from the Environmental Monitoring Group for the expert guidance and logistic support they have provided throughout the development of this book, especially in their role, together with Stephen Turner, as members of the editorial committee.

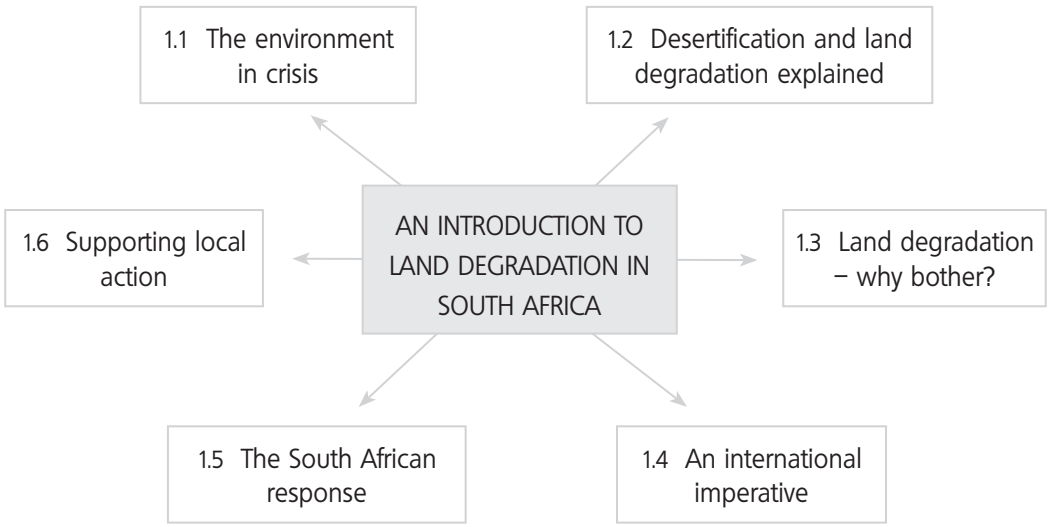
Timm Hoffman and Ally Ashwell

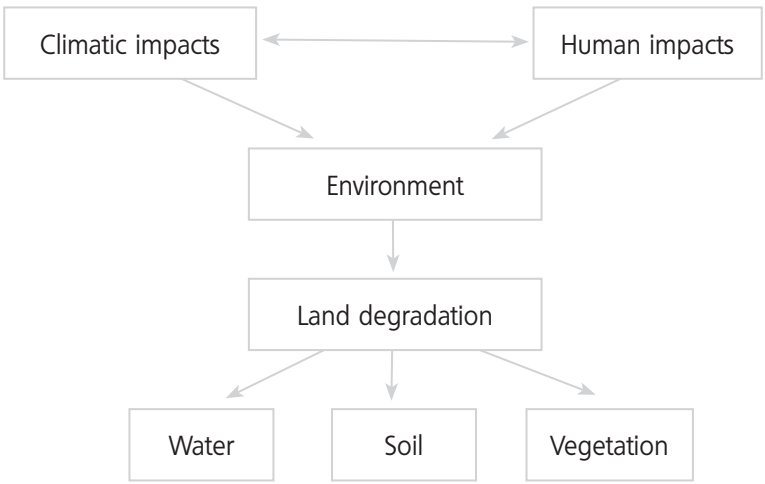
National Botanical Institute and Enviroeds
2001

List of acronyms

ANC	African National Congress
CARA	Conservation of Agricultural Resources Act, No. 43 of 1983
CDI	Combined degradation index
CONNEPP	Consultative National Environmental Policy Process
COP	Conference of the Parties
DBSA	Development Bank of South Africa
DEA&T	Department of Environmental Affairs and Tourism
DWAF	Department of Water Affairs and Forestry
EDA	Environmental Development Agency Trust
EMG	Environmental Monitoring Group
GGP	Gross geographic product
GIS	Geographic information system
LSU	Large stock unit
LUT	Land use type
MAP	Mean annual precipitation
NAP	National Action Programme
NEMA	National Environmental Management Act
NBI	National Botanical Institute
NGO	Non-governmental organisation
PAC	Pan Africanist Congress
PET	Potential evapotranspiration
PLAAS	Programme for Land and Agrarian Studies
RDP	Reconstruction and Development Programme
SADC	Southern African Development Community
SDI	Soil degradation index
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCOD	United Nations Conference on Desertification
UNEP	United Nations Environment Programme
UNPACD	United Nations Plan of Action to Combat Desertification
VDI	Veld degradation index
WOCAT	World Overview of Conservation Approaches and Technologies

Desertification is one of the most serious global environmental issues. The United Nations Convention to Combat Desertification (1994) aims to combat desertification and mitigate the effects of drought. The Convention is unique in that it promotes local participation in addressing a global issue. All signatories to the convention are legally obliged to draw up and implement a National Action Programme (NAP) to combat desertification. In South Africa, the Department of Environmental Affairs and Tourism is responsible for developing the NAP: it commissioned a national review process to establish the status of land degradation in South Africa. This book is the popular version of the report from the review.





Land degradation: a conceptual framework

1.1 The environment in crisis

In the closing decades of the 20th century, the state of the environment became a shared concern and global rallying call as people living in cities, towns and rural areas became increasingly aware of the risks associated with environmental degradation. The complex and interconnected nature of life on Earth means that environmental issues affect us all.

In 1992, representatives of 179 countries met at the United Nations Conference on Environment and Development (UNCED), also known as the Rio Earth Summit, to seek ways to halt and reverse the effects of environmental degradation. The conference agreed on an action plan for sustainable living, known as Agenda 21. They recognised three environmental issues as being of such global significance that each became the subject of an international convention. These key issues are the loss of biological diversity, global climate change and desertification.

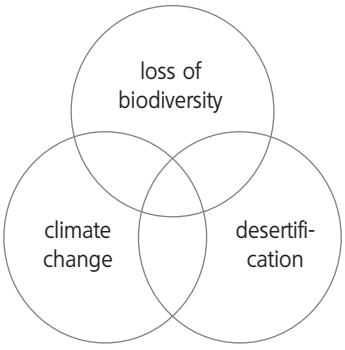


Figure 1.1 *Three key inter-related environmental issues recognised by UNCED and developed into international conventions*

This book explores the issue of desertification in South Africa. It reports on the findings of a study carried out between 1997 and 1999 (Hoffman et al, 1999) which investigated the extent, causes and effects of the degradation of South Africa's water, soil and vegetation resources.

Desertification and land degradation are clearly issues of concern to rural communities, farmers and natural resource managers, who experience their effects first hand. On the other hand, the majority of people who live in cities are not even aware of the problem. However, food security, poverty and urban migration are all issues associated with land degradation that have a wide impact on metropolitan and rural areas alike.

Food insecurity, poverty and urban migration are all issues associated with land degradation resulting from vegetation loss, soil erosion and siltation. Weenen district, KwaZulu-Natal.

By providing an overview of the status of land degradation in South Africa and highlighting some areas of debate, we hope to reveal something of the complex nature of the problem and encourage popular participation in a National Action Programme (NAP) to combat desertification.

1.2 Desertification and land degradation explained

So what are desertification and land degradation? The United Nations Convention to Combat Desertification (UNCCD 1994) provides official definitions (see boxes). But what do they mean?

The term desertification has several contradictory definitions. It was introduced in the late 1940s to describe a series of degradation processes in tropical Africa. In terms of the UNCCD definition it now applies only to land degradation in dryland areas. Although desertification may be aggravated by drought, it is primarily caused by poor land management, such as overcultivation, overgrazing, deforestation and ineffective irrigation.

While desertification conjures up pictures of sand dunes encroaching upon villages and cultivated fields at the desert's edge, this image is misleading. Rather than picturing desertification as an 'advancing tide' of sand, it could be seen as the outbreak of a 'rash'. Separate, poorly managed patches of land, which may be far away from natural deserts, become degraded. If degradation is unchecked, these patches may indeed spread and combine into large expanses of unproductive desert-like land. Restoration of such areas usually becomes more difficult and costly as the degree and extent of desertification increases.

Land degradation is the loss of biological or economic productivity of an area caused primarily by human activities. It can occur in any climatic zone, including the tropics. However, in the context of the UNCCD, the areas under consideration are arid, semi-arid and dry sub-humid areas. These areas are collectively called drylands.

… '**land degradation**' means reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as:

(i) soil erosion caused by wind and/or water

(ii) deterioration of the physical, chemical and biological or economic properties of soil; and

(iii) long-term loss of natural vegetation …

UNCCD, 1995

… '**desertification**' means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities …

UNCCD, 1995

Desertification often follows localised overgrazing, which leads to the loss of vegetation cover. If poor land management continues, previously isolated patches of degraded land coalesce and the whole area becomes desertified. Climatic patterns, particularly drought, may influence the rate of patch expansion and contraction.

Did you know?

- More than 70% of Africa's over 500 million people are subsistence farmers and more than 70% of Africa's food is grown by women.
- Two thirds of Africa is either desert or drylands – and 73% of Africa's agricultural drylands are already degraded.
- Desertification affects nearly one billion people – or one-sixth of the Earth's human population.

Land degradation can take many forms, including urban development on productive agricultural lands, alien plant invasions of grazing lands, and pollution of ground and surface water resources. It is generally considered to be a permanent loss of productivity in terms of the time and money that can be spent on restoring such an area. Short-term changes in the environment caused by climatic fluctuations should not be confused with land degradation.

In this book, we take a broad and inclusive view of the term land degradation in South Africa. We consider not only soil and vegetation cover as mentioned in the UNCCD definition, but also ground and surface water resources.

1.3 Land degradation – why bother?

It is sometimes hard for people who live in the city, far removed from the day-to-day experience of farming or living off the land, to identify with issues like land degradation and desertification. Yet they are of concern to all of us because we experience their effects either directly or indirectly.

Desertification is a widespread and enormous problem. The United Nations Environment Programme (UNEP) estimates that, globally, desertification affects 70% of all drylands – or a quarter of the Earth's land area. According to UNCCD definitions, 99% of South Africa comprises drylands. So we should not be deceived by the verdant parks and gardens of our towns and cities, which are often maintained by water piped in from distant catchments: South Africa is a dry country.

Survival risks

Let us consider some of the risks associated with desertification and land degradation in South Africa.

Desertification, drought and food security

Impacts of the 1991–1992 drought in South Africa

- The maize and wheat harvests were 22% and 59% of normal levels.
- There was a 20% reduction in livestock numbers in commercial farming areas. The figure was much higher in communal areas, with associated loss of milk and draught services.

South Africa's dependence on productive agricultural land for food security is self-evident. Roughly 80% of our land is used for agriculture, but only about 13,5% is considered arable. Droughts, such as the catastrophic episodes of 1982–83 and 1991–92, are inevitable in South Africa. However, while well-managed land recovers rapidly after drought, degraded land is less resilient. As land becomes degraded and more susceptible to drought, South Africa's ability to feed itself is undermined. This makes the country more reliant on expensive imports and foreign aid. In the face of a growing population, another drought as severe as that of 1991–92 poses a serious threat to food security.

A wildcard for the future is the threat of global warming. Increasing temperatures and changing weather patterns may tip the balance even further towards desertification in both marginal and productive agricultural areas.

Undermining the economy

Land degradation costs money. UNEP estimates that desertification costs the world $42 billion per year. The annual cost to Africa is $9 billion – a crippling sum for a continent already plagued by war, AIDS and foreign debt.

Well-managed land is better able to withstand and recover from the effect of droughts than degraded land, as this comparison between degraded and well-contoured croplands shows.

Some estimates suggest that soil degradation cost South Africa nearly R2 billion during the 1992/93 financial year. Water erosion, especially on arable lands, is the most significant degradation cost, largely as a result of the sedimentation of dams and associated water purification costs. Additional costs include the loss of soil fertility, waterlogging and salinisation. The annual cost of soil degradation is 7,5 times greater per hectare on arable land than on grazing land.

The cost of degradation

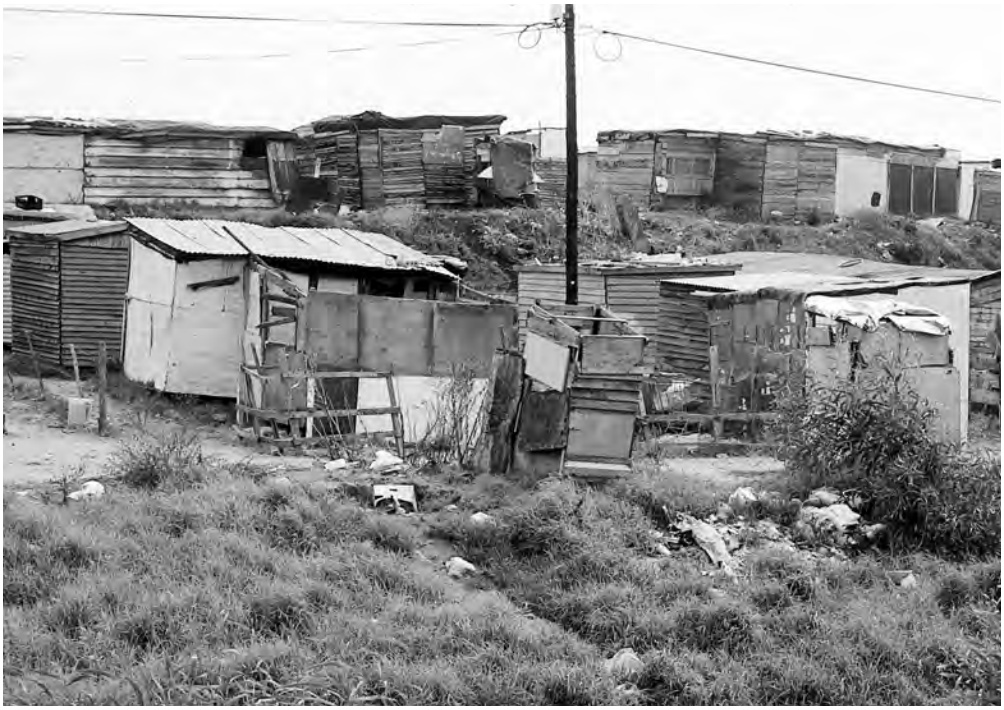
Soil degradation costs South Africa nearly R2 billion annually. Costs include both on-site effects, such as water and wind erosion, and off-site effects, like sedimentation of dams and the need for water purification.

The figure of R2 billion per year does not include the cost of other forms of land degradation, such as bush encroachment, alien plant invasions, deforestation and the loss of plant cover. Whatever the actual figure, degraded land supports fewer crops and animals. In order to maintain productivity under such circumstances, farmers need either to obtain more land or to farm more intensively by investing in irrigation and machinery, and using supplementary feed, fertilisers and pesticides. Increased production costs feed the inflation spiral and reduce the viability of farming.

Fraying the social fabric

Although most research into land degradation has focused on understanding the physical impacts on soil, vegetation and agricultural potential, it is probably the social effects that have the broadest implications. As land becomes degraded, it is increasingly difficult to farm productively. Urbani-

sation is one obvious effect, with its attendant problems of social disruption, unemployment, poverty and crime. Over the last two decades South Africa has experienced unprecedented rates of urbanisation. A fresh influx of environmental refugees will add greater stress to a society already stretched to cope with the provision of even basic services such as housing, water and electricity.



The degradation of agricultural land in rural areas may force more people into urban centres.

Drought and famine in the Sahel increased concern about desertification during the 1970s.

Competition and conflict

In later chapters we will consider some of the social and ecological causes and effects of land degradation in more detail. However, one further reason why we should all be concerned is the knowledge that, as resources become scarcer, competition for them increases. Wars have traditionally been sparked by territorial disputes – the competition for land. There is speculation that competition for water may be at the heart of conflicts in the new millennium. In South Africa both arable land and water are in short supply. As these are the two fundamental resources upon which all life on Earth depends, there is ample reason why we should all be concerned about desertification.

1.4 An international imperative

The United Nations Conference on Desertification (UNCOD)

International interest in desertification dates back to the UNCOD, which was held in Nairobi in 1977 in response to dryland concerns, notably the severe drought and famine in the Sahel (1968–74). South Africa was not officially represented at this conference because of its political isolation, so UNCOD had very little impact on South African policies. However, the Pan Africanist Congress (PAC) was present as an observer and highlighted the negative impacts of the homeland policy of the apartheid government upon the land and people.

The United Nations Environment Programme (UNEP) was charged with implementing the UNCOD Plan of Action to Combat Desertification (UNPACD) and achieving the vision of arresting desertification by the year 2000. However, desertification continued to worsen and UNCOD is generally considered to have been a scientific and political failure.

Learning from experience

Understanding the reasons for the failure of UNCOD has been essential in developing the United Nations Convention to Combat Desertification.

At an institutional level, although UNEP was given sole responsibility to oversee UNPACD, it had no executive authority and lacked the resources, staff and global presence to do so. Many of the signatory countries lacked the capacity to draw up or implement action plans. Funding was inadequate or inefficiently used because of poor planning and coordination.

In the late 1970s and early 1980s, desertification was poorly understood or defined. Few countries had monitoring programmes, so assessments of the extent of the problem lacked scientific rigour. Many scientists thought of desertification simply as an ecological problem caused by drought, and focused on responding to the physical symptoms of the problem rather than looking for root causes of a social or political nature. Experts and technology were relied upon to solve the problem of declining agricultural productivity in drylands.

Lessons learnt

Early international efforts to combat desertification in the 1970s and 1980s were generally unsuccessful. Local environmental, social and political conditions were often ignored in top-down intervention programmes. The United Nations Convention to Combat Desertification stresses the importance of public participation, partnerships and cooperation at all levels.

With natural scientists holding most of the important official positions in desertification programmes, it is understandable that few people would have considered this 'techno-fix' approach to be problematic. However, history has shown that most expert-driven interventions have failed to arrest desertification. In contrast, many of the successful initiatives have been small-scale projects coordinated by non-governmental organisations. They have consulted and worked with people at a local level to address specific problems. Unlike solutions imposed from the outside, which have generally been irrelevant to the people most directly affected by desertification, these programmes have drawn on indigenous knowledge systems and local technologies.

The spirit of UNCED – environment and development

It was not until after the United Nations Conference on Environment and Development (UNCED) in 1992 that South Africa participated formally in international efforts to combat desertification. At this landmark conference delegates agreed that sustainable living would occur only if the needs of both people and the environment were acknowledged.

This inclusive view of the social and ecological nature of the environment is reflected in the conventions and action plans that resulted from the Earth Summit. Such initiatives include Agenda 21, the Convention on Biological Diversity, the United Nations Framework Convention on Climate Change and, of course, the United Nations Convention to Combat Desertification (UNCCD). The United Nations has increasingly tried to establish links and synergies between the conventions to enhance implementation and avoid duplication of effort.

UNCCD – inspired by the South

> The objective of this Convention is to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, through effective action at all levels …
>
> UNCCD, 1995

The focus on desertification at the Earth Summit was largely due to affected developing nations insisting that the issue be given priority. This is revealed in the full title of the convention, which is *United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa*. The convention specifies four regional implementation annexes, covering Africa (which is given priority as the continent where desertification is most severe), Asia, Latin America and the northern Mediterranean.

The convention was adopted on 17 June 1994, and this date is celebrated annually as World Desertification Day. South Africa ratified the convention on 30 September 1997. Signatories are known as 'country parties' and the supreme body of the convention is the Conference of the Parties (COP), which includes all ratifying governments. A secretariat and the Committee on Science and Technology support the COP.

Unlike UNPACD, the UNCCD is legally binding, so all signatories are obliged to develop National Action Programmes (NAPs), allocate funds and other resources to the programme, and specify the roles of government, land users and local communities. The UNCCD is unique in that it specifically calls for local involvement in addressing an international problem. In contrast to the 1977 United Nations Conference on Desertification, it is guided by principles of public participation, partnership and cooperation at all levels.

Principles of the UN Convention to Combat Desertification

1 **Participation:** Affected people must be fully involved in decision-making, and design and implementation of programmes to combat desertification. Governments must create an enabling environment to facilitate action at national and local levels. Practical steps may include decentralising authority, improving land-tenure systems, and empowering women, pastoralists and farmers.

2 **International partnerships and coordination:** This principle aims to avoid the duplication of effort and inefficiency that result from poor coordination, and to develop partnerships between donors, recipients and international organisations, rather than dependency relationships. Cooperation is encouraged at subregional, regional and international levels.

3 **Partnerships within countries:** Cooperation and coordination are also required between all levels of government and communities, NGOs and landholders to address desertification and land degradation.

4 **Special needs:** Special consideration must be given to the needs and circumstances of developing country parties. Developed countries are expected to support developing countries by making technology, information and funding accessible.

The principles above reflect many of the lessons learned from the failure of UNCOD. In addition, the following themes come through strongly in the articles of the convention:

- ***Address the underlying causes of desertification*:** The UNCCD recognises that desertification is a complex problem with no 'quick-fix' solutions. In order to address desertification adequately, profound changes in local and international practices and institutions, such as international trade and land management, will be needed.
- ***Integration*:** Desertification cannot be understood or addressed simplistically. The physical, biological, social, political and economic aspects of the problem must all be borne in mind.
- ***Flexibility*:** Circumstances change and action programmes should be reviewed regularly so that they can respond to these changes and incorporate learning from local action and research.
- ***Sustainable development*:** Actions to combat desertification should be part of a broader objective of sustainable land use and food security in countries affected by drought and desertification. NAPs should be fully integrated into other sustainable development policies addressing issues such as climate change, biological diversity, and conservation of water and energy.

1.5 The South African response

The NAP – fulfilling international obligations

Since its first non-racial democratic elections in 1994, South Africa has been actively responding to the challenges of the Earth Summit. It signed the UNCCD in January 1995 and ratified it in September 1997. As a full member of the Convention, South Africa has an international obligation to develop a National Action Programme (NAP) to combat desertification.

According to a Cabinet decision, the Department of Environmental Affairs and Tourism (DEA&T) is responsible for coordinating South Africa's NAP. A National Coordinating Body (NCB), made up of representatives of the DEA&T, National Department of Agriculture, Department of Foreign Affairs, Department of Water Affairs and Forestry, Department of Land Affairs, Environmental Development Agency Trust (EDA) and the Environmental Monitoring Group (EMG), is the main decision-making body. EMG is a non-governmental organisation that coordinates participation of civil society in the NAP. A Reference Group representing civil society oversees the NAP and acts as a decision-making body.

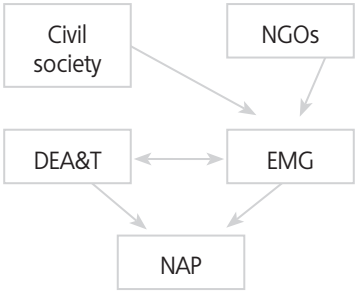


Figure 1.2 *Participation of state and civil society in the development of the NAP*

According to the UNCCD, the specific aims of the NAP are to secure environments, improve food security, reduce poverty and create alternative livelihoods for communities living in drylands.

South Africa's National Action Programme

Prior to the development of South Africa's NAP, the following preliminary actions took place:

Purpose of the review

The overall objective of the review is to conduct an assessment of the desertification problem in South Africa, as part of the country's obligations under the United Nations Convention to Combat Desertification.

- **The national review of land degradation**
  During 1997 and 1998 the National Botanical Institute (NBI) and Programme for Land and Agrarian Studies (PLAAS) at the University of the Western Cape, supported by the national and provincial Departments of Agriculture, and partly funded by the International Development Research Centre (IDRC), Ottawa, Canada, conducted a study on the status of land degradation in South Africa (Chapter 4). This book is based on the final research report, *Land Degradation in South Africa* (Hoffman et al, 1999).

- **The awareness-raising campaign**
  EMG coordinated a campaign to publicise the extent of the problem of desertification and the process of developing a NAP.

Building on this foundation, the NAP process was initiated by DEA&T in 2000, with the goal of developing a national strategy to combat desertification in South Africa.

A conceptual framework

In order to guide the review process, the researchers developed a conceptual framework that represents their view of the relationships between factors influencing land degradation:

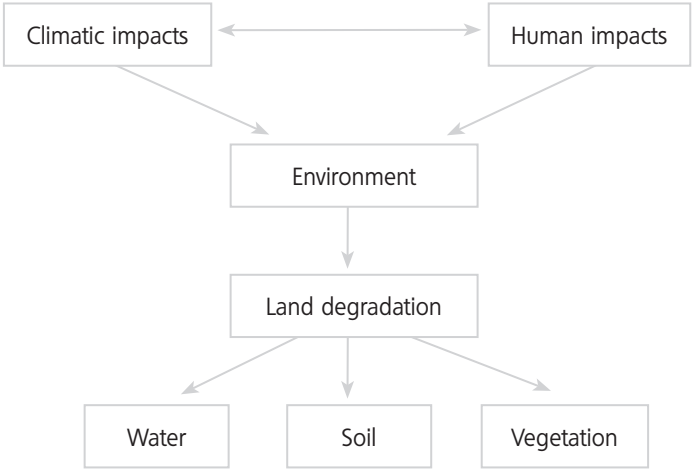


Figure 1.3 *A conceptual framework for land degradation*

This framework shows that the particular environmental conditions of a region will modify the effects of climate and people on the water, soil and vegetation resources of the area.

Throughout this book, we will continue to return to this framework as we investigate the role of people and the impact of climate on land degradation in South Africa.

1.6 Supporting local action

In the following chapters, we shall take a closer look at the causes and effects of land degradation in South Africa. The physical characteristics of the country (such as climate and physiography) play a role, as do the political history of the country and socioeconomic factors like land tenure systems.

The Convention to Combat Desertification, through National Action Programmes, requires citizens to work together with governments to identify and address the causes of land degradation. The national review process has provided up-to-date information about the status, causes and effects of land degradation. This book attempts to make that information more accessible to the public so that we may all help to solve the problems of land degradation and desertification in South Africa.

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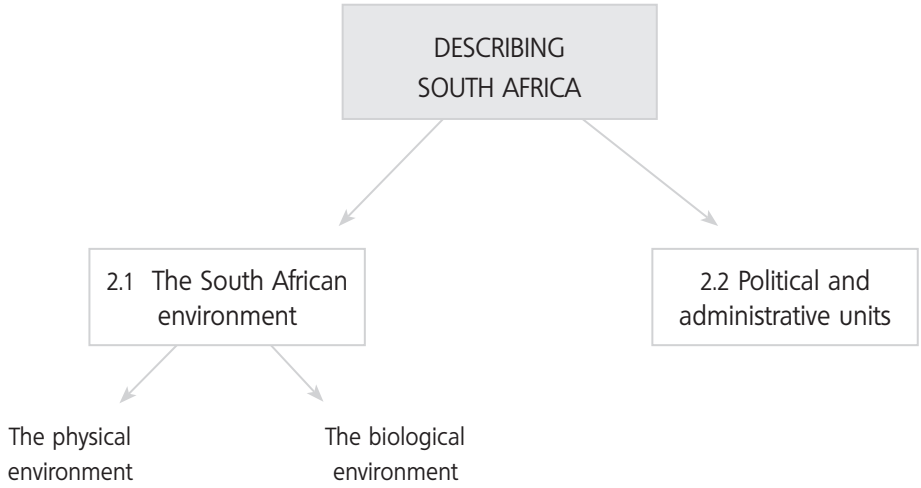
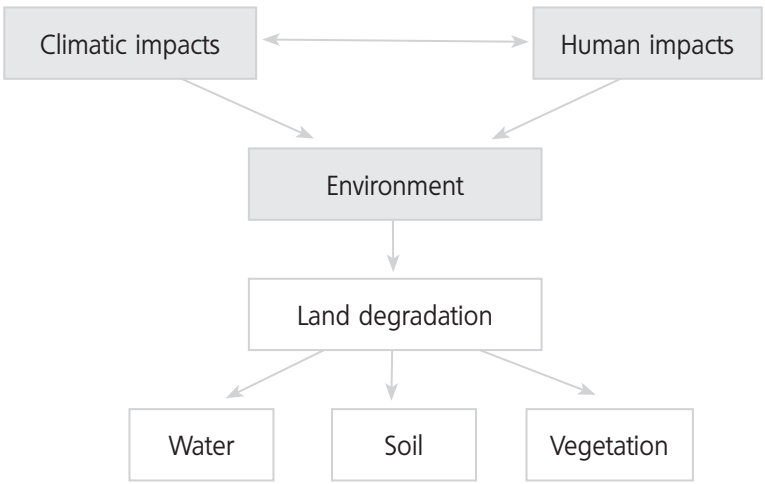
CHAPTER 2

This chapter provides a brief overview of the South African environment. Maps show the physiography, rainfall patterns and main biomes or natural regions of South Africa. The provincial boundaries and magisterial districts after 1994 are also shown. In later chapters, information about land degradation will also be presented in the form of maps. An overview of the South African environment is necessary as we investigate the causes and effects of the degradation of this country's water, soil and vegetation resources.





Land degradation: a conceptual framework

2.1 The South African environment

Introduction

Land degradation is a complex issue with causes and effects that are environmental, political, social and economic in nature. This chapter contains a brief introduction to the South African environment, focusing in particular on those aspects that have a bearing on the use and degradation of agriculturally productive land. The provincial boundaries after the transition to democracy in 1994 are also shown.

Should you be interested in finding out more about South Africa's biophysical and agricultural environments, please consult the reading list at the end of this chapter for a number of excellent references.

Physiography = physical geography

The physical environment

Physiography

The relief map of South Africa (Figure 2.1) shows low-lying areas along the coast and into the lowveld of Mpumalanga and Northern Province. The Great Escarpment in the east of the country is highest in the KwaZulu-Natal Drakensberg. The interior of the country is a vast plateau, sloping gradually downwards from 1 500 m in the east to 1 000 m in the west.

Physiography affects rainfall and temperature. For example, the seaward slopes of mountains are generally wetter than inland slopes. Average temperatures are usually cooler at higher altitudes, and north-facing slopes are hotter and drier than south-facing slopes.

In areas with high rainfall and steep slopes, soil is particularly susceptible to erosion by water.

Soil

Soil types vary greatly in terms of fertility and texture, and their ability to absorb, retain and redistribute water. These factors make certain soils more susceptible to degradation by waterlogging, salinisation and wind and water erosion. South Africa has many very ancient geological formations and therefore some soil types are highly weathered and relatively infertile, especially in wetter areas where more leaching occurs.

Summer vs winter rain

Two very different rainfall patterns exist in South Africa. Most of the country experiences summer rainfall while winter rainfall occurs in the west.

Climate

On average South Africa receives about 500 mm of rain every year. However, this is not evenly distributed across the country. Some areas receive much more than this, while others receive considerably less. Generally, annual rainfall increases from west to east (Figure 2.2). Hyper-arid areas like the Namib Desert, the Richtersveld and Bushmanland are situated in the west, while sub-humid and humid bushveld and coastal forest areas, such as those in KwaZulu-Natal, occur in the east.

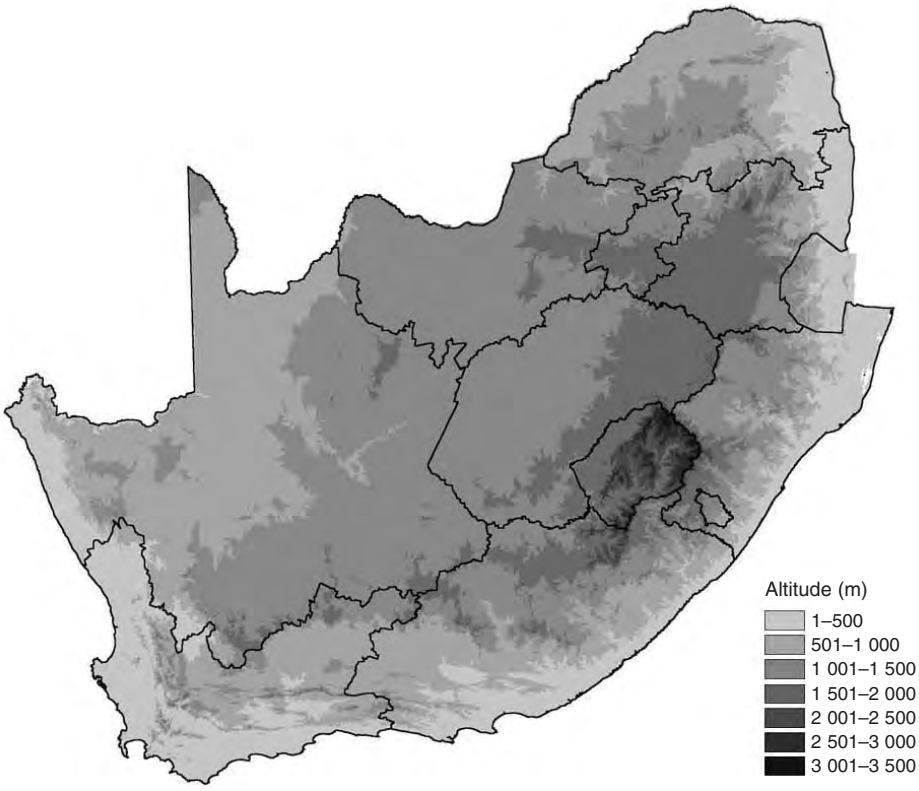


Figure 2.1 *The physiography of South Africa (after Schulze et al, 1997)*

Seasonal rainfall patterns also vary from west to east. Most of the country receives rain in summer, but the extreme western and southwestern parts experience summer drought and winter rain. A narrow coastal strip in the south receives rain throughout the year.

Mean average temperature is generally related to height above sea level, with the high Drakensberg Mountains being the coldest and the eastern coastal and lowveld regions the warmest parts of southern Africa.

The biological environment

Biomes

Climate is one of the most important factors determining where plants, and therefore animals, can live. The patterns of rainfall and temperature described above are reflected in ecological zones known as biomes. These are natural regions with characteristic climatic conditions and life forms. South Africa has seven biomes (see Table 2.1, Figure 2.3).

Biomes

… broad ecological units that represent major life zones extending over large natural areas.

Rutherford, 1997

Climate determines not only the natural vegetation of an area but also the dominant type of agriculture. For example, the shrubby vegetation of the Nama-Karoo and succulent Karoo biomes supports small browsing stock like sheep and goats. The grassland and savanna biomes provide pasture for cattle. Maize, related to the grasses, grows well in the grassland biome. Commercial forestry requires high rainfall and occurs in the forest biome, mountainous areas and coastal savanna.

Figure 2.2 *Mean annual precipitation patterns for South Africa (after Schulze et al, 1997)*

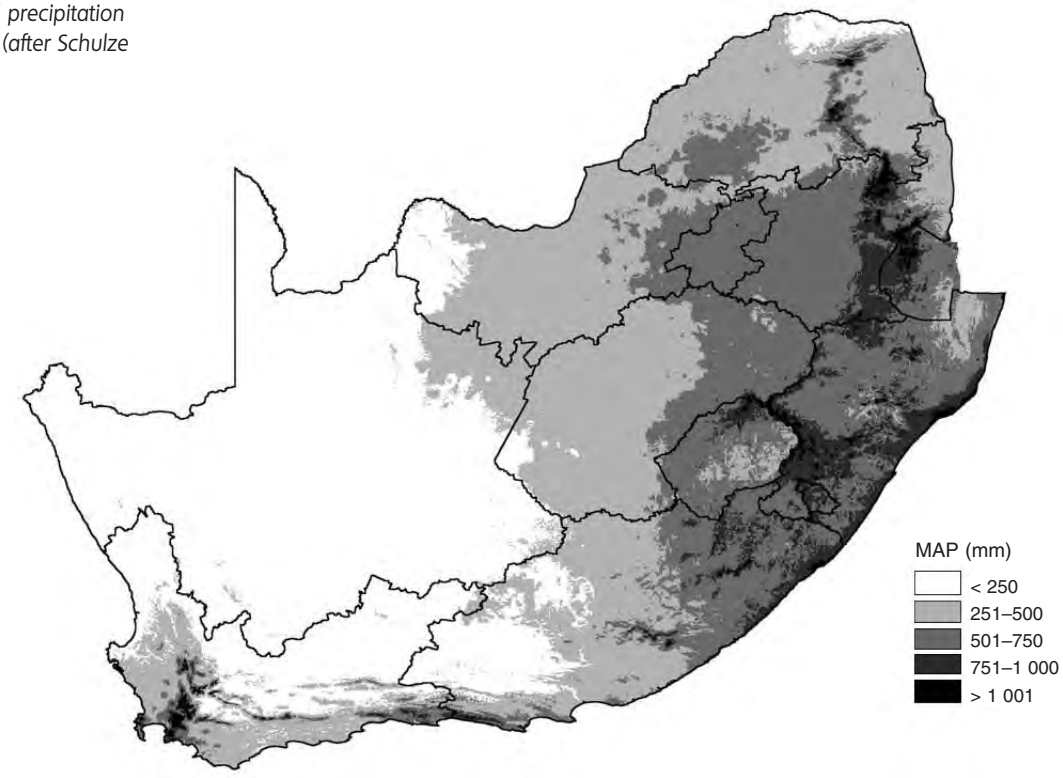


Figure 2.3 *The seven biomes of South Africa (from Rutherford, 1997)*

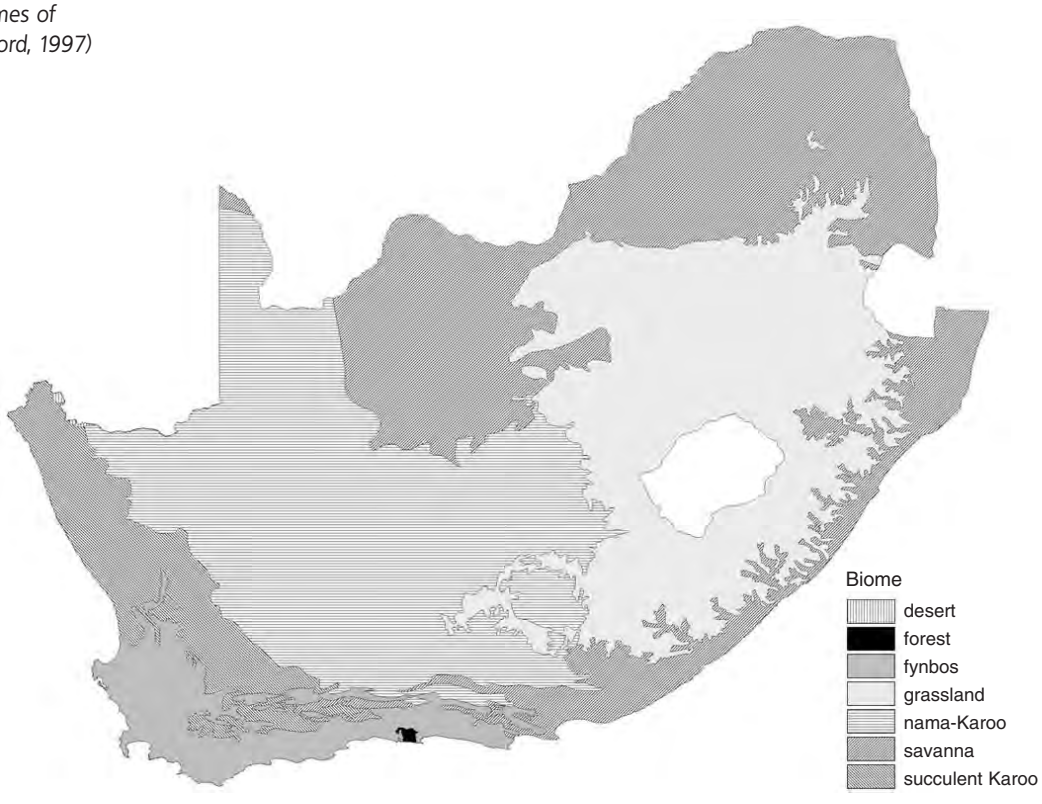


Table 2.1 *The biomes of South Africa*

Biome	% of SA	Vegetation	Biotic & abiotic factors
Savanna	32,1	grassland with scattered trees	summer rain; fire; grazing and browsing
Nama-Karoo	29,0	many small shrubs and some grass, especially in the east	low rainfall predominantly in summer; grazing and browsing
Grassland	26,3	grasses and small flowering plants; very few trees except along water courses or on hillsides	summer rain; fire; frost often experienced in winter; grazing
Succulent Karoo	6,7	small shrubs and other plants with succulent leaves or stems; many annual plants	low rainfall predominantly in winter; grazing and browsing
Fynbos	5,8	many woody shrubs, reeds and bulbs; few trees	rainfall predominantly in winter; usually associated with poor soils; fire
Forest	0,05	trees forming a closed canopy	rainfall throughout the year
Desert	0,05	very few plants	very little, unpredictable rainfall

Affected drylands

The natural regions of South Africa can also be classified in terms of their relative dryness or aridity. The United Nations Convention to Combat Desertification (UNCCD) has defined five aridity categories, namely hyper-arid, arid, semi-arid, dry sub-humid and humid. To work out which aridity zone an area falls into, one must compare its mean annual precipitation with its potential to lose water through evaporation and transpiration. This is known as the MAP:PET ratio (Table 2.2, Figure 2.4).

$$\frac{\text{mean annual precipitation}}{\text{potential evapotranspiration}}$$

For example, a desert receives very little precipitation, but the potential to lose water by evapotranspiration is high because the area is hot and dry. Hyper-arid zones like this have a MAP:PET ratio of less than 0,05.

On the other hand, in a place like Durban the rainfall is high and because it is very humid, relatively little water is lost by evapotranspiration. The MAP:PET ratio of humid areas is greater than 0,65.

The UNCCD is particularly concerned about arid, semi-arid and dry sub-humid zones, which it calls affected drylands. These are the fragile dryland areas that can be farmed and are most at risk of desertification. A staggering 91% of South Africa falls within this category. A further 8% of the land, in the Northern and Western Cape provinces, is hyper-arid. Only 1% of the country is classified humid, and is made up of small pockets of land, each a few square kilometres in extent, in the Eastern Cape, KwaZulu-Natal, Mpumalanga and Western Cape.

Precipitation
All the forms in which water reaches the Earth, e.g. rain, hail, snow, dew, fog

Transpiration
The loss of water vapour from a plant, usually through tiny pores in the leaves

The UNCCD requires countries to consider only their arid, semi-arid and dry sub-humid zones when developing a National Action Programme. In South Africa, because an insignificantly small area is classified humid and farming also takes place in the hyper-arid zones, the national review team decided to include the whole country in the research project.

Table 2.2 *Percentage of land area in each aridity zone in South Africa*

Aridity zone	Hyper-arid	Arid	Semi-arid	Dry sub-humid	Humid
MAP:PET	<0,05	0,05–0,2	0,2–0,5	0,5–0,65	>0,65
% of SA	8%	47%	39%	5%	1%
		Affected drylands			

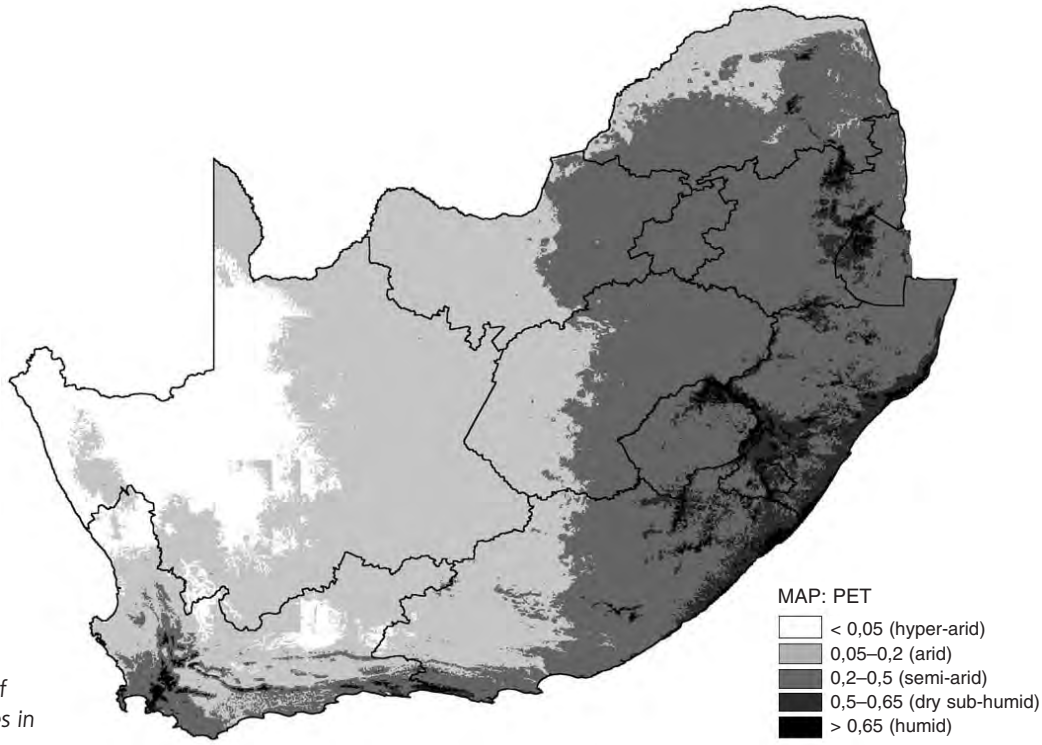


Figure 2.4 *The distribution of the five UNCCD aridity classes in South Africa*

Largest & smallest

The Northern Cape is the largest province but the most sparsely populated. Gauteng is the smallest province and has the highest population density.

2.2 Political and administrative units

Before the first non-racial democratic elections in 1994, South Africa was divided into four provinces: the Cape Province, Transvaal, Natal and Orange Free State (Figure 2.5). The 'national states' of Transkei, Bophuthatswana, Venda and Ciskei (the TBVC states) were nominally independent but were reincorporated into South Africa in 1994, as were a number of 'self-governing territories' (Gazankulu, KaNgwane, KwaNdebele, KwaZulu, Lebowa and QwaQwa). The history behind this system is explained in Chapter 3.

In 1994 the old provinces and homelands were replaced by nine new provinces, namely the Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Mpumalanga, Northern Cape, Northern Province, Northwest and the Western Cape. These provinces differ greatly in physical size and character, population density and economic productivity (Table 2.3, Figure 2.6). The 367 magisterial districts within the nine provinces were used in the national desertification review as the unit of investigation and comparison (Chapter 4).

