Land Resource Study

3 The Land Resources of Lesotho

Land Resources Division/Directorate of Overseas Surveys

The Land Resources of Lesotho

Central Office of Information

View over the gently undulating Basaltic Foothills towards the steeper slopes of the Maluti Mountains.

Ministry of Overseas Development

The Land Resources of Lesotho

by

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THE LAND RESOURCES DIVISION
OF THE DIRECTORATE OF OVERSEAS SURVEYS

The Directorate of Overseas Surveys, part of the Ministry of Overseas Development, assists developing countries in the fields of land survey, air photography, mapping and the investigation of land resources.

The Land Resources Division assesses land resources, and makes recommendations on the use of these resources for the development of agriculture, livestock husbandry and forestry; it also gives advice on related subjects to overseas governments and organisations, makes scientific personnel available for appointment abroad and provides lectures and training courses in the basic techniques of resource appraisal.

The Division endeavours to work in close co-operation with government departments, research institutes, universities and international organisations concerned with land resource assessment and development planning.

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PART 1. INTRODUCTION

PREFACE

Work on this project began in 1963 and a draft report was submitted to the Lesotho Government in 1966. It is now published with their kind permission.

The published version differs slightly from the draft report as a result of comments on the draft and because some more recent material has now been included.

ACKNOWLEDGEMENTS

We wish to thank the Permanent Secretaries and Directors of Agriculture and their staff for their willing co-operation and advice, and we are especially grateful to the Soil Conservation Officer and his staff for their friendly help and interest in our work. We also thank our colleagues at the Directorate of Overseas Surveys and the Tropical Section of the Road Research Laboratory for their advice and criticism throughout the project.

ABSTRACT

This reconnaissance assessment of the land resources of Lesotho is based on an interpretation of vertical aerial photographs taken in 1961 and 1962 and field work carried out in 1964 and 1965.

Lesotho has been divided into twenty-seven land systems, each with a characteristic association of topography, soils and vegetation. Both the general characteristics of Lesotho and the properties of each land system are described.

The present state of agriculture and the agricultural potential are discussed. Seven categories of potential land utilisation have been established: semi-intensive cultivation; extensive cultivation; grazing for smallstock; grazing for largestock; mixed farming with poor access; mixed farming with good access; unsuitable for agriculture.

The land systems, soils and agricultural potential are shown on 1:250 000 scale maps.

Attention has been drawn to areas which may be suitable for irrigation farming, and to areas requiring special conservation measures.

RÉSUMÉ

La présente estimation des ressources en terre du Lesotho se base sur l'interprétation des photographies aériennes faites au cours de 1961 et 1962 et sur des travaux éxécutés sur place en 1964 et en 1965.

Le Lesotho a été divisé en vingt-sept zones écologiques ('land systems') chacune étant caractérisée par une association particulière entre la topographie, les sols et la végétation. On y décrit aussi bien les caractères généraux du milieu que les particularités de chaque zone écologique.

On y discute l'utilisation actuelle des terres et le potentiel agricole. On a distingué sept catégories d'aptitude culturale: culture à demi-intensive; culture extensive; pâturage pour le menu bétail; pâturage pour le gros betail; culture associée au pâturage - d'accès difficile; culture associée au pâturage - d'accès assez.bon; impropre à l'agriculture.

On y a attiré l'attention sur des regions qui conviendraient peut-être à la culture avec irrigation et sur des régions qui auraient besoin de mesures spéciales de conservation.

Les zones écologiques, les sols, et les aptitudes culturales sont indiqués sur des cartes à l'échelle de 1:250 000.

SUMMARY OF RECOMMENDATIONS

Seven classes of land with differing agricultural potential are recognised:

1. **Land primarily suitable for semi-intensive cultivation** This is the major crop-producing zone of Lesotho and stock farming should only be assigned a secondary role within it. Cropping systems should aim at a five-crop rotation to include summer and winter cereals for cash, local consumption and fodder; legumes for cash; and, if possible, an annual grass hay crop.

2. **Land suitable for extensive cultivation** Cultivation practices in these areas should aim at long ley rotations with relatively short cropping periods and much of the poorer land in this class should be put into permanent pasturage.

3. **Grazing land primarily suitable for smallstock** These areas should be used for grazing sheep. Grazing should be controlled by using a three-camp system. A zone about the Drakensberg escarpment should be closed to stock. Stock should be moved out of the upper mountains during the winter months.

4. **Grazing land primarily suitable for largestock** These areas are most suitable for the grazing of cattle and Angora goats, but can also supply reserve winter grazing for sheep. Most of the area is unsuitable for either cultivation or village development.

5. **Land suitable for cultivation and grazing; poor access** The economy of these areas should be based on the production of a mixture of cash, food and fodder crops and the breeding and rearing of livestock.

6. **Land suitable for cultivation and grazing; good access** Land in this class should be used for the production of cash and fodder crops. It is well suited to the fattening of young beef animals and to small-scale dairy farming.

7. **Land unsuitable for agriculture** These areas must be strictly conserved, but are potentially valuable for tourism. Some local timber production and reserve winter grazing may be permitted.

PART 2. THE PROJECT

Lesotho, previously known as Basutoland, is an enclave within the Republic of South Africa. Most of its 11 700 square miles (30 300 square kilometres) is mountainous and subject to a rigorous winter climate. The population, fast approaching one million, is mainly concentrated in a lowland strip in the west of the country where the soils have been exhausted and eroded.