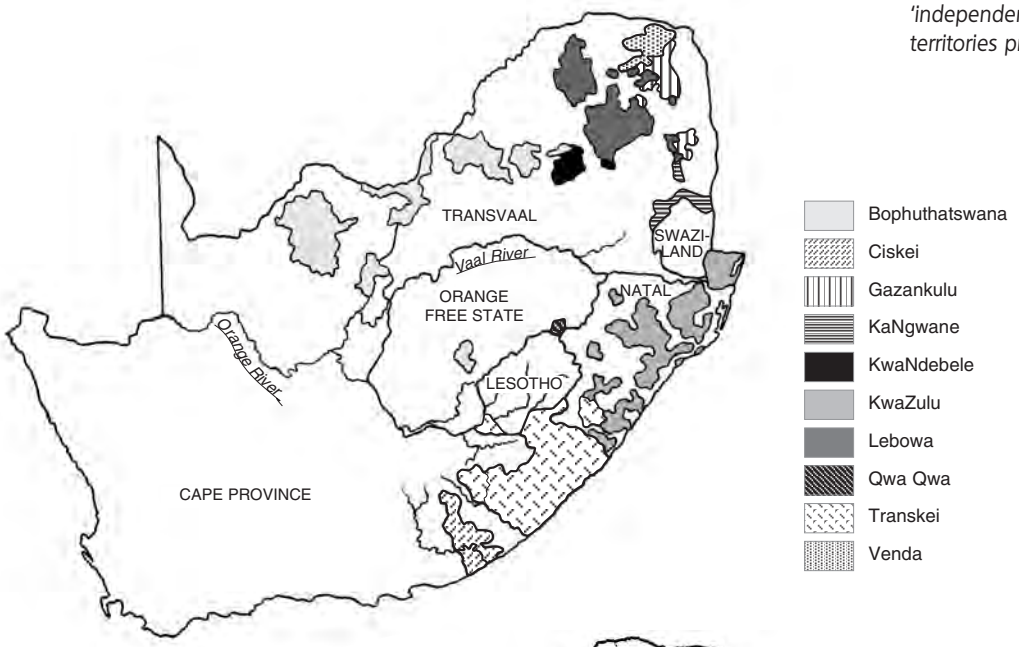


Figure 2.5 *South Africa and the 'independent' and 'self-governing' territories prior to 1994*

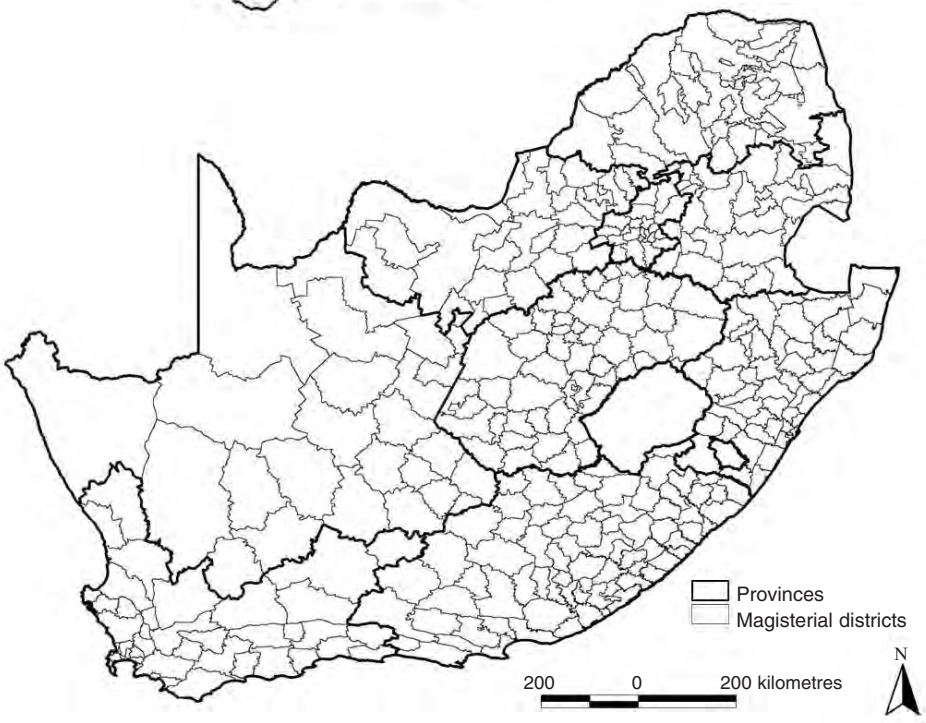


Figure 2.6 *The nine provinces and 367 magisterial districts of the Republic of South Africa*

Table 2.3 *A brief summary of the nine provinces of South Africa*

Name	Area (km^2)	Population (1996)	Agriculture as % GGP (1995)*
Eastern Cape	169 600	6 302 525	5,4%
Free State	129 480	2 633 504	10,4%
Gauteng	18 810	7 348 423	0,6%
KwaZulu-Natal	92 180	8 417 021	5,6%
Mpumalanga	78 370	2 800 711	7,8%
Northern Cape	361 800	840 321	10,0%
Northern Province	123 280	4 929 368	8,0%
Northwest	116 190	3 354 825	8,9%
Western Cape	123 370	3 956 875	6,5%
Total	**1 219 080**	**40 583 573**	**4,6% Gross Domestic Product**

* Gross Geographic Product (Source: Central Statistical Services)

Despite the vast areas of land used for agriculture in South Africa, this sector contributes only 4,6% of the country's total gross domestic product (GDP). However, this figure is based on commercial trade only and ignores both subsistence agriculture and informal trade. The above table thus grossly underestimates the substantial contribution of agriculture and natural resources to rural livelihoods.

Further reading

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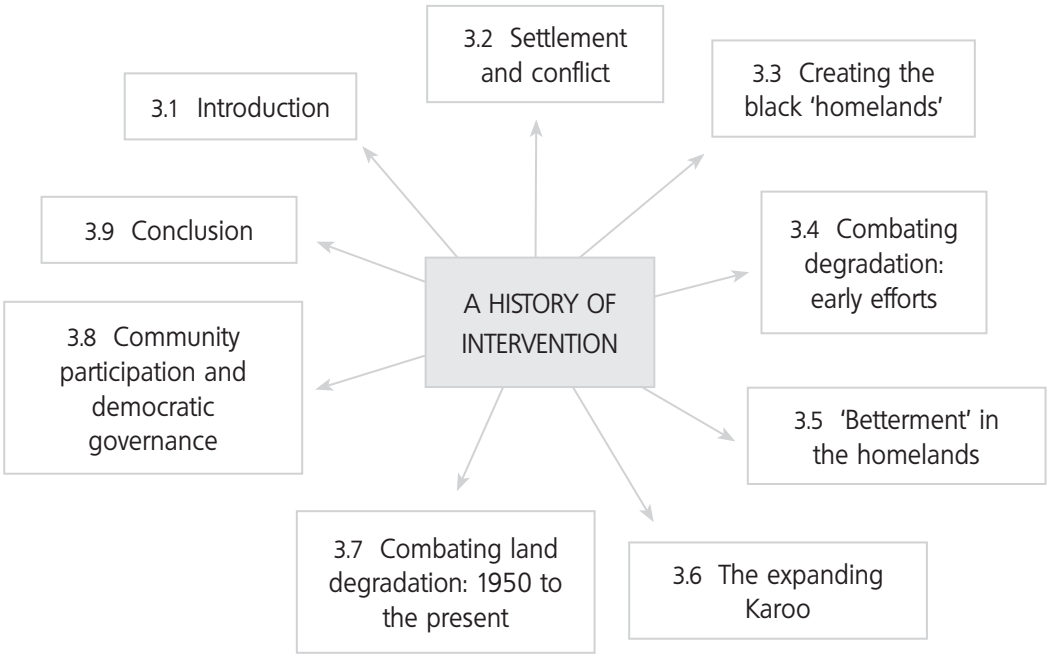
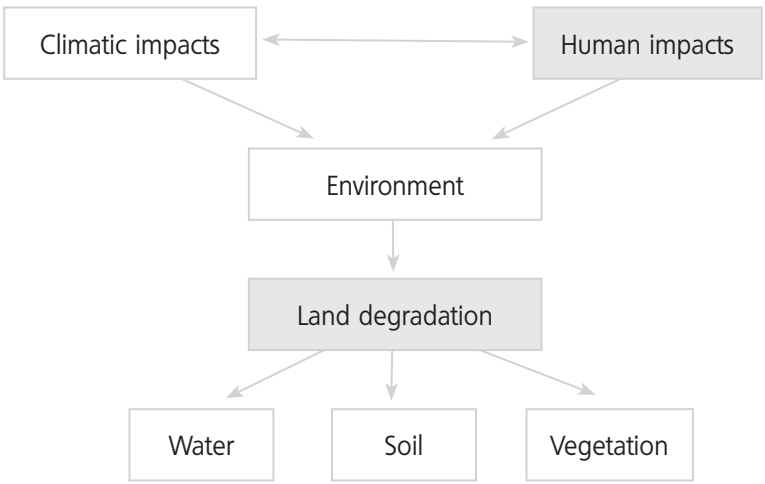
CHAPTER 3

The problem of land degradation in South Africa is deeply rooted in the history and politics of the country. This chapter provides a very brief historical overview of some of the sociopolitical factors that have shaped attitudes, policies and land use practices. The 20th century legacy of homelands and migrant labour has created a major challenge for the policymakers and agriculturists of the 21st century: to restore both the land itself and people's relationships with the land.





Early concerns

… the persistent and greedy system of overstocking farms [with merino sheep] has changed the flora, introduced and given undue influence to worse herbage, and bids in fair time to change the climate and, with this, the whole character of the vegetation.

Shaw, 1875

3.1 Introduction

Land degradation is not a new problem in South Africa. For centuries people have been concerned about issues such as overstocking, soil erosion and invasive alien plants. As early as 1775, the Swedish traveler, Anders Sparrman, noted that selective grazing by cattle was reducing the proportion of palatable grasses and herbs, while encouraging less palatable shrubs to flourish. In 1875, John Shaw, who later became Professor of Science at what is today the University of Cape Town, also expressed concern about the changes happening in the vegetation of the Karoo. By the 1880s, eradication programmes were already underway to remove prickly pear, introduced to South Africa as an ornamental, hedge and supplementary fodder plant in the 17th century.

This chapter sketches a brief history of some of the research programmes, policy interventions and awareness campaigns that have had a bearing on land degradation in South Africa during the last hundred years. The issue of land degradation is inseparable from that of land ownership, land tenure and labour, and a brief introduction to some of the major influences on the political economy of South Africa is also provided. Those interested in exploring the environmental history of South Africa in more detail are encouraged to consult the reading list at the end of the chapter.

Early impacts

First estimates of San-derived veld damage in the upper Seacow valley suggest that 0,28% of the total plant cover and 2% of the best (i.e. most diverse) cover was already severely damaged before the arrival of European stock farmers.

Sampson, 1986

3.2 Settlement and conflict

Early occupation and impact

Archaeologists tell us that southern Africa has been occupied by anatomically modern people for hundreds of thousands of years. Stone tools and other artifacts of great antiquity, which once belonged to small groups of San hunter-gatherers, have been found throughout the subcontinent. The first herders, the Khoe-khoen (Khoi-khoi), who brought domesticated fat-tailed sheep to the region, arrived about two thousand years ago. They lived as nomadic pastoralists predominantly in the western and southern parts of the subcontinent. At about the same time or perhaps slightly later, groups of Nguni Iron Age farmers, migrating southwards from eastern and central Africa, settled with their herds in the northern, central and eastern parts of South Africa. They also cultivated the soil and grew indigenous crops such as sorghum and millet. Colonial settlers were to arrive later, towards the end of the 17th century, but in relatively small numbers at first. While the impacts of all these early inhabitants on the environment were not insignificant, and can still be seen in places today, they did not compare with the scale and intensity of changes that have occurred in the last 200 years.

It has become apparent that there has been enough time for even a sparse human population, armed with axes and (later maybe) the hoe, to change profoundly the vegetation from its original state over broad areas, especially where the tree canopy was once closed.

Feely, 1980

Part of the reason for this is that precolonial South Africa was sparsely populated and groups of people were able to move relatively freely in response to the availability of game for hunting, grazing for their livestock, and the availability of water and fertile soil for their crops. Although skirmishes between groups contributed to the movement of people on the

subcontinent, these were nothing like the rapid and large-scale movements of people in response to disease, war, political aspirations and fortune-hunting that were to characterise the colonial period from the middle of the 17th century. These disruptions completely changed the nature of settlement, ownership and land use, and set the scene for the land degradation patterns we see today.

A Khoe-khoen encampment on the Orange River

The decimation of the San and Khoe-khoen

Colonial expansion was slow at first. But by the end of the 18th century, disease, war and land dispossession had decimated San and Khoe-khoen populations in the southern and western parts of the country. Some survived, however, beyond the colonial frontier, while many lived as labourers or servants on colonial farms. It was only later in the 19th century that some measure of protection was afforded the nomadic pastoralists of Namaqualand, and formal reserves were set aside for their use. Today these are known as the Coloured Rural Areas in terms of the relevant legislation, and this is where descendants of these early inhabitants live today.

The Mfecane/Difaqane

The central, northern and eastern parts of South Africa were also affected by a series of disruptions which started in the 19th century. These resulted in widespread migrations and dramatically altered ownership and land use patterns on the subcontinent. The first disruption was the Mfecane/Difaqane, the term given to the large-scale movements of people caused by Shaka's expansionism between 1816 and 1828. Some historians suggest that the desire to create a single kingdom may have been stimulated by, amongst other things, the need to reduce competition for grazing between separate minor chiefdoms, and to develop a stronger military force, able to seize and defend agricultural resources.

Shaka Zulu

The Great Trek, 1934–1840

Following the Mfecane, Dutch-speaking frontier farmers moved into the sparsely populated parts of the central and northern interior. In the western parts they negotiated with the BaTswana to purchase large tracts of land. Having escaped colonial rule, these early settlers established the two independent Boer republics of the Transvaal and Orange Free State, where they in turn subjugated the indigenous inhabitants.

Apart from the physical disturbance to the land which many large-scale mining operations create, social disruptions also occur as young, able-bodied men leave the land in search of wealth and a better life for themselves and their families.

Minerals and modernisation

The discovery of diamonds and gold in the interior resulted in a third 19th century wave of migration. South Africans and 'Uitlanders' (foreigners) flocked to mining towns like Kimberley, Johannesburg and Pilgrim's Rest, many of which were located in the Boer republics. The promise of a brave new world of instant riches resulted in a frenzy of development and wild fluctuations of fortune. But war with the British and defeat for the Boer republics followed soon after.

An understanding of how minerals and other resources have been controlled is central to any history of land degradation in South Africa. From the end of the 19th century, policies were imposed that led to the collapse of black peasant agriculture and the creation of large labour pools to supply the expanding mining industry. There were dramatic changes in land ownership, tenure arrangements and access to markets. All of these developments intensified during the 20th century and, as we shall see, help to explain the patterns of land degradation we see today.

3.3 Creating the black 'homelands'

The creation of black 'homelands' has had profound implications for land degradation in South Africa. Although apartheid has often been blamed for the homelands, much of the blueprint for their creation was in place long before the rise of Afrikaner nationalism and the apartheid ideology in the 20th century.

At first, decimation through disease, war and the relentless expansion of the colonial frontier were the main means whereby black South Africans were dispossessed of land. Towards the end of the 19th century, and throughout much of the 20th century, legislation and forced removals were the primary instruments for controlling black land ownership, activities, movement and access to urban markets. From 1950–1980 alone an estimated 1,4 million people were forced to leave white-owned farms and a further 90 000 were removed from urban areas; 94% of these displaced people were resettled in black homelands. Natural population growth, coupled with resettlement, caused the homeland population to grow from 4 million to 11 million between 1960 and 1980. These movements affected profoundly the degree, extent and rate of land degradation in these areas.

Early legislation

Several pieces of legislation during the 19th century paved the way for the formal creation of black homelands in the 20th century.

- The 1884 Native Location Act (Cape Colony) dispossessed sharecroppers, forcing them to become labour tenants on white-owned farms.
- The 1887 Squatter Laws (Transvaal) restricted the number of black families per white household to five and removed 'surplus' blacks to designated areas.

Official definitions

Sharecroppers

Tenant farmers who pay rent with part of their crop.

Labour tenants

Africans older than 15 years who occupy parts of white farms. Instead of paying rent they work for the farmer for 3 to 9 months a year for very little or no money.

Squatters

Africans older than 18 years living on white farms as sharecroppers or for a cash rental. Squatters had to be registered and farmers had to pay licence fees. They could be evicted, usually at 3 months' notice.

Desmond, 1970

- The 1894 Glen Grey Act (Cape Colony) introduced the idea of 'one man one plot' to the Transkei. The total amount of land where blacks were allowed to settle was so limited that each man was allowed only one plot to a maximum of ten acres. This effectively made commercial farming impossible.

In the political economy of the late 19th and early 20th centuries, demand for cheap mine labour was growing. Legislation such as that described above limited the number of blacks on white-owned farms, leading to large-scale evictions of people who then sought work in the urban and mining sectors.

In 1903 the British High Commissioner, Lord Milner, appointed a Native Affairs Commission to make recommendations for a common 'native' policy for South Africa. The report recommended territorial and political segregation of blacks and whites, and approved locations for urban blacks. The creation of two parallel worlds was well underway.

1913 Natives Land Act

The Natives Land Act, No. 27 of 1913, accelerated the process of segregation in South Africa. This act restricted black land ownership to 7% of the area of South Africa and permitted only customary rather than freehold tenure. Labour tenancy replaced sharecropping and rent-tenant contracts. The 'native reserves' were taking shape as reservoirs of labour for white-dominated agriculture, mining and industry.

The effects of migrant labour on land degradation will be considered in more detail in Chapter 10. Suffice to say that the migration of large numbers of economically active men and later women from the rural areas to towns left children and the elderly to look after the land in the communal areas. Turning black peasant farmers into migrant labourers effectively undermined their self-sufficiency, political power and the environmental sustainability of their agriculture. The introduction of pass laws and the reservation of certain jobs for whites only were further expressions of segregation and control. Despite protests in South Africa and Britain by the newly established South African Native National Congress (forerunner of the African National Congress), the law was upheld.

The Union government soon realised that the amount of land allocated to the reserves was not enough to support the people living there. The Beaumont Commission, which was established in 1916 to investigate the allocation of land to the reserves, concluded that the current 7% was enough to support only half the existing black population of about 4 million, not to mention any future increases in numbers. The commission recommended that more land should be allocated to the reserves, but legislation to this effect was not implemented for another 20 years.

Sol Plaatje, author of Native Life in South Africa *(1915), an indictment of the Natives Land Act*

Entrenching segregation

By 1936, South Africa's black population had reached 6,6 million, with 45% living in the reserves, 34% on white-owned farms and the remaining 21% in urban areas. Under Prime Minister Hertzog, political and territorial segregation were further entrenched by three acts:

- The 1936 Natives Trust and Land Act made provision for the state to purchase land to increase the size of the 'native reserves' to 13,7% of South Africa's land area. The South African Native Trust was established to administer these areas.
- The 1936 Natives Representation Act removed blacks living in the Cape from the common voters' roll.
- The 1937 Native Laws Amendment Act strengthened urban segregation and influx control.

Thus, before the outbreak of the Second World War, most of the structures that would enable the system of apartheid to take root and flourish were already in place. Between 1948 and 1994, the 'native reserves' were consolidated into homelands where only blacks had tenure, with the intention of developing these areas into separate self-governing states.

The Tomlinson Commission, 1950–1953

In 1950 the Malan government appointed Professor F.R. Tomlinson to lead the Commission for the Socio-Economic Development of the Bantu Areas. Its aim was to develop an effective socioeconomic plan to rehabilitate and develop black areas into self-governing homelands. The 1951 Native Authorities Act abolished the Native Representative Councils, paving the way for greater self-government in the homelands.

Tomlinson's report, published in 1953, recommended separate development as a strategy to avoid racial tension in South Africa. Although the report formed the basis for the demarcation and development of the homelands, many of its recommendations were rejected as they provided opportunities for black economic advancement.

H.F. Verwoerd, then Minister of Native Affairs, rejected the following recommendations:

- Tribal ownership should be replaced with freehold tenure for blacks in both rural and urban areas.
- Full-scale development of black areas would require a budget of more than R200 million over ten years.
- White capital should be invested in the homelands to develop industries and provide employment.
- A black peasant farming class should be developed to supply domestic markets with produce.

Forced removals

In the early 1980s, 200 000 people were forcibly moved to QwaQwa, a tiny bantustan with no industries and almost no farming opportunities.

A further 50 000 people were moved from Herschel to Glen Grey. After only two years prime land had become so degraded that people were dependent on government rations to survive.

Tomlinson urged acceleration of land purchases to make up the full quota recommended in the 1936 Natives Trust and Land Act, noting that the homelands were overcrowded and unable to support even existing populations. He highlighted a major need for agricultural development and recommended the restructuring of 'betterment' planning (see section 3.5). Tomlinson worked out the amount of land in each ecological area that would provide a black family with an appropriate standard of living, but the Malan government reduced this to the equivalent of just £60 per year, making even subsistence farming untenable.

As apartheid became entrenched in policy and practice between the 1950s and 1990s, internal and international resistance grew. The South African government retreated into the laager of separate development. Soon after South Africa became a Republic in 1961, Prime Minister Verwoerd withdrew the country from the Commonwealth and banned the African National Congress and Pan Africanist Congress. Hundreds of thousands of people were resettled in fragmented homeland areas (see map page 19).

3.4 Combating degradation: early efforts

From the end of the 19th century and throughout the 20th century, numerous attempts were made to raise awareness about land degradation in South Africa and find ways to address it. Actions took the form of state interventions, inquiries, research programmes and laws. For example, the establishment of the Drought Select Committee of 1914 was prompted by severe drought and associated agricultural and economic losses. Amongst both government agencies and civil society there was evidence of genuine concern about the state of the nation's agricultural resources. Except for the unpopular and generally unsuccessful homeland 'betterment schemes', during the 20th century, efforts at combating land degradation were directed overwhelmingly at white commercial farmers.

The Drought Investigation Commission, 1920–1923

Following hot on the heels of the 1914 Drought Select Committee, the Drought Investigation Commission was appointed in 1920 to examine existing land use practices and find ways to prevent drought-related agricultural losses. The commission held over a hundred public meetings throughout South Africa, gathering information from farmers representing most of the commercial farming areas. There is, however, no evidence of black farmers being involved. In addition to gathering information for its formal report, the meetings were a valuable awareness-raising and educational opportunity.

The Drought Investigation Commission Report was released in 1923, and contained background information, a synthesis of the findings gathered from the public meetings, and a number of appendices compiled by various experts and people with special interests. The report stated that there was no evidence

that 'the mean annual rainfall of [South Africa had] altered appreciably within recent historic times.' Instead, it concluded that land use practices such as overstocking and particularly the kraaling of domestic stock at night were responsible for veld degradation and soil erosion. It suggested that: 'The experience of the small number of South African farmers who, having the jackal under control, have abandoned the kraaling system, proves indisputably that stock losses can be reduced greatly or entirely prevented by the adoption of their system of allowing the stock to run free day and night.' Soil erosion was identified as the key factor aggravating the effects of drought.

Recommendations included:

- extermination of the jackal, making it unnecessary to kraal animals at night
- providing cheap fencing material to create paddocks in which sheep could run free
- developing water points so that animals did not have to walk long distances each day
- state intervention to control soil erosion.

The Drought Investigation Commission report suggested that eradicating the jackal would allow rotational grazing in large paddocks, reducing erosion and overgrazing caused by keeping sheep close to kraals where they could be protected at night.

Unfortunately, by the time the report was published, the drought was over. The 1920s were a period of relatively good rains, and there was little reason to develop drought-related legislation or change land use practices. In fact, sheep numbers continued to climb from 31 million in 1923 to more than 48 million in 1930 – the highest number on record.

The government gets involved

While farmers themselves might have ignored the findings of the Drought Investigation Commission, the government did not. The Agricultural Extension Service was established in 1925 to support development in white farming areas and this marked the beginning of a long period of state patronage of the white farming community. In 1929 a national soil erosion conference held in Pretoria heralded two decades of intense interest in soil conservation. The Soil Erosion Advisory Council, representing various government departments, was established in 1930. It was motivated by political and economic interests as well as by soil conservation. Following the October 1929 Wall Street Crash and the much-publicised American Dust Bowl disaster, the need for agricultural self-sufficiency made soil conservation a national priority.

The first substantial legislation promulgated to control soil erosion and related problems in South Africa was the Forest and Veld Conservation Act, No. 13 of 1941. The Department of Agriculture established a new Division of Soil and Veld Conservation under J.C. Ross, who saw his role as conducting a propaganda campaign, including the production of films about soil erosion, to prepare farmers for the period of post-war reconstruction.

This farm in Oklahoma, USA, was one of many submerged in a sea of sand during the Dust Bowl disaster of the 1930s.

Public concern

Public pressure for action against soil erosion was also growing. In 1943 the National Veld Trust was formed, providing a forum for people from across the white political spectrum to lobby for soil conservation. In 1944, the National Veld Trust cooperated with the government to bring Hugh Bennett, Chief of the Soil Conservation Service of the United States Department of Agriculture, to South Africa for an extensive two-month study and lecture tour. Bennett was a world authority on soil conservation and his visit was covered in the popular press, stimulating public interest and pressure. He stressed the role of the state in providing farmers with education, technical advice and financial help so that they could tackle their own problems. His report formed the basis for new legislation affecting white farming areas. However, his approach was incompatible with the politics of the Department of Native Affairs and he had few recommendations for the 'native reserves'. Inspired by Bennett's visit, the National Veld Trust drew up a draft Soil Conservation Bill. The Department of Agriculture submitted a somewhat watered-down version to parliament in 1946.

Wartime provided metaphors to describe the soil conservation issue:

'In keeping with the military tenor of the times, soil conservation became a "battle" to be waged against an "enemy" with "propaganda" as one of the key "weapons".'

Dodson, 2000

The Soil Conservation Act, No. 45 of 1946, made provision for:

- the establishment of a non-executive Soil Conservation Board to advise the Departments of Agriculture and Native Affairs on soil conservation in white and black farming areas
- the formation of locally administered soil conservation districts
- state powers to enforce soil conservation, including expropriation of land
- state subsidies to enable farmers to construct soil conservation works.

By the late 1940s, despite the soil conservation legislation, campaigns and schemes mentioned above, neither the soil nor people's livelihoods in the rural areas had shown any marked improvement. The Department of Agriculture was reluctant to offend white rural voters by using the powers vested in it by the Act to enforce soil conservation measures. Black farmers, as we shall see, were unwilling to cooperate with the Department of Native Affairs because its policies were based on assumptions of white supremacy and black dispossession. But while the early soil conservation efforts might have failed in practice they did raise awareness of the problem, especially within the white farming community.

3.5 'Betterment' in the homelands

While nearly all of the efforts already discussed addressed land degradation problems in white farming areas only, a series of parallel interventions were occurring in the 'native reserves'. By the 1930s, these areas were experiencing severe environmental problems including soil erosion, destruction of grazing and drying up of springs. In 1932 the Native Economic Commission called for action, and four years later the Secretary for Native Affairs announced plans to rehabilitate the reserves, starting with surveys of each local area.

'Betterment', a strategy to address land degradation in the 'native reserves', was introduced by Proclamation 31 of 1939. It combined practical land reclamation, such as gully rehabilitation, with land use planning. Where it was implemented, scattered rural settlements were concentrated into villages, areas were prescribed for grazing and cultivation, and livestock culled. In some cases, fields were fenced into camps to enable rotational grazing, anti-erosion measures were implemented and dipping tanks were built to combat stock disease. This ambitious programme was slow to be introduced before 1950, but influenced homeland policy for decades. Further proclamations in 1949 and 1967 introduced amendments that ensured that the homelands continued to serve the ends of segregation and cheap labour.

From the beginning, it was unlikely that government interventions to address soil erosion in the reserves would succeed. As pointed out by D.D.T. Jabavu, leader of the African Farmers' Union, it was the very political and economic policies of separation and dispossession that were at the root of the problem. But instead, official investigations blamed '... the irrational desire [of black farmers] to accumulate cattle and an unwillingness to accept

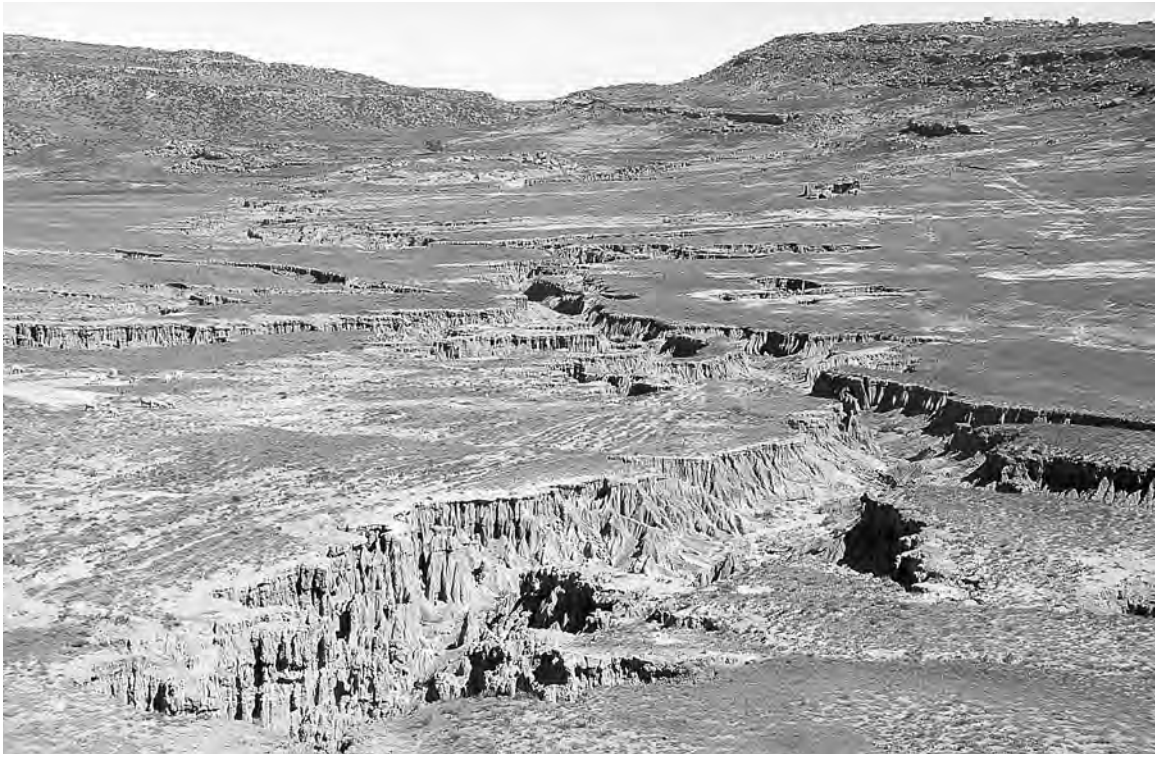
'Betterment' rejected

Throughout the reserves, betterment was rejected largely because it was seen as unwarranted interference and because it was associated with economic hardship and deprivation.

McAllister, 1989

crop rotation ...'. Insensitivity to prevailing socioeconomic conditions and cultural practices antagonised communities and heightened resistance to soil conservation efforts that, although potentially helpful, addressed the symptoms rather than the causes of land degradation.

Moving rural people from scattered homesteads into villages was intended to conserve natural resources. In reality, however, it caused numerous environmental problems. The concentrated demands for water and firewood led to the degradation of resources around the new villages. Fencing around pastures did not remain intact for long. Instead of livestock being left in the fields at night, animals were brought back to the villages, worsening erosion and compaction of soil around settlements.

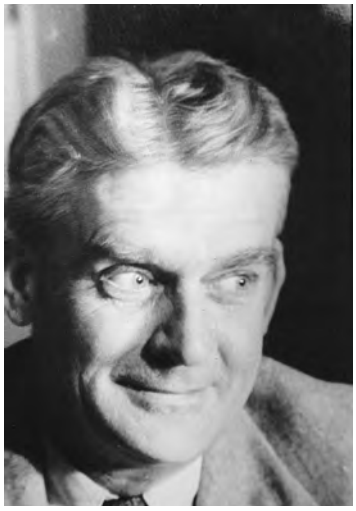


This valley near Entsimekweni village, Herschel district, was used for cropping in the 1950s but was rezoned as a grazing land under the Betterment Planning Act. This led to an abandonment of people's interest in soil conservation measures and accelerated rates of erosion.

3.6 The expanding Karoo

John Acocks' *Veld Types of South Africa*

No overview of land degradation in South Africa would be complete without reference to the theory of the expanding Karoo. John Acocks, a botanist with the forerunner of the National Botanical Institute, travelled the length and breadth of the country between 1945 and 1951 doing detailed vegetation studies for his major work, the *Veld Types of South Africa*. Several published



John Acocks, author of Veld Types of South Africa

studies before Acocks had mentioned with concern that overgrazing by sheep in particular had changed the composition of vegetation in the Karoo. Acocks demonstrated graphically how this could have happened in a series of full-colour maps of South Africa that showed the distribution of different key vegetation types prior to colonial influence in AD 1400, in 1950 when he conducted his survey, and in 2050 if overgrazing continued.

Acocks believed that the eastern margins of the Karoo had been spreading in a northeasterly direction into the grasslands since colonial times. His vision of a past, present and future environment was to have a powerful and lasting impact on the desertification scene in South Africa. The maps were distributed widely in a number of publications, including those of the National Veld Trust, and repeated the message of the 1923 Drought Investigation Commission – that poor land management by commercial small-stock farmers had degraded the environment and caused the spread of the Karoo.

The Desert Encroachment Committee

In January 1948, the Desert Encroachment Committee was appointed to investigate the deterioration of vegetation, particularly in the Karoo and adjacent grassland areas. Acocks served on the committee and his research greatly influenced its findings. The committee held 29 public meetings in magisterial districts in the Nama-Karoo, grassland and arid savanna biomes. Like the Drought Investigation Commission before it, the Desert Encroachment Committee reported in 1951 that incorrect veld management, and not changes in rainfall patterns, was responsible for vegetation changes in the eastern Karoo.

Karoo on the move

The most striking and alarming change is the spread of Karoo at the expense of sweet grassveld. This spread of the Karoo eastwards has amounted to 250 km in parts [and] is still proceeding … the conversion of 32 200 km^2 of grassveld into eroded Karoo can only be regarded as a national disaster.

John Acocks, 1953

After the Desert Encroachment Committee's report and the publication of *Veld Types of South Africa*, very little original research was done on veld degradation until the 1980s. For many years, the expanding Karoo hypothesis informed the development of policy and focused the attention of interventions such as the Stock Reduction Scheme (1969–1978) and the National Grazing Strategy (1985). It remains a pervasive influence, as shown in recently published maps depicting both soil and vegetation degradation in South Africa (Figure 3.1). In all cases, the eastern Karoo is depicted as being seriously degraded or threatened.

Although the eastern Karoo has indeed suffered degradation due to overgrazing, recent research has questioned whether Karoo vegetation is actually encroaching into the grasslands at all. In fact, some researchers feel that after decades of special attention, the vegetation in many parts of the eastern Karoo has recovered significantly, and the issue is still hotly debated. But whatever the outcome of this particular debate, the time has come to broaden the definition of land degradation to include impacts on soil, water and vegetation and attend to the needs of other, possibly far more degraded and neglected, parts of South Africa.

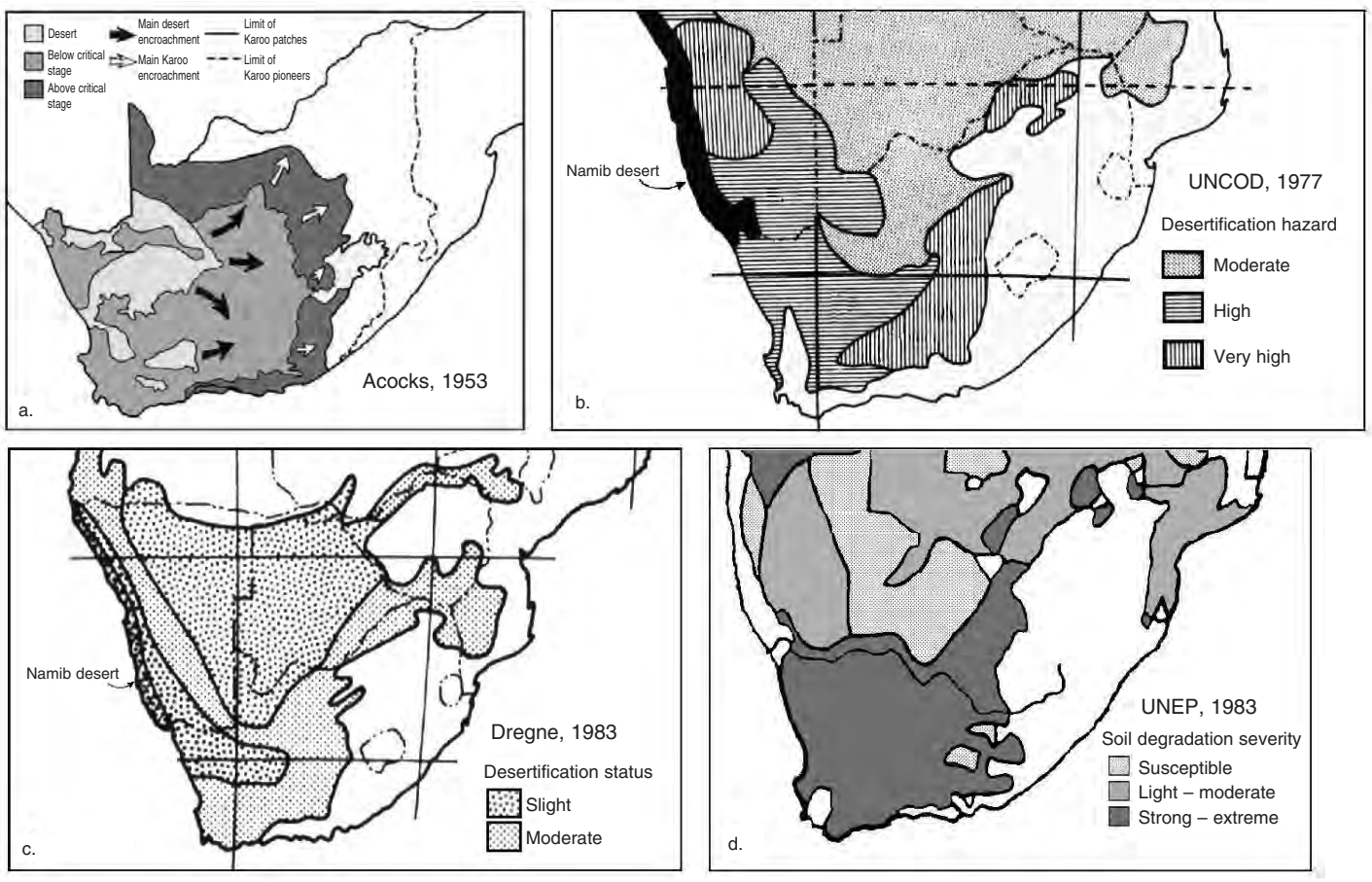


Figure 3.1 *Perceptions of land degradation in South Africa 1953–1993. The maps show the influence of Acocks' hypothesis of an expanding Karoo on subsequent international syntheses. These perceptions differ significantly from those reflected in this book.*

3.7 Combating land degradation: 1950 to the present

We now focus on the efforts to combat land degradation which emerged in South Africa in the second half of the 20th century and which have continued to the present.

This period was characterised by a number of new agricultural and conservation acts, most of which applied to 'white' South Africa only. The government progressively distanced itself from the communal areas, creating the 'independent' homelands and 'self-governing' territories where different rules applied in law and in practice. These communal areas also only received a fraction of the state subsidy that was paid out to support white commercial farmers in their battle against environmental degradation and drought losses.

Soil conservation

The origins of the soil conservation movement in the 1930s and 1940s have already been noted. After World War II, there was greater emphasis on soil

conservation research and monitoring. Soil erosion figures vary greatly, but in 1966 one informed study estimated that South Africa lost 233 million tons of topsoil each year through soil erosion. Statistics like this stimulated awareness campaigns such as the Festival of the Soil, organised by the government in 1967, and the National Veld Trust's Save Our Soil campaign in 1980.

The Soil Conservation Act, No. 45 of 1946, was amended in 1967, and replaced in 1969 by a new Soil Conservation Act, No. 76. This act made subsidies available to white farmers to construct and maintain soil conservation works. Soil erosion continued, and the perceived failure of the Act was blamed on the lack of officials to enforce it. This law was amended in 1977.

The CARA and soil conservation

The overarching Conservation of Agricultural Resources Act (CARA), No. 43 of 1983, replaced the earlier Soil Conservation Acts. It applied to white farming areas only and sought to maintain the productivity of the land through ensuring the conservation of water, soil and vegetation resources. At the time of writing this book, agricultural legislation was under review but the CARA had not yet been superseded by a new Act.

In terms of soil conservation, the CARA required the landowner to:

- refrain from the cultivation of virgin soil, steep slopes and certain types of soil without the written permission of the Department of Agriculture
- prevent and control waterlogging of soil
- prevent salinisation
- restore and reclaim eroded land
- construct and maintain soil conservation works.

Although the CARA empowered the State to impose relatively harsh penalties, the Department of Agriculture generally took a lenient, persuasive approach.

Veld management

Whereas considerable research into veld management has been carried out in the commercial farming areas, very little has been done in the communal areas. Research to determine appropriate grazing and land use strategies in the unique conditions of the former homelands is urgently needed.

The CARA also introduced measures to protect grazing lands in the commercial farming areas only. These included:

- the general protection and control of the use of the vegetation
- the setting of fairly conservative grazing capacity norms and control over the number and type of animals kept on the veld
- the prevention and control of veld fires
- the control of weeds and invader plants.

In contrast to the approach to soil conservation, which relied heavily on legislation, interventions encouraging judicious grazing in the commercial

farming areas usually took the form of agricultural extension and voluntary schemes. Farmers generally responded more readily to these schemes in times of drought.

From the 1960s onwards several intervention schemes and strategies initiated by the government sought to address the problems of veld degradation. The most important of these were the Stock Reduction Scheme, the National Grazing Strategy and numerous Disaster Drought Assistance Schemes.

The Stock Reduction Scheme

This scheme was implemented between 1969 and 1978, in response to concerns about veld deterioration in white commercial farming areas of the Nama- and succulent Karoo, grassland and arid savanna biomes. It aimed to improve veld condition by reducing stock numbers, resting eroded and vulnerable areas, and managing grazing lands effectively. More than 4 000 farmers, managing 16,6% of South Africa's land surface, volunteered to participate for a five-year period. They were required to reduce the number of animals on their farms to at least one third below the stocking levels recommended by the Department of Agriculture, and to rest a third of their grazing lands each year.

The Department of Agriculture compensated farmers for animals removed, and paid out nearly R47 million in subsidies between 1969 and 1978. There was an improvement in the condition of the veld during this time, but it is not certain whether this was due to the Stock Reduction Scheme or the high rainfall experienced between 1974 and 1976. In fact, surveys of the Karoo during 1977 showed no significant correlation between veld condition and participation in the scheme. All the same, the scheme brought about an improved agricultural extension service and raised awareness among farmers about stocking rates and veld management. A five-year period was not long enough to allow for passive rehabilitation of the arid western areas or Little Karoo, and many farmers reverted to pre-scheme practices once subsidies were no longer available.

The greatest campaign in South African conservation history

The target area was the Karoo. The aim was to get the grass back. The method was to pay farmers not to farm. And a mind-boggling amount of money was set aside to cover the costs for five years. No farmer was forced to join the scheme – he joined if he wanted to, and 4 095 wanted to.

Pringle, Bond & Clark, 1982

The National Grazing Strategy

This strategy, announced in 1985, was concerned with sustainable agricultural development. Although it had no legal status, it proposed an integrated action programme, including an information campaign, study groups, agricultural research, curriculum development in agricultural colleges, more rigorous management of the extension service, financial assistance to farmers, and better management of the agricultural extension service.

After six years, although farmers had become more aware of the importance of conservation, there had been little progress with research or monitoring. This made it difficult to assess objectively the success of the National Grazing Strategy.

Objective of the National Grazing Strategy

To use, develop and manage the natural and cultivated pastures in the RSA in such a way that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.

Du Toit, Aucamp & Bruwer, 1991

The Disaster Drought Assistance Scheme, 1990

This scheme, which came into effect in June 1990, was one of a number of subsidy and loan schemes implemented from the 1970s onwards to relieve farmers affected by drought. The commercial farming sector benefited overwhelmingly from this assistance. While more than R500 million was spent in the 1992/93 financial year in the homelands on drought relief activities, more than R3 billion was used in the same year to assist the commercial farming sector. Subsidies and rebates were provided for, amongst other things, stockfeed and the reduction of stock numbers. But drought relief was also linked to debt relief. In effect the scheme prevented foreclosure of a number of highly indebted commercial farms and is considered to have represented a lost opportunity for land reform. Instead of degraded farms being repossessed and made available to emerging farmers, commercial farmers were baled out by the government.

As with other interventions, it is hard to assess the impact of drought assistance schemes on veld condition, as little research or monitoring was done.

Control of bush encroachment

The first government schemes to combat bush encroachment took place on a fairly localised basis after 1980. They followed a workshop on bush encroachment held in Pretoria at which delegates called for state intervention to address the problem. Prior to this, although some areas had received subsidies, the Department of Agriculture and Fisheries had decided that, because bush clearance increased the productivity of rangeland, loans would not be made available for this purpose.

After 1980, two larger-scale schemes were introduced for the chemical eradication of trees and shrubs, particularly swarthaak or black thorn (*Acacia mellifera*). One scheme was centred on the Kuruman district (1986–1991) and the other on the Vryburg district (1991–1995). The eradication schemes were popular with farmers, but subsidies have since fallen away and no follow-up has been done to assess the long-term success of the programme. It is essential that this should be done before recommendations regarding future eradication programmes are made.

Stop press

For more recent legislation on the control of invading alien plants, see page 74.

Eradication of weeds and invading alien plants

Invading alien plants have been recognised as a problem since the 1850s, with the control of prickly pear starting as early as 1883. The Weeds Act, No. 42 of 1937, was the first national legislation introduced to control weeds and alien plants.

A number of acts and provincial ordinances currently apply, the most important again being the CARA, which replaced the 1937 Weeds Act. Under this act the Minister can declare a plant a weed or invader plant in any part of South Africa except those areas covered by the Mountain Catchment

Areas Act, No. 63 of 1970. The CARA prohibits the selling or spreading of weeds and requires landowners to clear or control declared weeds on their properties. Invader plants must be controlled where they have a negative effect on agricultural productivity.

The Plant Protection Research Institute was established as part of the Agricultural Research Council to investigate weed control, including biological control and quarantine measures. The state has provided considerable financial support through national, provincial and local structures to eradicate invader plants such as prickly pear, hakea and pines. The CARA empowers the Minister to make financial aid available and to expropriate and rehabilitate land if necessary.

Ironically, the government departments responsible for agriculture and forestry have sometimes played opposing roles in terms of the introduction and control of alien plant species. For example, fast-growing pines and wattles were introduced to provide raw materials for the timber, pulp and tanning industries. However, these species have become naturalised and now contribute to the alien invader problem that the Working For Water Programme (Chapter 13) is trying to address.

The black wattle: industry versus conservation

In the 1970s, an interesting case emphasised the power of industry to suppress conservation and research. The Australian black wattle (*Acacia mearnsii*) is a dangerous invader of river banks in the Western Cape, but in the eastern parts of the country it is grown in plantations to supply bark for the tanning industry. The industry lobbied the government and prevented research into biological control of black wattle for about 15 years, a delay that allowed a doubling of the area invaded by wattle.

Wattles introduced for the tanning industry have invaded many river systems in South Africa.

Water conservation

One of the most important early items of legislation dealing with water conservation was the Water Act of 1956. South Africa is a semi-arid country, but this law was promulgated under Roman Dutch Law, a system developed in Europe where water is more abundant. As a result, water was inadequately protected as a resource. Groundwater and water that fell, drained or was led onto private land was available for the sole use of the landowner, and was designated 'private water'.

The interests of the time are reflected in the distinction made between pollution standards for water bodies: general standards applied to most water bodies, but those containing exotic trout were protected by special standards. The effects of pollutants on the ecosystem were not considered, but it was an offence to pollute water so that it harmed fish or other aquatic life. The law prohibited the introduction of certain problem plants and animals into water bodies.

The Mountain Catchment Areas Act, No. 63 of 1970, was declared to protect the country's main sources of water and applied to both private and state-owned land. The act restricted the planting of exotic timber plantations in upper catchments.

Invasive pine trees in the Cape mountains above Genadendal

Solutions can cause problems

F.E. Kanthack, head of irrigation affairs from 1907, encouraged afforestation of upper catchments, believing that planting trees would prevent soil erosion and siltation of dams, as well as make arid areas cooler and moister. In the early 1900s, members of the Mountain Club of South Africa were given pine seeds to plant while climbing.

Ironically, experience has shown that afforestation in fynbos and grassland areas reduces rather than increases runoff because trees extract more water from the soil than the natural vegetation. These very trees planted to preserve and cool the slopes are now being removed in order to ensure that streams flow freely.

3.8 Community participation and democratic governance

Coordinated action

After several decades of government-led legislation, coordination at senior government levels appeared lacking. In 1972, Cabinet established the South African Committee on Environment Conservation (later the Council for the Environment) to initiate environmental programmes. Two years later the Habitat Council was established to coordinate activities of environmental non-governmental organisations (NGOs). Over the years, both government and NGOs coordinated awareness-raising campaigns. For example, in 1970 and 1980 the National Veld Trust organised the campaigns Our Green Heritage, Man and Environment, and Man: Endangered Species.

NGOs did much to develop an integrated view of land degradation issues that acknowledged sociopolitical and economic aspects as well as the environment. For example, the Biomass Initiative, launched in 1992, called for an integrated strategy to address fuelwood sufficiency. Instead of focusing narrowly on ecological concerns, the programme investigated the problem in the context of rural development, land access and tenure, and sociocultural issues. Rather than seeking large-scale, generalised, technological solutions to the problem, the initiative encouraged local involvement in developing solutions appropriate to particular situations. The initiative recommended a multi-faceted action plan to address the fuelwood problem, including a national social forestry programme, education and training in the management and development of community woodlots and nurseries, the promotion of electrification and alternative fuels, and poverty eradication.

Reconstruction and development

A major concern of the ANC government after 1994 was to create a single South African nation out of the patchwork of provinces, homelands and self-governing territories, and to begin the long process of reconstruction and development to bridge the gaps described earlier in this chapter. The reconstruction of political boundaries required the dissolution of the homelands and old provinces and creation of nine new provinces (see Figure 2.5).

Principles of integration, access, participatory decision-making and empowerment characterised South African environmental initiatives during the 1990s, particularly after 1994. The Reconstruction and Development Programme (RDP) stimulated numerous projects to address the legacy of Apartheid. The needs of environment and development started to be considered together.

Since 1994, many laws have been revised, and apply to the country as a whole and not just to one sector or another. The process of lawmaking has reflected the values of participatory democracy enshrined in the Constitution. Indeed, the Consultative National Policy Process (CONNEPP) by which the National Environmental Management Act (NEMA, 1997) was

developed was one of the most ambitious public participation processes ever embarked upon in South Africa.

Land and agriculture

After the dissolution of the Government of National Unity, the two previously separate ministries of Agriculture and Land Affairs were merged into a single new ministry. This reflected the need to address issues of land tenure and land use in an integrated manner. However, land affairs and agriculture remained separate government departments within this ministry.

One of the urgent tasks facing the new government was to start reversing discriminatory laws around land rights and land tenure and to address the injustices caused by racially-based land allocation. Many laws have been passed and a range of land reform programmes established. There was growing concern, however, that because land reform was not adequately considering environmental issues, some land reform schemes could potentially contribute to land degradation. The Department of Land Affairs therefore introduced a systematic programme of action to promote sustainable resource use in all aspects of land reform work.

As previously mentioned, the CARA also came up for review after 1994. A new White Paper on Agriculture, which promoted the principle of sustainability, was published in 1995. In 1998 a discussion document, *Agricultural Policy in South Africa*, was circulated. At the time of writing, however, the new act had not yet been promulgated.

Managing the water resource

Since 1994, the Department of Water Affairs and Forestry (DWAF) has been responsible for developing and implementing legislation and action programmes to manage the water resource in South Africa. Prior to developing the new Water Act, No. 36 of 1998, DWAF undertook a National Water Law Review in 1996. The review determined water quality guidelines for all categories of water users and recommended a system of integrated catchment management, which requires management of aquatic systems to take cognisance of land use practices in the catchment. The Act acknowledges that South Africa is a dry country, and seeks to manage the *demand* for water rather than its *supply*.

The combining of water affairs and forestry into one department also facilitated the implementation of the Working for Water Programme in 1995 (Chapter 13). This integrated programme employs people to remove invading alien plants, mainly from catchment areas, providing dual benefits of improved stream flow and reduced unemployment.

Some important provisions of the Water Act, No. 36 of 1998

- Defines all surface- and groundwater resources as public water
- Replaces riparian rights with the notion of beneficial and efficient use in the public interest
- Allows government to control boreholes as there are no separate provisions for groundwater
- Gives special protection to the riparian zone
- Protects the flow of the river for the sake of the ecosystem (known as the 'ecological reserve')
- Abolishes subsidies for irrigation works: farmers pay capital costs, operation and maintenance, and realistic tariffs for water
- Introduces the polluter pays principle: the polluter is responsible for the removal of pollutants and restoration of the ecosystem
- Protects aquatic plants and animals from activities that degrade aquatic habitats

3.9 Conclusion

This brief review of interventions affecting land degradation in South Africa has highlighted the complexity of the problem. We have seen how political and economic systems such as colonialism, apartheid and migrant labour have fundamentally influenced land use practices, the management of resources, and ultimately the quality of life of all South Africans. We have also noted that often, for a host of reasons, the best-intentioned interventions have failed. This observation should encourage all involved in addressing land degradation to remember the complex nature of the problem and to approach the task with an open mind rather than a dogmatic plan. Considerable effort has been spent over the years in combating degradation and we owe much to those who have gone before us. In time, history will be the judge of this generation's attempts to understand and respond to the challenge of land degradation.

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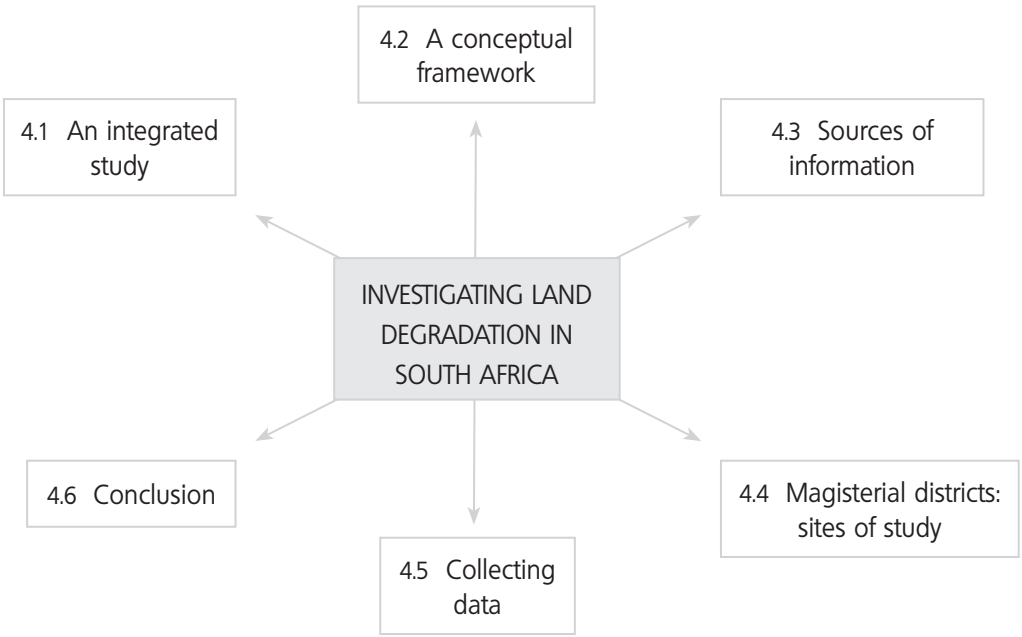
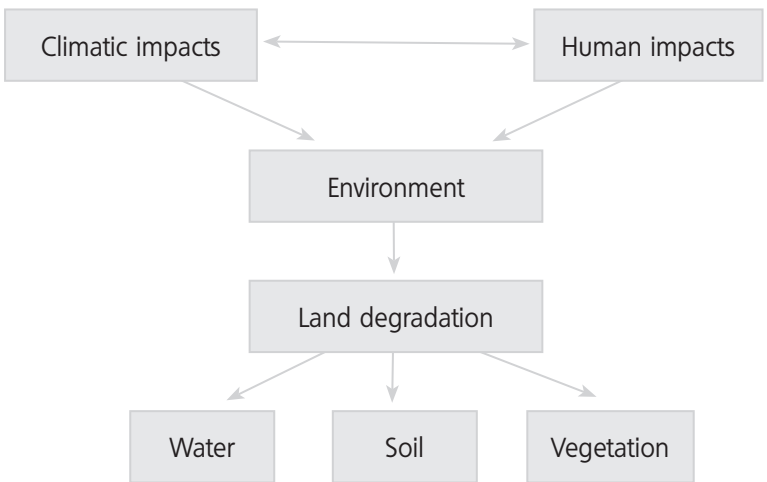
In the absence of adequate statistics about the status of soil and vegetation resources in South Africa, the researchers investigating land degradation in South Africa for this project relied on the knowledge and experience of agricultural extension officers and resource conservation technicians. Information was gathered during a series of 34 workshops and verified by comparison with the literature and with seven in-depth case studies. Advantages of this approach were that it was rapid and that it provided an opportunity for a large number of people to participate in the study and in discussions about land degradation.





Land degradation: a conceptual framework

4.1 An integrated study

The national review of land degradation

Under the conditions of the United Nations Convention to Combat Desertification (UNCCD), South Africa is obliged to develop a National Action Programme (NAP) indicating how it is going to tackle the problem of land degradation in the country. But this is possible only if the problem is clearly articulated and agreed upon. As mentioned in Chapter 1, the Department of Environmental Affairs and Tourism contracted the National Botanical Institute (NBI) and the Programme for Land and Agrarian Studies (PLAAS) to report on the status of land degradation in South Africa. The purpose of the report was to provide a scientific basis for decision-making about land degradation. In this chapter we report on the conceptual framework that guided the study and the methods used to gather information.

The objectives of the project

- to conduct a literature review of the scientific and socioeconomic debates around desertification in South Africa
- to develop an annotated bibliography of the desertification debate
- to create a series of consensus maps of the status of desertification in South Africa
- to contribute to the development of South Africa's NAP.

An integrated approach

The project report resulting from the study is unique in South Africa because it brings together in one publication:

- current information on the status of water, soil and vegetation resources in South Africa
- perspectives on both environmental and socioeconomic aspects of the problem of land degradation
- information about land degradation in both commercial and communal farming areas.

4.2 A conceptual framework

The conceptual framework that guided the study has already been introduced (Chapter 1). It shows that both climatic and human influences can have an effect on land degradation, but that the extent of land degradation is influenced by the environmental characteristics of the area, such as soil type or vegetation cover. The model reminds us that land degradation is a broad term encompassing the degradation of water, soil and vegetation resources.

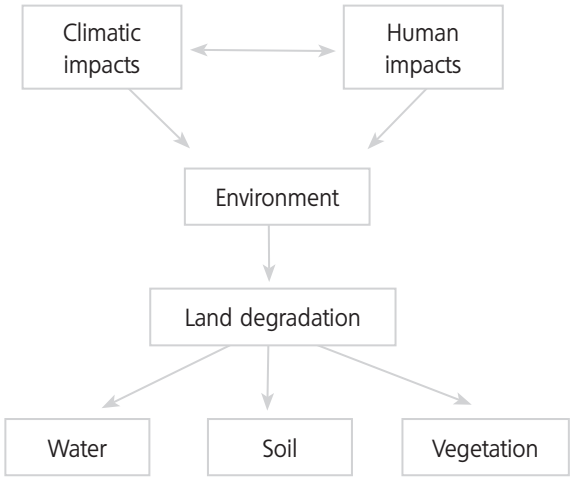


Figure 4.1 *A conceptual framework showing how climatic and human impacts influence land degradation*

4.3 Sources of information

Information about the various aspects of land degradation mentioned above came from a variety of sources, including:

- the South African literature on resource degradation
- a series of 34 consultative workshops with agricultural extension officers and resource conservation technicians held between June 1997 and February 1998
- case studies carried out in seven magisterial districts during 1998
- statistical records for each magisterial district.

4.4 Magisterial districts: sites of study

The national review of land degradation focused on farming areas and chose magisterial districts as the unit of assessment and comparison. These districts were defined as either commercial or communal areas, depending on whether the dominant form of land tenure was freehold or communal. In this definition, commercial areas correspond largely to the farming regions and urban centres within the former Republic of South Africa where property can be bought and sold by individuals. The communal areas are largely synonymous with the former homelands and self-governing territories, where individuals have few rights to own and sell land. Each of the 367 magisterial districts in South Africa was further described according to 31 characteristics that included both environmental and socioeconomic variables.

There were a number of reasons why the review team chose magisterial districts as the unit of study:

- The boundaries of the magisterial districts have been fairly stable since the declaration of the Union of South Africa in 1910. Therefore it is easy to

compare historical data with present-day conditions. On the other hand, provincial boundaries were completely redrawn in 1994.

- Over the years both the National Department of Agriculture and the Central Statistical Services have carried out a number of censuses in magisterial districts. Agricultural, demographic and socioeconomic statistics are thus available for comparison.
- Because magisterial districts are relatively small, they usually represent fairly homogenous environments.
- While environmental conditions may be very similar in adjacent magisterial districts, land use history and socioeconomic indicators may differ substantially. This often results in great contrasts in the extent and severity of degradation between adjacent communal and commercial farmlands.
- Agricultural extension officers generally serve one or several magisterial districts. Although there have been considerable changes in the agricultural extension service over the last decade, many officers are very knowledgeable about the agricultural history of the districts under their care.

4.5 Collecting data

The literature review

Did you know?
You can access the literature database on the Internet at the following address: http://www.nbi.ac.za/landdeg

Before 1997, the literature on land degradation in South Africa was scattered and poorly synthesised. Much of the information existed in unpublished reports or obscure journals, and the first research task was to source copies of available literature and collate them into a single collection.

To make it easier to access the information, a database of articles has been compiled, and keywords for each article have been assigned. Summaries exist for 70 per cent of the more than 2 000 references. This collection of mainly South African literature was used as the primary source of information for the land degradation review.

Furthermore, to facilitate networking, the researchers also compiled a directory of more than 100 organisations involved in research into the degradation of South African drylands. This information is available on the website (see box).

The workshops

The UNCCD encourages popular participation in the process of developing a NAP, and the methods chosen to gather information for the land degradation review reflect this principle. A total of 34 workshops were held during 1997 and 1998 (Figure 4.2) to develop a series of consensus maps reflecting the status of land degradation in South Africa. Each workshop lasted between five to seven hours and a total of 453 people attended, most of them agricultural extension officers and resource conservation technicians. On occasion, nature conservation officers and members of soil conservation committees

also participated. In some cases it was the first time agricultural personnel from commercial farming areas had had an opportunity to share ideas about land degradation with their counterparts working in communal districts.

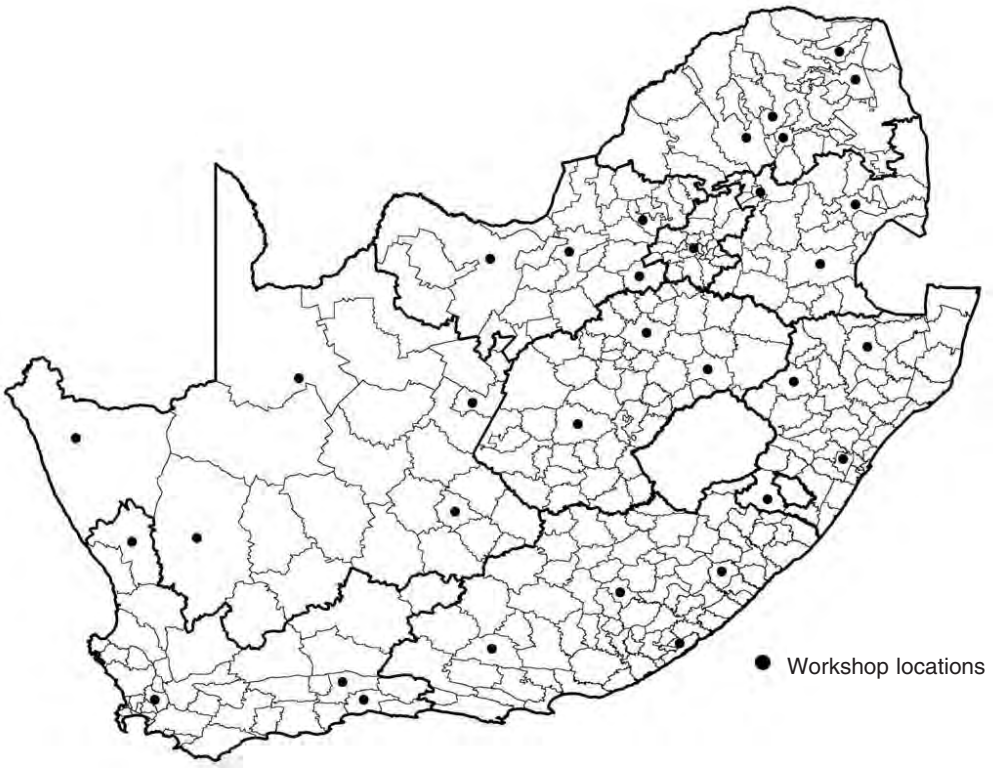


Figure 4.2 *The location of 34 consultative workshops on land degradation held between May 1997 and March 1998*

For the workshops the research team adapted a method developed by a consortium of international institutions for one of their programmes, called the World Overview of Conservation Approaches and Technologies (WOCAT). This formal workshop protocol was used in all workshops.

The purpose of each workshop was to gather information about three aspects of land degradation in each of the 367 magisterial districts:

- **Land use practices**
  Participants estimated the proportion of each magisterial district used for each of six land use types (Chapter 5) and determined whether the type of land tenure in each district was predominantly freehold ('commercial') or communal. They commented on changes in the area of each land use type and changes in the intensity of use over a ten-year period.

- **Soil degradation**
  Participants determined the main types of erosive and non-erosive forms of soil degradation in each magisterial district (Chapter 7). For each type, they estimated the degree, extent, severity and rate of soil degradation.

They also discussed the main reasons for soil degradation and calculated a soil degradation index for each district. If no degradation was evident, participants were able to indicate this as well.

- **Veld degradation**
  The review listed six main types of veld degradation (Chapter 8). If veld degradation occurred, participants determined the two or three most important types of veld degradation in grazing lands in each magisterial district. They estimated the degree, extent, severity and rate of veld degradation over a ten-year period. They discussed reasons for veld degradation and calculated a veld degradation index.

In order to obtain an overall impression of land degradation in each magisterial district, the soil and veld degradation indices were added together to produce a single combined index of land degradation.

After discussing and completing the questionnaire schedule mentioned above, there was time at each workshop for general discussion that helped the researchers to understand the broader context of the magisterial districts represented and verify the workshop results.

Discussing the issue of land degradation with village members in the Herschel district of the Eastern Cape

Case studies

Although the consultative workshops provided a useful national overview of land degradation, the time available for meetings limited the amount of detailed information that could be gathered. In general, only agricultural

extension officers and resource conservation technicians were involved in the workshops, with the result that other land users could not raise their points of view.

In order to address these problems, more detailed case studies were carried out in seven magisterial districts: Herschel, Kuruman, Moutse, Nongoma, Peddie, Reitz and Weenen. These districts represented both commercial and communal farming areas, as well as a range of levels of land degradation severity.

During the case study investigations, which lasted up to a week at a time, the researchers met with different groups of people from several villages and farms in the district.

The case studies provided an opportunity to:

- describe the environmental resources of the district in more detail and check the validity of the workshop results
- ask people how the status of land degradation had changed during their lifetimes
- find out how local people used the land, what the main reasons for degradation were, how land degradation affected local livelihoods, and what was being done to conserve agricultural resources in the district.

Magisterial district statistics

Information from a variety of sources was collated at a magisterial district level so that it could be correlated with land degradation information from the consultative workshops.

Sources included:

- Department of Agriculture census records (1911-1991): primarily livestock numbers and crop production estimates
- Central Statistical Services 1991 census: population data
- Development Bank of South Africa: demographic, employment and economic data for all magisterial districts since 1995
- Geographic Information System (GIS) data, especially select environmental statistics developed by the Computing Centre for Water Research (CCWR).

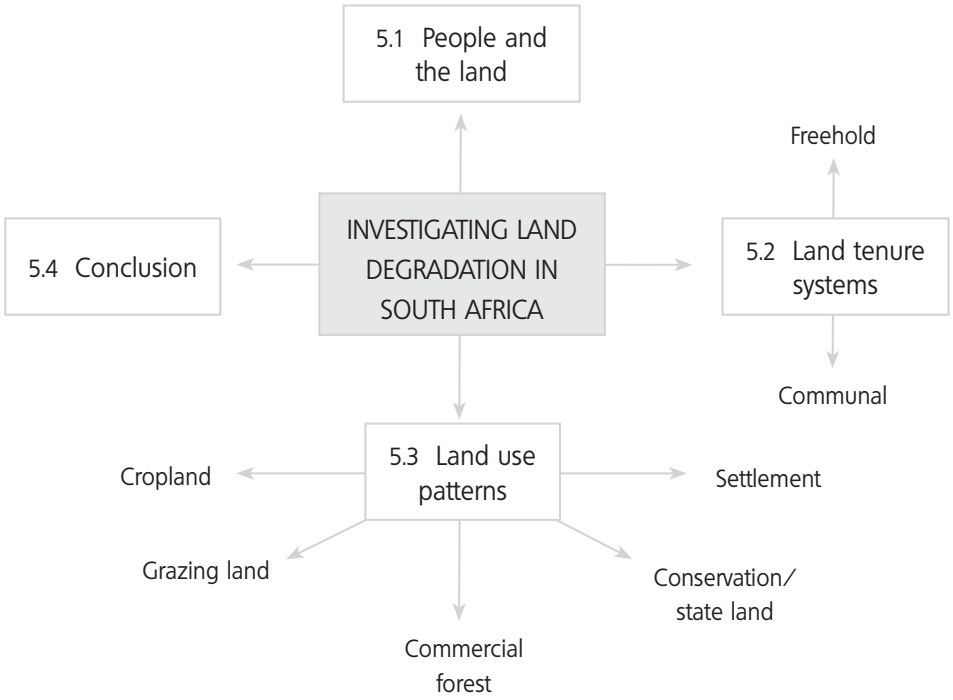
4.6 Conclusion

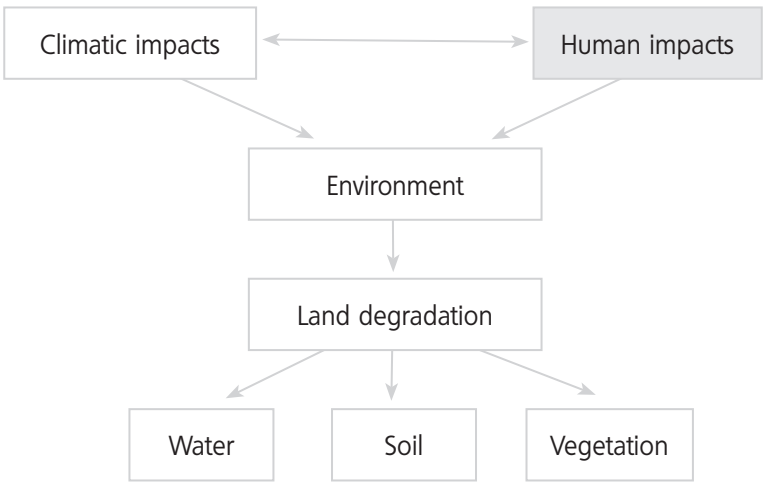
Although the workshop method employed in this study could be criticised for lacking scientific rigour, in the absence of recent or complete statistical data about the status of land degradation or agricultural production, it was both rapid and effective.

Comparison with independent studies shows significant correlation. In-depth case studies were also carried out as a means of checking some of the data in more detail. Agricultural extension officers and resource conservation technicians were chosen as the main participants in the workshops because of their experience and because, according to an independent study on veld condition, they tended to have a reasonably accurate and balanced perception of the status of resources in a region.

At a time when official statistical services are declining, participatory methods that draw on the experience and expertise of local people offer a valuable method for monitoring the status of the land. An advantage of these approaches is an increased involvement in, and understanding of, the need to conserve the land and its resources.

In order to understand patterns of land degradation, it is necessary to know how land is used. This chapter compares the environmental and socioeconomic conditions in districts in which the predominant agricultural system is either commercial or communal. In South Africa, these two agricultural systems are closely associated with freehold and communal systems of land tenure. The chapter introduces six types of land use, namely, cropland, grazing land, commercial forest, settlement, conservation areas and state land, and 'other'. In later chapters we will look more closely at the impacts of some of these types of land use on the land.





Land degradation: a conceptual framework

CHAPTER 5

5.1 People and the land

Before considering the status of the country's water, soil and vegetation resources (Chapters 6 to 8), it will be useful to become more familiar with the two dominant systems of land tenure in South Africa, which in general are closely related to the dominant systems of agriculture. This chapter briefly introduces freehold and communal systems of land tenure, and compares conditions in magisterial districts in which either commercial or communal systems of agriculture are dominant. It provides a brief overview of patterns of land use, in particular crop production and grazing.

5.2 Land tenure systems

Freehold and communal systems of tenure

Freehold land tenure
An individual has property rights and can sell land for individual profit. Freehold was the dominant land tenure system in the former white farming areas and urban centres of the Republic of South Africa. Generally speaking, commercial agriculture takes place in these areas.

In very broad terms, two distinct forms of land tenure operate in South Africa, namely freehold and communal land tenure.

Freehold tenure has had a long history of development under both Dutch and British colonial governments. Today it essentially provides for individual or corporate ownership of a surveyed area that may be sold. Most of the land outside the former homelands and self-governing territories is privately owned under a system of freehold tenure. In areas of freehold tenure commercial agriculture is the dominant farming system, and these areas equate broadly to the former white farming areas of the Republic of South Africa.

Communal land tenure
Although tenure is often quite secure, individuals have few rights to own or sell land. In the case of South Africa, this right is usually vested in the state. Areas managed under communal tenure are broadly equivalent to the former homelands and self-governing territories.

On the other hand, communal land tenure refers very broadly to the system affecting the approximately 13% of land that was set aside for the homelands and self-governing territories by colonial and apartheid governments. Under communal land tenure, individuals have few rights to own or sell land, which is ultimately owned by the state. A complex set of rules governing land rights usually prevails in areas managed under communal land tenure systems. Communal systems of agriculture operate in these areas.

The distribution of agricultural systems in South Africa

Agricultural systems in most magisterial districts are either entirely commercial or communal. However, for the purposes of the land degradation review, if both systems occur in one district, it was classified in terms of the agricultural system that accounted for more than 50% of the area. Using this approach, 262 of the 367 magisterial districts in South Africa (or 71%) are classified as commercial areas. The remaining 105 magisterial districts (or 29%) represent the communal areas. With the exception of parts of Namaqualand in the dry west, most communal areas are found in the northern and eastern parts of the country (Figure 5.1).

Comparing commercial and communal areas

Political and economic conditions, demographic patterns and land use practices differ markedly in commercial and communal areas. The land

degradation review compared magisterial districts on the basis of 31 attributes, including both environmental and socioeconomic factors, and found some surprising results (Table 5.1).

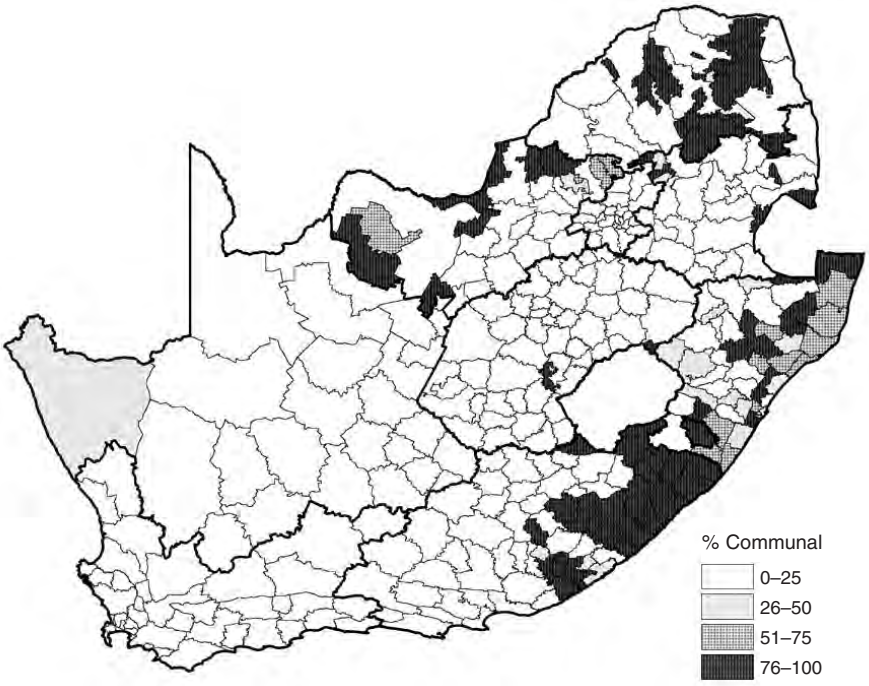


Figure 5.1 *The distribution of communal areas in South Africa. The percentage of a magisterial district that is managed under a communal agricultural system is shown.*

Interpreting information: a few considerations

Table 5.1 shows that, in general terms, environmental and climatic conditions are not significantly harsher in communal areas than in commercial farming areas. Steeper slopes and higher rainfall may result in a greater risk of soil erosion in communal areas, particularly in hot climates, but the fertility of the soil is similar to that in commercial farming areas. Rainfall and sunlight conditions are, on average, more favourable for agriculture in communal areas, with a greater number of 'grow days' being recorded.

Land quality

If we use arable land as the criterion for quality, then the homelands are as well endowed or better endowed than South Africa.

Tapson, 1985

The issue of which areas have the better and more productive agricultural land has been hotly debated over the years, as reflected in the quotations opposite. The suitability of land for agriculture is a complex issue and is glossed over in this very general analysis. There are also large differences within a particular land tenure and agricultural system and lumping magisterial districts together in order to arrive at an average value is problematic. However, it is fair to say that in general terms, the communal areas of South Africa are not situated predominantly in marginal environments, as is the case in Zimbabwe, for example.

It is … difficult to conclude that the [homelands] possess a higher percentage of high potential arable land than white farming regions do in these eastern regions [of South Africa].

McKenzie, Weiner & Vink, 1989

While environmental conditions might be favourable for agriculture in many communal areas, the demographic, employment and economic indicators shown in Table 5.1 suggest that life is tough for the majority of inhabitants. Many economically active men, and more recently women, have left the

communal areas to work on the mines and in the major urban centres, leaving women, children and the elderly on the land. This labour shortage partly explains why agriculture is not a major employer or source of income in these areas. Because many of the economically active members of society live elsewhere, job creation in the communal areas also suffers and unemployment is rife. The resulting poverty and associated dependency on natural resources for people's daily food, energy and construction needs, is a fundamental cause of land degradation. We shall come back to some of these issues later.

Table 5.1 *A comparison between commercial and communal magisterial districts*

Category	Source of information	Attributes	Communal (vs commercial)*
Physical environment	Geographic Information System (GIS) data	Land area Altitude Slope Runoff Erodibility Fertility	Smaller Lower Steeper More Greater Same
Climate	GIS data	Mean annual rainfall Summer aridity index MAP:PET Mean annual temperature 'Grow days'	20% more Lower Higher Higher More
Land use	Participatory workshops Dept of Agriculture	% Area under freehold tenure % Area used for croplands % Area used for grazing lands % Area used for forestry % Conservation and state land % Area occupied by settlements % Area for 'other' (e.g. mining, dams) Stocking densities	Less Similar Less More Less More Less > Twice as high
Demography	Development Bank of SA (DBSA) Census 1991	Population density % Males in population % People aged 15–64 years old % People living in rural areas	Higher Lower Lower > Twice as many
Labour & employment	DBSA Census 1991	Unemployment People employed in agriculture Growth of employment in agriculture Number of dependants per wage earner	> Twice as high Fewer Faster > Three times as many
Economic production	DBSA Census 1991	Gross Geographic Product (GGP) per capita Contribution of agriculture to GGP Average annual growth in agriculture Average annual growth in GGP	Less than a quarter Half as much Much faster Much faster

* Describes how conditions in communal areas rate, on average, compared with conditions in commercial farming areas
> = more than

Although we have classified magisterial districts according to the dominant agricultural system it should be borne in mind that this is a gross oversimplification. In reality, considerable variation exists between districts that share a common system, particularly with regard to how the land is managed. For example, in some communal areas in South Africa, traditional authorities exercise a close and tight control over land management issues in their wards. Certain areas are rested during the year and livestock are withdrawn from the cropping areas during the growing season. In other communal areas, democratically elected institutions have taken control of the management of the region's resources. In yet other areas, these two institutions are in conflict over who is the rightful authority and management of the resources is therefore complicated. Sometimes very little control exists at all over the natural resources of an area and a state of 'open access' prevails.

Similar differences within commercial farming areas could also be highlighted. In one sense then the division of magisterial districts into two broad agricultural systems could be considered false and unhelpful in assessing the extent of the problem. However, it was evident right at the start of the South African land degradation review that this division was crucial for understanding the patterns of degradation that emerged.

5.3 Land use patterns

Land use patterns, trends and intensities

In order to understand land degradation, it is important to consider how the land is used. The land degradation review gathered information on six land use types, namely, cropland, grazing land (rangeland or veld), commercial forest, conservation or state land, settlement and 'other', which included mines, dams and lakes (Table 5.2). Because the study focused on the impact of land degradation on agriculture, this overview emphasises the first two land use types and briefly mentions forestry, conservation land and settlements.

This section introduces:

- current patterns of land use in communal and commercial farming areas
- changes in patterns of land use over an approximately ten-year period from the late 1980s to the late 1990s
- changes in the intensity of land use, including technology, infrastructure and management, during the same period.

The information was gathered at the participatory workshops and from census figures. Research such as this relies heavily on the availability of accurate statistics. It is therefore of concern to note that the most recent agricultural census figures are from 1981. For South Africa to fulfil its obligations as a signatory to the Convention to Combat Desertification, it will need to monitor regularly the status of land degradation in the country. Records such as stock numbers, crop yields and areas under cultivation must be maintained.

It is heartening to note the success of the recently-completed National Land-cover (NLC) Database project in South Africa, which should be consulted for more extensive and more accurate land use statistics (see Fairbanks et al, 2000, as well as the following website: http://www.sac.co.za).

Table 5.2 *Land use types used in workshops to describe magisterial districts*

Land use type	Definition
Cropland	Land used to cultivate crops, including fallow land and annual, perennial, tree and shrub crops
Grazing land/veld	Land used for domestic stock and game production, including natural veld and planted pasture
Commercial forest	Land used for commercial wood production
Conservation/state land	National, provincial and municipal conservation areas; state land (e.g. South African National Defence Force property)
Settlement	Rural and urban settlements; roads and construction sites
Other	Mines, lakes and dams

Cropland

Previous studies have shown that 13% to 14% of land in the commercial farming areas and 11% to 12% of land in the communal areas is suitable for rain-fed agriculture. The wetter Western Cape, Free State and Mpumalanga provinces have the highest proportion of land used for crops, while the arid Northern Cape has the lowest.

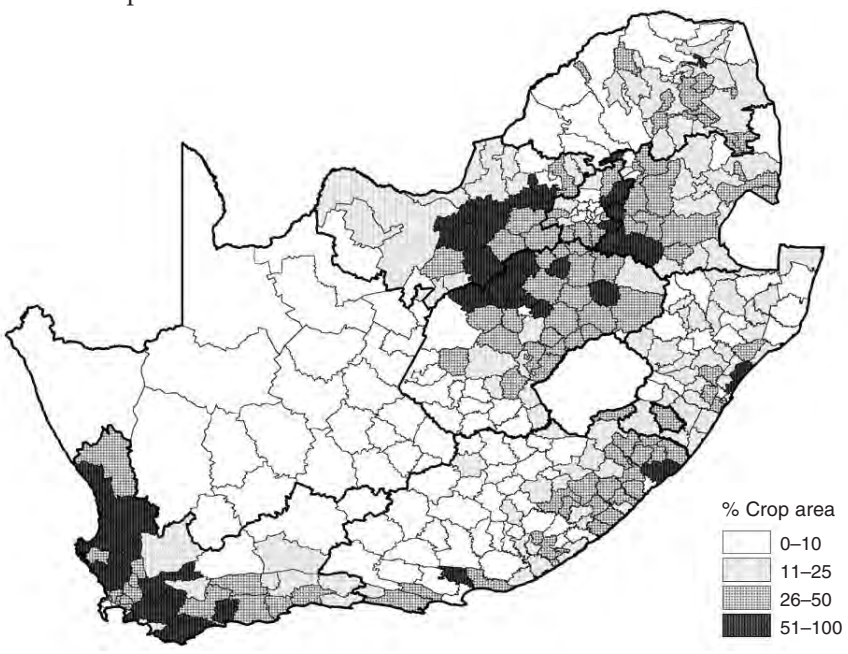


Figure 5.2 *The percentage area of croplands in the magisterial districts of South Africa*

Whether used for large-scale monocultures or small-scale mixed gardens, arable land is scarce in South Africa.

Changes in cropland area and productivity in the 20th century

According to the 1981 agricultural census, four major crops – maize, wheat, sunflower seeds and sugar cane – account for 80% of cultivated land area. The area of cropland used for these crops in the former white farming areas of South Africa increased to a peak of 7,6 million hectates in 1976. From 1990, the area decreased fairly steadily to around 6,2 million hectares. Despite this, overall productivity increased and in 1997 the combined harvest of the four major crops was the highest on record, at just less than 34,7 million tons (Figure 5.3).

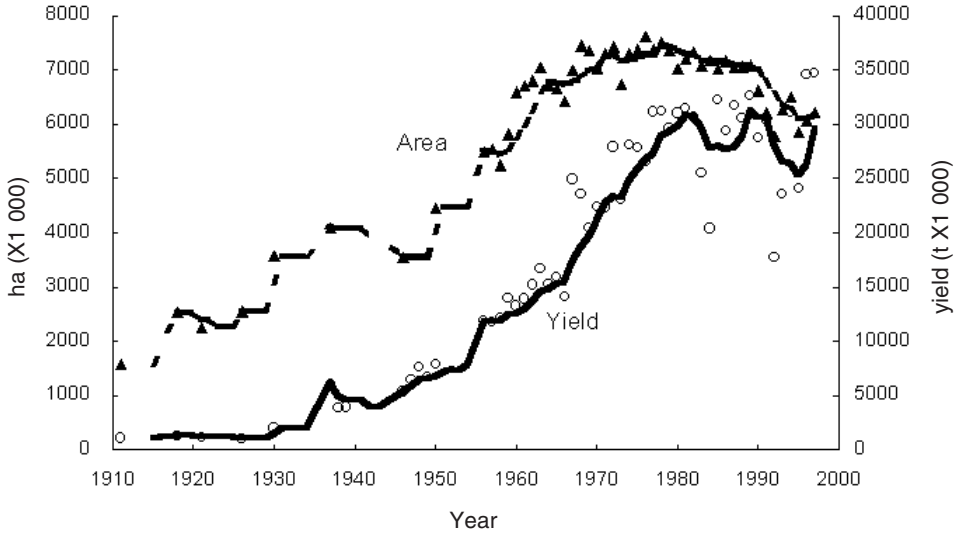


Figure 5.3 *The area cultivated (ha X 1 000) and yield (t X 1 000) of four of the most important crops grown in commercial farming districts of South Africa from 1911–1997*

Reasons for recent changes

In general, over the ten-year period from the late 1980s, the total area of cropland has decreased in both commercial and communal farming areas, especially in Gauteng, the Free State and KwaZulu-Natal.

Some reasons for this decline are:

- increase in other forms of land use, e.g. settlements, forestry plantations, ecotourism, conversion to pasture for grazing
- inadequate resources, training and labour and inadequate access to loans
- loss of financial viability through increased costs of production
- droughts
- collapse of infrastructure, such as protective fencing
- violence in some communal areas, which has made people reluctant to spend time in the fields, where they feel vulnerable
- invasion of croplands by weeds such as *Prosopis* spp
- government support of conversion of marginal cropland to grazing land.

On the other hand, there has been a slight increase in the area of croplands in the Northern Cape and Northern Province, owing to:

- increased availability of irrigation water
- introduction of new crops
- bush-clearing, converting bushveld to croplands
- new markets, which have driven the expansion of croplands, (e.g. the impact of the export grape market on developments along the Orange River)
- improved technology and soil preparation methods.

Changes in the intensity of cropland use

The fact that crop yields have increased despite an overall reduction in the area cultivated is due to an increase in the *intensity* of cropping. This has taken place in most districts, especially in communal areas. Two exceptions are in the southern Cape between George and Swellendam, where intensively farmed croplands have been converted into pasture, and in the Hartswater district, where waterlogging of soils and deterioration of infrastructure have halved the productivity of the land.

Agricultural intensification

Examples of increasing intensity of farming include mechanisation, more sophisticated irrigation technology and the use of fertilisers, herbicides and pesticides.

Croplands have been farmed more intensively because of changes in technology, infrastructure and management, such as:

- increased mechanisation
- improved agricultural practices, e.g. stubble cultivation, minimum tillage
- more intensive crops and improved varieties or cultivars
- better use of irrigation
- increased productivity through better pest control, harvesting and packing
- better education and support of farmers through extension services, study groups and farmers' associations
- drought relief funds being used to buy fertilisers.

Grazing land or veld

South Africa consists predominantly of grazing lands, especially in the more arid districts where there is inadequate water for either rain-fed or irrigated cultivation of crops. It follows then that the Northern Cape has the highest proportion of grazing land, followed by the Eastern Cape, Free State, KwaZulu-Natal, Northern Province and Northwest. Gauteng, the most densely settled province, has the lowest incidence of grazing lands.

The 1990s saw a decline in the areas used for grazing in all provinces except the Free State. The provinces of Gauteng and the Western Cape experienced the greatest decline because of rapid urbanisation. On average, communal districts lost about three times as much grazing land as commercial farming areas, largely as a result of settlement expansion.

Other general reasons for a decline in grazing lands include:

- a relative increase in other land use practices, e.g. crops, forestry, conservation and mining
- land degradation, e.g. sand mining, soil erosion and invasion by alien plants.

South African rangelands

More than 80% of the land area in South Africa is grazing land or veld and the raising of livestock is thus the dominant form of land use in the country.

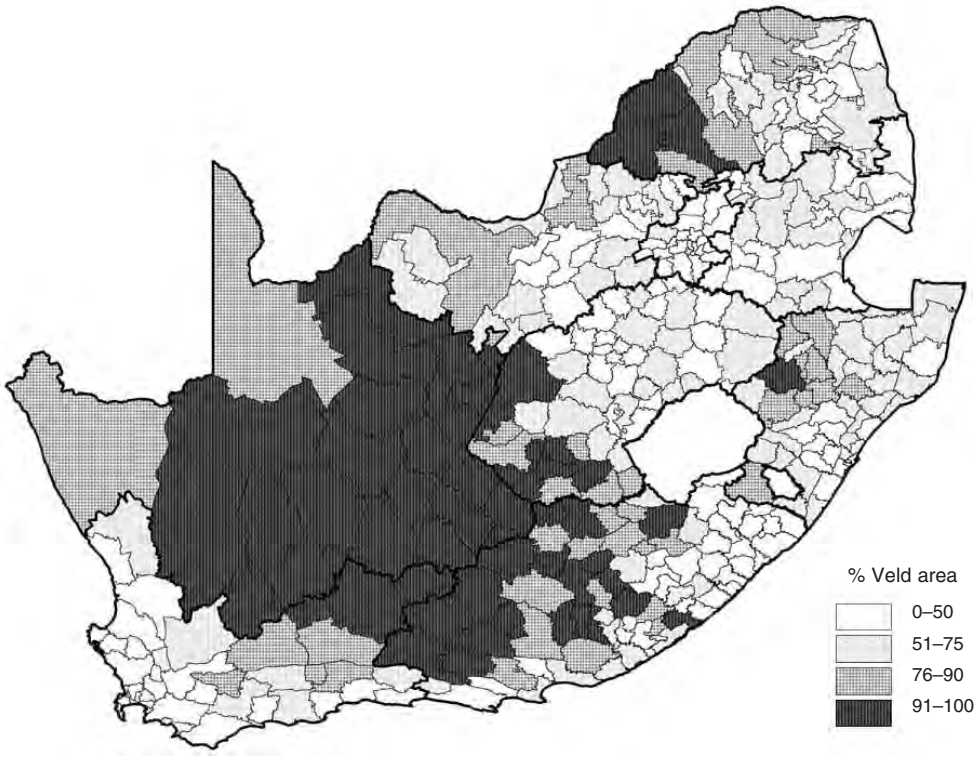


Figure 5.4 *The percentage area of grazing lands in the magisterial districts of South Africa*

Stocking rates

Grazing by livestock can have a large impact on the land and the Department of Agriculture has for many years recommended appropriate stocking rates

Different objectives

Management objectives are very different for commercial and communal farmers and this leads to large differences in stocking rates between the two.

for sustainable commercial livestock production across the country. These stocking rates increase with increasing annual rainfall. Over the last few decades, stocking rates in commercial farming areas have been maintained very close to these recommended levels (Figure 5.5). However, communal farmers have very different management objectives when compared to their commercially-oriented colleagues. They keep animals for a wide variety of purposes, such as for meat, milk, manure, draught power for ploughing and transport, ritual slaughter, bridal payments, and investment and cash sales. Such farmers generally keep the maximum possible number of animals on their lands and their stocking rates are about 1,85 times higher than those in the commercial farming areas, which are equivalent to recommended levels.

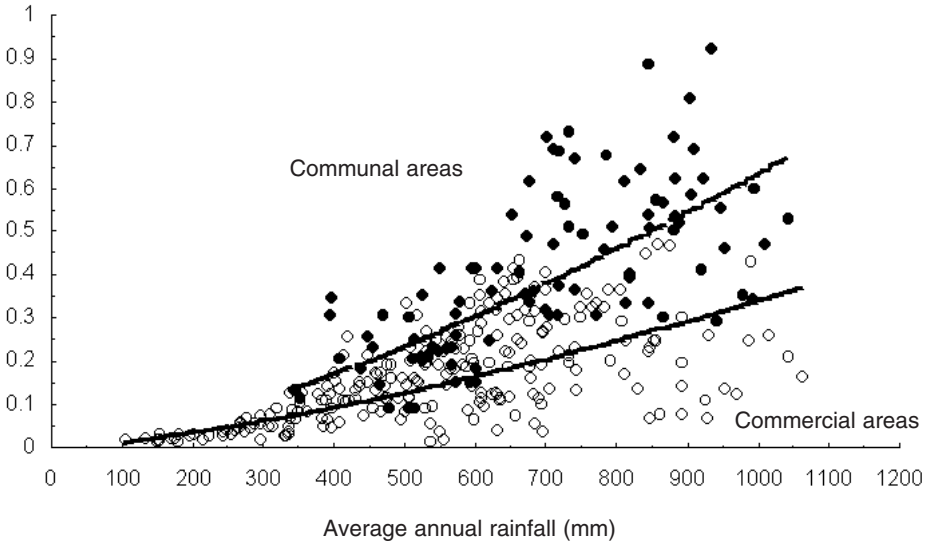


Figure 5.5 *Stocking rates increase with increasing rainfall. In the commercial farming areas (circles and lower line), stocking rates are not significantly different from the recommended values. In the communal areas (dots and upper line) they are about 1,85 times higher than those in the commercial farming areas.*

Changes in stock numbers in the 20th century

The populations of goats and cattle in South Africa remained fairly constant between 1904 and 1996. However, sheep populations fluctuated greatly over this period. The population in 1930 was the highest ever with over 48 million animals, whereas levels in 1996 were the lowest in 90 years at just more than 25 million animals (Figure 5.6).

Large stock unit

A large stock unit or LSU is the number of animals roughly equivalent to a mature cow. Six adult sheep or goat ewes are regarded as equivalent to one LSU.

Trends in stocking rates (large stock units per hectare) have been different for commercial and communal farming areas (Figure 5.7). While stocking rates have remained relatively constant in commercial farming areas, they increased dramatically in communal areas between 1918 and 1930. This may have been related to stock recovery after the rinderpest epidemic and outbreaks of East Coast fever at the end of the 19th century, or as a result of the 1913 Land Act, which forced black stock farmers into homeland areas.

Changes in the intensity of rangeland use

In most districts, especially in communal areas, there has been a decline in grazing intensity largely because:

- Settlements have encroached into grazing areas, making it more difficult to manage livestock – fencing material has been stolen, and stock theft has increased.
- Poor maintenance has resulted in the collapse of infrastructure, such as boreholes and windmills.
- Institutional support of grazing in communal areas has declined.
- Stock diseases have increased as dipping schemes have ceased.

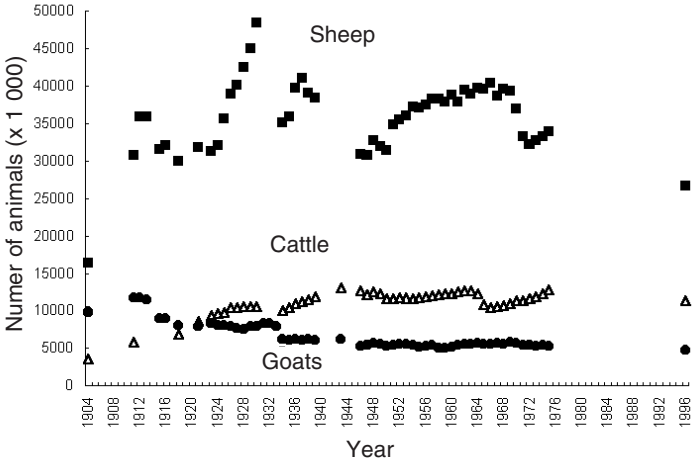


Figure 5.6 *Total number of sheep, cattle and goats in South Africa for the period 1904–1996*

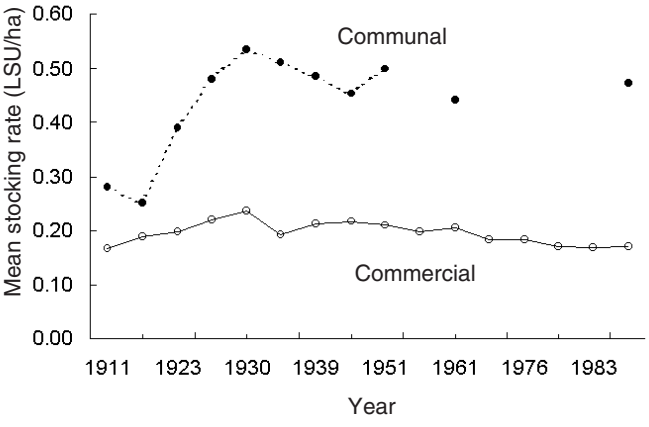


Figure 5.7 *The stocking rate (LSU/ha) in commercial and communal farming areas of South Africa from 1911–1996*

By way of contrast, grazing intensity has increased slightly in the Northwest, Free State and Northern Cape because of:

- improved infrastructure, such as watering points
- support of the Department of Agriculture in planning commercial farms
- better grazing management, including multi-camp systems and lower stocking levels
- effective education and extension programmes
- changing to game farming or drought-tolerant breeds such as Dorper sheep.

Commercial forests

Commercial forestry has expanded rapidly during the last few decades in both commercial and communal farming districts in KwaZulu-Natal and Mpumalanga. It has not developed in provinces with insufficient rainfall, such as the Free State, Gauteng, Northern Cape and Northwest.

Forestry has replaced beef production in some commercial farming districts as it has become more economically viable. Two districts of the Eastern Cape reported a decline in forestry because of forest fires and theft of timber.

The physical loss of rangelands as a result of soil erosion, the collapse of infrastructure and theft of fencing, and generally poor institutional control, are all factors which threaten the grazing lands of many communal areas.

Conservation areas and state land

Mpumalanga, home of numerous provincial game reserves and a large section of the Kruger National Park, has the highest concentration of conservation land in South Africa. In all other provinces, less than 3% of land is classified as conservation area or state land.

The area of conserved land is increasing, with new areas being acquired and existing reserves like the Karoo National Park and Addo Elephant National Park being enlarged. In many conservation areas, the advent of ecotourism has encouraged an improvement in management and infrastructure.

The expansion of formal and informal settlements onto areas that were previously used for grazing and cropping represents one of the most important trends in changing land use patterns in the communal areas of South Africa.

Settlements

Gauteng is the most densely settled province and the Northern Cape the most sparsely populated. Settlement areas make up between 5% and 14% of land in the other provinces. On average about twice as much land is used for settlements in communal areas as in commercial farming areas.

Settlement areas have generally been increasing in all provinces, with by far the greatest expansion being in communal districts. Around rural towns and villages, increased settlement has resulted in semi-urban sprawl. People move to rural towns to seek work because there are few employment opportunities on the farms. The closure of mines and retrenchment of farm workers by farmers worried about the implications of the Labour Relations Act have increased the rate of urbanisation. The abolition of influx control and provision of a settlement subsidy of R15 000 by the government have also encouraged people to move to towns.

Moving to town may enable rural people who have lived under communal land tenure systems to buy and sell property. If work can be found, access to a cash economy enables them to supplement the livelihoods of relatives in rural areas.

After 1994, the Reconstruction and Development Programme (RDP) initiated housing schemes and projects to provide electricity, water and sanitation. These improvements also attracted people to towns and cities. The greatest increase in housing projects has occurred in the Free State, Gauteng and Northern Province, whereas the Eastern Cape has experienced least development.

Immigrants from other African countries have also been moving into South African towns and cities to seek work and escape national and regional conflicts.

5.4 Conclusion

In South Africa, magisterial districts with predominantly commercial or communal systems of agriculture differ significantly in terms of a range of environmental and socioeconomic features. Many of the communal areas are found in places where steeper slopes and higher mean average rainfall result in more erosion. However, the review showed that, on average, growing conditions in the communal areas are more favourable than in the commercial farming areas. Demographic and economic factors, many of which are related to homeland and migrant labour policies, appear to be primarily responsible for the high levels of land degradation experienced in communal areas.

A brief review of changes in land use patterns and intensities over a ten-year period also reveals large differences between districts with predominantly commercial and communal systems of agriculture. In the next three chapters, we shall look more closely at the impact of different types of land use on South Africa's water, soil and vegetation resources.

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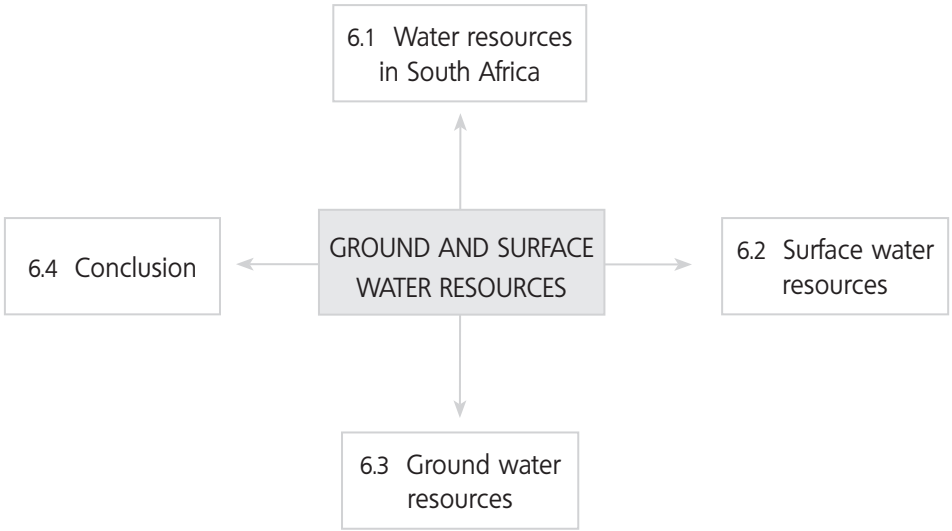
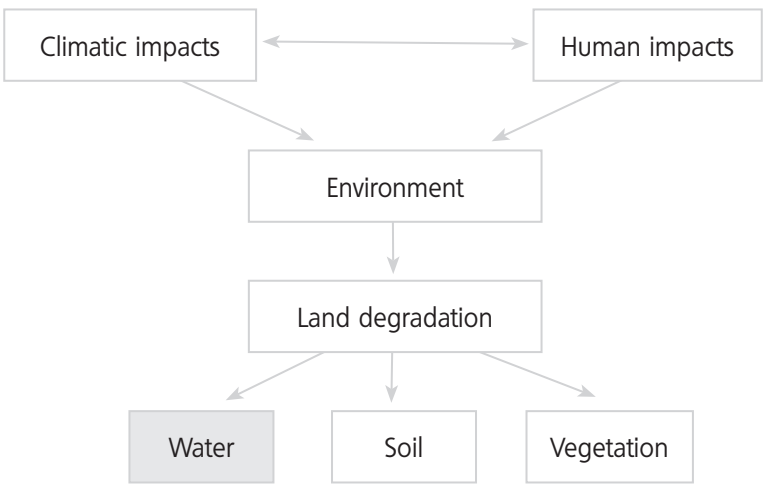
CHAPTER 6

Although water was not specifically investigated during the land degradation workshops, information from the literature about South Africa's ground and surface water resources is presented in this chapter. Integrated catchment management reminds us that water cannot be managed in isolation from the land, nor can the land be productive without water. This section deals with the causes and effects of degradation of fresh water resources in South Africa.





Land degradation: a conceptual framework

Integrated catchment management

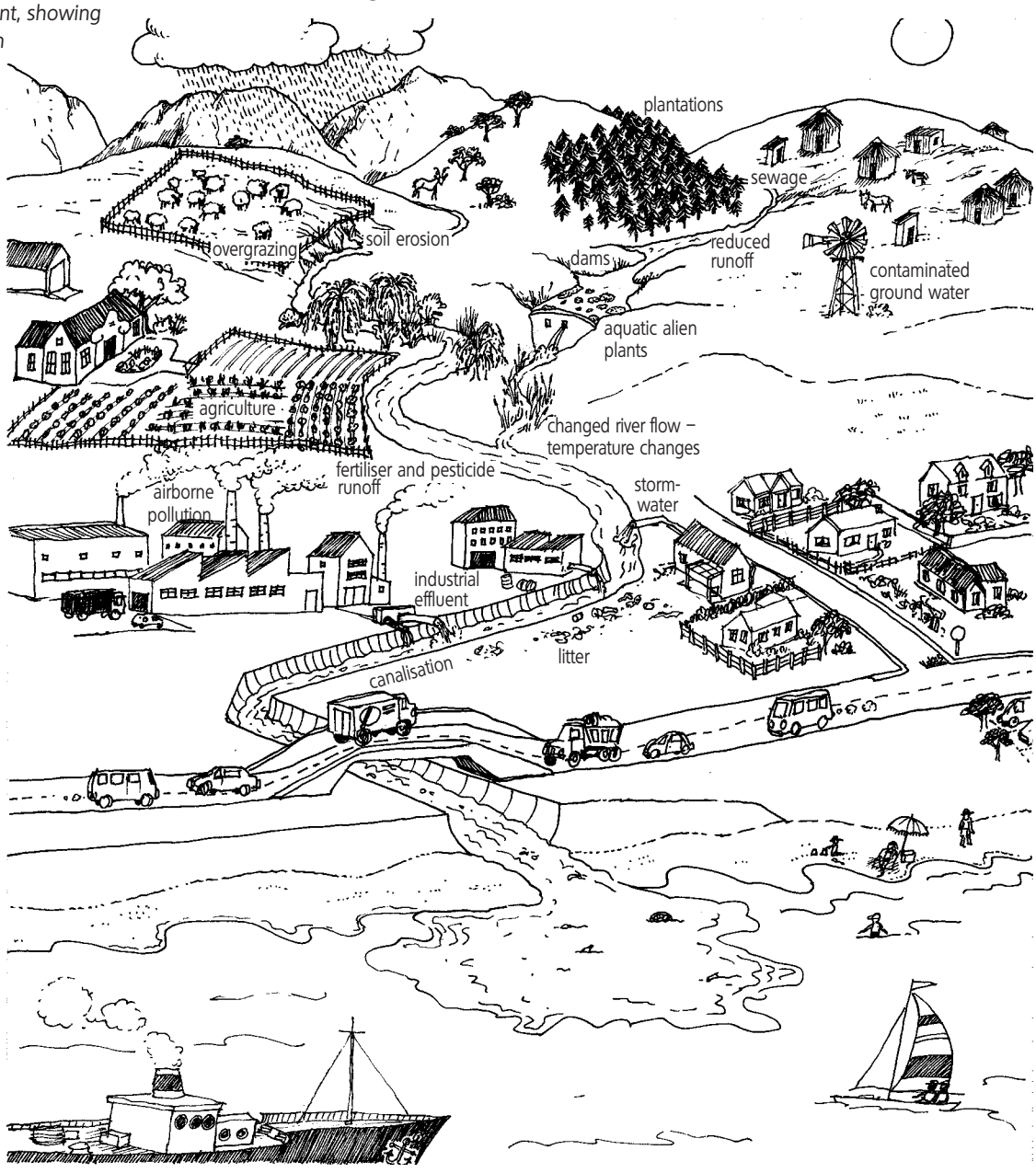
An approach to managing water that considers water, soil, vegetation and people together, rather than as separate entities.

6.1 Water resources in South Africa

Fresh water for a dry land

Why include a chapter on water in a book about land degradation? Simply because it is impossible to consider using land for agriculture, industry or urban development without an adequate supply of fresh water. And any form of land use has an impact on the availability and quality of water. Thus, although the land degradation workshops did not specifically question participants about water, this chapter focuses on the relationship between land use and ground and surface water resources in South Africa.

Diagram of a catchment, showing sources of degradation



As mentioned in Chapter 2, South Africa has limited fresh water resources. Rainfall is variable and unpredictable, and high evaporation rates result in only about 8,6% of rainfall being converted to runoff – one of the lowest figures in the world. The country has no large natural lakes and few aquifers, so most water used comes from rivers. In the drier parts of the country where rivers are seasonal or ephemeral, ground water is used.

Did you know?

South Africa's mountain catchments represent only 8% of the land – but generate 49% of the runoff.

Water concepts

- Water is both a solvent and a transport medium. It carries both soluble and insoluble substances, including pollutants.
- Water finds the lowest level: under the force of gravity, water runs off surfaces or infiltrates into porous substances until it can go no further. Water running downhill picks up soluble and insoluble substances as it goes.
- The quality of water in a river is a reflection of the quality of land management in the catchment.

6.2 Surface water resources

What is surface water?

Surface water resources include rivers, lakes, estuaries and wetlands. In South Africa, about 40% of rivers are seasonal. Although the rivers in the eastern part of the country are relatively short, together they contribute more than half South Africa's runoff. The largest catchment, the Orange River, contributes only 13,5% of the runoff.

Catchment area

An area from which rainfall drains into a river or reservoir

Availability and demand

With surface water being so unevenly distributed, both in space and time, it is not surprising to discover that water is not always naturally available where people need it most. Most of the rivers in South Africa have been impounded, with dams or weirs built to store water. Inter-basin transfer schemes, like the Tugela-Vaal Scheme and the Lesotho Highlands Water Project, pipe water between catchments to supply large urban populations, agriculture and industry. For example, the economy of Gauteng is almost entirely dependent on water from inter-basin transfer schemes.

Riparian zone

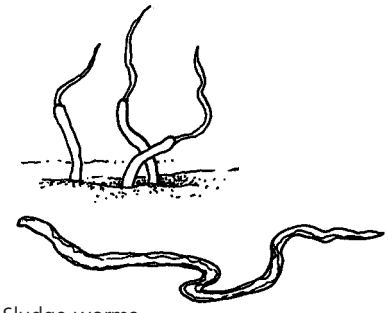
The area adjacent to the watercourse

Thinking about catchments

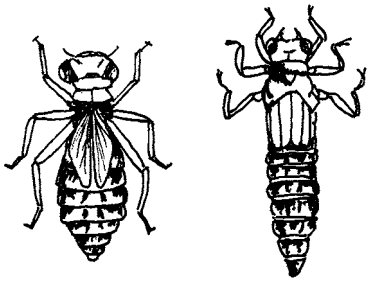
Integrated catchment management has brought an ecological perspective to bear on the management of fresh water resources. The new Water Act, No. 36 of 1998, views fresh water as part of an ecosystem, not simply as a resource independent of its environment to be exploited by the most efficient means possible. The law requires provision of what is known as the ecological reserve – sufficient stream flow to support aquatic plants and animals and ensure continuity of ecological processes.

Indicators of water quality include:

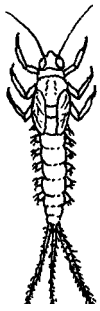
- dissolved oxygen
- acidity/alkalinity (pH)
- nutrient salts (nitrogen, phosphorus, ammonia)
- heavy metals
- saline salts (sodium, chloride)
- faecal bacteria
- turbidity (cloudiness)
- electrical conductivity.



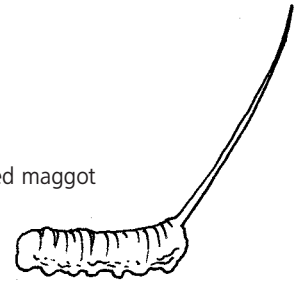
Sludge worms



Dragonfly nymphs



Mayfly larva



Rat-tailed maggot

Fresh water invertebrates such as these are used as indicators of water quality.
Source: Choveaux, 1991

The conservation and restoration of river systems makes sound economic sense. In its natural state a river is a self-cleaning system and can save local authorities considerable amounts of money by purifying water naturally. Maintaining natural riverine vegetation, especially within the riparian zone, can reduce erosion and attenuate flooding, with associated benefits for people.

In this chapter we will therefore give attention to concerns about fresh water ecosystems, as well as issues relating to the quantity and quality of the fresh water resource.

Describing surface water degradation

The degradation of surface water resources includes both the deterioration of water quality (e.g. pollution) and the physical degradation of the river or wetland (e.g. erosion, hardening of surfaces).

Water quality

Acceptable water quality means different things to different people. For example, what an ecologist calls 'fresh' water might be unacceptably saline according to a local authority providing drinking water. In 1996, the Department of Water Affairs and Forestry (DWAF) published guidelines for water quality standards for five different sectors, namely: domestic, recreational, industrial, agricultural and aquatic ecosystems. These guidelines provide useful indicators of surface water degradation for different categories of user.

In addition to carrying out chemical and microbiological tests, those who monitor water quality also assess the invertebrates living in the river, such as insect larvae, worms and crustaceans. Certain groups of invertebrates are relatively sensitive to pollution and oxygen depletion. Their presence or absence thus reflects the overall quality of the water. An example of an index based on invertebrate life is the South African Scoring System, Version 4 (SASS4).

Physical degradation

Indicators of physical degradation of surface water systems include unnatural changes in temperature, suspended solids, the quantity of water flowing at different times and the shape of the river channel. River ecosystems are adapted to seasonal changes in stream flow but dams often disrupt these natural cycles by reducing flows or maintaining minimum flows throughout the year. In order to maintain ecosystem processes downstream, it is necessary for the outflows from dams to be regulated according to natural river cycles.

In a natural river ecosystem the channel provides a variety of habitats, such as gravel, sand, riffles, quiet pools and marginal vegetation. Each habitat

supports a different assemblage of plants and animals. Habitat indices, such as the Habitat Quality Evaluation (HABS1), describe the quality of the physical component of aquatic systems.

Biotic degradation

The importance of plants and animals as indicators of the integrity of aquatic systems has already been noted. Biotic degradation can be measured by comparing the diversity or abundance of plants and animals in natural and degraded systems. In addition to the SASS4 index mentioned above, the Index of Biotic Integrity (IBI) measures the state of fish communities in freshwater ecosystems, and the Riparian Vegetation Index (RVI) provides an assessment of the conservation status of vegetation associated with rivers.

In 1986, O'Keeffe used observations such as those mentioned above to develop a map showing the conservation status of rivers throughout South Africa. Biotic, physical and water quality measurements were used to classify rivers into five categories, in order to identify areas of high conservation importance.

Causes and effects of surface water degradation

Degradation of catchment areas results in deterioration of the quality, quantity and ecological integrity of surface water resources. Some examples of surface water degradation follow.

Population pressure and river regulation

Increasing populations and more affluent lifestyles put pressure on local water resources, increasing water abstraction and pollution. Increasing water use decreases stream flow and the dilution of pollutants, making pollution more severe.

Who uses water?

60% agricultural use (including irrigation)
18% environmental use
11,5% urban & domestic use
10,5% mining & industry use

More than 50% of South Africa's mean annual runoff is stored in large dams. Smaller, unregistered dams increase storage capacity further. The construction of dams and weirs changes the flow characteristics of rivers in various ways. A dam represents a discontinuity in a river – a body of standing water within a continuous system of flowing water. Suspended solids settle out, leaving the water clearer. However, the force of water flowing out of the dam scours the river channel, causing erosion downstream. Dams and rivers support different communities of plants and animals. Plants and other organisms in dams take up nutrients from the water, so that water leaving a dam tends to be poorer in nutrients than water upstream. Dams also change the temperature and oxygen content of water, and therefore the communities of organisms that can survive downstream.

By regulating river flow, areas downstream of dams may no longer experience the flood events that maintained the productivity of floodplains and flushed accumulated salts from alluvial soils. For example, the Pongolapoort Dam

Did you know?

There are very few unregulated rivers left in South Africa. Two exceptions are the Sabi and Msimvubu Rivers.

has disrupted one of the few active floodplain systems in South Africa, on the lowland reaches of the Pongolo River in northern KwaZulu-Natal.

Much of the sediment carried down rivers settles out when it reaches dams and weirs. Sedimentation decreases the storage capacity of dams, and is made worse by erosion in the catchment area.

As mentioned earlier, most metropolitan and industrial areas depend on water supplied by inter-basin transfer schemes. The ecological impacts of these schemes include:

- changing flow characteristics of both the source and receiving rivers
- changing water quality in the receiving river (e.g. pH, conductivity)
- introducing plants and animals from the source catchment into the receiving catchment where they may not have occurred before.

A further example of river regulation is canalisation, particularly in urban areas. Canalisation becomes necessary because the paved surfaces of cities and towns are unable to absorb rainfall. Stormwater drains are built to allow large volumes of runoff to flow away quickly, avoiding flooding. From the stormwater drains, water flows into concrete canals, some of which receive so much refuse from streets and settlements that they resemble open sewers. Canals provide very little habitat diversity, so cannot support populations of aquatic plants and animals that could help to purify the water.

In order to address the ecological, health and economic problems caused by river regulation, the Department of Water Affairs and Forestry has started to focus on managing the *demand* for water rather than its supply.

Storage dams dramatically change the flow characteristics of rivers. The Cahora Bassa Dam on the Zambezi River, shown here, is a hydro-power dam which discharges large quantities of highly erosive sediment-free water. Together with flow mismanagement, this has caused extensive geomorphological degradation downstream.

Understanding concepts and processes

Acid rain
Coal-burning power stations and other industries release chemicals like carbon dioxide, sulphur dioxide and nitrous oxide into the atmosphere. These products of combustion dissolve in atmospheric moisture to form acids such as carbonic, sulphuric and nitric acids. When acid rain falls, it reacts with substances like calcium carbonate in limestone, releasing soluble ionic salts (e.g. calcium and bicarbonate) into ground and surface water.

Bioaccumulation
Non-biodegradable chemical substances may be taken up by plants or animals and become stored in the living tissues of these organisms. For example, organic pesticides are fat-soluble, so if an animal ingests sub-lethal doses, they become stored in its fatty tissues. For example, when a herbivore eats leaves coated with pesticide, it absorbs the poison, which is then stored in its body tissues. When a predator eats the herbivore, it also ingests the pesticides and they are deposited in its own body fat. Considering that the predator will probably eat a number of prey animals containing traces of pesticide, it will accumulate relatively more pesticide in its tissues than was present in the tissues of the herbivore. This may cause ill health or death. This increasing concentration of non-biodegradable substances up the food chain is called bioaccumulation.

Eutrophication
Eutrophic literally means 'well fed' and refers to an increase in the concentration of nutrients (nitrogen and phosphorus) in a water body that encourages the growth of algae and water plants. For example, rivers and dams that receive runoff contaminated with fertilisers may become clogged by aquatic plants (e.g. water hyacinth, parrot's feather, Kariba weed) or green slime (algae). A further problem occurs when water plants and algae die and are decomposed by bacteria in the water. Decomposition removes oxygen from the water, and this can cause the death of aquatic animals such as fish and invertebrates.

Salinisation
In semi-arid areas, irrigation can cause salinisation of rivers and ground water. Salts dissolved in the irrigation water combine with salts from mineral weathering and fertilisers. These salts remain in the soil after the evaporation and uptake of irrigation water by plants. The return flows to rivers and ground water becomes more saline.

Where deep-rooted natural vegetation is cleared in order to plant shallow-rooted crops, the water table rises. Saline water seeps into rivers or moves upward in the soil into the root zone. If fields are not well drained, evaporation further concentrates salts in the soil water. Eventually, soil and irrigation water can become too saline for crops.

Eichhornia crassipes *(water hyacinth), an aquatic weed from the Amazon Basin, doubles its biomass every four days and transpires large amounts of surface water from its leaves. This picture was taken on the Crocodile River at Malelane, Mpumalanga, on the southern border of the Kruger National Park.*

Did you know?

Where riverine vegetation remains unburned, fires in mountain fynbos catchments have little impact on the quality of runoff.

Pollution

Numerous substances enter river systems via surface runoff, stormwater drains and effluent pipes. Table 6.1 lists some of the main types and sources of pollution and their effects:

Removal of riparian vegetation

Riparian vegetation acts as a physical and biological filter for sediments and nutrients from catchment runoff. It helps to stabilise riverbanks and soils, reducing erosion and associated problems of turbidity and sedimentation. If riparian vegetation is removed, reduced shade increases water temperatures, harming some aquatic organisms. Increased nutrient levels and sunlight cause algae to flourish. Preserving the riparian zone increases stream flow, improves water quality and enhances the functioning of aquatic ecosystems.

Afforestation

As mentioned in Chapter 3, we now understand that afforestation in catchment areas generally reduces rather than enhances stream flow. As a general rule, the greater the plant biomass above ground, the higher the rate of transpiration and the lower the runoff into rivers. This is particularly the case with most alien species. For example, if the natural grassland or fynbos in a catchment is replaced with pine plantations, runoff from that catchment will decrease. The greater the difference in biomass between natural and introduced vegetation, the greater the percentage reduction in runoff. Similarly, the drier the climate, the greater the impact of afforestation.

Table 6.1 *Types of pollution affecting ground and surface water resources*

Pollutants	Sources	Effects
Nitrates and phosphates	Irrigation return flows from fertilised lands Detergents Raw sewage and effluent from sewage treatment works Effluent from urban, industrial and agricultural areas	Eutrophication: increase in algae, cyanobacteria and water plants Mats of vegetation reduce light penetration into water and increase loss of water through transpiration Blockage of canals and pipelines Taste and odour problems and health risks: some algae produce toxic substances
Trace elements (e.g. aluminium)	Occur naturally in rocks but also released by mining and industry	Toxic under certain circumstances (e.g. low pH); affects nervous system
Heavy metals (e.g. cadmium, mercury, lead)	Mining (e.g. Gauteng, Mpumalanga) Industries (e.g. Richards Bay) Road runoff (e.g. lead from petrol) Landfill sites	Contaminate wetlands and estuaries Highly toxic, becoming concentrated in living tissues (bioaccumulation) Persist in environment as they do not break down
Salts (e.g. sodium, calcium, carbonates, sulphates)	Natural weathering of rocks Airborne salts near the sea Mining, industrial, sewage purification and domestic runoff and effluents Leaching encouraged by acid rain Irrigation-related salinisation	Salinisation (increased total dissolved salts) is a major problem in croplands Makes water unsuitable for drinking or irrigation (brackish) May make habitat unsuitable for plants and animals
Acids	Mining, chemical, beer and tanning industries Acid rain caused by coal-burning power stations (e.g. Gauteng, Mpumalanga)	Changes soil pH, affecting which plants are able to grow there
Organic pollution	Commonest type of pollution in SA and more severe in urban areas Raw and partially treated sewage Effluent from food processing plants, animal feedlots, abattoirs and aquaculture enterprises	Decomposition of organic matter reduces oxygen in water Released nutrients cause algal blooms Toxic to many organisms and may result in respiratory and nervous system disorders
Biocides (e.g. herbicides, fungicides, insecticides)	Used to control pests Industrial and agricultural effluents Reach rivers and wetlands in surface runoff, wind, ground water	Accumulate in sediments Levels increase up the food chain through bioaccumulation Toxic to many organisms
Pathogens (e.g. bacteria and viruses)	Untreated sewage from leaking sewers, pit latrines	Spread diseases, (e.g. gastroenteritis, amoebic dysentery, cholera, typhoid fever)

Understorey plants
Low-growing plants on the forest floor that thrive under the shady canopies of taller plants such as shrubs and trees.

Invasion by alien plants

Many alien plants that invade catchment areas are trees. If they replace vegetation like fynbos and grassland, they effectively reduce stream flow, as described above. Alien plants and weeds grow easily in disturbed areas such as riparian zones, which are frequently trampled by people and animals or scoured by floods. Seeds may be dispersed by water, and the moist environment encourages plant growth. Although the roots of some alien trees can help to stabilise river banks, some actually increase erosion by suppressing the growth of understorey plants.

In the upper reaches of catchments, much of the primary production comes from leaves of trees and shrubs that fall into the stream and are eaten by invertebrates. Alien plants may disrupt nutrient cycles by dropping their leaves at different times of year, or producing leaf litter that is unpalatable or nutritionally unsuitable for the indigenous organisms living in and around the streams.

Aquifer
A source of underground water

In addition to alien trees and shrubs which tend to grow along riverbanks, a number of floating aquatic plants invade dams and slow-flowing rivers. These include Kariba weed, parrot's feather and water hyacinth, as well as the small water fern called *Azolla filiculoides*.

Invasion by alien plants is most serious in the Western Cape, where more than 20% of riparian areas are invaded. The total area covered by invasive alien plants in South Africa is equivalent to the area of KwaZulu-Natal province. It is estimated that the area covered by aliens doubles every 15 years. Considering the impact that these plants have on reducing stream flow, it is essential that the state continues to fund programmes to eradicate alien plants, like the Working For Water Programme. We shall return to the problem of alien plants later.

Legislation to control invading alien plants
In 2001, the original Conservation of Agricultural Resources Act, No. 43 of 1983, was superseded by new legislation aimed at ridding the country of the most aggressively invasive alien species. Category 1 plants must be removed and destroyed immediately, Category 2 plants may be grown under controlled conditions only and Category 3 plants may no longer be planted. For further information, visit http://www-dwdf. pwv.gov.za/projects/wfw or phone 0800 005 376.

Habitat loss

Development has destroyed riverine habitats. Vegetation has been removed, wetlands drained and cultivated, riverbanks trampled and bulldozed, rivers canalised and surfaces paved. We are starting to count the cost of uncontrolled development as we realise the economic and health benefits of maintaining healthy fresh water ecosystems.

6.3 Ground water resources

What is ground water?

In the more arid parts of South Africa where most rivers are ephemeral and flow only after rain, many people rely on underground water from aquifers to supply their domestic and agricultural needs. Ground water accounts for 15% of water used in South Africa, and supplies about 280 towns and villages. Almost 80% of the ground water supply is used for irrigation.

Ground water is particularly important in the arid areas of South Africa.

There are two types of aquifers from which ground water can be extracted. The first are called primary aquifers and develop in unconsolidated sand, such as the Cape Flats near Cape Town, and in the sandy alluvium along rivers. The second are called secondary aquifers and are found in cavities and cracks in underground rocks. These rocks may be sedimentary or igneous in origin, and include sandstones, shales, basalt, granite and dolomites. Most ground water in South Africa comes from secondary aquifers.

Ground water is recharged by rain, which percolates through the soil until it reaches impervious rock. It then moves along cracks and crevices in underground rock formations. The rate at which aquifers are replenished depends on a number of factors, including the amount of rainfall, the topography of the area, the geology of the underground rocks and human-induced factors such as hardening of surfaces or removal of vegetation.

As with the case for surface water resources, this section considers issues relating to the quality and quantity of ground water.

Issues of quantity

Ground water reserves are threatened by overexploitation. This can occur as a result of:

- increasing human populations in arid areas, caused by natural population growth or migration
- more affluent lifestyles, which lead to an increase in the average consumption per household
- more intensive irrigation of agricultural lands and gardens, caused by changing irrigation technology or by the cultivation of plants which require more water.

Abstraction of ground water is not a problem if balanced by natural recharge or replenishment. However, at the same time that demand for ground water is increasing, the rate of recharge is declining. The hardening of surfaces through paving or construction prevents water infiltrating into the soil. Similarly, the trampling of surfaces by people and livestock hardens soil surfaces and causes water to run off rather than soak into the soil. Afforestation may also reduce ground water reserves.

In many cases, the failure of supply from boreholes is not caused by the depletion of the ground water itself. Rather, it is caused by the poor siting of the borehole, by the collapse of the borehole lining, or by damage to pumps.

The old Water Act, No. 54 of 1956, made provision to declare areas that needed special protection of the ground water resource. Permits were required before new boreholes could be drilled. The new Water Act, No. 36 of 1998, has declared ground water to be public water in an attempt to improve and ensure equitable distribution of water in the public interest.

In 1995, the Department of Water Affairs and Forestry published a report stating that, in the arid western and northern regions, ground water levels had dropped significantly over the previous 20 years. In many cases there was evidence that over-extraction had caused this decline. If ground water continues to be used in an unsustainable manner, its depletion will threaten the very settlements and farms that depend upon it.

Availability versus demand: meteorological drought and ground water drought

It takes time for rainwater to recharge aquifers. The water has to soak into the soil and move, sometimes very slowly, along cracks in underground rocks to the aquifer. Thus, there is a lag between wet and dry meteorological cycles and periods when ground water is relatively plentiful or depleted. If the demand for ground water outstrips supply, this is termed 'ground water drought'.

Issues of quality

It is no longer safe to assume that ground water is pure and unpolluted. All the pollutants mentioned in Table 6.1 can also contaminate ground water. Toxic substances and pathogenic viruses and bacteria enter the ground water from landfill sites, mines, slimes dams, industrial operations, informal settlements and farmlands, making ground water unfit to drink. Because ground water moves very slowly, there can be a long delay between pollution and contamination. This makes it difficult to hold the polluter responsible for ground water deterioration.

Leaching
Leaching is the process whereby dissolved or suspended substances are transported in ground water.

Not all ground water contamination is caused by human activities. Natural salts from underground rocks also dissolve in ground water, making it too salty or brackish to drink.

The Department of Water Affairs and Forestry has been charged with responsibility for preventing ground water pollution, and has recourse to a number of Acts, including:

- the Water Act, No. 54 of 1956
- the Environment Conservation Act, No. 73 of 1989
- the Environmental Conservation Amendment Act, No. 79 of 1992
- the Health Act of 1997
- the Water Act, No. 36 of 1998.

6.4 Conclusion

The Department of Water Affairs and Forestry has, since 1994, introduced a number of new programmes and regulations in an attempt to manage South Africa's water resources and ecosystems more equitably and effectively. Notably, integrated catchment management has emphasised the links between land use and management of aquatic systems.

Existing information on degradation of fresh water resources in South Africa is, however, variable and incomplete, with relatively little known about the situation in the communal areas. The National Biomonitoring Programme has been established to assess the state of riverine ecosystems. A similar overview and long-term monitoring programme is urgently required for ground water resources.

Both ground and surface water were designated public water in the new Water Act, No. 36 of 1998. The government has the authority and responsibility to develop long-term monitoring programmes to ensure that the quality and quantity of water continue to sustain the growing human population without compromising ecosystem processes.

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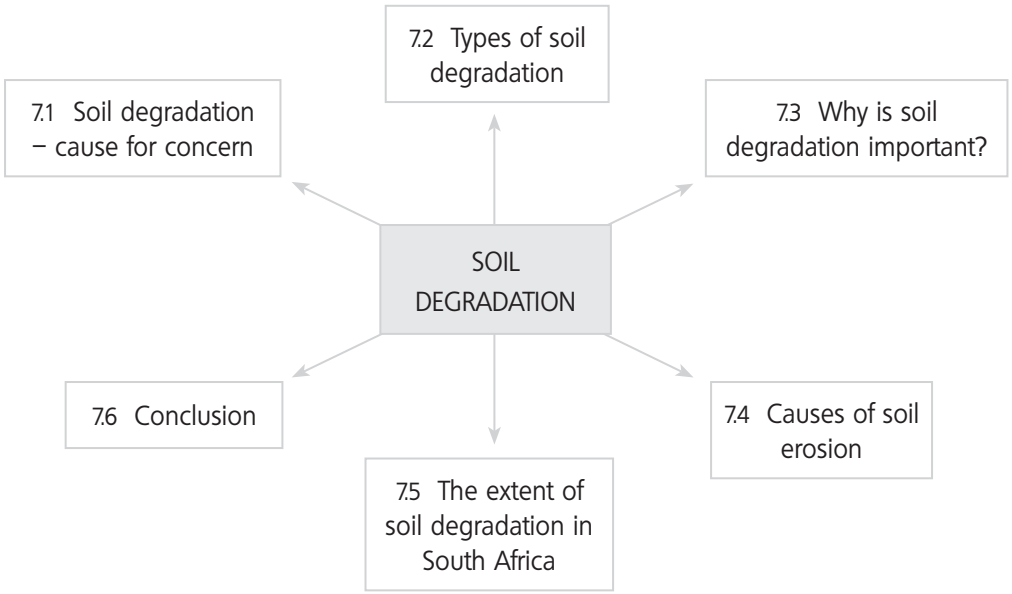
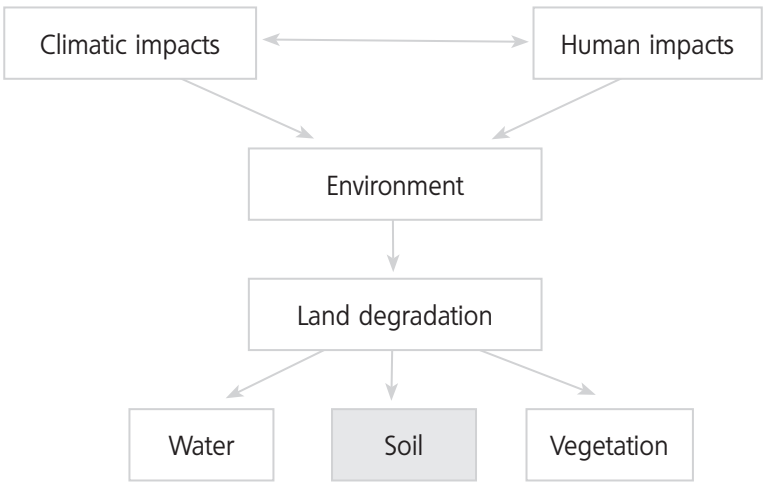
CHAPTER 7

Soil erosion is the most widespread soil degradation problem in South Africa, affecting croplands, grazing lands and settlement areas in particular. Since the 1940s, most soil conservation initiatives have taken place in the commercial farming districts. The land degradation workshops pointed out that this has had the effect of reducing the severity and rate of soil degradation in these areas. In many of the communal areas, however, soil degradation has reached crisis proportions, and rates continue to increase.





Land degradation: a conceptual framework

A very slow process

The rate of soil formation under favourable conditions is estimated to be between 12 and 40 years, or even longer, for each millimetre of topsoil.

7.1 Soil degradation – cause for concern

In 1936, General Smuts described soil erosion as '… the biggest problem confronting the country, bigger than any politics'. A matter for debate, perhaps – but nonetheless, over the years, statements like this in the scientific and popular literature have helped to make soil conservation an issue of national importance.

Although erosion is not the only form of soil degradation, it is by far the most common and widespread problem. Soil erosion threatens agricultural production and food sufficiency, causes siltation of dams which increases the costs of surface water storage, and can inhibit socioeconomic development.

Soil formation is a very slow process and within a country's borders, soil and land resources are, for practical purposes, finite. Continued exploitation of the soil, with no effort to rehabilitate it, is not sustainable.

7.2 Types of soil degradation

Although systems for classifying soil degradation do exist, they tend to focus on one particular aspect, such as erosion. The national review of land degradation used a simple, inclusive list of categories that differentiated between erosive and non-erosive forms of soil degradation (Table 7.1).

Table 7.1 *Types of soil degradation considered in the land degradation survey*

Type		Description
Erosive: water	Sheet erosion	Raindrops detach soil particles, which are transported away. Removal of surface soil is fairly uniform. Crusting and compaction can accelerate runoff.
	Rill & gully (donga)	Flowing water detaches soil particles, forming streams and gullies which concentrate the flow of water. Includes river and stream-bank erosion, landslides and landslips.
Erosive: wind	Loss of topsoil	Wind uniformly removes soil particles which blow above or bounce across the land surface. This problem is made worse by removing vegetation.
	Deflation hollows & dunes	Wind removes soil particles unevenly, causing localised hollows and dunes.
	Overblowing	Soil particles are deposited on agricultural lands and infrastructure (e.g. roads, fences). Soil often originates far from the place where it is deposited.
Non-erosive	Salinisation	Salts accumulate, usually in a cropland soil, often under poor drainage conditions.
	Acidification	Acid is deposited on the soil, usually from pollutants in the air (e.g. from burning coal).
	Waterlogging	The spaces between soil particles are saturated with water, usually because of poor drainage.
	Pollution	Soil is polluted by substances such as heavy metals, pesticides and herbicides.
	Soil mining	Topsoil and sand are physically removed for construction purposes.
	Compaction & crusting	The use of heavy machinery and livestock trampling forms a dense, less permeable soil layer just below the soil surface. Rain-splash causes a crust to form on bare soil.

7.3 Why is soil degradation important?

Food security and sustainable land use

Annually, agriculture in South Africa loses about 34 000 hectares of arable land to other types of land use. Furthermore, various forms of soil degradation affect plant growth, rendering an unknown area of land unproductive.

Given South Africa's projected population growth rate, by the year 2050 an average of only 0,2 hectares of arable land will be available per person. This is much less than accepted international norms, and will reduce South Africa's chances of achieving food security. As the country's ability to feed itself declines, so its dependence on expensive imports and foreign aid will increase.

There is evidence that commercial agriculture in South Africa is not sustainable. The earlier reliance on government subsidies suggests that investments in production were not being matched by returns from sales of produce. To what extent land degradation has contributed to this situation is not known.

Africa is no stranger to drought-related famine.

Economic implications

The various forms of soil degradation cost the country billions of rands per annum in reduced productivity and clean-up costs. For example, just to neutralise the effects of acid rain on soils in Mpumalanga costs in the region of R25 million per annum. This figure does not include the costs of livestock losses, veld deterioration or corrosion.

Did you know?

Each year, soil erosion in South Africa causes losses of:
30 000 tons of nitrogen
26 400 tons of phosphorus
363 000 tons of potassium.

The total cost of replacing soil nutrients exceeds R1,5 billion per annum.

Soil erosion removes clay particles and organic matter from the soil, decreasing its water-holding capacity. This reduces crop yields and aggravates the effects of drought. Silt enters watercourses, causing siltation of storage dams and damage to pumps and other infrastructure. One estimate suggests that the cost of dealing with siltation-related problems amounts to more than R850 million every year.

Deterioration of rivers, dams and estuaries

Silt entering streams and rivers makes water more turbid or cloudy. This has a number of effects, including reducing light penetration, increasing water temperatures and suffocating water organisms. All these changes disrupt the ecology of the river and its ability to clean itself.

The impacts of siltation on dams and infrastructure have been noted above. Dams silt up relatively rapidly, necessitating either dredging or the building of new dams. For example, the Inanda Dam, built in the early 1990s to supply the rapidly growing Durban and Pietermaritzburg metropolitan areas, has been accumulating about 3,5 million tons of silt per year, which equates to 1,3% of its storage capacity. In 1989, a national survey of dams revealed that the country loses 0,35% of its water storage capacity per year through siltation.

Erosion also increases the nutrient status of surface water resources, resulting in eutrophication. The growth of algae and water plants causes both physical and chemical problems, such as clogging of waterways and unpleasant-tasting water.

Estuaries are breeding grounds for many marine fish, and their continued health is essential for the survival of fisheries. Estuaries naturally experience periods of siltation and scouring. However, soil erosion in the catchment area may increase the sediment load to such an extent that the estuary becomes unnaturally silted up. The construction of dams further aggravates the problem, as it reduces the scouring effect of floods. Research shows that sedimentation has degraded many estuaries along the east coast of South Africa.

7.4 Causes of soil erosion

The physical environment

Soil degradation, in particular soil erosion, is affected by the characteristics of the soil itself, the slope of the land and rainfall erosivity. The actual relationships are, however, not always clearly understood.

The physical characteristics of soil include:

- soil chemistry (e.g. its mineral and ionic composition)
- particle size (e.g. proportions of clay, silt and sand)
- soil structure (e.g. texture and organic content).

All these factors influence the susceptibility of soil to erosion. For example, coarse, sandy soils are more permeable to water, and therefore less likely to erode than clay soils are.

In 1992 Rooseboom et al developed a simplified erodibility map for the whole country. Based on the observation that clay, silt and fine sand make up the greatest proportion of sediment in dams, they created soil erodibility categories that reflect the distribution of soils with particular particle sizes.

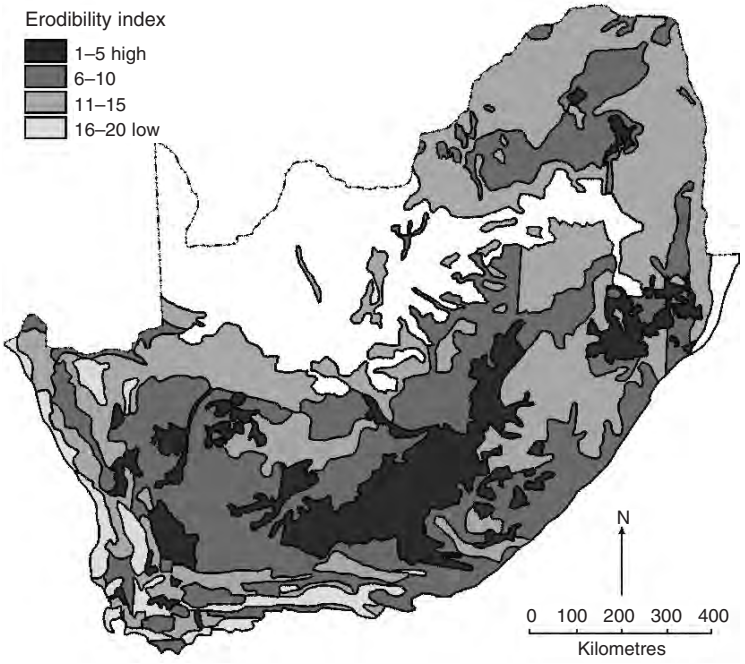


Figure 7.1 *Relative soil erodibility categories for South Africa (Rooseboom et al, 1992)*

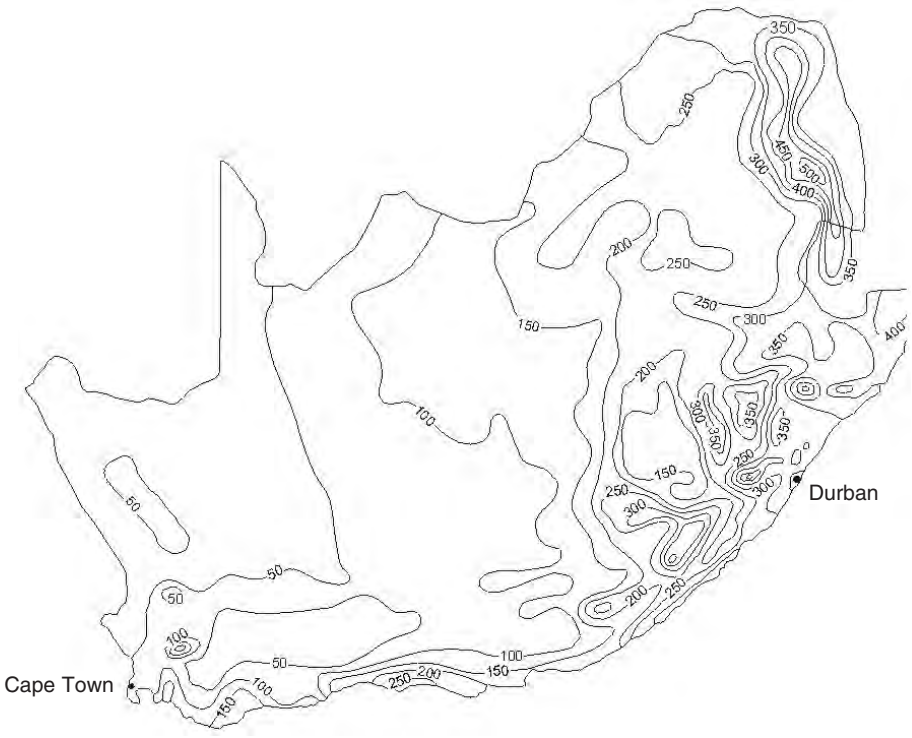
Conventional wisdom suggests that the steeper the slope, the more readily soil will erode. However, local experience reveals that foothill areas with less than a 15% gradient are most susceptible to erosion. Research undertaken in various parts of the country has led to conflicting and therefore inconclusive results. It appears that land-use and vegetation cover may be more important than slope in predicting soil erosion.

Rainfall erosivity
The power of rainfall to erode soil

Relatively little research has been done in South Africa on the relationship between rainfall and soil loss. Furthermore, researchers have tended to adopt international rainfall erosivity indices even though these have sometimes proven inappropriate in the South African context. Rainfall monitoring stations are sparsely distributed through the country, and this has hampered development of local indices.

In comparison with other countries, South African erosivity values are relatively low. The highest mean annual erosivity values have been recorded in Northern Province, Mpumalanga, parts of KwaZulu-Natal and the Eastern Cape. Erosivity is much lower in the Free State, Northern Cape, Gauteng and Northwest (Figure 7.2).

Figure 7.2 *Average annual erosivity for the whole country based on the erosive intensity of rainfall over a 30 minute period (EI_{30}units) (after Smithen & Schulze, 1982)*



Did you know?

The population of QwaQwa, one of the smallest homelands, grew from 23 000 to 158 000 in only ten years.

There is '… a direct and symbiotic relationship between human poverty and ecological destruction'.

Wilson, 1991

Measuring soil loss

Soil loss is usually calculated using measured experimental plots called run-off plots. It is, however, often difficult to extrapolate from a run-off plot to a catchment area.

The political, social and economic contexts

The high incidence of soil degradation in the communal areas suggests that social, political and economic factors also influence the process. As discussed in Chapter 3, policies like the 1913 Land Act, the 'betterment' schemes and the development of a vast migrant labour system in South Africa have all influenced land degradation in one way or another.

The restriction of land rights for blacks to about 13% of the area of South Africa made it increasingly difficult for communal farmers to manage their resources in a sustainable way. Population growth rates in the homelands and self-governing territories were very rapid, due both to the relocation of people and to natural population growth. The resultant poverty and reliance on natural resources for energy, food and construction materials have also contributed to soil degradation. Furthermore, many of the communal areas are located in hilly parts of the country with an environment naturally predisposed to higher than average levels of erosion.

But as we shall see later, soil degradation is not restricted to the communal areas. In the commercial farming areas, the pressure on farmers to make South Africa agriculturally self-sufficient at a time of rapidly increasing costs resulted in many farmers falling into debt. Short-term economic survival became more important than investing in soil conservation works. Overstocking and inappropriate irrigation caused problems of soil erosion and salinisation in many commercial areas.

Land use practices

There is abundant research to show that land use influences soil loss. In Zululand, for example, one study compared soil losses from two physically similar catchments with different patterns of land use. A highly populated catchment supporting plantations, subsistence agriculture and sugarcane yielded 3,8 times more suspended soil than a forested catchment that was managed as a nature reserve.

Did you know?

Ridged pineapple cultivation has been shown to increase soil losses by 300% compared to bare ground cultivation.

Conservation

Undisturbed veld in conservation areas experiences natural rates of soil erosion of between 0,02 and 0,75 tons per hectare per year depending on local slope, rainfall and soil conditions. These rates are used as a benchmark with which to compare soil losses from other land use areas.

Agriculture

In terms of agricultural land use, light grazing of natural veld usually causes a slight increase in soil loss but this increases in heavily grazed veld, where there is often an associated loss of plant cover. Erosion from cropland varies greatly, depending on the type of crop and where and how it is cultivated. For example, soil yields from sugarcane and wheat fields are relatively low. However, cultivation of maize, pineapples and cassava can cause large soil losses. Little research has been done to analyse soil losses caused by subsistence agriculture, fruit orchards or vegetable growing.

Soil losses are influenced by cultivation practices such as ploughing, tilling and mulching, and by the degree of plant cover. For example, in two separate studies, both mulch tillage and the regular addition of organic matter decreased soil losses by up to 30%. Contour ploughing has long been implemented to combat erosion, and soil conservation works (e.g. stone packs, gabions, retaining walls, check dams) have definitely helped to reduce soil erosion. Some of the highest soil losses have been recorded from fallow lands that have been dug over or ploughed and left bare.

Table 7.2 *Soil losses (in tons per hectare per year) from experimental plots with a 5% slope. Source: Mathee, 1984*

Surface	Soil loss (tons per hectare per year)
Bare soil	25,7
Continuous maize cultivation	7,6
Rotational cultivation (maize, cowpeas, teff)	5,9
Pasture grass	0,6
Natural veld	0,5

Erosion in croplands can cause severe soil losses.

Forestry

Although undisturbed forests protect the soil, commercial forestry can increase erosion. Plantations are often established on slopes where clearing, ploughing and harrowing cause soil losses. Harvesting practices such as the construction of skid roads, along which logs are dragged, can cause severe gully erosion.

Fires in forests, whether natural or cultivated, generally increase soil erosion. For example, one of the highest soil loss figures measured was from a wattle plantation in which brushwood was burned after the trees were harvested (see Table 7.2). Soil loss is not as marked after fires in fynbos and grassland, probably because these vegetation types are adapted to survive regular fires and are able to establish some ground cover fairly soon after a fire.

7.5 The extent of soil degradation in South Africa

In this section we present information on soil degradation gathered at the land degradation workshops in 1997 and 1998. The first part is a brief overview of the extent of different types of soil degradation in the country (Figure 7.3). We then look in more detail at estimates of the severity and rate of soil degradation in the three land use types associated with the greatest degree of soil degradation, namely croplands, grazing lands and settlement areas. Estimates of the severity and rates of soil degradation provided by participants in the workshops were used to calculate soil degradation indices and the consensus map of soil degradation.

Mega-donga

A gully in Stanger, north of Durban, is 2 km long, 50 m deep and 80 m wide.

Where do the different types of soil degradation occur?

Water erosion

Water erosion (rill, gully and sheet erosion) is the most widespread soil degradation problem in South Africa, affecting 70% of the land. It occurs in croplands in the northern and eastern areas, settlements, and a broad band of grazing lands stretching from the southwest to the northeast of the country.

Water erosion includes both donga erosion (top) and sheet erosion (above).

KwaZulu-Natal experiences some of the highest levels and most rapid rates of soil degradation in South Africa. For example, sheet erosion affects about a third of the Mfolozi catchment.

In the 50 years between 1938 and 1988, aerial photographs taken in the Peddie district of the Eastern Cape showed a 12% to 13% increase in the area affected by sheet erosion and rills, and a 2% to 6% increase in gully erosion. In the Transkei region of the Eastern Cape, gullies up to 20 m wide and 16 m deep occur. In settlement areas, inadequate treatment of stormwater runoff from paths and tracks causes erosion problems. In the Golden Gate area of the Free State, indiscriminate veld burning hastened gully expansion. Gullies as long as 120 m to 500 m can be found, and expansion of as much as 1 350 m^2 in seven years has been measured.

Erosion was not identified as a serious problem in the Western Cape, other than some gully formation due to agricultural mismanagement in the grain farming area known as the Swartland.

Wind erosion

Soils that are poor in nutrients and contain less than 15% clay are most susceptible to wind erosion. Furthermore, wind erosion is most severe when high winds coincide with periods when the soil is dry. The Northwest province experiences the most severe wind erosion, with overblowing being an important problem in the Vryburg district. About a third of the province is susceptible to wind erosion because of the particular soil types. Namaqualand also experiences wind erosion.

An example of wind erosion where windblown sand has piled up against the fence.

Salinisation

Irrigated croplands in the arid western areas are susceptible to salinisation because of high levels of evaporation.

Acidification and soil pollution

Mining and coal-burning industries in both Mpumalanga and Gauteng cause acidification and pollution of soils in these provinces. The burning of coal causes acid rain, which acidifies the soil when it falls. Mining and the subsequent extraction of minerals introduce acids and pollutants into the soil and groundwater.

Where is soil degradation most severe?

The highest levels of soil degradation in South Africa occur in cropland, grazing land and settlements. In most cases, soil degradation is more severe in communal than in commercial areas. In this section we look at the severity and rate of soil degradation and the calculation of soil degradation indices for these three land use types in all nine provinces, and in the commercial and communal areas. The consensus maps were compiled using soil degradation indices calculated for each of the magisterial districts.

The soil degradation index is calculated as the sum (Σ) of the severity plus the rate of soil degradation, multiplied by the percentage area of each land use type (LUT) in the magisterial district:

$$\text{soil degradation index} = \sum (\text{LUT severity class} + \text{LUT degradation rate}) \times \% \text{ area of LUT}$$

Cropland

According to Table 7.3, soil degradation in the croplands of South Africa is most severe in the Northern Province, Northwest and KwaZulu-Natal, and lowest in the Western Cape. The rates of soil degradation are decreasing in the Free State, Gauteng and Western Cape, but increasing in the Northern Province, Northwest and Eastern Cape.

Combining perceptions of the severity and rates of soil degradation and multiplying these by the area of cropland in each magisterial district, soil degradation indices are highest in Northern Province, the Eastern Cape and Northwest and lowest in the Western Cape, Northern Cape and Free State (Figure 7.4).

Soils in croplands in communal areas are significantly more degraded than in commercial farming areas, and degradation is taking place at a much higher rate (Table 7.3).

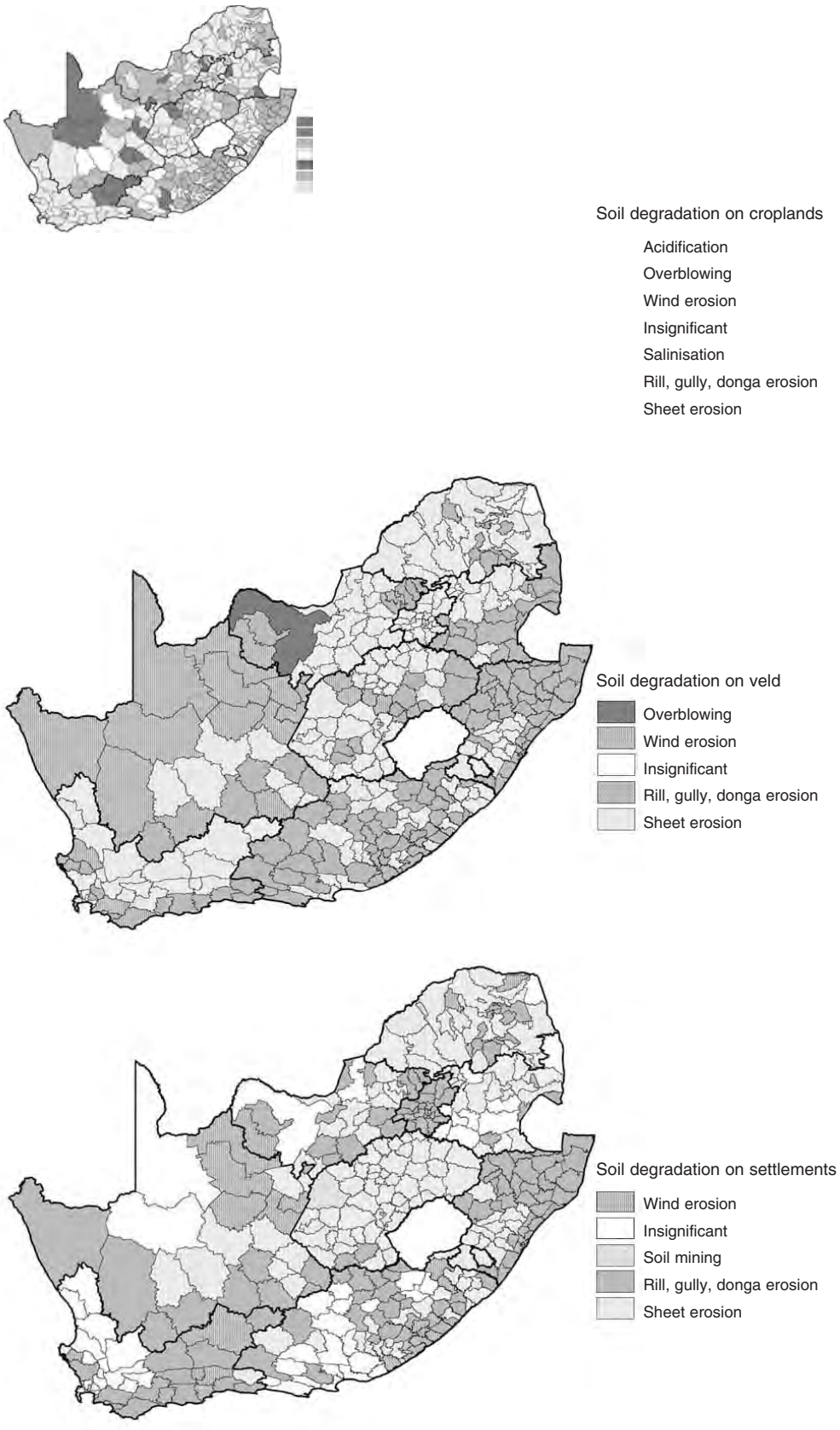


Figure 7.3 *The most important types of soil degradation in each district for croplands (top), grazing lands or veld (middle) and settlement areas (bottom)*

Province	Severity	Rate	SDI
Eastern Cape	1,3	0,6	50
Free State	1,3	−1,0	4
Gauteng	1,3	−0,1	31
KwaZulu-Natal	1,5	0,0	28
Mpumalanga	1,4	0,0	38
Northern Cape	1,3	0,0	7
Northern Province	1,6	0,3	59
Northwest	1,7	0,8	44
Western Cape	1,2	−0,2	14
Commercial districts	1,3	−0,4	17
Communal districts	1,6	0,9	67

Table 7.3 *Comparative severity and rates of soil degradation and soil degradation indices (SDI) in croplands for the nine provinces and commercial and communal areas. A negative rate implies that degradation is decreasing (i.e. the situation is improving).*

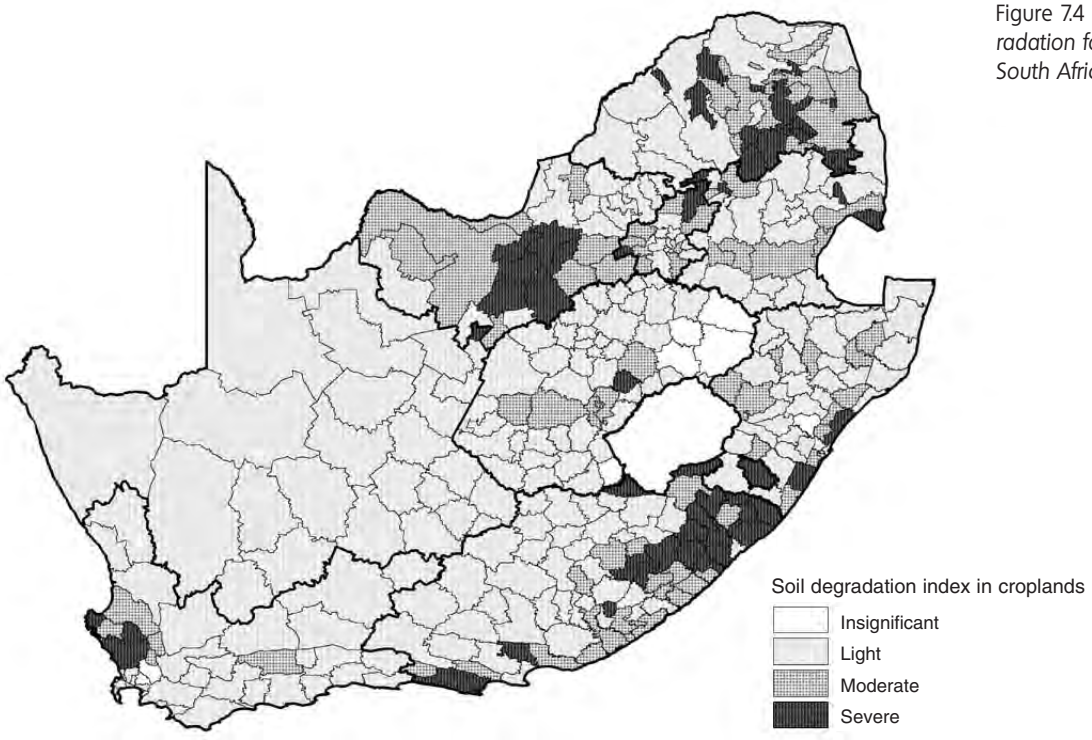


Figure 7.4 *An index of soil degradation for the croplands of South Africa*

Grazing land (veld)

Table 7.4 shows that soil degradation in South Africa's grazing lands is most severe in KwaZulu-Natal, Northern Province and the Eastern Cape and lowest in Mpumalanga, Gauteng and the Western Cape. The rate of soil degradation is decreasing in the Free State, Northern Cape and Western Cape, but increasing in most other provinces, especially Northern Province, KwaZulu-Natal and Eastern Cape.

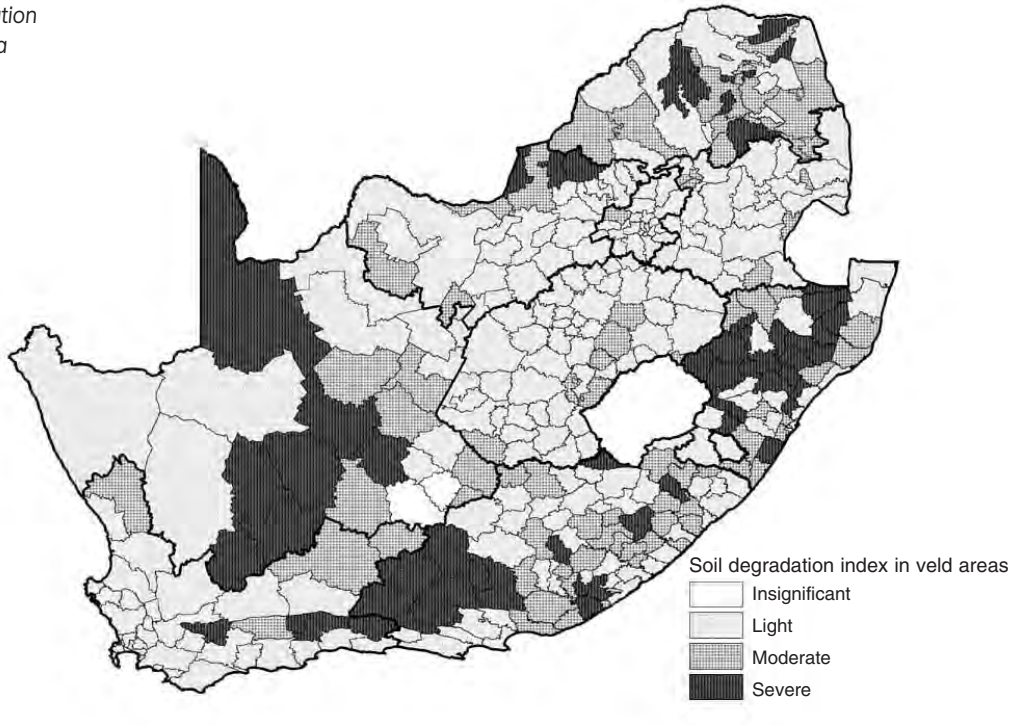
Soil degradation indices are highest for KwaZulu-Natal, Northern Province and the Eastern Cape and lowest for Gauteng and Free State (Figure 7.5). In isolated areas of the Western Cape, particularly in the Little Karoo, soil degradation is particularly high. Another area of concern is a broad band stretching from Jansenville magisterial district in the southeast to Gordonia in the northwest.

Once again, soil degradation in grazing lands of the communal areas is more severe and taking place more rapidly than in commercial areas.

Table 7.4 *Comparative severity and rates of soil degradation and soil degradation indices in grazing land (veld) for the nine provinces and commercial and communal districts. A negative rate implies that degradation is decreasing (i.e. the situation is improving).*

Province	Severity	Rate	SDI
Eastern Cape	1,6	0,6	116
Free State	1,4	−0,6	36
Gauteng	0,9	0,1	24
KwaZulu-Natal	2,0	0,0	181
Mpumalanga	1,2	0,1	56
Northern Cape	1,3	−0,5	80
Northern Province	1,7	1,0	144
Northwest	1,3	0,0	72
Western Cape	1,2	−0,1	56
Commercial districts	1,3	−0,2	68
Communal districts	1,9	1,3	159

Figure 7.5 *An index of soil degradation for the grazing lands of South Africa*



Settlements

Soil degradation in settlement areas is most severe in the Northern Province, Northwest and KwaZulu-Natal and lowest in the Western Cape (Table 7.5). Settlements in isolated districts of Mpumalanga and the Eastern Cape are also badly degraded. Workshop participants perceived the rates of soil degradation to have increased in all provinces except Gauteng, where rates remained fairly stable over the ten-year period under review.

Soil degradation indices are highest for settlement areas in Gauteng, the Northern Province and the Eastern Cape, particularly in the former Transkei and Ciskei regions (Figure 7.6).

The extent and rate of soil degradation is much greater in settlements in communal areas than in commercial areas.

Table 7.5 *Comparative severity and rates of soil degradation and soil degradation indices in settlement areas for the nine provinces and commercial and communal districts*

Province	Severity	Rate	SDI
Eastern Cape	1,1	0,7	31
Free State	1,1	0,2	6
Gauteng	1,0	0,0	50
KwaZulu-Natal	1,5	0,6	29
Mpumalanga	1,0	0,3	20
Northern Cape	1,2	0,7	2
Northern Province	1,8	0,9	47
Northwest	1,5	0,9	29
Western Cape	0,5	0,2	3
Commercial districts	0,9	0,3	9
Communal districts	1,8	1,1	60

Total soil degradation index

Table 7.6 shows the total soil degradation index for all land use types in each province and in commercial and communal districts. The total index of soil degradation for each magisterial district is shown graphically in Figure 7.7.

When all land use types are considered, soil degradation is perceived to be most severe in KwaZulu-Natal, the Northern Province and the Eastern Cape. A number of the most degraded areas are in the former homelands and self-governing territories of Ciskei, Transkei, KwaZulu, Lebowa and Venda. The soil degradation index for communal areas is nearly three times that for commercial areas. Commercial districts in which soil degradation is considered a problem include districts around Graaff-Reinet, Jansenville and Somerset East.

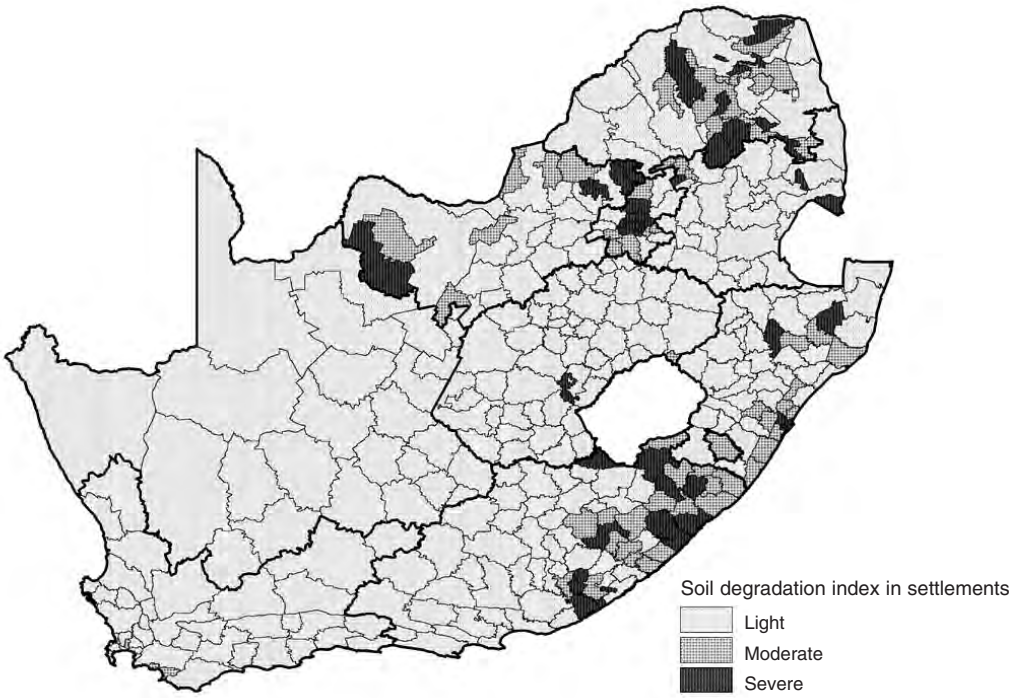


Figure 7.6 *An index of soil degradation for the settlement areas of South Africa*

Province	SDI	Rank
Eastern Cape	200	3
Free State	48	9
Gauteng	112	6
KwaZulu-Natal	254	1
Mpumalanga	143	5
Northern Cape	90	7
Northern Province	254	1
Northwest	148	4
Western Cape	77	8
Commercial districts	102	–
Communal districts	292	–

Table 7.6 *Average soil degradation index values for the nine provinces and commercial and communal districts.*

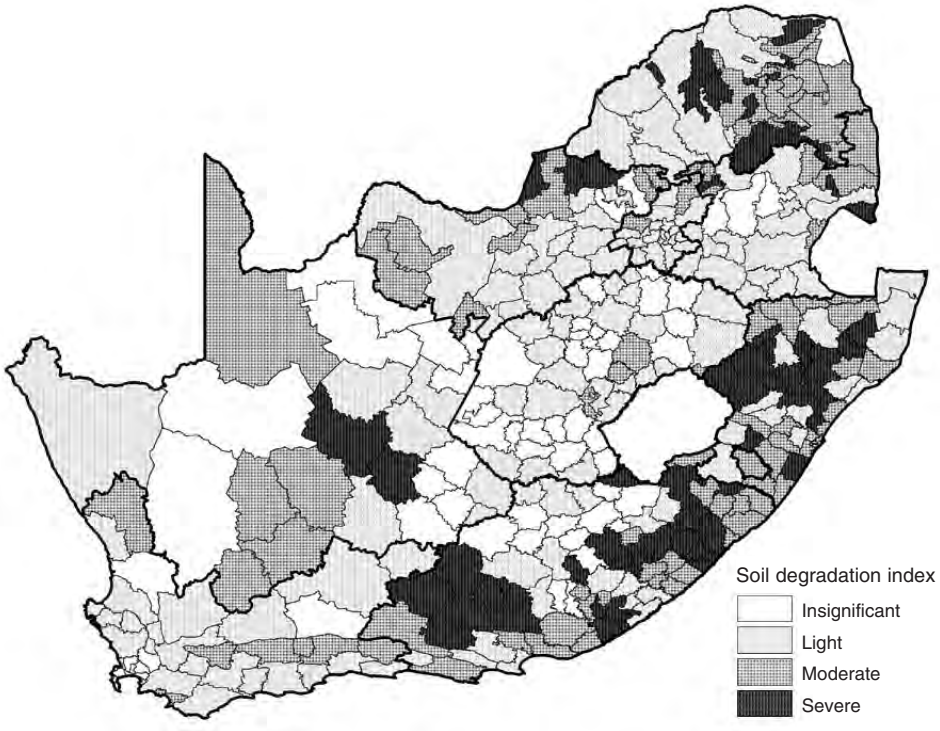


Figure 7.7 *The total soil degradation index (SDI) for each magisterial district of South Africa*

Reasons for increased rates of soil degradation

Participants in the land degradation workshops suggested that some of the following reasons explain why rates of degradation have increased in some areas, and particularly in communal areas:

- absence or poor maintenance of soil conservation works
- poor cultivation practices or veld management
- the legacy of 'betterment' planning
- lack of soil conservation regulations or law enforcement
- overstocking above recommended carrying capacities
- lack of education and extension services
- poor planning of settlements, in particular paths and runoff control
- deforestation
- removal of sand or soil for the building industry.

7.6 Conclusion

Soil is a finite resource, and it is therefore essential to manage it sustainably. A greater investment of effort is needed in the communal areas to develop locally appropriate soil conservation programmes. These programmes will have to take cognisance not only of biophysical conditions in the worst-affected areas, but also of political and economic factors that have contributed in large measure to the problem. If soil degradation is to be reversed, the people most directly affected by it must be involved in developing solutions that take account of their aspirations, needs, knowledge and experience.

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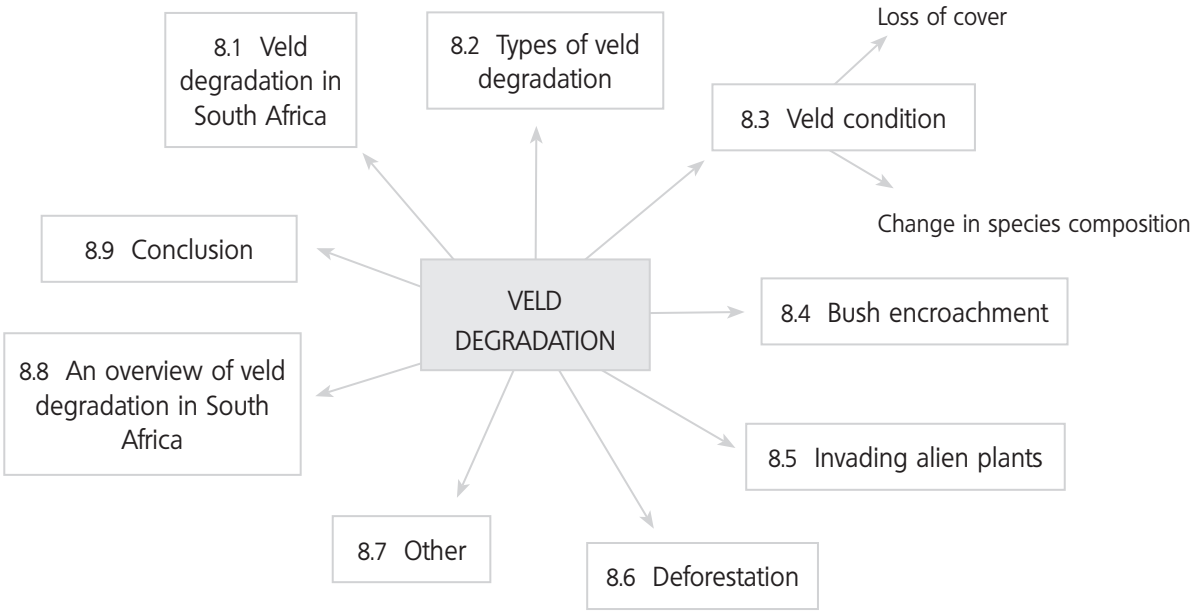
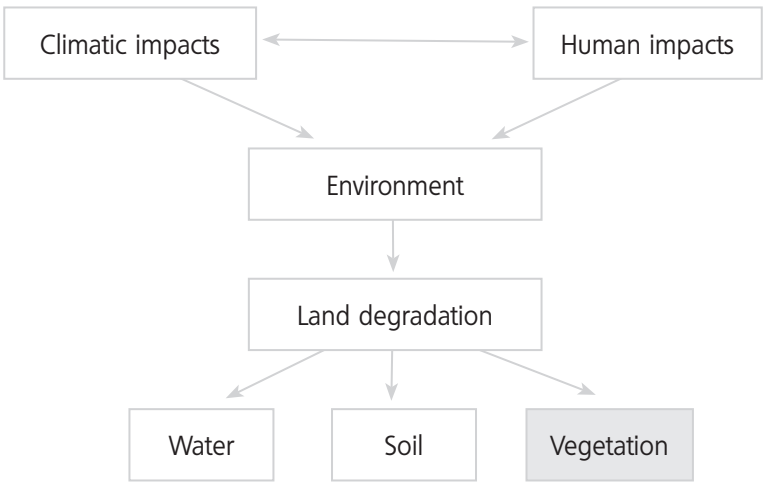
The national review of land degradation investigated six types of veld degradation, namely, loss of cover, change in plant species composition, bush encroachment, alien plant invasions, deforestation and a general category – 'other'. Different types of veld degradation are problems in different parts of the country, with the Northern Province and KwaZulu-Natal experiencing the worst levels of veld degradation overall. On average, the veld in communal areas was considered to be twice as degraded as that in commercial areas. This chapter discusses the extent, causes and effects of veld degradation and reasons why rates are increasing in some areas but decreasing in others.





Land degradation: a conceptual framework

8.1 Veld degradation in South Africa

During the last half of the 20th century, veld conservation research and interventions were significantly influenced by the work of the botanist John Acocks (Chapter 3). Acocks believed that poor farming practices were causing the Karoo to spread in a northeasterly direction, replacing areas of natural grassland. This perspective dominated rangeland science and focused government interventions for decades in South Africa.

One of the important goals of the review of land degradation was to test whether Acocks' theories about the expanding Karoo were still valid. The review also set out to gather information about a wide range of types of veld degradation, from veld condition to alien plants.

8.2 Types of veld degradation

The national review of land degradation investigated six types of veld degradation, namely:

- **loss of cover** largely as a result of the grazing and trampling patterns of domestic livestock such as sheep, goats and cattle
- **change in composition of plant species**, again largely as a result of the selective grazing patterns of domestic animals
- **bush encroachment** caused by the increase in cover of indigenous trees and shrubs, usually in response to poor management practices
- **alien plant invasions** caused by plants introduced to South Africa from other parts of the world
- **deforestation** as a result of the removal of trees and shrubs by people, usually for firewood or construction purposes
- **other** forms of veld degradation, which usually include the clearing of veld to plant agricultural crops, or mining pollution.

8.3 Veld condition

Veld condition, or the 'state of health' of the veld, combines, in a single concept, the first two types of veld degradation mentioned above, namely, loss of cover and change in species composition. It refers not only to the number and type of plant species present, but also to their palatability and value as fodder.

Assessing veld condition

Veld condition … is a deceptive phenomenon, it is difficult to define, changes over time, and is not easy to assess accurately and objectively. It is also, to a considerable extent, a matter of perception. It could thus have a different meaning to different people.

Roux, 1990

Different schools of thought

Assessing veld condition is fraught with difficulty and relies on assumptions about the ideal state of the veld. For about 50 years, veld management research in South Africa has been strongly influenced by the theory of ecological succession. According to this view, after vegetation in an area has been disturbed (e.g. by fire, heavy grazing or bush clearing), plants will recolonise the area in a series of overlapping stages. The early stages

of succession are characterised by weedy 'pioneer' plants such as many annuals, which are able to grow rapidly in disturbed areas. Later stages contain longer-lived plants such as many shrubs and trees, which are generally sensitive to disturbance. If the area is left undisturbed for long enough, a stable 'climax' community of plants develops which is in equilibrium with the prevailing climate. Many veld management schemes consider the climax community to be beneficial for ecological processes and for commercial livestock production. They therefore recommend managing the veld to maintain the climax community. Too many grazing animals are thought to push the plant community down the successional gradient, while reducing the number of animals allows the vegetation to proceed towards the climax once again. Finding the correct balance between livestock production and vegetation composition has been a major pursuit of range ecologists over the last 50 years.

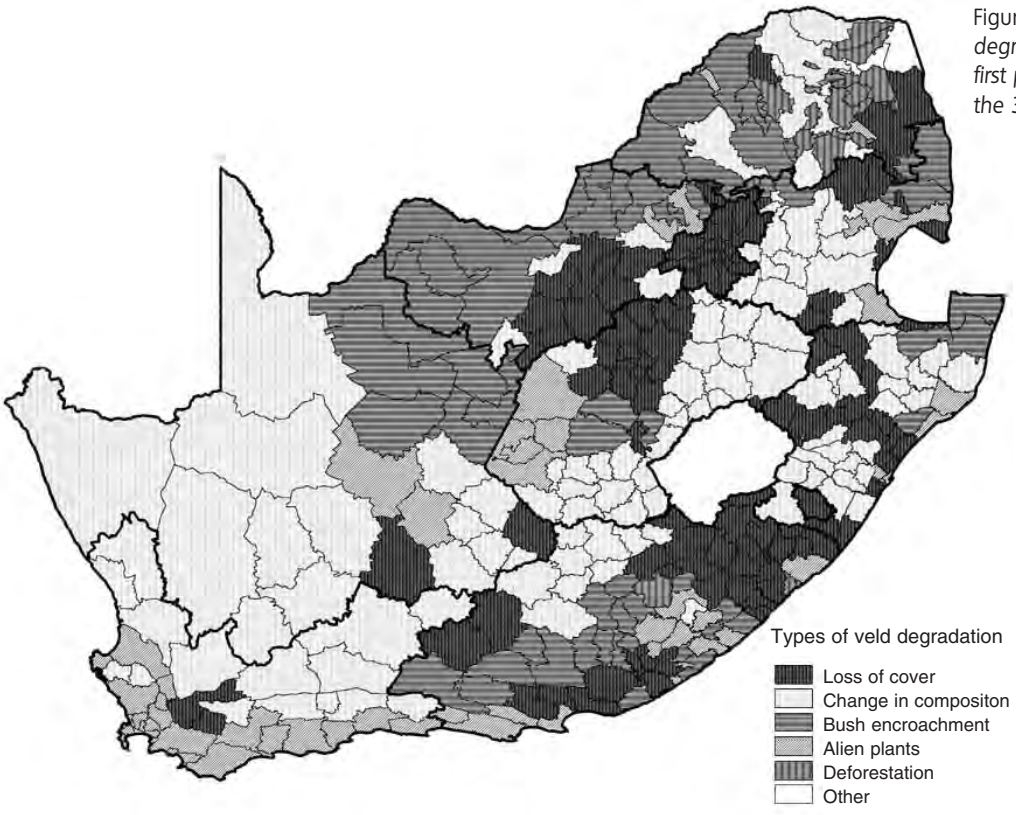


Figure 8.1 *Types of veld degradation perceived to be first priority concerns in each of the 367 magisterial districts*

Recently, another approach to rangeland ecology has been suggested, especially for arid and semi-arid areas. This approach suggests that the equilibrium model of succession described above is not appropriate for these areas as they are naturally subject to extreme disturbances or 'events' such as droughts, rather than to long periods of ecological stability or equilibrium. Proponents of this theory question the value of veld condition assessments in arid and semi-arid areas, especially where climate is a primary influence in determining the composition of the vegetation.

A fence-line contrast, showing the effects of overgrazing

In the commercial sector, where farmers strive to maximise meat and wool production, the equilibrium model continues to be favoured. However, this approach applies less to veld management in the communal areas, where farmers keep animals for many more purposes besides meat or wool production. The differences between conditions and farming practices in the commercial and communal areas make the development of a general theory of veld management difficult. The unique conditions in communal areas necessitate the development of veld management systems that take account of their particular historical, climatic and socioeconomic contexts.

Occurrence

During the consultative workshops, participants reported that the loss of plant cover is the most important veld degradation problem in grasslands in the higher-rainfall eastern parts of the country (Figure 8.2). It is also a problem in the savanna biome of the eastern Northern Province. Loss of plant cover was considered a problem in nearly 80% of communal districts, but fewer than half the commercial farming districts. On the other hand, change in species composition was recognised as a problem in the dry west. It also occurred in the eastern grassland areas, often in association with loss of plant cover. It is a greater problem in commercial areas than in communal areas, owing to the impact of selective grazing.

Causes

Grazing by domestic livestock, in association with rainfall, is the most important factor influencing veld condition. In addition to removing mature plants, animals eat flowers, thus reducing seed set. They also trample and

kill young seedlings. Palatable fodder plants are particularly susceptible to overgrazing because they are repeatedly grazed by animals and not given the chance to flower and disperse their seed. Continuous grazing can have long-term effects on the composition of plant communities. Veld condition is also affected by woodcutting (see 8.6 Deforestation), fire, drought and grazing.

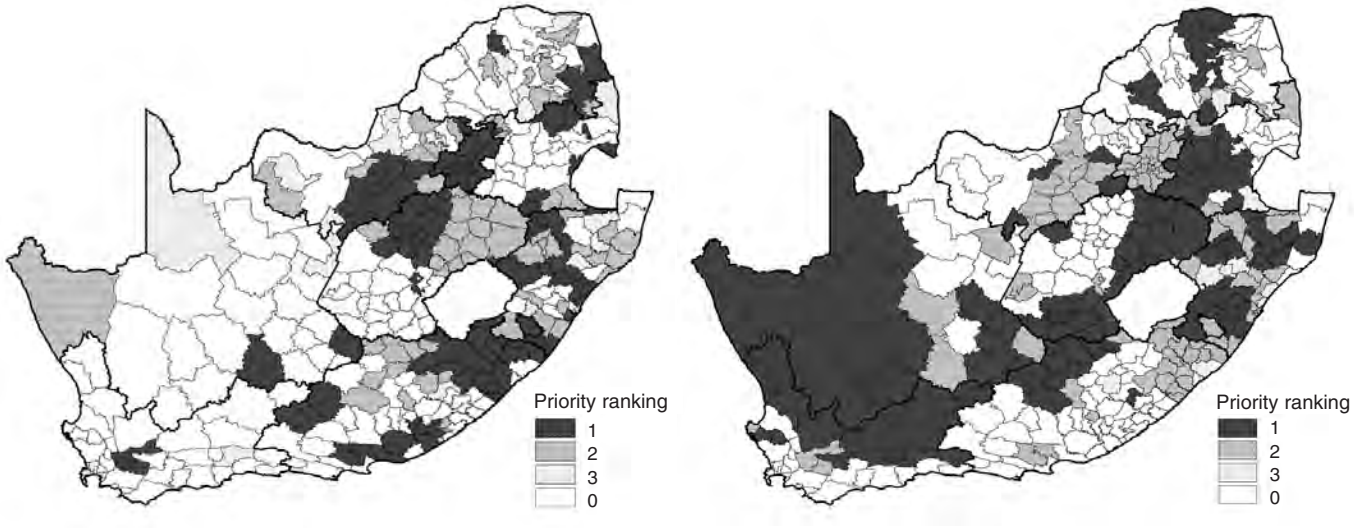


Figure 8.2 *Magisterial districts in which workshop delegates perceived veld condition (loss of cover and change in species composition) to be a first, second or third order veld degradation priority. Loss of cover (map on left) was a problem in 205 magisterial districts, while a perceived change in species composition (map on right) was a problem in 218 magisterial districts.*

In commercial districts much research has been done on the role of fire in veld management and manuals have been written to guide farmers in the use of fire as a veld management tool. In the communal areas, however, where fire is often used to stimulate grazing out of season, this information has not been generally adopted. Incorrect burning practices have been blamed for poor veld condition, soil erosion and the invasion of rangelands by unpalatable grasses in many communal areas.

Did you know?

As much as 97% of west coast Renosterveld (a vegetation type in the Fynbos Biome) has been destroyed by agricultural development.

Effects

It is difficult to generalise about the effects of veld degradation as these vary according to the vegetation type. However, research indicates that veld degradation has an effect on plant populations, ecosystem processes and the carrying capacity of veld.

Plant populations

Agriculture has directly caused the extinction of at least 15 recorded plant species in South Africa: ten due to ploughing of land, three because of grazing pressure, and two because of afforestation. Many other plants and animals are now endangered because agricultural development has reduced their populations to isolated remnant patches of veld.

Basal cover
The area of ground taken up by the rooted parts of plants.

The effect of grazing on plant diversity and species composition varies in different parts of the country. For example, studies have shown that heavy grazing pressure seemed to have no effect on the richness of plant species in communal areas of KwaZulu-Natal and the succulent Karoo, but caused a decrease in the richness of subtropical thickets in both communal and commercial areas of the Eastern Cape. A reduction in plant basal cover and general plant vigour are also often associated with long-term heavy grazing. Additional effects are an increase in weedy plants, such as annuals and unpalatable shrubs that are able to tolerate grazing, and an increase in the proportion of plants adapted to more arid conditions.

Ecosystem processes

A long-term study on the effects of grassland degradation conducted by the Free State University from 1977 to 1991 indicates that the condition of the veld has a significant effect on ecosystem processes. The study (Snyman, 1998) found that veld degradation increases runoff, reducing the amount of water soaking into the soil and increasing soil erosion. Veld degradation also reduces the nutrients in the soil and depresses agricultural production.

Carrying capacity

Several studies have shown that veld condition and long-term profitability are related to each other in commercial livestock production systems. If all else is the same (e.g. rainfall, soil nutrient levels), animals living on veld in poor condition will not produce as much meat or wool as those living on veld in good condition. However, in communal areas where meat and wool production are seldom the main objectives of farmers, veld in relatively poor condition appears quite capable of sustaining large numbers of animals for long periods. Thus, despite several decades of high stocking rates, the number of animals in many communal areas appears not to have declined significantly.

8.4 Bush encroachment

Bush encroachment and bush thickening are problems affecting mainly cattle farming areas. Indigenous shrubs and trees encroach onto former grassland areas, changing them to savannas, or the density of trees and shrubs in existing savanna areas increases. Both these processes reduce the relative amount of grass and, therefore, cattle production.

Occurrence

The most comprehensive account of the problem of bush encroachment in South Africa was developed at a workshop held in 1980. Officials from the Department of Agriculture met with scientists to estimate the extent of the problem, but their discussion was limited to the four provinces of the old Republic of South Africa and did not include the communal areas. Of the 38 million hectares of veld analysed, just under half was either affected

by or vulnerable to bush encroachment. Four percent of this was heavily encroached upon, 24% light to moderately encroached upon and 19% vulnerable to bush encroachment. The remaining 54% was unaffected.

At the consultative workshops in 1997 and 1998, participants considered bush encroachment to be a problem in 42% of the magisterial districts, particularly in the Northwest, Northern Cape, Eastern Cape and Northern Province. Participants from Gauteng and the Western Cape did not recognise bush encroachment as a problem. About 50% of communal districts and 38,5% of commercial districts were affected (Figure 8.3).

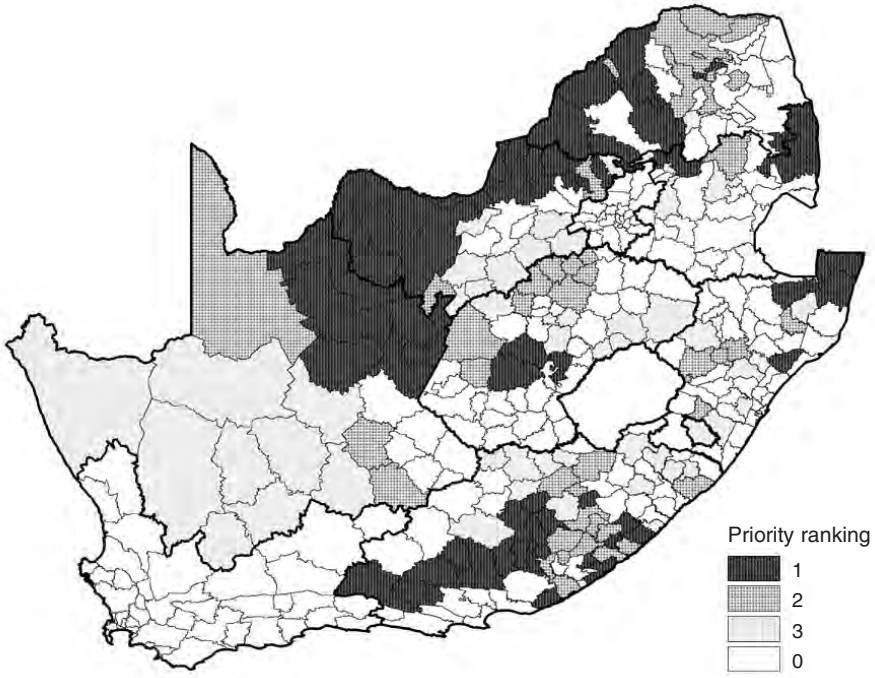


Figure 8.3 *Location of the 154 magisterial districts in which workshop participants perceived bush encroachment to be a first, second or third order veld degradation priority*

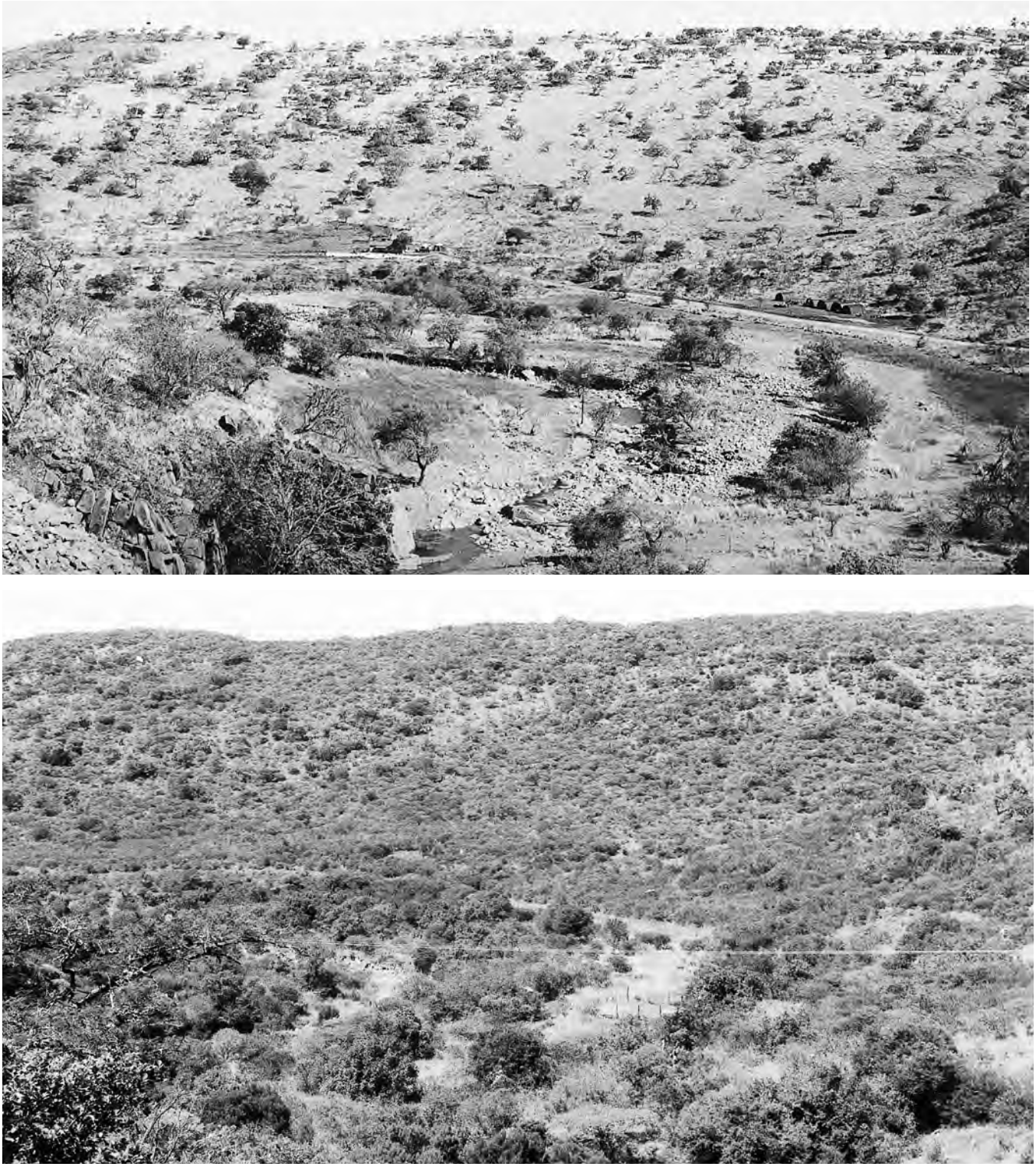
Bush encroachment: a type of succession

Bush encroachment is a fairly recent problem, having first been recorded in the 1920s and1930s in savanna areas of the Northern Province and KwaZulu-Natal, and in the 1940s in arid savanna of the Kalahari. It is a form of ecological succession that follows veld disturbance. First weedy, woody pioneer plants such as acacias (e.g. scented thorn, sweet thorn and umbrella thorn) invade what was previously open grassland. Seeds of these plants are dispersed by large herbivores and germinate readily, especially following good rainfall events.

If seedlings are not destroyed by fire or browsing animals, they grow into mature trees that provide perches for birds with a shady, moist environment beneath them. The next stage in succession takes place when bird-dispersed shrubs and trees start to germinate in the shade of the pioneer trees. These are mostly broad-leafed trees and include species such as the bush guarri, rock cabbage tree, common spike-thorn, white stinkwood and wild camphor bush.

Did you know?

Acacias are legumes and produce their seeds in pods, like beans or peas. Many legumes have nodules on their roots that enable them to use nitrogen from the air in the soil to make amino acids and proteins. They can therefore grow in relatively poor soil and in turn enrich the soil for other plants.



The rate of bush thickening can be rapid and depends on topography and aspect, amongst a host of other factors. The top photograph was taken near Muden, KwaZulu-Natal, in 1955. The same scene was photographed again in 1998. Woody plant cover on this north-facing hill slope had increased from 25% to 70% while in the valley bottom it had increased from about 15% to 45%.

Bush encroachment can be fairly rapid. At 13 sites in the Weenen and Muden areas of KwaZulu-Natal, photographs taken in 1955 were compared with photographs of the same sites in 1998. On average, bush cover had increased by 38%, with hillsides and north-facing slopes being more prone to bush encroachment than plains and south-facing slopes. The impact of bush encroachment can be seen in the accompanying photographs.

Causes

Because bush encroachment is a relatively recent phenomenon, many researchers feel that it may be caused by changes in land use practices rather than changes in climate.

The most important factors influencing bush encroachment are thought to be the replacement of indigenous browsing animals with grazers such as cattle and sheep, the removal of the grass layer by continuous grazing, and the resultant reduced frequency of fire. In natural bushveld, large browsers such as elephant and giraffe keep the trees from encroaching by pushing them over and browsing their crowns. Smaller animals, including many antelope, browse lower-growing shrubs and young trees and keep them at a height at which they are likely to be killed by fire. Cattle, however, selectively graze grass while ignoring tree seedlings that can then grow to maturity. In the Eastern Cape, bush encroachment is less of a problem in communal areas than in commercial areas. This may be due to the presence of large numbers of goats that fill the niche of the small browser, thus limiting the growth of woody plants.

In the past, African pastoralists ranged widely with their cattle, using different vegetation types at different times of year. Under this practice, the veld was able to rest and recover. When European settlers arrived, however, they introduced private ownership of land and settled permanently on farms that they then fenced. Boreholes were sunk to provide water for the stock, and continuous grazing of the same areas caused the grassveld to deteriorate. Overgrazing reduced the fuel load and fires became less intense. Their frequency also declined, allowing woody plants to grow and set more seed, which was in turn dispersed by domestic stock.

Did you know?

After removal of trees, grass production can increase by 50% to 500%.

Effects

The obvious effect of bush encroachment is to decrease grass production and therefore the grazing capacity of the veld, particularly for cattle. The effect on production was demonstrated in an experiment as long ago as the 1930s, when bush clearing resulted in an average weight gain of 14 kg per head of cattle per year, as compared to a loss of 7 kg per head per year in an uncleared plot. Grazing days increased from 114 to 147 days, and there was a 141% increase in the basal cover of grasses in this experiment.

The increase in grass cover following bush clearing can be explained in terms of the reduction in competition for water and nutrients and the

increase in availability of nutrients provided by the decay of trees. As most grasses prefer growing in full sun, bush clearing makes the area sunnier and more conducive to the growth of grass.

At low levels of bush encroachment, there is not as direct a relationship between the number of woody plants and meat production as there is when the density of bush increases. In fact, more meat can be produced if some bush is retained, as the veld will support mixed herds of grazers (cattle) and browsers (goats).

Control methods and costs

Bush encroachment can be controlled by mechanical, chemical and biological means, and by using fire. After unwanted bush has been cleared, follow-up operations must take place to prevent the bush encroaching again. For this reason, it is recommended that no more than 20% of a farm is cleared at a time.

Whatever method is chosen, good veld management practices should be employed to reduce soil erosion and the depletion of soil nutrients. There is an emerging view that suggests that it is better to maintain mixed landscapes of grass and trees to enhance productivity than to clear all woody vegetation. Trees, especially acacias, enrich the soil considerably, and if retained can be cut at chest level to reduce shading of grass and to make fodder available to browsing animals like goats.

Mechanical control

Trees can be cut down completely, chopped to stump height or dragged out of the ground by the roots using tractors and bulldozers. These methods are labour-intensive and therefore the most expensive.

Chemical control

Aerial spraying with herbicides is quick and can be done on a large scale. Herbicides such as Tordon, Garlon and Reclaim work by inhibiting specific aspects of woody plant metabolism. They work selectively on one or more species and may delay reinfestation by 10 to 15 years.

Biological control

Biological control combines the effects of browsers and fire. As has been mentioned, low levels of bush encroachment in many communal areas are ascribed to browsing by goats. Browsers can kill woody plants, but usually they keep trees short or nibble the lower branches and leaves so that cattle can reach the grass underneath. The recommended fire frequency varies according to the vegetation type, and is more frequent in higher rainfall areas (3 to 4 years) than in arid areas (10 to 15 years). Together with browsers, fire helps to reduce the regrowth of trees as well as the establishment of seedlings.

8.5 Invading alien plants

An alien invasion

Over 700 alien plants have become naturalised in South Africa, with 161 of these being classified as significant

In this chapter, alien plants are defined as those species that are not indigenous to South Africa. They have been introduced from other countries for a variety of purposes, including horticulture, agriculture and forestry. Many have been extremely successful, and it is difficult to find any parts of South Africa that are totally free of alien plants. In general, it is the shrubs and trees that are of most concern as they are most able to dominate and transform the natural vegetation. This has an impact on both the productivity of agricultural land and ecosystem processes.

Occurrence

Extent of invasions

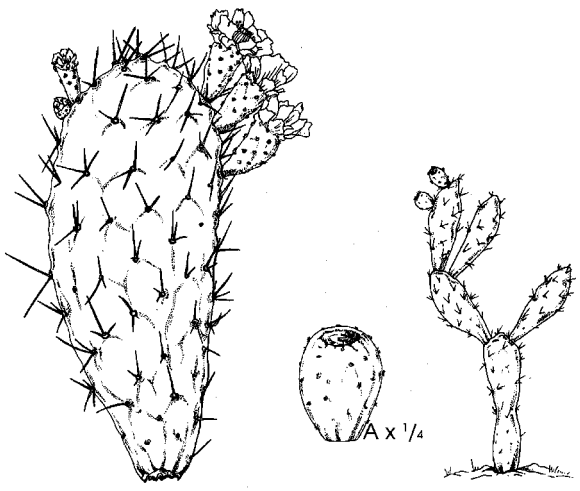
Invading alien shrubs and trees cover an area of about 10 million hectares in South Africa. If all these plants were condensed into a single area, they would cover the equivalent of 1,7 million hectares which is more than the total area under commercial forestry, and about the size of Gauteng province. Because most trees and shrubs require at least 500 mm of rain per annum, woody aliens usually become established in places where there is adequate water. In most provinces, they invade both seasonal and perennial river courses. In the Western Cape, however, invading aliens are also a serious problem in coastal mountains and the lowlands of the southwest.

Participants in the land degradation workshops suggested that invading alien plants were a serious veld degradation problem in the Western Cape, Northern Cape and KwaZulu-Natal (Figure 8.4). Mpumalanga and the Northern Province also have large areas invaded by alien plants (Table 8.1). In general, alien plants were perceived as being a bigger problem in the commercial areas than in the communal areas.

Table 8.1 *Areas invaded by alien plants in the different provinces, expressed in hectares and as a percentage of the provincial area (after Versfeld et al, 1998)*

Province	Total area invaded	
	ha	%
Eastern Cape	671 958	4,01
Free State	166 129	1,28
Gauteng	22 254	1,35
KwaZulu-Natal	922 012	9,75
Mpumalanga	1 277 814	16,06
Northern Cape	1 178 373	3,26
Northern Province	1 702 816	13,94
Northwest	405 160	3,49
Western Cape	3 727 392	28,82
Total	10 073 908	8,27

Prickly pear (Opuntia ficus-indica)



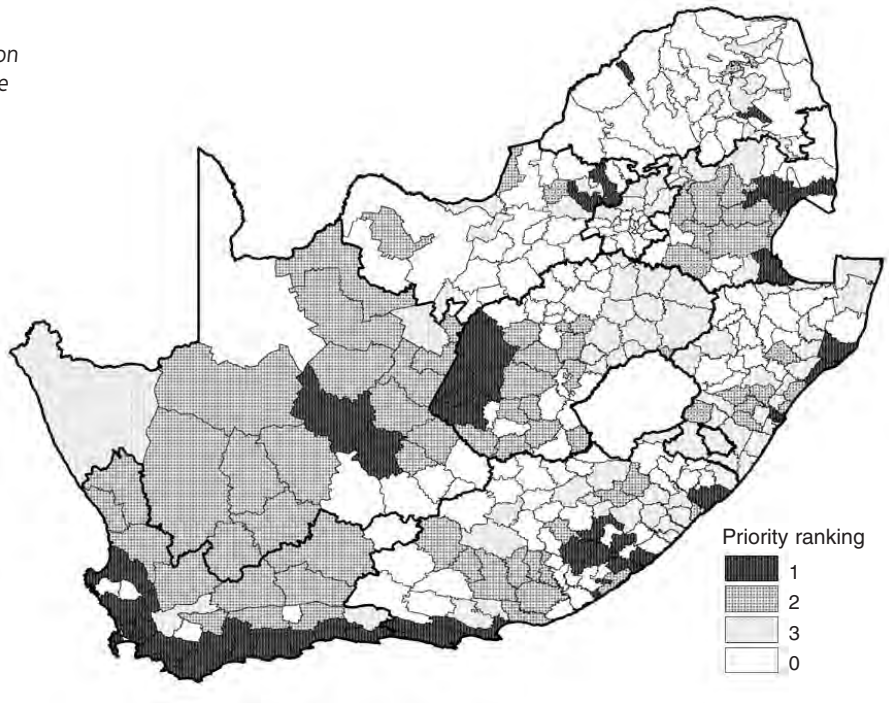


Figure 8.4 *The location of the 213 magisterial districts in which participants at land degradation workshops perceived invading alien plants to be a first, second or third order veld degradation priority*

Most important species

In a recently-compiled list of the top 25 invading alien plants in South Africa, ranked according to the total area invaded, three of the top ten species are members of the genus *Acacia* (Table 8.2). A total of 18 of the top 25 species invade primarily along river and stream banks. Only species within the genera *Prosopis* and *Opuntia* are significant invaders of the arid interior. The great majority of invader species occur in the region between the coast and the escarpment.

In terms of the impact of invading alien plants on agricultural production, the workshop participants identified twelve plants as being of major importance (Figure 8.6). There are many similarities with the species shown in Table 8.2, but also some important differences.

Rapid expansion

Alien invasions can be rapid. At a conservative annual rate of expansion of 5%, the extent of alien invasions doubles every 15 years.

The process of alien plant invasion

The process of alien plant invasion can be divided into two phases:

- **Expansion:** dispersal from existing patches to establish new colonies
- **Densification:** increases in the density of newly-established colonies.

Increases in density are usually slow to start with, and then accelerate rapidly. Densification rates of 4,5% to 19,4% per year have been measured in fynbos.

Factors influencing invasion

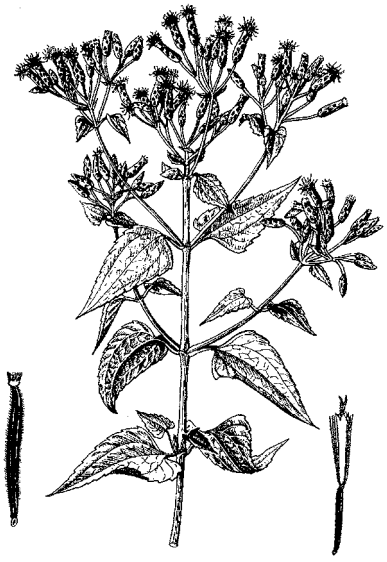
Almost all alien plant invasions result from people accidentally or deliberately introducing a new plant to an area. In general, alien plants invade disturbed

land with open soil more readily than they do veld with a good cover of vegetation. Disturbance may happen as a result of floods, fire, construction or overgrazing.

Table 8.2 *The top 25 invading species or groups of species in South Africa, ranked by the total invaded area (from Versfeld et al, 1998)*

Species name	Common name	Total area invaded (ha)
Melia azedarach	Syringa	3 039 002
Acacia mearnsii	Black wattle	2 475 748
Eucalyptus species	Eucalyptus (gum) trees	2 397 132
Lantana camara	Lantana	2 236 961
Acacia cyclops	Rooikrans	1 855 792
Acacia saligna	Port Jackson willow	1 852 155
Jacaranda mimosifolia	Jacaranda	1 819 008
Prosopis species	Mesquite	1 809 229
Solanum mauritianum	Bugweed	1 762 264
Sesbania punicea	Sesbania	1 404 505
Pinus species	Various pine trees	1 338 359
Caesalpinia decapetala	Mauritius thorn	1 317 243
Acacia melanoxylon	Blackwood	1 201 417
Populus species	Poplar	1 179 884
Pinus pinaster	Cluster pine	1 174 183
Morus alba	White mulberry	997 960
Psidium guajava	Guava	759 844
Hakea sericea	Silky hakea	717 962
Rubus species	Bramble	647 347
Acacia dealbata	Silver wattle	615 171
Chromolaena odorata	Triffid weed	534 655
Pinus radiata	Monterey pine	457 391
Acacia decurrens	Green wattle	441 146
Acacia longifolia	Long-leafed wattle	200 160
Arundo donax	Spanish reed	187 948
Acacia baileyana	Bailey's wattle	187 743

Riparian zones are particularly susceptible to alien plant invasions as they are physically dynamic environments where floods may expose areas of bare soil where weeds can start to grow. The seeds of alien plants may be dispersed by the river itself or by birds that roost in the trees and shrubs in the riparian area.



Paraffin weed or triffid weed (Chromolaena odorata)

Some of the characteristics of invading alien plants that enable them to compete successfully with indigenous plants are:

- They produce seed early and therefore have short generation times.
- They produce many seeds (or other propagules).
- Water, wind and birds disperse seeds over a wide area.
- Seeds germinate earlier than indigenous species.
- Plants grow taller or faster than indigenous species.
- They lack natural pests and pathogens.

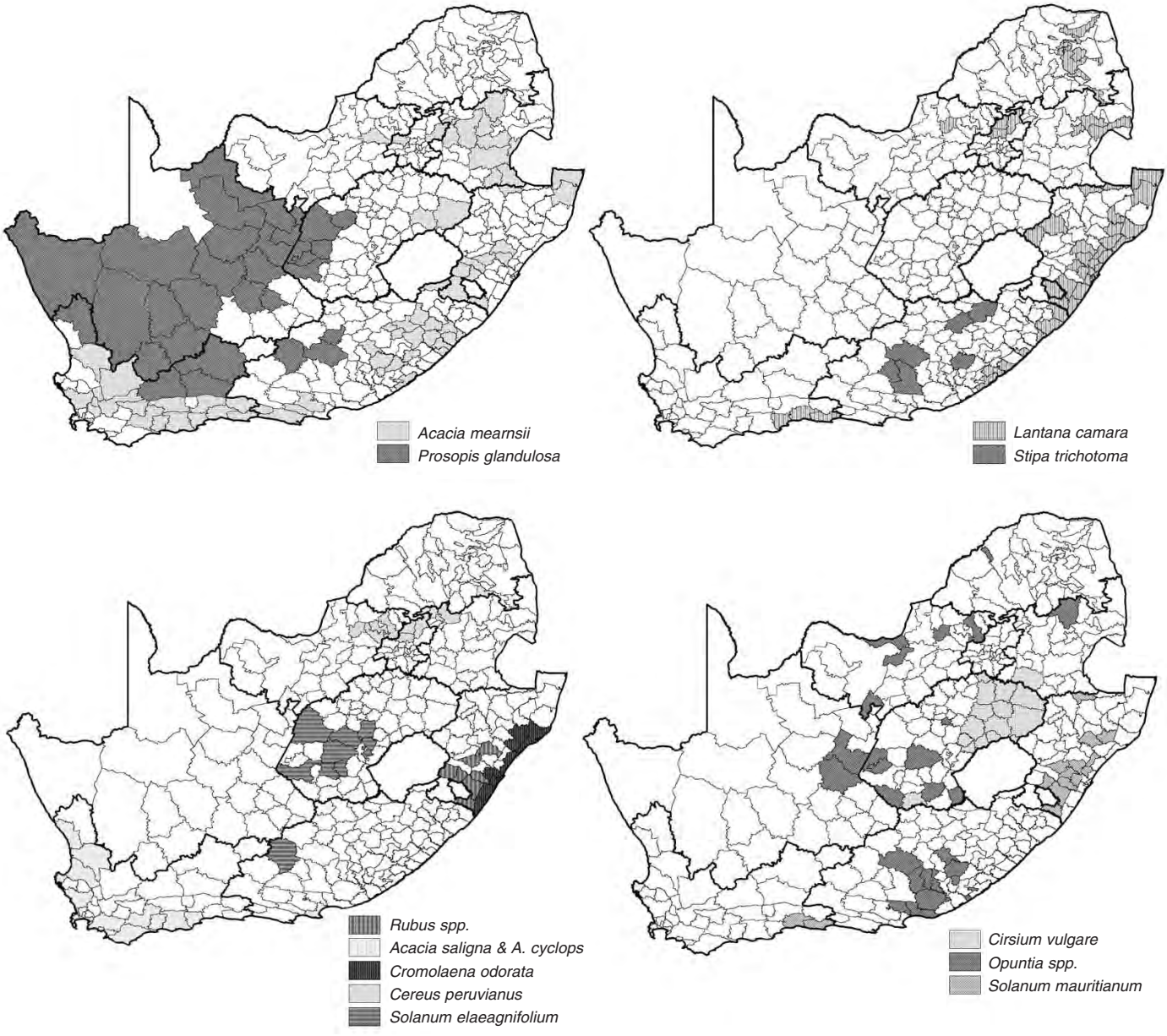


Figure 8.5 *The distribution of the 13 alien plant species having the greatest impact on South African rangelands. The information was obtained from consultative workshops held during 1997 and 1998.*

Causes

Although some alien plants, like the castor oil plant (*Ricinus communis*), predate European settlement in South Africa, the vast majority of invading alien plants have been introduced since the 1650s for agriculture, horticulture or forestry purposes. Some examples of these introductions are described below.

Rooikrans (Acacia cyclops)

In the past, poor veld management sometimes made it necessary to introduce fodder plants such as prickly pear and mesquite into arid areas where stock had depleted the natural veld. Many weed seeds were also introduced accidentally in imports of fodder for horses during the Anglo-Boer War. In addition, alien plants like jacaranda, lantana and syringa were introduced as ornamental plants, but have subsequently become naturalised as environmental weeds.

The need to stabilise driftsands, mainly in coastal areas of the former Cape Province, led to the introduction of especially Australian acacias from 1875 onwards. Rooikrans and Port Jackson willow proved to be extremely efficient, fast-growing sand-binders. By 1934, the government had reclaimed nearly 11 000 hectares of driftsands, not to mention work done by private landowners.

Black wattle (Acacia mearnsii)

Aliens were introduced for many other reasons as well. For example, black wattle was introduced to provide bark for an expanding tanning industry. Use of bark reached a peak in the 1960s, with an estimated 290 000 hectares under black wattle production. By the end of the 1990s, however, this area had decreased to about 110 000 hectares as synthetic materials replaced the need for black wattle products.

Another reason to bring alien plants to South Africa arose from the shortage of natural timber at the Cape, and the first plantations were planted soon after colonisation began in the 1600s. In the 1880s, much research took place, notably at the Tokai plantation in Cape Town, to determine which species to cultivate. By the end of the 19th century, plantations had been established in the eastern and southern Cape. With the development of gold and diamond mining, plantations were also established in the former Transvaal to supply poles for mineshafts. The demand for wood products continues unabated and pine and eucalyptus plantations continue to grow. Because the source area is expanding, the problem of pine and eucalyptus invasions is likely to continue in the future.

Effects

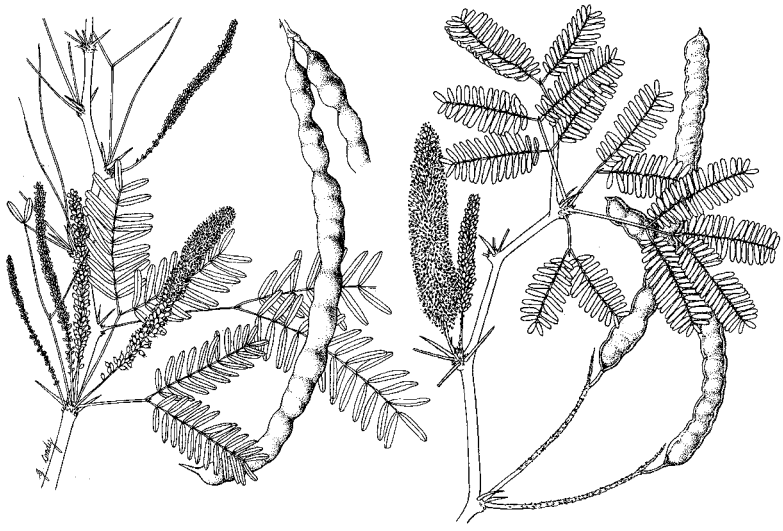
Two of the most significant effects of alien plant invasions are their impacts upon water resources and ecosystem processes.

Australia acacias introduced as sand binders have invaded large areas of the Western Cape coast, as this aerial view of Robben Island shows.

Water resources and river systems

Alien trees use much more water than natural fynbos or grassland vegetation. It is estimated that woody aliens use approximately 3 300 million cubic metres of water per year, which is equivalent to 6,7% of South Africa's total mean annual runoff. In the Western Cape, alien plants reduce mean annual runoff by 33%, in KwaZulu-Natal by 17%, and in Mpumalanga by 14%. Rather than building dams in new catchment areas, a much cheaper and more sustainable alternative is to remove aliens that reduce runoff to existing dams.

In the arid interior, invasions of alien plants are threatening ground water supplies. For example, prosopis (mesquite) extracts about 192 million cubic metres of water each year.



Mesquite or suidwesdoring (Prosopis glandulosa *and* Prosopis velutina)

As described in Chapter 6, shallow-rooted alien plants growing along rivers may be washed out during floods, destabilising the river banks and releasing sediments that then cause siltation of dams. On the other hand, willow and poplar trees have such extensive root systems that they can cause narrowing of the river channel, obstructing the flow of the river and causing it to burst its banks.

Ecosystem processes and biodiversity

Alien plants change the species composition and vegetation structure of an area, which in turn has an effect on many other organisms, such as pollinators and the decomposers that live in the soil. With over 22 000 species, South Africa is famous for its plant diversity, particularly in the fynbos and succulent Karoo biomes. Invasions of alien plants pose a significant threat to the biodiversity of these and other biomes.

In the main agricultural areas, alien plants can significantly reduce the total grazing area, while some species are poisonous to livestock. Woody aliens also change the natural fire regime. In the fynbos biome, for example, stands of acacias or hakeas tend to burn at a higher temperature than fynbos vegetation, increasing the fire hazard and interfering with regeneration.

The cost of alien invasions includes both the loss of productivity of the land and the cost of eradicating the alien plants. When the ongoing costs of controlling regrowth are included, this can be greater than the value of the land.

The cost of aliens

It is estimated that 4 km^2 of pristine fynbos could yield products and services worth R300 million. With a dense cover of alien plants, this is reduced to about R19 million – mainly as a result of invading alien plants reducing surface runoff.

8.6 Deforestation

Unlike bush encroachment, which is a fairly recent phenomenon, deforestation has been happening for a very long time. Well before European settlement, wood was being used for construction, heating, cooking and iron smelting. Fires set by pastoralists to enhance grazing for their cattle helped to maintain a mosaic pattern of grassland and woodland in precolonial and early colonial times.

Occurrence

Today, firewood is used by a surprisingly large number of people, particularly in rural areas within the former homelands and self-governing territories (Table 8.3). Deforestation is currently a serious problem, particularly in communal areas where, by 1994, only 10% of rural dwellings had electricity. In that same year, it was estimated that firewood provided 8% of South Africa's primary energy needs.

Firewood dependency

About 17 million people in 3,2 million households in South Africa depend heavily on firewood for energy.

Most fuelwood is collected from natural shrubland or savanna woodland. Trees and shrubs are also used extensively for construction, fencing, crafts, fruits, medicines and fodder. In 1986, one study in the Msinga district of KwaZulu-Natal estimated that thornveld was worth at least R48 per hectare per year to the local inhabitants.

Participants in the land degradation workshops in 1997 and 1998 felt that deforestation was seriously problematic in the Northern Province, and less so in Mpumalanga, the Eastern Cape and Northwest (Figure 8.6). Whereas deforestation was considered to be a priority in 49 communal districts, it was mentioned as cause for concern in only three of the commercial districts.

Table 8.3 *The percentage of households in different sectors using wood for fuel (1996)*

Sectors using wood for fuel	% Households
Rural households in communal areas	99%
Farm labour households	97%
Peri-urban households	68%
Township households	38%

Despite rapid electrification of rural areas, levels of fuelwood collection remain high.

Now you see them ...

... of the 250 forests in KwaZulu proclaimed ... [in] 1936, three quarters have all but disappeared as a result of human population pressures.

Gandar, 1983

A dwindling resource

Several attempts have been made to predict fuelwood availability in the future. Taking into account factors such as accessibility, usability and wastage of wood, woodlands in communal areas can supply only about 4,6 million tons of fuelwood per year. However, between six and 11 million tons of wood are used annually, leaving a deficit of at least 1,4 million tons, and possibly far more, each year. Much of the additional fuelwood is obtained by cutting down live trees. Some estimates suggest that at current rates of harvesting, woodlands in many of South Africa's communal areas could be decimated by 2020.

Causes

The causes of deforestation, as indicated above, are linked in many cases to more general problems of rural poverty and government policies, such as the creation of homelands and 'betterment' planning. Settling large numbers of people in rural villages without the provision of electricity left these populations highly dependent on the gathering of wood for their energy needs.

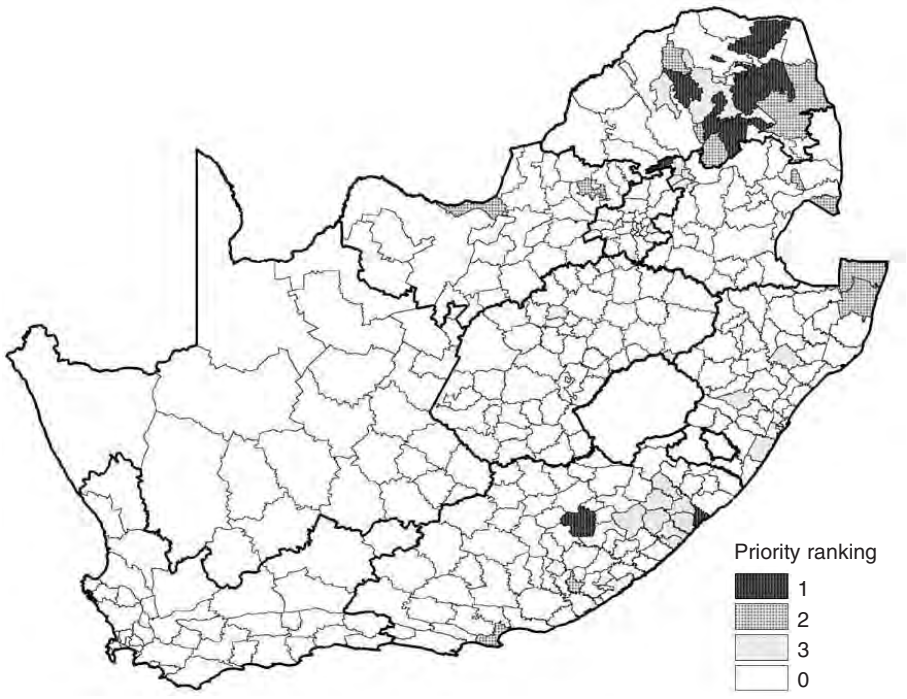


Figure 8.6 *The location of the 49 magisterial districts where deforestation is perceived as a first, second or third order veld degradation priority in South Africa. Deforestation was not seen as an important veld degradation problem in 318 districts.*

Growth in the demand for traditional medicines in urban areas has also led to the unsustainable harvesting of a number of indigenous plants, including trees. In addition, in both communal and commercial areas trees are used for construction and crafts, and as fodder for animals. Forests and woodlands have also been cleared for crop production and settlements.

Effects

Deforestation has both ecological and social costs. Removal of trees can worsen soil erosion, as there is less plant cover to shield the earth from the erosive power of wind and rain, and fewer tree roots to bind the soil. When accompanied by overgrazing, erosion can be severe.

Forests grow naturally in areas of high rainfall. Leaves falling from the trees decay and enrich the soil with nutrients which, in turn, nourish the trees. When trees are felled for crop production, soils may soon become unproductive as the rainfall leaches existing nutrients from the topsoil and soil fertility is no longer replenished by leaf fall. Soils that once supported trees soon require the application of expensive fertilisers to support crop production.

As trees provide habitat for a wide range of animals, from insects to birds and small mammals, their removal can lead to local extinctions. Deforestation in woodland areas can change habitat structure from open savanna with tall trees into shrubby woodland with lower-growing trees and shrubs. Up to half of the birds living in forests either roost or nest in holes in trees, so wood collection can force them to move elsewhere. A study in the Eastern Cape showed

that three of the original 15 bird species using holes in trees and one of two small mammal species disappeared from a 10-hectare area of heavily used woodland. Breeding was also affected as, in a similar sized area of relatively undisturbed woodland nearby, 60% more breeding pairs of birds were found.

Women have traditionally been collectors of firewood in rural areas. As trees and shrubs become scarcer, women have to spend longer finding firewood. The further away the source of wood is, the more needs to be collected to make the journey worthwhile. A number of surveys have calculated that an average trip to collect firewood takes about 3,6 hours. This must be repeated a number of times each week, reducing the time available for other activities. Attempts to use firewood sparingly may lead to nutritional problems caused by reduced cooking time or fewer cooked meals. As wood becomes scarcer, solar cookers and hot boxes may provide a viable alternative to expensive commercial fuels like paraffin.

8.7 Other

Other forms of veld degradation include the clearing of grazing land to plant crops and the expansion of rural and urban settlements. Trends are similar for both commercial and communal areas. In general these forms of veld degradation were considered a problem by workshop participants only in the Western Cape, parts of the Northern Province, and in the Port Elizabeth district of the Eastern Cape.

Although settlement areas are expanding in nearly all magisterial districts, workshop participants felt that rangelands were under more direct threat from overgrazing, deforestation, bush encroachment and invading alien plants than from settlements. However, the Port Elizabeth metropolitan area is expanding into subtropical thickets of the Sundays River valley, and in the Northern Province expansion of communal villages is threatening grazing areas.

8.8 An overview of veld degradation in South Africa

Information about the severity and rate of all forms of veld degradation gathered at the consultative workshops was combined to obtain an overall index of veld degradation for each magisterial district in South Africa (Table 8.5).

Severity of veld degradation

Workshop participants perceived 15 magisterial districts, or 4% of the total, to be severely degraded. These districts are scattered throughout South Africa. Overall, the provinces with the most severely degraded veld are KwaZulu-Natal, Northern Province and the Western Cape. The eastern Karoo, traditionally considered to be the most degraded part of the country, was thought to be relatively undegraded. Overall, workshop participants perceived the severity of veld degradation to be 66% greater in the communal areas than in the commercial areas.

Rate of veld degradation

The provinces experiencing the greatest overall *rate* of veld degradation over the ten years from 1988 to 1998 are the Northern Province, KwaZulu-Natal and the communal areas of the Eastern Cape. There was an order of magnitude difference between the mean rates of veld degradation in communal and commercial areas. In a number of commercial districts, there had been no significant change in veld degradation over the ten years under review.

Veld degradation index (VDI)

When severity and rate of degradation were considered together, the Northern Province and KwaZulu-Natal emerged as having the most serious overall problems of veld degradation (Figure 8.7). These provinces have high proportions of grazing lands and experience problems with bush encroachment, alien plant invasions and changes in species composition. The overall veld degradation index for communal districts is twice that of commercial areas and was calculated as follows:

$$\text{veld degradation index} = (\text{veld degradation severity class} + \text{veld degradation rate}) \times \text{area of veld}$$

Table 8.4 *Comparative average severity, rates of veld degradation and veld degradation indices for the nine provinces and for commercial and communal districts*

Province	Veld degradation			
	Severity	Rate	VDI	Rank
Eastern Cape	1,7	0,6	116	5
Free State	1,5	0,0	86	7
Gauteng	1,1	0,2	31	9
KwaZulu-Natal	2,3	1,0	187	2
Mpumalanga	1,8	0,2	81	8
Northern Cape	1,9	−0,3	140	3
Northern Province	2,2	1,2	189	1
Northwest Province	1,9	0,3	122	4
Western Cape	2,0	0,3	93	6
Commercial districts	1,6	0,1	96	–
Communal districts	2,4	1,3	183	–

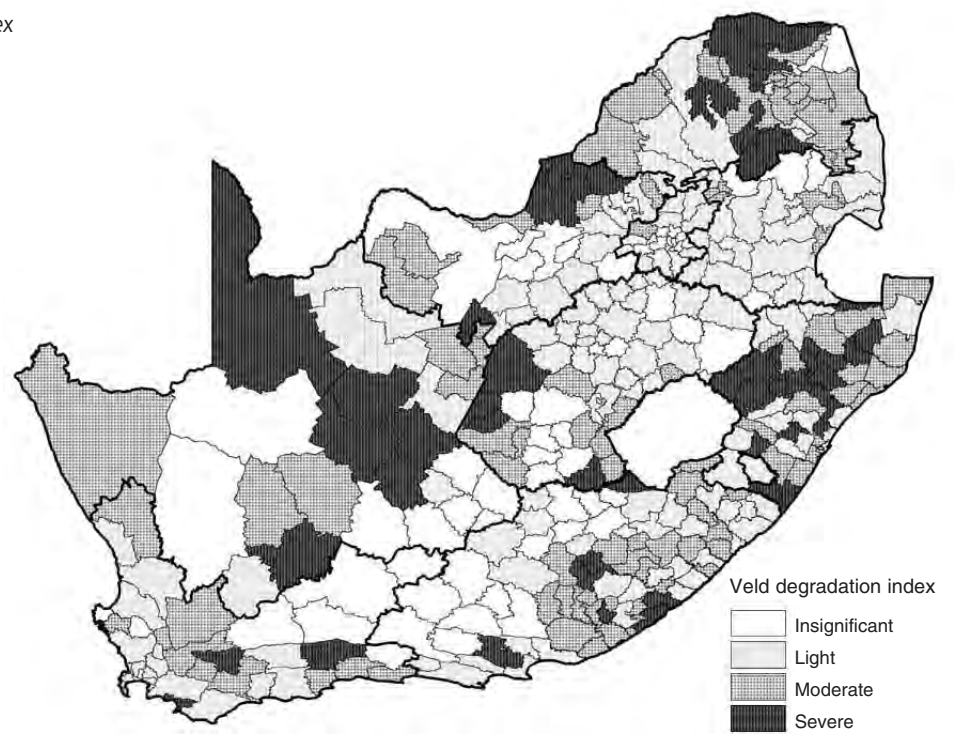


Figure 8.7 *A general veld degradation index for each of the 367 magisterial districts of South Africa*

Reasons for increases in veld degradation

Some factors causing an overall increase in veld degradation during the period 1988 to 1998, particularly in the communal areas, are:

- the absence of local programmes to control alien plants
- the removal of plants for traditional medicines and the cutting of trees for firewood
- increases in stock numbers because of an increase in human populations
- a decrease in the extent of grazing lands in communal areas, with the number of animals either remaining constant or increasing
- limitation of drinking points so that large numbers of animals are concentrated around a few water points
- historical impacts of overgrazing in some areas, making restoration very difficult
- poor infrastructure, theft of infrastructure and poor management practices
- incorrect veld burning programmes
- better beef and ostrich prices, encouraging some farmers to overstock.

Reasons for decreases in veld degradation

Some factors reducing veld degradation, particularly in the commercial areas, are:

- education through the agricultural extension service, local soil conservation committees and farmer study groups

- a stronger conservation ethic amongst farmers
- the involvement of local conservation groups in alien eradication
- reduction of stocking rates as a result of agriculture department recommendations, stock theft, the consolidation of farms into larger units and increased meat prices
- government intervention schemes and policy documents, such as the Grass Conversion Scheme, the Stock Reduction Scheme, the National Grazing Strategy and several drought subsidy schemes
- the large-scale electrification of some communal area settlements in recent years.

During the consultative workshops, a breakdown in traditional forms of communal land tenure was frequently mentioned as a major stumbling block in the rehabilitation of degraded grazing areas. The current lack of institutional control in many communal areas was also often cited as a reason for the high levels of veld degradation in these areas.

8.9 Conclusion

The results of this study present a very different picture from many previous studies. First, this study rejects the notion that veld degradation is increasing throughout the country and that no lessons have been learned from the past. The workshop participants perceived that in many of the commercial districts in particular, veld degradation has been reversed thanks to education and state intervention programmes over the past 30 years. The communal areas, however, are in dire need of attention, and the focus of government has indeed moved towards communal and emerging, small-scale commercial farmers.

The study also shows that the traditional focus on the eastern Karoo as the most seriously degraded area of rangeland in South Africa is no longer valid. The work of John Acocks can be linked directly to the subsequent investment of research and extension work in the eastern Karoo. This part of the country is now better managed and no longer directly threatened by desertification.

Research clearly indicates that it is the communal areas that now require the greatest attention. The challenge will be to maintain the quality of land in areas where degradation has been addressed, while attending to the problems threatening ecological processes, food security and livelihoods in the communal areas. We shall return to this point later.

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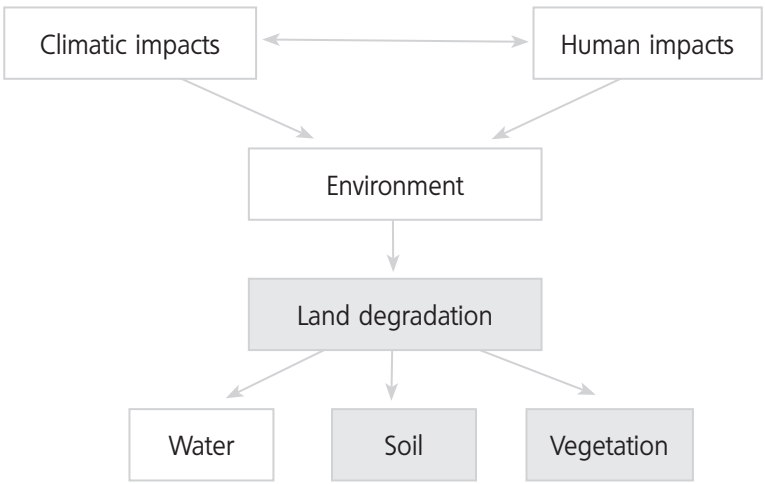
The soil and veld degradation indices from Chapters 7 and 8 were added together to calculate a combined index of land degradation for each of the 367 magisterial districts. Combined indices of land degradation were also calculated for each of the nine provinces and for commercial and communal areas. When both soil and vegetation degradation are taken into account, the Northern Province and KwaZulu-Natal emerge as the most seriously affected provinces. Although there are many exceptions, communal areas are considered in general as being more than twice as badly degraded as commercial areas.

9.1 Calculating a combined index of land degradation

A COMBINED INDEX OF LAND DEGRADATION

Figure 9.1 A combined index of land degradation in 367 magisterial districts

Table 9.1 Provincial indices of land degradation



Land degradation: a conceptual framework

9.1 Calculating a combined index of land degradation

In the previous two chapters, we have seen how information provided by agricultural extension officers and resource conservation technicians at 34 consultative workshops on land degradation resulted in the development of separate soil degradation and veld degradation indices and consensus maps for the 367 magisterial districts of South Africa.

A simple calculation

soil degradation index
+ veld degradation index
= combined degradation index

To calculate a combined index of land degradation for each of the magisterial districts the soil and veld degradation indices were simply added together. These results were used to produce a consensus map of land degradation (Figure 9.1). Results for each of the nine provinces and for communal and commercial areas are shown in Table 9.1.

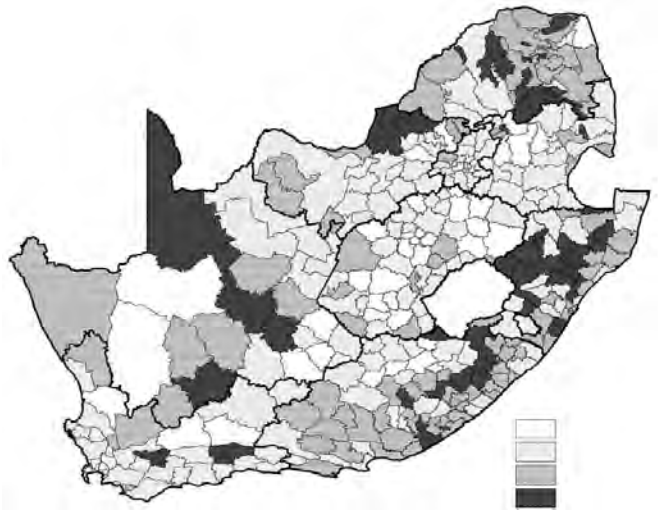


Figure 9.1 *A combined index of land degradation in the 367 magisterial districts of South Africa*

Areas of concern

The land degradation map reveals the following areas of particular concern:

- steeply sloping environments along the eastern escarpment, particularly in the communal areas of the former Ciskei, Transkei and KwaZulu
- communal areas in the Northern Province and Northwest
- commercial areas in the Northern Cape and the Little Karoo of the Western Cape.

When using soil and veld degradation indices in a combined degradation index, communal areas were perceived as being significantly more degraded than commercial areas.

The two provinces emerging as having the most serious problems of land degradation are the Northern Province and KwaZulu-Natal, followed by the Eastern Cape and Northwest.

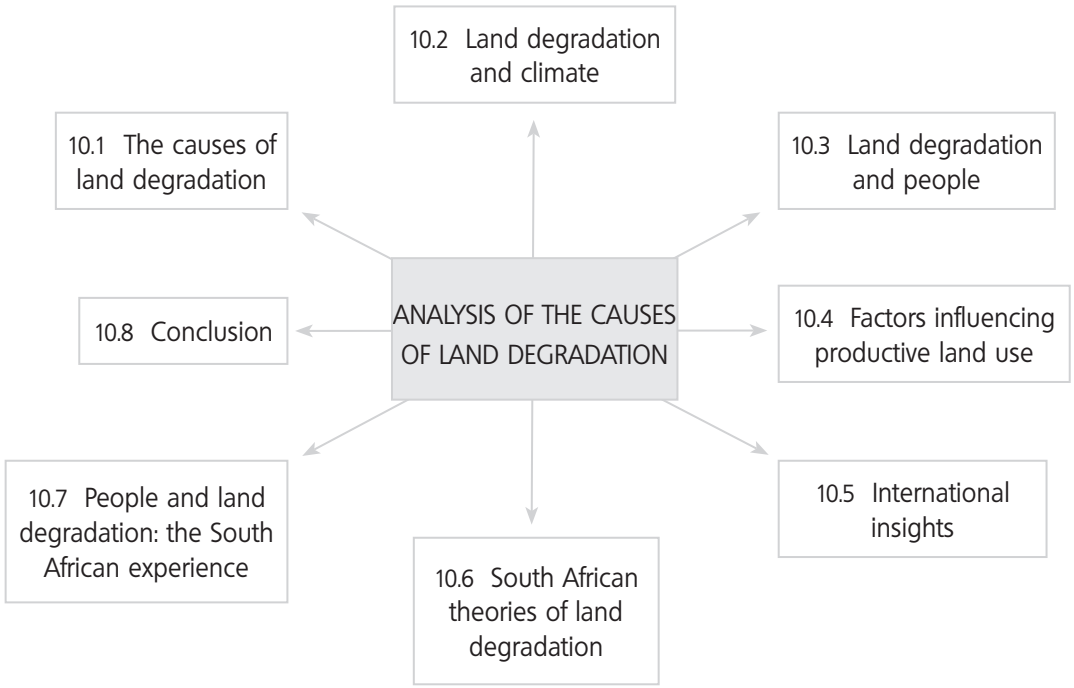
Table 9.1 *Average values in the magisterial districts for the soil degradation index (SDI), veld degradation index (VDI) and combined index of land degradation (SDI + VDI) in each province and for commercial and communal areas.*

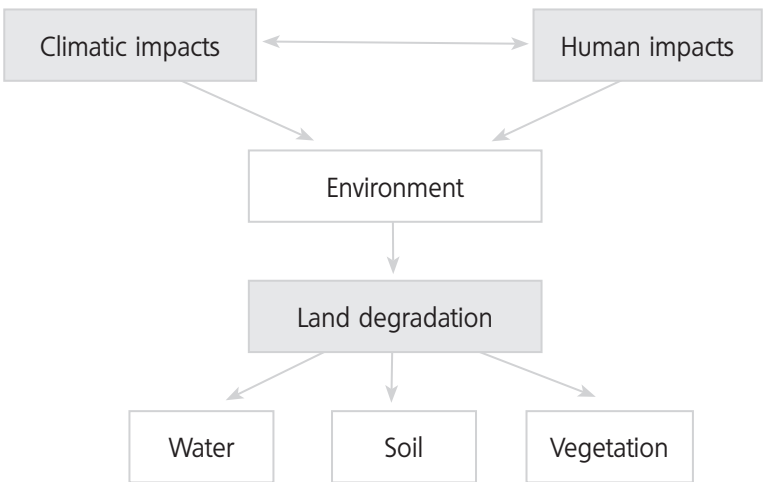
Province	Number of magisterial districts	Average values for degradation indices		
		SDI	VDI	CDI
Eastern Cape	78	200	116	316
Free State	51	48	86	134
Gauteng	22	113	31	143
KwaZulu-Natal	51	253	187	440
Mpumalanga	30	143	81	223
Northern Cape	26	92	140	232
Northern Province	39	255	189	444
Northwest	28	149	122	270
Western Cape	42	77	93	170
Commercial districts	262	102	96	198
Communal districts	105	292	183	475

Land degradation threatens the future of both commercial and subsistence farming in South Africa.

CHAPTER 10

In the past, a decline in rainfall has been discounted as a cause of land degradation in South Africa. However, this review shows that temperature has increased and that rainfall has decreased significantly at some sites. Climate change can therefore no longer be ignored as an influence on land degradation. People's activities have also had a profound effect on land degradation. This chapter provides an analysis of ways in which issues like land tenure, demography, land use policies, livelihoods and land use practices influence land degradation. The effects of global climate change and globalisation have increased the complexity of factors to which agricultural planners and farmers in South Africa will have to respond.





Land degradation: a conceptual framework

10.1 The causes of land degradation

Having considered in some detail the status of land degradation in South Africa, what can we conclude about the causes of the problem? Has land degradation been caused mainly by changes in climate or are people's activities also responsible? Where does the emphasis lie?

The dry '90s
1991 to 1995 was the driest sequence of years during the 20th century in southern Africa.

In the past, severe droughts often stimulated research into land degradation because the lack of rain aggravated the effects of poor land management. Most of this research, however, discounted the effect of climate, noting that variation in rainfall from year to year was a natural phenomenon, and that no long-term decline in rainfall was evident. People, rather than climate, were held responsible for land degradation.

In recent years, however, the threat of global climate change has come under the spotlight and measured changes in rainfall and temperature patterns may well be influencing the severity and rate of land degradation in South Africa. But the role of people should not be forgotten or ignored and in this chapter we discuss the influence of both climate and people on the process of land degradation.

10.2 Land degradation and climate

Rainfall and temperature trends

Rainfall amounts vary substantially between particular years or decades and until about 1980, no upward or downward trend in southern African rainfall patterns could be identified. From then, however, rainfall declined fairly steadily to the end of the 1990s (Figure 10.1). In parts of southern Africa, midsummer rainfall for the period 1961 to 1990 declined by 5% to 10% when compared with the period from 1930 to 1960. It is, however, too early to say whether this represents a long-term trend or whether it is simply part of a prolonged dry period. The above-average summer rains experienced towards the end of the 20th century and during the beginning of the 21st century, however, suggest that the alternating cycle of wet and dry rainfall periods, which characterises the long-term rainfall pattern in southern Africa, is continuing.

The heat is on
The 1990s was the hottest decade on record.

One of the explanations given for the decline in rainfall is the El Niño/Southern Oscillation phenomenon, in which changes in sea surface temperatures in the Pacific, Indian and South Atlantic Oceans cause drier than average conditions on the subcontinent. Since 1982 there have been three El Niño events. However, since 1970 there have only been two La Niña events (wet periods), the most recent resulting in severe flooding in the eastern parts of southern Africa during 1999–2000.

While rainfall patterns point to a drier period in the late 20th century, temperatures on the subcontinent appear to have been increasing steadily. An increase in temperature affects the water cycle, for example by increasing evapotranspiration and changing weather patterns. These effects will in turn have an impact on land degradation.

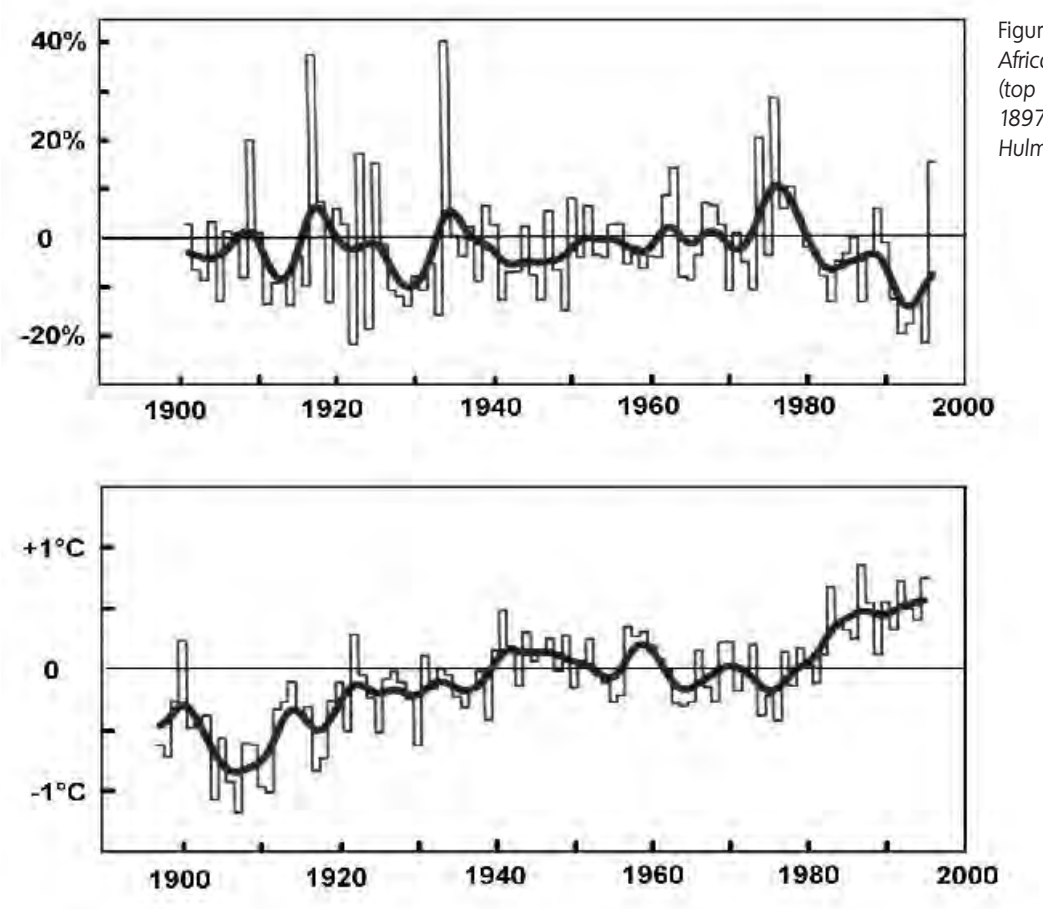


Figure 10.1 *Changes in Southern African rainfall from 1901 to 1996 (top diagram); and temperature from 1897 to 1995 (bottom diagram) (from Hulme, 1996)*

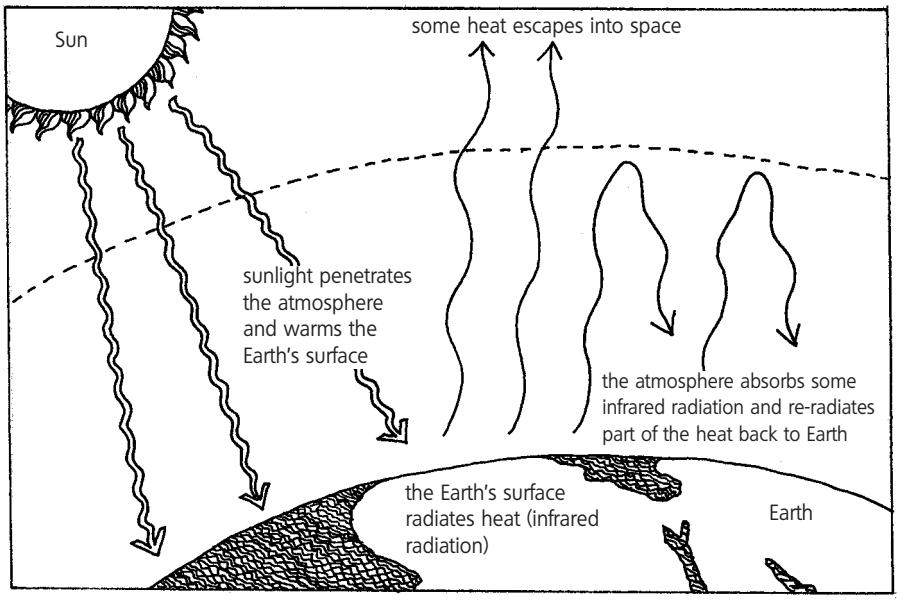
Significant increases in summer temperatures of 0,8 °C to 2,7 °C were measured between 1940 and 1989. Overall, it is estimated that global temperatures increased at roughly 0,05°C per decade during the 20th century, fuelling concerns about global warming.

Global warming (see diagram on following page)

Global warming is caused by a phenomenon known as the greenhouse effect:

- Rays of sunlight (made up in part of relatively short-wave visible and ultraviolet radiation) penetrate the Earth's atmosphere.
- Some of the energy strikes the Earth's surface and warms it up.
- Heat energy radiates from the Earth as longer-wavelength infrared radiation.
- Gases like carbon dioxide, water vapour and methane absorb much of the infrared radiation and prevent it from escaping from the atmosphere.
- As the concentration of these energy-absorbing 'greenhouse gases' increases, the amount of heat trapped in the atmosphere also increases, resulting in global warming.
- This effect is known as the greenhouse effect, because greenhouses (glasshouses) operate in the same way. Light can penetrate glass but infrared radiation cannot, so during the day heat is trapped in the greenhouse, causing it to heat up. You can feel this effect if you get into a car that has been standing in the sun – it is much hotter inside than outside.

The greenhouse effect



Future scenarios

It is very difficult to predict how increasing greenhouse gas emissions will affect climate and land degradation in future. However, some climate change models suggest that a doubling in atmospheric carbon dioxide will have the following effects on the South African climate:

- a 10% to 20% decrease in summer rainfall over the central interior
- an increase in the frequency and intensity of floods and droughts
- a gradual, linear increase in mean annual temperatures, making the country on average 1,5 °C to 2,5 °C hotter by 2050.

The impacts of these climatic changes may include:

- a 5% to 20% increase in rates of evapotranspiration (i.e. evaporation from water bodies such as lakes or dams, plus the water transpired by plants)
- a 30% increase in runoff in eastern southern Africa
- changes in the distribution of the biomes of South Africa, with savanna replacing grassland and large areas of the Karoo becoming desert.

The advent of human-induced global climate change has major implications for future land use practices in South Africa. Increasing temperatures, decreasing or more variable rainfall and changes in vegetation types will require a flexible and integrated approach to land use planning that can respond to these changing conditions.

10.3 Land degradation and people

While climate has an important influence on land degradation processes and rates, people and their activities also have a fundamental impact. Although natural resource management programmes may enhance the natural environment, many human activities also result in degradation through, for example:

- the use of natural resources for productive purposes, e.g. mining, agriculture, construction and fuelwood collection
- non-extractive uses of natural resources, e.g. recreation, settlement and infrastructure
- unintended or remote impacts of economic activity, e.g. pollution.

The rest of this chapter focuses mainly on the use of natural resources for agricultural production. We consider both international and South African theories and experience in an attempt to understand the complex factors that have contributed to land degradation in this country.

10.4 Factors influencing productive land use

When analysing the impact of agriculture on the status of land, it is worth remembering that a number of factors influence how land and its resources are used. Some examples are given below.

Production goals

Farmers engaging in commercial or subsistence agriculture use the land very differently. For example, with adequate inputs of fertiliser and irrigation, cash crop monocultures may produce high yields, but without due care may eventually reduce the fertility of soil and contribute to salinisation and erosion. Well-maintained indigenous multi-cropping systems may be less profitable but often meet a wider range of nutritional requirements, can minimise the risk of crop losses and can conserve land and its resources. Sustainable and unsustainable practices can be found in both commercial and subsistence agriculture.

Environmental and agricultural knowledge systems

The ways in which people understand natural processes and agricultural practice influence the use and status of the land. Briefly, two broad knowledge systems are recognised, namely 'western scientific' and 'indigenous' knowledge systems. Western science has been based on reduction of phenomena to constituent parts, whereas traditional knowledge often takes into account both the natural and social contexts when addressing problems. Both systems of knowledge continue to evolve. In recent years western science has begun to recognise the value of traditional philosophies and practices. Until recently, western scientific thought dominated agricultural policy and practice and indigenous knowledge systems tended to be marginalised.

Socioeconomic context

Socioeconomic factors influencing how people use the land and its resources include economic structures and relationships (labour costs, product prices, alternative economic opportunities), social, political and institutional factors (dominant political dispensation, decision-making structures, gender issues), land rights, land tenure systems and the diversity of rural livelihoods.

Technology

Both the agricultural knowledge system and socioeconomic context influence the types of technology available to and used by a particular farmer. Different approaches to cultivation, irrigation, pest control and fertilisation of soil will have very different effects on land resources.

10.5 International insights

The debate in the international literature on the role of people in land degradation has focused on two important issues:

- the role of demography in land degradation
- the role of land tenure in land degradation.

In both cases, experience has led to conventional wisdom being challenged and alternative explanations being proposed.

Demography and land degradation

The Machakos story

In the Machakos area of Kenya, increasing human numbers have resulted in adequate production and less erosion through agricultural intensification. This has been possible because of the growth in agricultural markets in Nairobi and a supportive economic environment.

Do more people automatically cause more soil erosion? The traditional answer to this question, influenced by the work of Malthus in the 18th century, is yes. This argument assumes that the productivity of the land is fixed. However, agricultural intensification and the development of new technologies can ensure that production keeps pace with increasing human numbers.

The demography argument also ignores a number of other influences that can affect the environment in agricultural areas, for example, pressures of globalisation, levels of affluence and consumption, and the role of technology.

A key question for South Africa is whether conditions exist for sustainable agricultural intensification. As we shall see later, the fact that rural livelihoods in the communal areas are only partly reliant on agriculture may count against this.

Land tenure and land degradation

Should land degradation be blamed on the type of land ownership? Many analysts maintain that security of tenure, in particular the freehold system, is necessary before land users will invest in resource conservation. This argument is based on a number of assumptions, each of which can be questioned:

- **Indigenous tenure systems are static and cannot adjust to changing circumstances**
  Evidence suggests that indigenous African tenure systems are evolving all over the continent in response to changing economic and demographic conditions.

- **Land users in non-freehold tenure systems feel insecure and therefore do not invest in conservation works**
  There is little empirical evidence for a significant direct relationship between tenure security and land improvements or productivity. This relationship assumes that other necessities, for example, labour, capital and markets for produce, are available – which is often not the case in Africa. Non-freehold African farmers involved in communal farming often do feel secure and will invest in agricultural conservation and development if market prospects demand this.

- **Group ownership or management of land cannot result in its conservation**
  The idea of the 'tragedy of the commons' has been challenged by those who maintain that the real issue in land degradation is not common property, but rather, unrestricted access to that property. In the past, there were indigenous common property systems that effectively regulated land use, but these systems broke down as a result of policies and interventions like 'betterment'. Synthetic systems such as cooperatives have not been successful in South African communal areas.

- **Substantial, long-term investments are needed to combat land degradation**
  Conventional agricultural conservation methods, such as stock reduction and the construction of soil conservation works, have been expensive, and the long-term nature of the benefits has necessitated security of tenure. However, many soil and water conservation technologies now integrate production with conservation, resulting in higher yields after a single season.

The tragedy of the commons

According to this notion, common property will be overexploited as each person with rights to the resource competes to get the maximum benefit from it, without concern for sustainability. Some individuals benefit from overexploiting the resource, while the risk is shared by the whole group.

Colonial powers introduced private land ownership in many countries where that form of land tenure had previously been unknown. Indigenous people were often seen as ignorant of proper land conservation practices, and their traditional practices were blamed for land degradation. Ironically, however, new thinking in range management in arid and semi-arid parts of Africa suggests that the model of livestock production used successfully in many commercial areas is inappropriate in most communal areas and should not be imposed on people living there. Instead, flexibility and mobility of stock movement in response to unpredictable environmental conditions is recommended. This requires flexible, multiple, negotiated land access rights, rather than fixed, rigid land ownership. Given South Africa's particular history, however, it seems unlikely that it will be possible to reintroduce this form of large-scale communal land tenure, which resembles the precolonial situation, in arid and semi-arid parts of the continent.

10.6 South African theories of land degradation

As in other countries, issues of land tenure and demography have influenced the land degradation debate in South Africa. In this section we consider how popular assumptions have shaped attitudes and guided policy and practice in both communal and commercial areas of South Africa.

In the Herschel District, people were somewhat reluctant to rehabilitate their land because the general feeling was that government must take care of its land … what they believed was theirs was in actual fact something that the government can interfere with as it wishes.

Turner and Ntshona, 1999

Land degradation in communal areas

In South Africa, as with many other countries in Africa, the notion of colonial superiority influenced attitudes towards black farmers, the development of land use policies, and interpretations of agricultural practices in the communal areas. As noted in Chapter 3, both colonial and apartheid governments enforced land use plans and regulations on unwilling black subjects, rather than employing education or positive incentives to encourage changes in land use practices. When black South Africans resisted what they considered to be uninformed or unwelcome interventions, this was interpreted as an unwillingness to care for the land.

Supporters of apartheid often described black farmers as ignorant and irresponsible or greedy and exploitative. Government officials were generally uninterested in indigenous agricultural knowledge, and interpreted non-freehold tenure as an obstacle to sustainable land use. The problem of land degradation was explained in terms of the 'tragedy of the commons'.

In the communal areas, instances of severe land degradation seemed to support the assumption that more people cause more erosion. Certainly, there was little evidence of rapidly increasing human populations in the communal areas resulting in sustainable agricultural intensification. One notable exception is the former Venda homeland in the Northern Province, where the tradition of building and maintaining stone-walled terraces has continued, enabling expansion of cultivation without increased erosion.

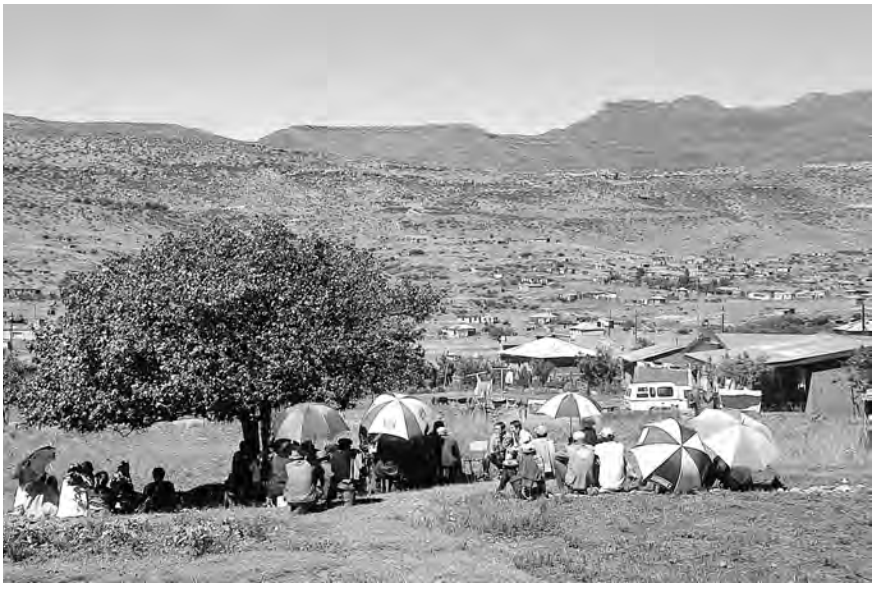
Case study: indigenous natural resource management

In all the case study areas visited (in the districts of Moutse, Peddie, Nongoma and Herschel), people [in historical times] had sustainable indigenous ways of managing their land resources. As people were scattered in their villages, they would manage portions of land close to their homesteads individually, and other areas as common property. Boundaries were marked with beacons. All members of a particular village respected the verbal management of chiefs. Rotational grazing was enforced by using rock cairns, not fences. People would be told which areas to graze and which not to graze. Trenches were dug to control water and prevent it from causing dongas. This was done mainly in mountainous areas like Herschel. There, people reported that a donga scar would not have been allowed next to a person's homestead, as they were settled on mountains. If they had allowed such scars to develop, that would have had a detrimental effect on arable lands, because their fields were at the foot of the mountain.

Turner and Ntshona, 1999

Land degradation in commercial areas

Colonial attitudes also influenced farming practices in commercial areas where a European model of private land ownership was assumed appropriate for South Africa. The process of laying claim to land and erecting fences rapidly put an end to the nomadic pastoralism of some indigenous people.



Case studies were carried out in seven magisterial districts during 1998 to verify the findings of the consultative workshops. Here residents of one of the villages in the Herschel district are involved in discussions.

How green was my valley?

… This dominant mindset has therefore developed a fundamentally flawed strategy … It has imposed 'wet' agricultural practices and assumptions on a predominantly 'dry' country.

Turner and Ntshona, 1999

The environment was seen as a frontier to be tamed and western technological ingenuity was employed to overcome environmental constraints. Artificial fertilisers, irrigation and pesticides coaxed higher and higher yields from the land, but these practices were not always sustainable, resulting in unintended effects such as water pollution, salinisation and poisoning of non-target species in some cases. While legal sanctions were available to punish commercial farmers who acted irresponsibly, compliance was usually encouraged through agricultural extension, subsidies and persuasion.

10.7 People and land degradation: the South African experience

Simplistic explanations of the role of people in land degradation are neither accurate nor helpful, especially in South Africa. The political history of the country has shaped the parallel socioeconomic realities of the communal and commercial farming areas, and complicated relationships between people and the land.

This section presents an analysis of the relationships between land tenure, demography and land use practice, which seem to be linked in a complex chain of causation involving the following factors:

- land distribution and tenure
- demography and settlement
- land use policy
- livelihoods and poverty
- land use practice.

A wild card: HIV/Aids

The impact of HIV/Aids on land degradation has not been a focus of this research project. However, it is clear that greatly increased mortality among economically active adults could have a variety of significant effects on land degradation – both directly (for example, through deaths in rural areas) and indirectly (through impacts on the country as a whole).

An understanding of these factors and their interactions helps to explain how certain land tenure systems and demographic patterns result in sustainable land use, while others lead to land degradation.

Land distribution and tenure

The racial distribution of land rights in South Africa took place in two stages (see Chapter 3). During the first phase of colonial conquest and settlement, legislation was passed to entrench freehold land tenure. At a later stage, further legislation restricted black land ownership to designated 'homeland' areas in which only non-freehold tenure systems were permitted. The white minority became the commercial farming class with access to large land holdings. Interventions like the Glen Grey Act, the Land Acts and 'betterment' restricted black farmers to small landholdings and a communal land tenure system. All were the result of policy intended to assure cheap labour for the mines, industry and commercial agriculture.

Demography and settlement

Population pressures

The Tomlinson Commission recommended that the Msinga district of KwaZulu-Natal could support 2 100 families. By 1980 the area was home to 14 000 extended families with an average of 10 to 12 family members each.

This highly inequitable access to land resulted in low population densities in white farming areas, but very high population densities in communal areas (Figure 10.2, Table 10.1). As black South Africans were removed from towns, cities and white farms and resettled in the 'homelands', populations increased rapidly. Official statistics suggest that between 1960 and 1980 the population of the rural reserves in South Africa increased from about 4,5 million to 11 million people. Many of these communal areas were situated in parts of the country where soil erodibility and topography of the land contributed to land degradation.

The migrant labour system also had a critical effect on the demography of the communal areas. The 'homelands' became pools of cheap labour. Ironically, the migration of men to towns to seek work left the overcrowded homelands with a particular type of labour shortage. Once women of economically active age also started moving to the urban areas, it was often only children and the elderly who were left to manage the land. In many cases, the result was under-farming, with production below subsistence levels and insufficient labour to invest in conservation measures.

Wages for migrant labourers were notoriously low, partly because it was assumed, erroneously, that their families lived on 'farms' and could therefore produce enough food to live on. These sub-subsistence wages were insufficient to invest in agricultural improvements, reducing the potential productivity of the land still further.

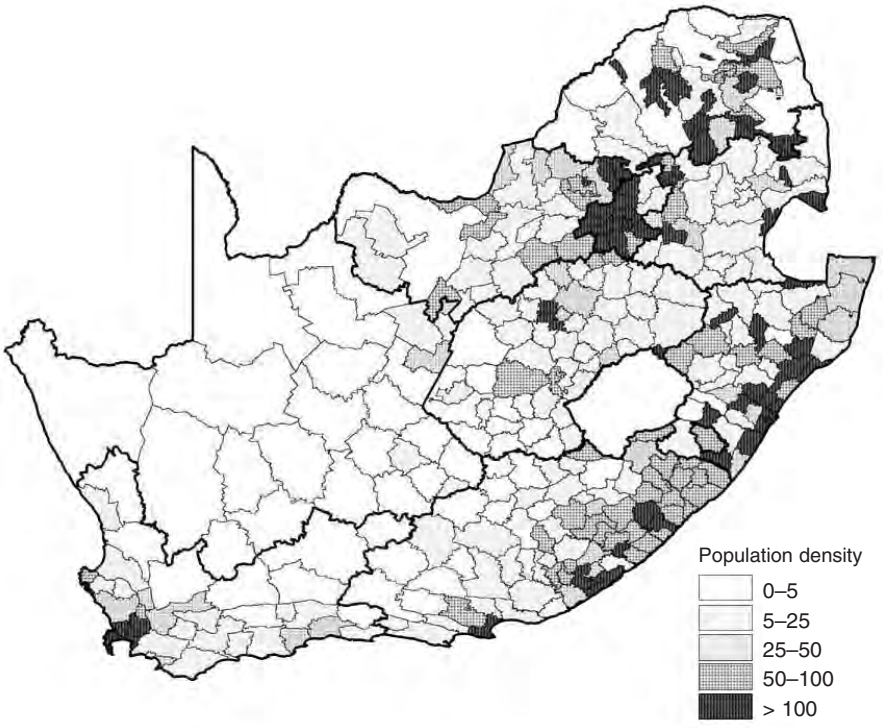


Figure 10.2 *Population density in South Africa (people per km²) (1991 census data)*

Table 10.1 *Population density of rural commercial areas and communal areas in the former Transvaal province in 1980*

Regions in the Transvaal	**Population density (people per km²)**
Rural commercial farming areas	11
Bophuthatswana	29
KaNgwane	63
Lebowa	65
Gazankulu	74
KwaNdebele	193

Land use policy

The history of land use policy has been covered in some detail in Chapter 3. The government intervened in very different ways in communal and commercial districts to combat land degradation. In general, interventions in commercial farming areas took the form of soil conservation policies and campaigns. Land use policies such as 'betterment' were designed for and imposed on the communal areas. The effectiveness of these two approaches was markedly different.

Although not an unqualified success, it is generally agreed that soil conservation efforts have been fairly effective in improving the quality of

> … in the commercial areas, land degradation happened despite the land use policies that were in place … In the communal areas, land degradation happened in large part because of the land use policies that were enforced on an unwilling population.
>
> Turner and Ntshona, 1999

the land in commercial farming areas. The government encouraged farmers to participate in soil conservation by organising awareness programmes, providing extension services and subsidies, and recommending self-organisation through the establishment of soil conservation committees. The law made provision for coercion, but this was seldom resorted to.

On the other hand, in the communal areas the government introduced land use planning programmes such as 'betterment' in a non-consultative, coercive manner. 'Betterment' was a well-researched plan based on the best technical principles of the time. However, the way in which it was implemented not only failed to ensure sustainable land use but also served to alienate people from the land, mainly because the programme was imposed upon an unwilling population.

Livelihoods and poverty

Compared to the levels of poverty experienced by rural black people, white commercial farmers in South Africa enjoyed relative prosperity in the last half of the 20th century (Tables 10.2 and 10.3). But commercial farming can also be a precarious way of making a living, and reliance on credit has often resulted in farmers making unsustainable decisions, such as overstocking the veld or planting ecologically unsuitable cash crops in order to repay debt.

Table 10.2 *Poverty risk by race (from May et al, 1995)*

Population Group	% of people in poverty
African	60,9
Coloured	28,2
Asian	2,0
White	0,7

Table 10.3 *Poverty risk by type of settlement (from May et al, 1995)*

Settlement type	% of people in poverty
Rural	68,1
Urban	39,1
Metropolitan areas	17,2

The worst levels of poverty in South Africa are experienced in the Eastern Cape and Northern Province (Figure 10.3). Both of these provinces had homelands to which large numbers of people were forcibly removed. How have people in these areas used the land, and how have rural livelihoods contributed to sustainable land use or to land degradation?

Prior to about 1980, livelihoods in the communal areas consisted of a combination of sub-subsistence agriculture and sub-subsistence wages earned by migrant labourers. However, since about the 1980s, as the conventional migrant labour system started to decline, rural communities diversified their sources of income. Today, families depend in various combinations on remittances, old age pensions and social welfare, the retail sector (in particular, informal trading), farming and gathering of natural resources. In recent years people have become less reliant on farming and harvesting of natural resources, so that the use of the term 'farmer' to describe rural inhabitants of the communal areas is more and more misleading.

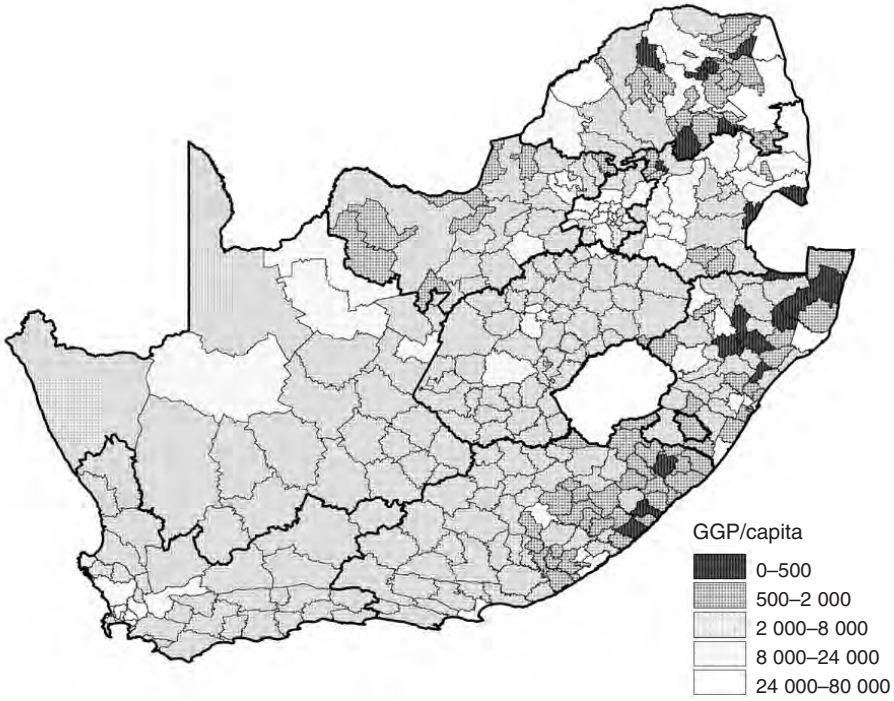


Figure 10.3 *Distribution of gross geographic product (rand per capita) (1995)*

It is ironic that, although the previous homelands are overpopulated, in many areas they are also under-farmed. Numerous factors have contributed to this, including restricted market access, insecure tenure, the lack of able-bodied labour, the unavailability of herders as schooling became compulsory, the lack of access to appropriate advice and technology, and inadequate money to pay for labour or resources.

Under conditions of inadequate agricultural inputs, both stock farming and the extensive cultivation of staple grain crops contributed to land degradation. Gathering wood, dung and crop residues to provide fuel for cooking and heating further reduced the fertility of the soil. As livelihoods diversified, many of the less productive, fragile and degraded areas ceased to be farmed. Today degraded areas do not necessarily reflect current agricultural land use practices, but often reflect historical patterns of use.

In general it appears that successful livestock farmers in communal areas are among the wealthier inhabitants, whereas dependence on gathering natural

Poverty & degradation

Poverty and environment are becoming inseparable twins … because the poorest people (who have least access to investment capital and technology) occupy the lands that need the most infrastructure, management and external inputs if their utilisation is not to result in land degradation and environmental destruction.

Leonard, 1989, in Elliot, 1994

resources, in particular fuelwood, is an indicator of poverty. Under current conditions, sustainable intensification of agriculture in these areas appears unlikely.

Land use practices in commercial areas

Land use patterns in the commercial farming areas of South Africa are related to prevailing ecological conditions. For example, small stock farming is carried out in the arid western parts, while crops are grown in the wetter areas such as the Western Cape coast, the Free State grasslands, Northwest and Mpumalanga. Commercial farming is highly regulated, with limitations on areas that may be cultivated and guidelines governing actions such as cultivation, veld management and soil conservation.

At the consultative workshops, agricultural extension officers and resource conservation technicians agreed that there had been a general improvement in the conservation status of commercial farming lands during the 1990s. They ascribed this to:

- **Agricultural legislation**
  Although seldom used, legislation has been a useful tool in the hands of conservation committees and the extension service.
- **Government subsidies**
  These provided an effective incentive to encourage soil conservation practices and stock reduction.
- **Agricultural extension service**
  This introduced farmers to improved farming methods, and formed a link between the Department of Agriculture, farmers and farmers' unions.
- **Farmer study groups**
  Farmer-to-farmer dialogue and learning has been a persuasive force for change.

Participants at the workshops cautioned that removal of subsidies for major soil conservation works and the decline of the extension service threatened the continued success of the commercial sector and its role in maintaining food security.

Land use practices in communal areas

In communal areas, land use policies disrupted indigenous land use practices which had also been ecologically adapted. 'Betterment' displaced people from areas and types of land uses to which they were accustomed, resulting in lower production, less conservation commitment, less effective resource management and, in some cases, accelerated land degradation. Instead of being able to respond flexibly to climatic circumstances and to the ecological patchiness inherent in any landscape, land use planning allocated resources in a rigid manner.

Workshop participants acknowledged that the agricultural extension service had made a valuable contribution to addressing land degradation in commercial farming areas.

Current land use practices in communal areas include:

Field cultivation

Despite the relatively small scale of crop production in the communal areas, this form of land use has resulted in a considerable amount of land degradation.

Reasons for land degradation in croplands include the following:

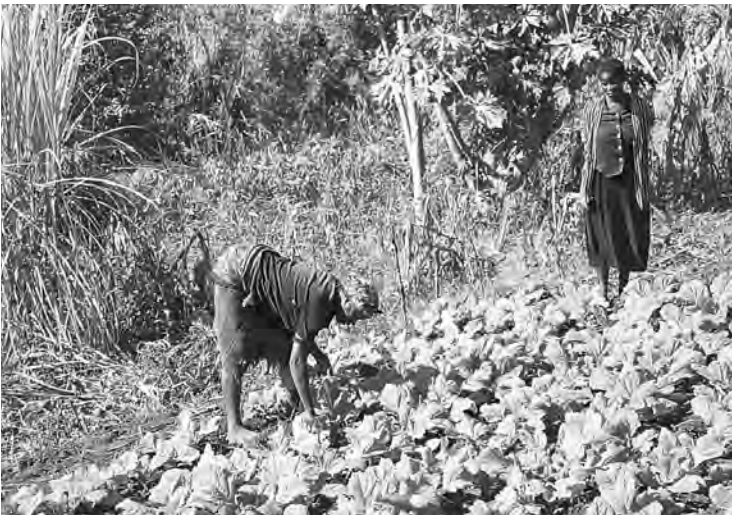
- Rising population densities have forced people to cultivate marginal or unsuitable lands.
- People have become excessively dependent on grain crop monocultures, such as maize.
- There has been a shortage of able-bodied labour.
- The agricultural extension service in communal areas has generally been unavailable, unsuitable or politically unacceptable.
- Soil conservation programmes have been ineffective.

As a result of under-farming, field cultivation is declining as a major cause of land degradation in the communal areas. The stronger, more fertile soils are being farmed in preference to the poorer, more easily eroded soils. The key question is whether crop production will become a significant land use type in future in the communal areas. If it does, land degradation could once again accelerate, unless appropriate conservation farming methods are developed.

Garden cultivation

Gardening is a labour-intensive practice which does not usually contribute to land degradation. Rather, the provision of water to crops and improvement

of the organic content of the soil through composting and mulching improves the status of the land. Gardens offer an approach to sustainable food production in otherwise degraded landscapes.



Gardens provide a model of sustainable land use in both urban and rural areas.

Cattle in the communal areas are kept for many purposes, including milk, meat, draught power and investment.

Livestock production

There can be little doubt that high stocking densities in many communal areas have been a major cause of land degradation, in particular sheet and gully erosion. However, livestock, in particular cattle, have many uses for people living in the communal areas, who generally believe that they own too few rather than too many animals.

There are signs that under-farming is starting to affect stock-holdings as well as crop production. Reduced veld productivity, unavailability of herders and an increase in stock theft may all be contributing to a decline in stock numbers. Unfortunately, an inadequate statistical record, especially for agriculture in the communal areas, makes it difficult to verify such speculation.

In some areas land degradation has been so severe that it may prove irreversible. Despite this, the development of sustainable and flexible range management systems in communal areas is a high priority. The imposition of commercial ranching models onto communal areas is unlikely to succeed. Similarly, the adoption of range management systems used in communal areas elsewhere in Africa might prove equally disastrous. Solutions applicable to South Africa's own political, ecological and socioeconomic situation are urgently needed.

Plant resource collection

The social and ecological impacts of fuelwood harvesting have been covered in Chapter 6. In many communal areas traditional restrictions on the

harvesting of wood have broken down and firewood collection has had a major negative influence on the ecology of the region. Some of these impacts might be partially addressed by the current large-scale electrification projects underway in many rural areas.

While the collection of wild vegetables and medicinal plants may not contribute to land degradation, their harvesting is becoming a threat to biodiversity in many areas.

10.8 Conclusion

While increasing temperatures and changing rainfall patterns associated with global climate change may in time contribute significantly to land degradation in South Africa, people's land use practices remain the major cause of the problem of degradation of the country's biophysical resources.

Exploring the links between people and land degradation has revealed a complex chain of causality. The history of land allocation in South Africa, issues of demography and settlement, land use policies, the nature of rural livelihoods and, of course, the various types of land use have all contributed to land degradation in commercial and communal areas.

The improvement in the conservation status of commercial farming areas can be ascribed to adequate land holdings, government support, farmer organisation and the development of a conservation ethic. Political and economic conditions in the communal areas forced people to pursue alternative livelihoods. In the late 20th century, a trend towards under-farming started to emerge, which in some cases has reduced the role of the rural poor in land degradation.

Future trends are uncertain, but three possible scenarios include:

- a further decrease in the intensity of rural resource use, slowing degradation
- an increase in rural resource use without the allocation of adequate resources or extension, thus aggravating land degradation
- sustainable agricultural intensification.

South Africa needs to be ready to respond to future trends in a way that manages its natural resource base sustainably and productively. More research and extension are needed to develop small-scale, intensive farming practices that are appropriate in terms of local ecology and combine effective conservation with high food yields.

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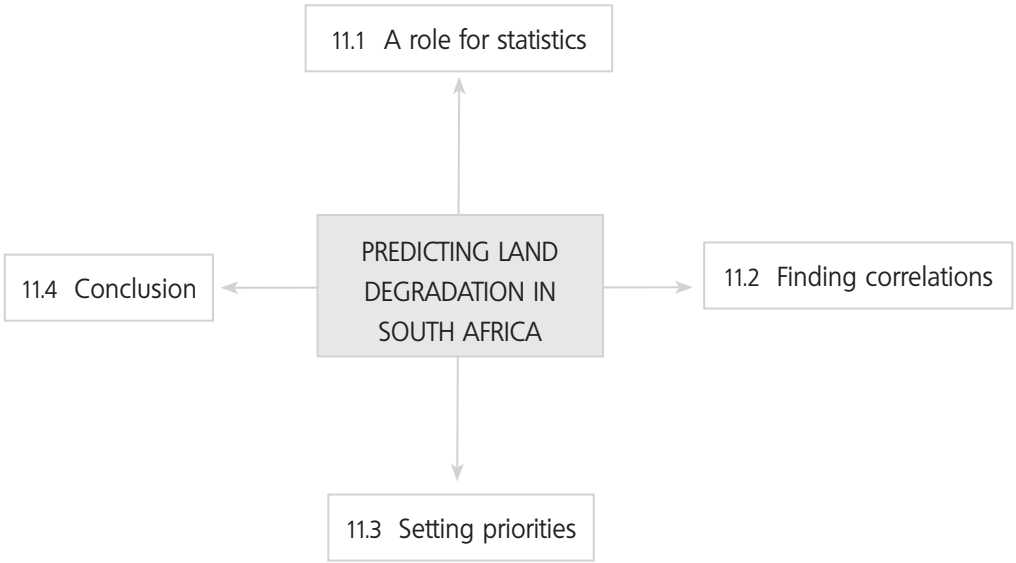
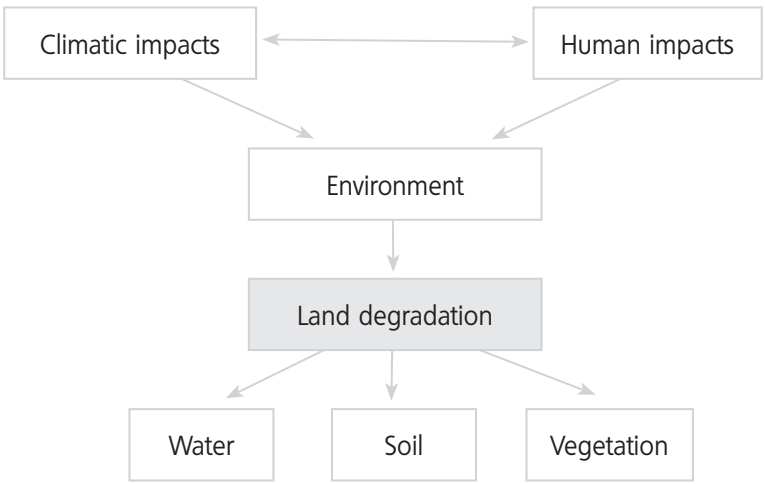
Wilson, F. 1991. A Land out of Balance. In: Ramphele M. and McDowell C. (eds). *Restoring the Land. Environment and Change in Post-Apartheid South Africa.* Panos, London. pp. 27–38.

Statistical analyses using information from the consultative workshops, as well as data from several other sources, were employed to determine which environmental and socioeconomic variables were most closely correlated with land degradation. Results show that districts with steep slopes, high temperatures and low rainfall, and which have a poor, mostly rural population, were the most likely to be degraded. These results were used to identify and map priority areas in terms of their current and potential land degradation status.





Land degradation: a conceptual framework

11.1 A role for statistics

The causes of land degradation are obviously complex, but are some factors of greater significance than others? If we learn to recognise the factors most closely correlated with land degradation, will that help us to understand the problem better and address land degradation more effectively? Is it possible to identify particular causes so that we can predict high-risk areas, conditions and activities, and make informed decisions about priorities?

In an attempt to answer questions such as these, a variety of statistical techniques were applied to the data obtained from the land degradation workshops (Chapters 7 and 8) and from various statistical databases (Chapter 5). A final list of 31 variables was used. The variables were all thought to have a potential influence on land degradation. Investigations sought to determine which of the variables were most significantly correlated with the soil, veld and combined degradation indices. This was done for all magisterial districts together, and for commercial and communal areas separately. The results of this analysis were used to recommend which magisterial districts require priority attention in terms of action to combat land degradation.

Details of the statistical analyses are available in the project report *Land Degradation in South Africa* (Hoffman et al, 1999) and are not reported on here.

11.2 Finding correlations

When analysed statistically, land degradation seemed to be most closely related to whether a district was managed commercially or communally. This held true for soil, veld and the combined index of degradation. In general, districts managed communally were significantly more degraded than districts managed commercially (i.e. under freehold land tenure).

A place for communal land tenure

Nowhere is it suggested that communal land tenure causes degradation. In some cases the two may be associated, especially where institutional control has broken down. But communal tenure has also been shown to be an effective means of managing a region's natural resources for a large number of users.

It does not follow, however, that communal land tenure *per se* is necessarily responsible for the destruction of a district's resources. There are two important reasons for saying this. First, communal land tenure, and the way in which it is implemented, varies enormously across South Africa. In some regions, local authorities manage the land sustainably, using systems of land use that have evolved over many decades. In other regions, this institutional control has broken down to some extent, while in yet other regions the commons is little more than an open access area which is exploited by all, with little attention given to recovery or sustainable harvesting. The same variation exists within freehold land tenure systems.

A second reason why it is incorrect to blame the land tenure system for the high levels of degradation perceived in communal areas is that land tenure is a complex variable comprising several more direct influences on degradation, such as history, demography, socioeconomic conditions and land use factors. In South Africa, communal tenure is synonymous with high population density, poverty, poor infrastructure and a strong reliance on natural resources for survival. Some of these factors influence degradation more directly than the type of land tenure system.

Table 11.1 *Variables shown statistically to be positively (+) or negatively (-) correlated with land degradation indices. Separate analyses were done for 348 magisterial districts, and for 226 predominantly commercial or 89 communal farming districts. Some 19 highly urbanised districts were excluded from the analysis. See also Table 5.1 (CDI = combined soil & veld degradation index, SDI = soil degradation index, VDI = veld degradation index)*

Variables	All districts			Commercial			Communal		
	SDI	VDI	CDI	SDI	VDI	CDI	SDI	VDI	CDI
Biophysical									
Area of district									
Altitude									
Slope	+	+	+	+	+	+	+	+	+
Runoff									
Erodibility	+	+							
Fertility								+	+
Climatic									
Mean annual rainfall							–	–	–
Summer aridity index									
MAP:PET		–							
Grow days								+	+
Mean annual temp	+	+	+	+	+	+			
Land use area									
Crops									
Veld	+		+			+			
Forest									
Conservation									
Settlement	+								
Other									
Stocking density			+			+			
Demography									
Population density									
% Male									
% Economically active									
% Rural	+		+						
Labour & employment									
% Unemployed	+	+	+						
% Employed in agriculture									–
Growth of agric employ									
Dependency ratio	+								
Economic production									
GGP/capita (poverty)								–	–
Agric contribution to GGP									
Annual growth in agriculture									
Average GGP growth									

Other than land tenure, variables significantly correlated with the soil, veld and combined degradation indices include slope, soil erodibility and fertility, mean annual rainfall, MAP:PET ratio, grow days, mean temperature, the proportion of the district that is rural or used for grazing and settlement, stocking density, levels of unemployment, the proportion of the population employed in the agricultural sector, numbers of dependants and poverty (Table 11.1). In general, areas with steep slopes, high temperatures and low rainfall and where the population is largely rural and poor, are the areas where degradation is highest. This corresponds, in large measure, to the situation in many of South Africa's communal areas.

11.3 Setting priorities

Using the degradation indices, as well as the variables identified as being significantly related to the degradation indices, districts were ranked from high priority to low priority in terms of their degradation status. A list and map of the top 20 districts identified by this analysis are shown below for the full data set (Table 11.2) and for the commercial areas only (Table 11.3). An independent analysis of communal areas resembles almost exactly the analysis of all magisterial districts, and is therefore not presented separately.

When deciding on where a limited budget should be spent on combating desertification, many factors besides those discussed here should be taken into account. Expert knowledge of an area and statistical records of the environmental and socioeconomic conditions reflect only part of the story. Decisions about where to invest time, energy and money should take into account other factors, including institutional capacity, levels of conflict within a district and the rehabilitation potential of the area. Prioritisation is an enormously difficult task and should be done with great caution.

Table 11.2 *The twenty magisterial districts in South Africa, independent of land tenure system, with the highest priority in terms of land degradation*

Eastern Cape	KwaZulu-Natal	Northern Province
Engcobo	Mahlabatini	Mutale
Herschel	Mapumulo	Naphuno 2
Middledrift	Msinga	Praktiseer
Mount Ayliff	Nkandla	Schoonoord
Mount Fletcher	Nongoma	Sekgosese
Mqanduli	Nqutu	
Qumbu	Weenen	
Xhora		

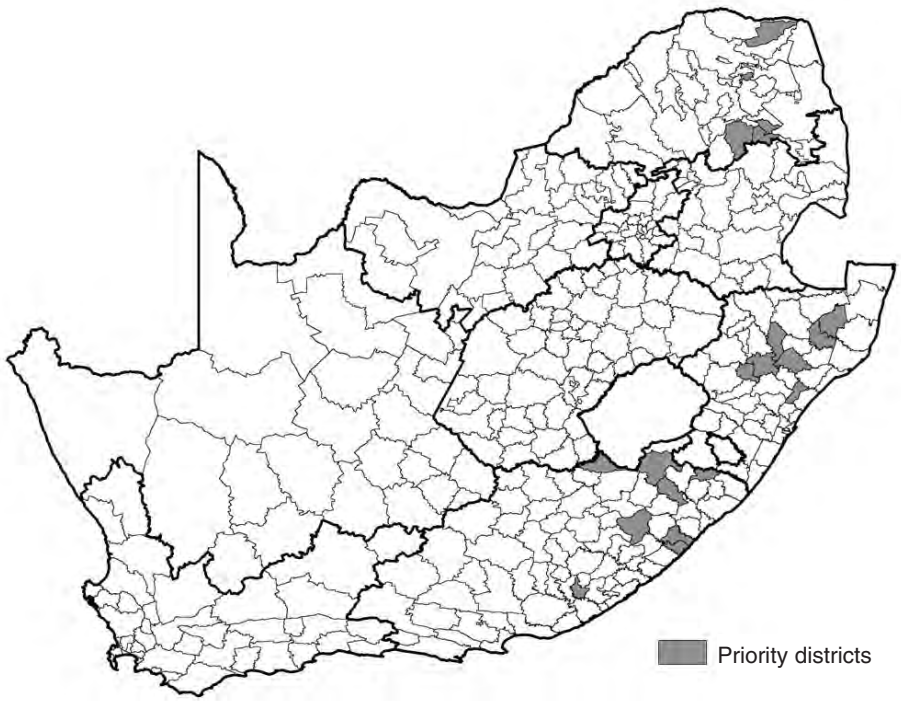


Figure 11.1 *The twenty magisterial districts, independent of land tenure system, identified as priority areas in terms of their current and potential land degradation status*

Table 11.3 *The twenty commercial magisterial districts selected as having the highest priority in terms of land degradation. A commercial district was defined as one in which at least 80% of the area was managed under a freehold land tenure system. A total of 226 districts were used in the analysis.*

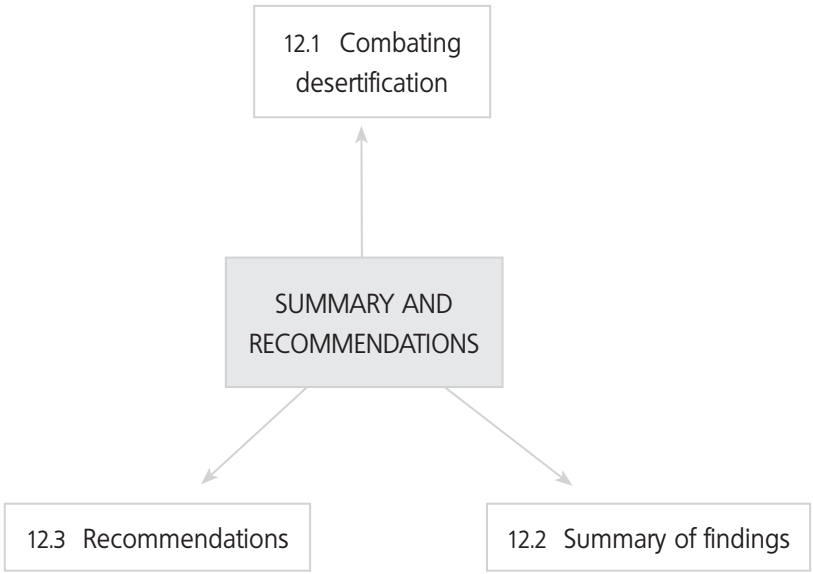
Eastern Cape	KwaZulu-Natal	Northern Cape	Northern Province	Northwest	Western Cape
Komga	Glencoe	Britstown	Messina	Marico	Calitzdorp
	Kliprivier	Carnarvon	Phalaborwa		Montagu
	Ngotshe	Fraserburg			Oudtshoorn
	Weenen	Gordonia			Vanrhynsdorp
		Hay			
		Hopetown			
		Prieska			
		Williston			

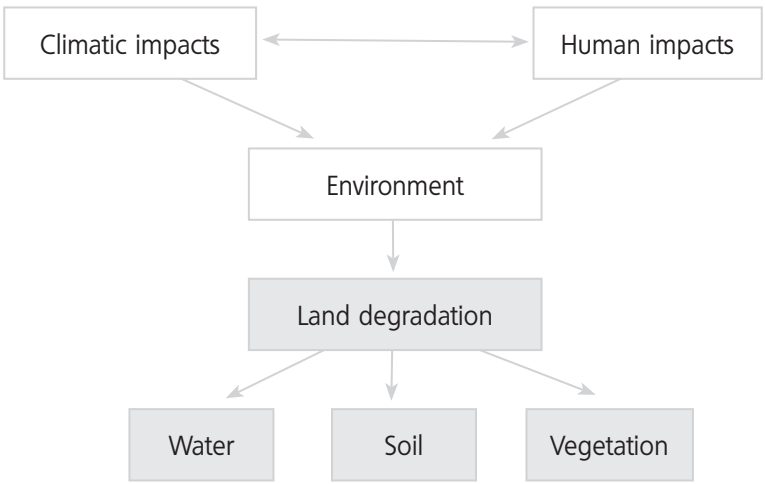
Figure 11.2 *The twenty magisterial districts with at least 80% freehold land tenure (i.e. the commercial farming areas) identified as having the highest priority in terms of land degradation*

11.4 Conclusion

It is not a simple matter to decide which districts and areas most require or deserve assistance in combating land degradation or desertification. This wide-ranging and integrated overview of the problem of land degradation in South Africa should go a long way towards helping decision-makers and practitioners alike to allocate resources and effort fairly and effectively. However, a host of other factors should also be considered before decisions are made concerning where to place effort into combating land degradation in South Africa.

Information gathered during the consultative workshops was used to develop consensus maps of land degradation. Statistics compiled for each magisterial district were used to determine which environmental and socioeconomic variables were most closely correlated with land degradation. These analyses were used to determine which magisterial districts required most urgent attention for combating land degradation. The overall analysis suggests that priority should be given to communal areas in the Northern Province, KwaZulu-Natal and the Eastern Cape.





Land degradation: a conceptual framework

12.1 Combating desertification

Desertification and land degradation

As much as 91% of South Africa's land surface can be described as arid, semi-arid or dry sub-humid. These are the dryland categories of particular concern to the United Nations Convention to Combat Desertification (UNCCD). A further 8% is hyper-arid and also susceptible to land degradation. As a signatory to the UNCCD, South Africa is required to develop a National Action Programme (NAP) to combat desertification.

The term desertification can be misleading. Many people think it means the expansion of natural deserts, but it actually refers to the degradation and loss of productivity of drylands owing to poor land management or climatic changes. To avoid confusion, we have used the term land degradation rather than desertification in this book. Land degradation encompasses a wide range of issues, such as soil erosion, salinisation, loss of plant cover, bush encroachment and alien plant invasions.

South Africa's National Action Programme

The Department of Environmental Affairs and Tourism (DEA&T) is responsible for coordinating the development of South Africa's NAP which, in the spirit of both the UNCCD and South Africa's participatory democracy, will be a partnership between the state and civil society. In 1997, as a first step in the process, DEA&T commissioned a study to determine the status of land degradation in South Africa. A research report on the findings of the study was produced in 1999. This popular version of the research report has been written to make the information in the report more widely available and to encourage broad participation in finding solutions to the complex problem of land degradation in South Africa.

12.2 Summary of findings

The main findings of the review are presented in point form below. The workshops did not gather information on the status of water resources. There is an urgent need for a national review of ground and surface water resources, and for the development of a national map showing the status of fresh water resources in the country.

Soil degradation

The study considered both erosive and non-erosive forms of soil degradation and found that:

- The problem is substantially worse in communal areas than in commercial farming areas.
- Land use type and land tenure system are important predictors of soil degradation, although it is not necessarily the land tenure system itself which is to blame for the observed relatively high levels of degradation in the communal areas.

- Steeply sloping land in the eastern parts of South Africa, in particular land that is now used primarily for grazing, is badly affected.
- The Northern Province, KwaZulu-Natal and Eastern Cape are the provinces most badly affected by soil degradation.

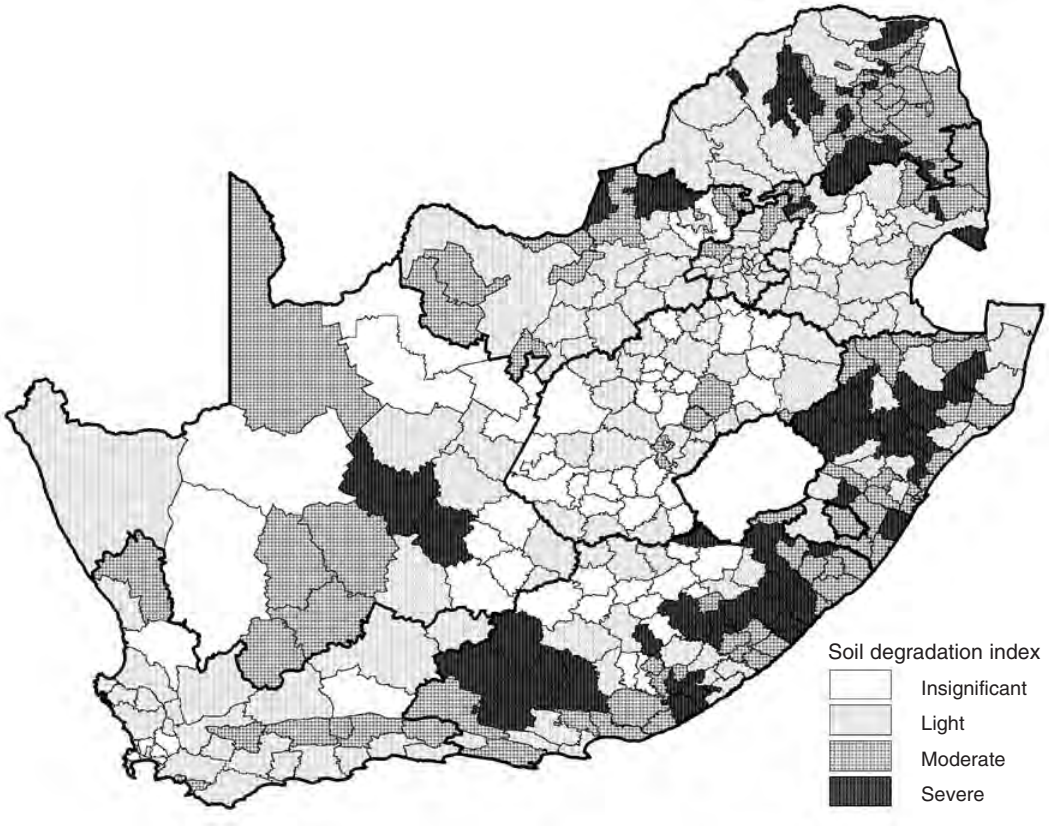


Figure 12.1 *A soil degradation index for magisterial districts in South Africa*

Veld degradation

The study considered five main categories of veld degradation, namely, loss of cover, change in species composition, bush encroachment, alien plant invasions and deforestation. The most important findings are:

- On the whole, veld is more degraded in communal areas than in commercial farming areas. However, in contrast to the case with soil degradation, the predominant land tenure system of a district appears not to be strongly related to the level of veld degradation. Degradation problems which relate to changes in plant species composition, bush encroachment and alien plant invasions are, in general, worse in commercial districts than in communal districts.
- Rural poverty and land use policies like 'betterment', which were only applied to communal areas, are closely correlated with veld degradation. In the first instance, poverty forces many people to rely on natural resources for their energy and food requirements, while in the second, policies such as 'betterment' diminished responsibility for sustainable management practices on the part of local land users.

- Veld degradation is worst in the Northern Province and in KwaZulu-Natal.
- The eastern Karoo is no longer perceived to be badly degraded by most agricultural experts. In fact, it appears to have benefited considerably from the attention received as a result of the writings of people such as John Acocks in the middle of the 20th century.
- The rate of veld degradation is decreasing in commercial districts, largely as a result of state intervention strategies and schemes, while it is perceived to be increasing in communal districts.

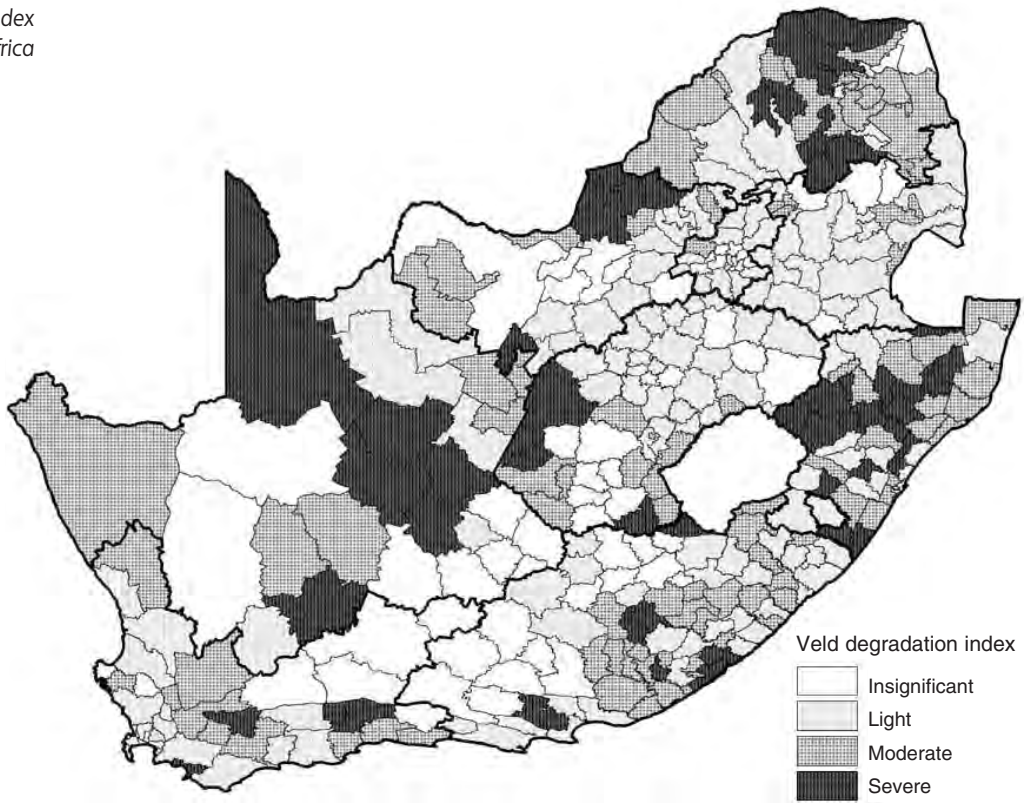


Figure 12.2 *A veld degradation index for magisterial districts in South Africa*

Combined soil and veld degradation

- When soil and veld degradation are considered together, communal areas are perceived to be significantly more degraded in general than commercial farming areas, although there are many exceptions.
- Overall, land degradation is most severe in the Northern Province, KwaZulu-Natal and the Eastern Cape. The problem is greatest in steeply sloping parts of the former Ciskei, Transkei and KwaZulu. On the whole, land degradation is perceived to be increasing (i.e. the situation is getting worse) in communal districts.
- The Northern Cape and Western Cape are the provinces with the most degraded commercial farming areas. In general, however, land degradation is perceived to be decreasing in commercial districts.

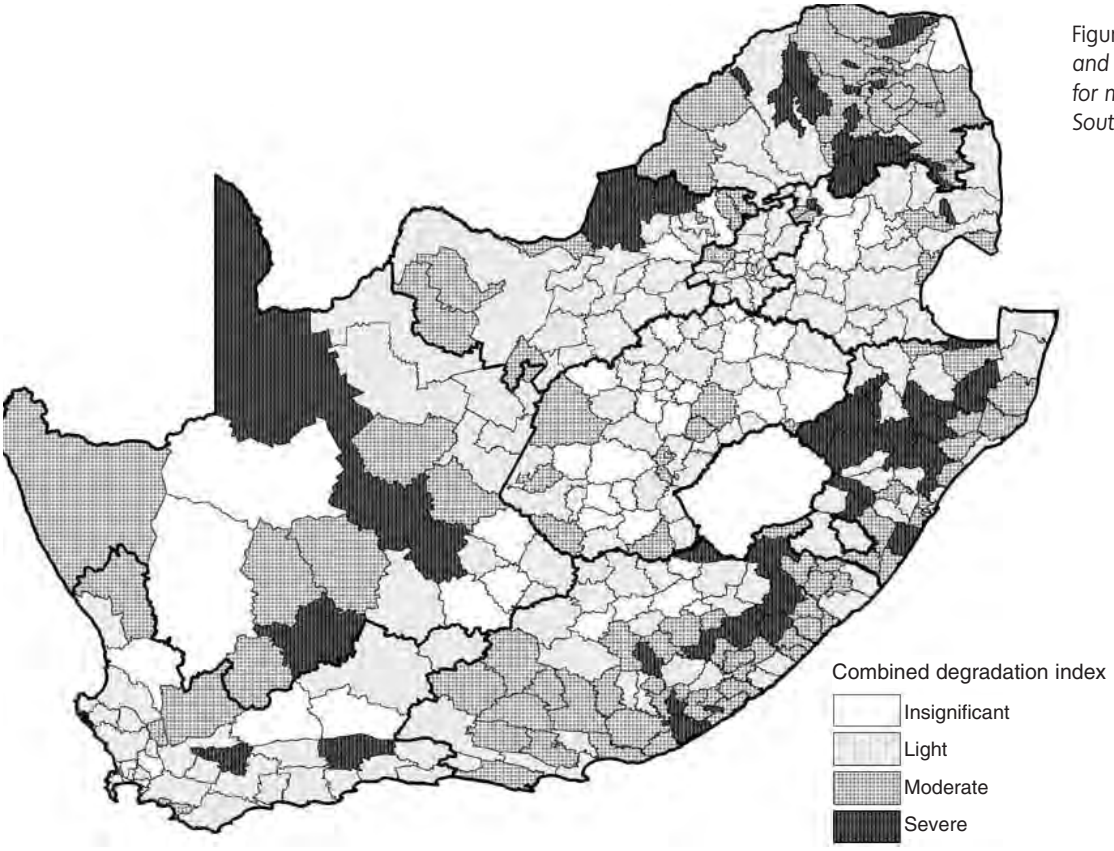


Figure 12.3 *A combined soil and veld degradation index for magisterial districts in South Africa*

Factors influencing land degradation

Contrary to popular belief, environmental and climatic conditions in many of the former homelands are conducive to productive agriculture. The problem of land degradation is more closely linked to a complex and interacting suite of environmental, climatic, historical, political and socioeconomic factors. Areas with steep slopes, low annual rainfall and high temperatures seem particularly susceptible to high levels of degradation. Similarly, areas with high levels of poverty also appear more degraded than those where poverty indicators are less extreme.

Workshop participants agreed on a number of additional factors that have served to increase or decrease the levels of land degradation over the last ten years.

Reasons for improvements in the quality of land

- adequate landholdings
- government interventions, e.g. legislation, schemes and subsidies
- agricultural extension services and better education
- farmer self-organisation and study groups
- decreases in stock numbers
- public pressure and a growing conservation ethic and awareness
- electrification of rural and peri-urban settlements

Reasons for increased land degradation

- inadequate landholdings
- inappropriate or enforced land use planning, e.g. 'betterment'
- economic policies, e.g. the migrant labour system, tariffs, lack of incentives for farmers in communal areas
- high population densities in rural areas
- high stock numbers, especially when there is no control over their movement and grazing patterns
- poverty.

12.3 Recommendations

Recommendations arising from this review include the following:

- Many of South Africa's communal areas are in dire need of attention. Intervention efforts should take account of the predictor variables and priority areas identified by this study and focus attention on these areas.
- Sustainable agricultural models must be developed for South Africa's communal areas that take account of their unique histories and biophysical as well as socioeconomic environments. The imposition of models developed for the commercial farming sector, as well as those from communal areas further north in Africa, are unlikely to prove successful in combating degradation.
- Research into land degradation must continue, particularly in South Africa's communal areas. Many more case studies are needed to deepen our understanding of this complex issue and to help develop locally appropriate solutions. Success stories in which local solutions to combating desertification have occurred are urgently needed (see Chapter 13).
- While ensuring redress in terms of the provision of support to the communal areas, sustainable land use practices must also be supported and maintained in the commercial farming areas in order to ensure food security for South Africa. The commercial farming sector is crucial for a productive future and should not be summarily abandoned.
- The agricultural statistical service must be revived and adequately supported to provide reliable data for planning in both commercial and communal areas.
- Similarly, a strong agricultural extension service in both the communal and commercial farming areas is essential if land degradation is to be reversed. The extension service needs to be strengthened as a matter of urgency and well-trained and effective personnel need to be deployed in all areas of the country.
- Agricultural planning must take account of the potential effects of global climate change and must be able to respond to short- and long-term changes in climate and vegetation. In particular the role of drought in affecting food security and livelihoods needs to be better understood and appropriate mitigating measures adopted.

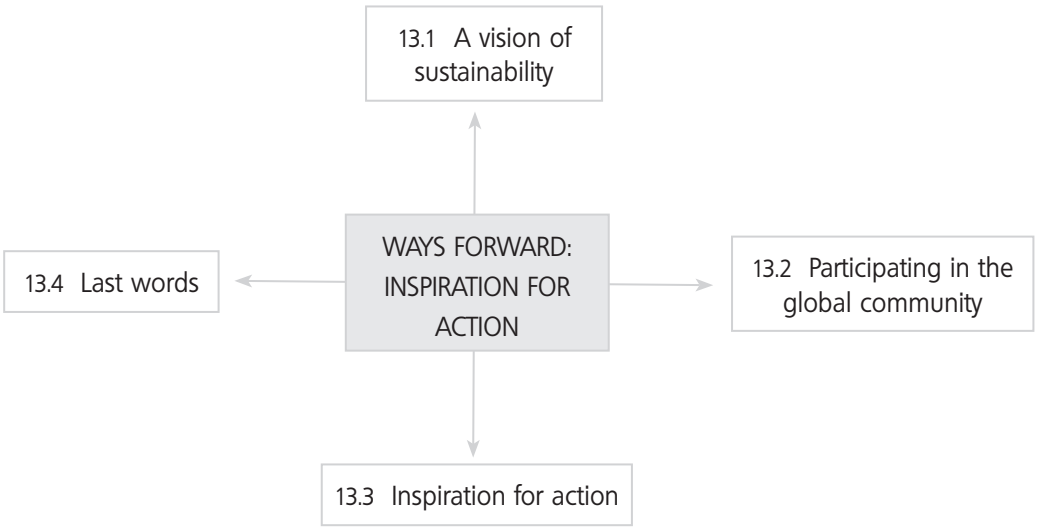
- A national review and map of the status of South Africa's freshwater resources are urgently needed. Without this knowledge, any intervention strategy arising from the National Action Programme (NAP) will be severely constrained.
- In order to develop a NAP that remains relevant and responsive, ongoing monitoring of various aspects of land degradation is essential. Agricultural planning must be able to respond to variable changes in climate and vegetation, particularly in the light of global climate change. Specific monitoring needs to cover rainfall, soil erosion and veld degradation. The assessment of state interventions to combat desertification will provide vital direction for future action.
- Public participation must be encouraged at all levels and efforts to combat land degradation must be better coordinated. The involvement of land users in decisions about their resources is essential if intervention strategies are to be successful.

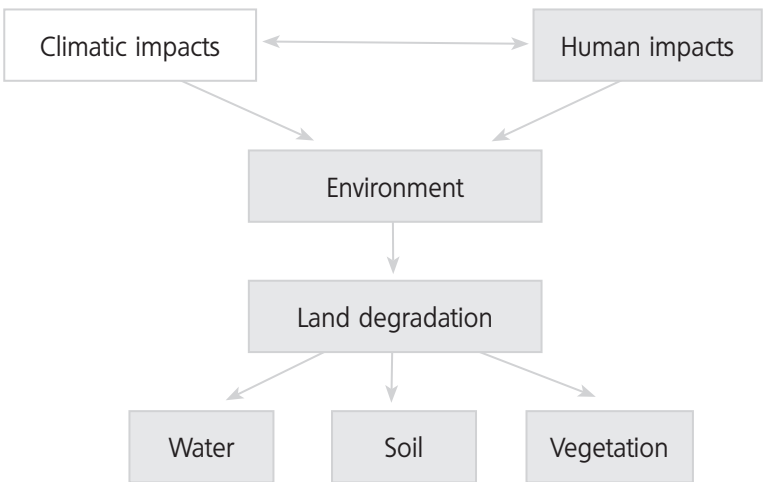
If South Africa's National Action Programme is to succeed, the involvement of land users is essential, particularly in the communal areas where many women are responsible for day-to-day land management decisions.

Recommendations in a nutshell

- Focus attention on communal areas but don't abandon the commercial farming sector.
- Information on water resource degradation at a national level is urgently needed.
- The effect on South Africa's food security of short- and long-term changes in climate is poorly understood. The impact of drought needs urgent attention.
- Planning requires accurate information: revive the agricultural statistical services and strengthen the agricultural extension service.
- You don't know where you are going if you don't know where you have come from: monitor, monitor, monitor.
- Include land users in decisions and intervention strategies. They are the people who have the greatest interest in combating desertification.

Having considered the status of land degradation in South Africa, what can be done to respond to the United Nations' imperative to combat desertification? The principles of participation and cooperation enshrined in the UNCCD, and the vision of sustainable land use, provide signposts for the way forward. There is no single recipe for sustainable land use, especially in a diverse and complex society like South Africa. However, in responding to the challenges of a particular context, the experiences of others can provide both inspiration and principles to guide practice. This final chapter shares a few stories of people and projects that have made a difference.





Land degradation: a conceptual framework

13.1 A vision of sustainability

The vision

Gatherings such as the Earth Summit of 1992 and documents like *Caring for the Earth, Agenda 21* and the *United Nations Convention to Combat Desertification* (UNCCD) all clearly describe a vision of sustainable living: the actions of this generation must not compromise the survival of future generations. In the past, conservation programmes tended to view people (the aggressors) as separate from the environment (the victim). That thinking is changing, and notions of integration, participation and collaboration characterise many environmental programmes today. People *can* be part of the solution, the environment and development *are* compatible ideas, and 'conservation farming' is *not* a contradiction in terms.

The imperative

As described in Chapter 1, South Africa is a signatory to the UNCCD and is therefore required to develop and implement a National Action Programme (NAP) to combat desertification. The Department of Environmental Affairs and Tourism (DEA&T) is responsible for coordinating this process.

In the spirit of the UNCCD, all sectors should participate in planning, making decisions and implementing actions to combat desertification. Traditional knowledge systems must be respected and developed, and the needs of developing countries must be given special consideration. Cooperation is encouraged at all levels, whether international, regional, national or local, in order to avoid unnecessary duplication of effort and share knowledge and resources.

Information for action

The national review of land degradation has been published in this popular form in order to enable informed participation in the development and implementation of South Africa's NAP.

The DEA&T will initiate, coordinate and write the NAP. The Department believes that it can most effectively address problems of land degradation and poverty nationally by coordinating the efforts of government departments, such as the Departments of Water Affairs and Forestry, Agriculture and Land Affairs, and Foreign Affairs.

Practical action at a local level will be enhanced if government and civil society work together as partners, sharing a common vision and purpose. South Africa can draw inspiration and encouragement from a number of existing initiatives, ranging in scale from efforts of individual farmers to national programmes. Later in this chapter a few short accounts are provided of ways in which people in South Africa are learning to work more sustainably with the land.

13.2 Participating in the global community

South Africa has many opportunities to participate in global forums around desertification. South African delegates participate in the Conference of the Parties (COP), the major decision-making body of the UNCCD, which currently meets every year. South African government delegates, an NGO representative and a member of the scientific community, attend the Committee on Science and Technology which advises the COP and is setting up a support network of scientists with expertise in the field of desertification.

For more information, try the following websites:
http://www.unccd.de
http://www.unccd.ch

Africa is recognised as the continent requiring most urgent attention in terms of desertification. At international meetings, South Africa can participate as part of the Southern African Development Community (SADC) and African blocs. Numerous conferences and discussion forums provide opportunities for African country parties to meet with representatives from other regions, for example the Afro-Asian Forum and the African-Latin American and Caribbean Forum.

From a research point of view, South Africa is a member of the Desert Margins Initiative, a research programme investigating land degradation issues and sustainable land management in sub-Saharan Africa.

By participating in these international research and decision-making forums, South Africa remains informed and helps to shape global thinking about desertification. South Africa can also form partnerships with other country parties, benefiting from the sharing of insights, technology and funding encouraged by the UNCCD.

13.3 Inspiration for action

The following stories are, to use an inappropriate metaphor, the tip of the iceberg of efforts to ensure sustainable land use in South Africa. For every example mentioned, there are hundreds of tales left untold – stories of vision and commitment, of innovative ideas that defy a lack of resources, and of a willingness to learn from tough experience. And this is the country's hope – that its people are reclaiming the land. Individuals, communities and government can once more identify with the land, and are taking responsibility to retrieve and restore what was lost.

Other success stories

Other success stories in Africa and elsewhere can be found at the following website:
http://www.unep.org/unep/envpolimp/techcoop/1.htm

Five stories have been chosen, reflecting a variety of contexts, approaches and scales of operation:

- stone terracing near Thohoyandou in the Northern Province
- agricultural extension in the Reitz district of the Free State
- resource sharing in the Tugela Valley in KwaZulu-Natal
- community-based land management in the Herschel district, Eastern Cape
- the Working for Water programme of the Department of Water Affairs and Forestry.

Venda stone terracing

In the foothills of the Soutpansberg, in the Thohoyandou district of the Northern Province, is a fertile area with a subtropical climate receiving on average 1 000 mm of rain per year. More farming takes place here than in the surrounding drier areas. Tribal land tenure is relatively secure, and the area has been inhabited and cultivated by Vhavenda people since at least 1200 AD.

The Vhavenda people have a long tradition of building stone terraces on sloping ground. Evidence includes remnants of stone terraces in the Buffelskloof Nature Reserve near Lydenburg in Mpumalanga that were abandoned in the early 1800s.

Farmers in the Thohoyandou area are well aware of the physical factors and land use practices that cause soil erosion. They list causes such as rainfall, slope and drought; and ploughing, burning, overgrazing and cattle paths. Their experience has taught them that erosion diminishes soil fertility and results in dongas and pollution of a nearby lake. Depending on the slope and the availability of rocks in the field, the farmers use stone terraces (*mitsheto*) and/or grass strips (*thambaladza*) to combat erosion.

The terraces are like low walls between 0,75 m and 1,25 m high, with a base width of 1,0 m to 1,5 m. Spacing between the walls is from 2 m to 10 m. Construction of the basic structure takes one season, but the terraces continue to be built up over the years. Fertile soils accumulate behind the walls, as is evident from the more luxuriant plant growth. The terraces work by trapping soil, retaining moisture and making the soil more productive.

Neighbours help to construct the terraces and are either compensated with food and beer, or helped when it is their turn to build terraces. No subsidies or cash incentives are involved: people well understand the conservation and production benefits of this long-standing tradition.

Contours, built from stones and rocks in the Thohoyandou district of the Northern Province, help prevent soil erosion and maintain production.

Agricultural extension in the Free State

The impact of the agricultural extension services on land management practice in commercial farming areas should not be underestimated. One of the case studies conducted as part of the national review of land degradation took place in the Reitz district of the Free State. Farmers were interviewed and aerial photographs of farms taken in the 1970s compared with photographs from 1991. The consensus was that in all cases, the condition of the land had either remained fairly constant or improved.

Farmers referred in particular to the efforts of Mr P.J. Theron, the district's soil conservation technician between 1972 and 1986, whose energetic efforts had resulted in a large number of soil conservation works, such as contours and grassed waterways, being constructed.

All the farmers interviewed recognised the need to care for and invest in the land, and understood that soil losses affected their profit margins. They noted that integrated farm planning and improved farm management and tillage practices had contributed to farm improvements. Over the years, conservation farming has become the norm, encouraged by a certain amount of peer pressure from other farmers in the district. An annual 'conservation farmer of the year' award helps to motivate farmers to care for the land.

Farmers interviewed were very concerned about the withdrawal of subsidies for soil conservation works, and the refocusing of agricultural extension efforts on the communal and emerging black commercial sectors. They felt that soil conservation should be a partnership between the farmer and the state, and were concerned about the deterioration of some soil conservation works in the absence of funds to maintain them.

The agricultural extension service has contributed to productive farming and sound land management in many of South Africa's commercial farming districts.

This story highlights the importance of education and communication in improving land management practice, and reminds us that the commitment of a single individual can often inspire many people to action. However, it also cautions us that times change, and that it is therefore essential to be able to respond flexibly to new circumstances. The case report from the Reitz district notes that 'All that remains ... is [the farmers'] own conscience and pride to conserve their own farms'. In the absence of state funding and a declining extension service, the condition of farming land in the Reitz district may deteriorate. Reliance on external funding through state subsidies may prove to have been an effective but ultimately unsustainable approach to soil conservation.

Mdukatshani/CAP Farm Trust

The Tugela River Valley in KwaZulu-Natal has been one of the most poverty-stricken and violent parts of

the country. The environment is hot and dry, and the land has been severely overgrazed. The homeland areas of KwaZulu were surrounded by a belt of marginally more productive white-owned land in the Weenen district. White farmers started agitating for more land and complained about overgrazing on the neighbouring farms. Labour tenancy came under attack from both liberal politicians, who described it as an 'evil', and the National Party government, which frowned upon the 'blackening' of the farming areas ('beswarting van die platteland'). The government outlawed labour tenancy in the 1960s and most of the black families were forcibly removed to the Msinga area, where overcrowding has been associated with ongoing faction fighting. By the mid to late 1970s, reaction against these evictions resulted in labour tenancy being reinstated in areas where tenants still lived.

Neil Alcock established Mdukatshani, a non-governmental trust, on 2 500 hectares of depopulated farmland on the Weenen-Msinga border in 1975. The titles of three adjoining farms are registered in the name of CAP (Pty) Ltd, a non-profit holding company which leases the land to Mdukatshani at a nominal rental. The land was to be used as a resource by the people who had previously lived in the area but been evicted.

The story of Mdukatshani has been one of vision and persistence tempered with the ability to be flexible and respond to changes. What started as a livestock cooperative has developed into a unique resource-sharing programme. After Neil Alcock died in the crossfire of one of the many faction fights that plague the area, the programme went through a dark period, resource-sharing broke down and the grazing lands were degraded. After the severe droughts of the early 1990s, negotiations between Mdukatshani staff and neighbouring communities resulted in a resource-sharing programme in which the resource-users are responsible for maintenance of the system.

The terms and conditions of the resource-sharing programme have been determined by a thorough process of negotiation in which the chief indunas (advisors to the local chiefs) have played a pivotal role. Neighbouring communities use the farms for winter grazing for their cattle and goats, and also agree on the amounts of thatching grass, wood and medicinal plants that may be gathered. During autumn, before livestock are driven onto the farms, work teams repair fences and burn fire breaks. The grazing pressure in winter is intense, but the veld is rested completely during summer. It is interesting to note that basal grass cover and species diversity have both improved markedly since this system was introduced. Veld condition is excellent and the land has been able to support extended periods of grazing during droughts.

In an area where government officials are unable to enforce the law, this programme seems to be working partly because the communities are aware of its benefits, and partly because a partnership of tribal authorities and the Trust enforce rules that have been developed through a process of negotiation.

Resting the veld in summer has enabled Mdukatshani to provide winter grazing for its neighbours and improved the quality of the vegetation.

NGO involvement in Herschel

The apartheid years spawned a large number of non-governmental organisations (NGOs). In the absence of adequate government support, NGOs frequently stepped in to support the development needs of marginalised communities. The Environmental Development Agency Trust (EDA) has been working in rural areas of the Eastern Cape for many years. Essential to the operation of the EDA is a participatory approach that is responsive to needs expressed by local communities.

In the Herschel district, the EDA recently started supporting the development of land management initiatives for range management, catchment management and social forestry. A central component of the project is the establishment of management structures. The community and support agency both offer their knowledge and skills and share a desire to increase the productivity of the land.

The scheme does not include cash incentives or pay for work, making this project somewhat unusual in South Africa. The benefits of involvement in the project are the knowledge and management experience gained, as well as the improvements in production already attained. A lack of reliance on external sources of funding and the development of institutional capacity may contribute to the long-term sustainability of this project.

The district of Herschel in the Eastern Cape is one of the most degraded areas in South Africa. Even greater efforts by NGOs, community-based organisations and government are needed to address the significant problems of land degradation in the district.

Working for Water

As mentioned in Chapter 8, South Africa has a serious problem with invading alien plants. Problems associated with alien plant invasions include reduction of runoff to rivers and dams, increased severity of veld fires, reduced productivity of land and threats to biodiversity.

The Department of Water Affairs and Forestry estimates that to clear the 10 million hectares of invaded land in South Africa, an initial 20-year clearing strategy is required, costing about R600 million per year. The Department rose to the challenge of securing a budget, raising funds and coordinating an ambitious national programme that focused on two of the benefits of alien eradication: increased runoff and job-creation.

In 1995 the then Minister of Water Affairs and Forestry, Kader Asmal, launched Working for Water, a multi-departmental public works programme. The beauty of Working for Water is its integrated vision: one programme responds simultaneously to the needs for alien eradication, water provision, economic empowerment and transformation. There are currently 300 projects in South Africa, spread through the nine provinces.

In a relatively short time, the programme has achieved many of its goals, raised public awareness and generated a number of unexpected opportunities and secondary projects. Benefits have included an increase in water available for irrigation, provision of firewood and building materials, the setting up of flower-picking industries, and even the production of educational toys for the crèches set up to look after the children of Working for Water workers.

The vision of Working for Water

The Working for Water programme will sustainably control invading alien species, to optimise the potential use of natural resources, through the process of economic empowerment and transformation. In doing this, the programme will leave a legacy of social equity and legislative, institutional and technical capacity.

Working for Water Project

Visit the Working for Water web page at: http://www-dwaf.pwv.gov.za/projects/wfw

The Working for Water programme employs people on a temporary basis only, but during their contract periods workers are encouraged to develop entrepreneurial skills so that they can tender privately for jobs such as eradication of aliens, firefighting and maintenance of fire breaks.

The Department of Water Affairs and Forestry has been in a position to involve a number of other national ministries in the Working for Water programme. Partnerships with departments such as Agriculture and Land Affairs, Welfare and Population Development, and Environmental Affairs and Tourism have strengthened the influence and effect of the programme.

No programme of this magnitude will be without its problems or detractors, but Working for Water has shown that integrated thinking, an inspiring vision, energetic leadership and political will can transform both lives and landscapes.

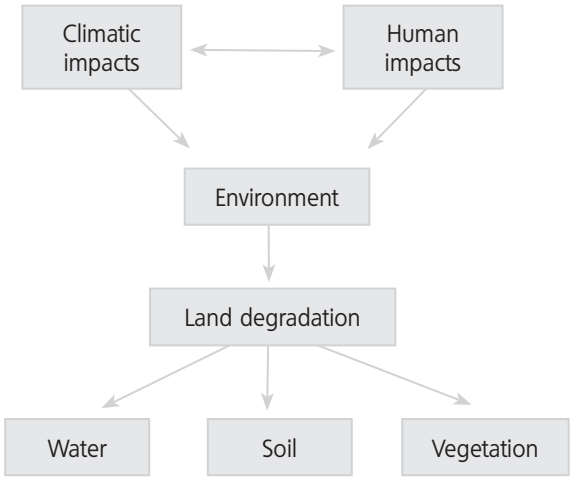
The Working for Water programme has combined alien plant eradication with job creation and training.

13.4 Last words

Throughout this book, the land has seldom been mentioned without some reference to people. Indeed, looking at the conceptual framework that has guided our discussion, it is clear that people influence all parts of the model.

People have a direct impact on the land through various types of land use and resource extraction. These vary according to the particular biophysical environment: some areas are suitable for crops, others offer better grazing. People have also begun to have a significant impact on the climate, which in turn has an effect on the land. People use and abuse the water, soil and vegetation resources of the country, and this often results in serious land degradation problems.

Learn from others and work within existing structures and action groups. Contact details for many such groups can be found by visiting the following website address: http://www.nbi.ac.za/landdeg



But that is not the whole story. People and the land do not have to be adversaries. After all, our health and survival both depend on and reflect the state of health of the land.

In all times and in all countries there have been those who have recognised the inalienable connection between people and the land. If we are serious about reclaiming the land, we would do well to listen to their stories and follow their examples.

13.5 Further reading

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