The economy of Lesotho is based almost exclusively on subsistence agriculture, a livestock industry and the earnings of labour employed outside the country. The country is not yet economically self-sufficient.

ORIGIN OF THE PROJECT

In 1960 an Economic Survey Mission reported that 'the prosperity and indeed the economic survival of Basutoland depend on the conservation of its soil' and emphasised the need for a land analysis survey of the whole country. The then Basutoland Government sought assistance from the British Government in conducting such a survey and, as a consequence, the Directorate of Overseas Surveys undertook a Land Resources Survey of Lesotho. The purpose of this survey was to describe the topography, soils and vegetation of the country in order to provide a basis for the assessment of its potential and to indicate areas suitable for development or in need of further conservation measures.

TEAM COMPOSITION

At the start of the project M. G. Bawden was a member of the Forestry and Land Use Section of the Directorate of Overseas Surveys and D. M. Carroll a member of the Pool of Overseas Soil Scientists. Both organisations were subsequently combined to form the Land Resources Division of the Directorate of Overseas Surveys.

During the preliminary stages of the project close liaison was maintained with P. J. Beaven of the Tropical Section of the Road Research Laboratory, who was investigating the distribution of road-making materials in Lesotho. During the field work the team relied greatly on the experience and local knowledge of the Conservation Officer, S. H. Youthed.

PROGRAMME AND PROCEDURE

The procedure adopted for this Land Resources investigation was similar to that developed by the Division of Land Research and Regional Survey of the Commonwealth Scientific and Industrial Research Organisation in Australia (Christian and Stewart, 1953) and used by the Land Resources Division in Botswana (Bawden and Stobbs, 1963). The method of survey is based on the concept that different types of landscape are expressed on aerial photographs by distinctive patterns and that conversely by recognising these patterns on the aerial photographs a map of the different types of landscape can be produced. The different types of landscape which are mapped are called land systems and each system is defined by its relief, soils and vegetation. Each system can subsequently be classified in terms of agricultural potential.

Vertical panchromatic aerial photographs taken by Aircraft Operating Company, Johannesburg, partly in 1961 and the remainder in 1962, cover the whole of Lesotho. Those of the eastern and most mountainous part of the country are at a scale of 1:40 000, the remainder are at a scale of 1:30 000. The Directorate of Overseas Surveys has produced a series of contoured topographic maps at a scale of 1:50 000 (D.O.S. 421) from earlier photography taken in 1952. A 1:250 000 map of Lesotho, in two sheets, has been produced from these 1:50 000 maps and has been used as a base for the maps accompanying this report.

Stereoscopic examination of the aerial photographs, in conjunction with the 1:50 000 scale maps, was started in 1963 after a brief visit to Lesotho by Bawden in September 1962. During this examination prominent elements of the landform such as plateaux, scarps, plains and river terraces were recognised and the boundary between the sandstone and the overlying basalt was mapped. Selected photographs were studied in more detail to ascertain the extent to which variations in rock type, soils and vegetation could be mapped from the aerial photographs. During this period information in the literature was related to the information obtained from the examination of the aerial photographs.

Bawden and Beaven subsequently prepared a preliminary landform map of the mountains (Beaven, 1966) and Carroll, after a field season of more detailed pedological work in Lesotho, produced a similar map of the lowland area. These two maps were combined to provide a provisional land system framework for the land resources investigation of the territory.

Carroll was based in Lesotho from February 1964 until May 1965 and was responsible for the field work connected with this survey. Much of the field data was collected in the course of detailed investigation of betterment areas and potentially irrigable areas. Data collection was also more concentrated in areas which seemed to have some development potential. In this way, it was possible to describe the whole country and to provide additional information for future more intensive surveys of the more promising areas. Although nearly all parts of the lowlands are easily reached by Land Rover, there are few motorable tracks in the mountains, and pony-trek routes were selected which allowed each provisional land system to be investigated.

Soils were mainly inspected by augering; pits were dug to sample typical representatives of the more extensive soil types in areas considered to have an arable potential. Field notes were made on geology, topography, vegetation and land use.

After the field work, Bawden and Carroll together re-examined the aerial photographs and contoured maps to amend certain of the provisional boundaries in the light of the field data. These boundaries were compiled into a land system map at a scale of 1:250 000.

In this report the land system is the basic mapping unit and consists of an area throughout which there is a recurrent pattern of topography, soils and vegetation. Land systems with similar lithology and morphogensis have been combined to form land regions; in general the systems within a region have similar land use potentialities. The regions themselves have been combined into two land provinces. In Part 4 each land system in described separately and its properties discussed.

The potential for agricultural development has been assessed on the information collected during this survey combined with the experience of the Lesotho Department of Agriculture which is presented in the Department's Agro-Ecological Plan (Lesotho, Ministry of Agriculture, 1963). The conclusions on the potential of the various land systems are summarised on the 1:250 000 scale Agricultural Potential map.

A reconnaissance soil map at 1:250 000 scale has also been compiled to provide a more detailed picture of the soil distribution within the land systems.

In addition to this report and the accompanying maps, a set of 1:50 000 scale maps covering the lowlands province has been supplied to the Agricultural Department. These give the units of the landform in as much detail as the photographs and limited field work allow and will be of use for more detailed surveys and assessments in areas of higher potential.

MAP I

LESOTHO RELIEF

Scale 1:1,000,000

Miles

0 10 20

REFERENCE

Roads

Bridle Paths

District Boundaries

District Headquarters

Townships

Villages

Trading Station

27°

28°

29° East of Greenwich

29°S

30°

ORANGE FREE STATE

FOURIESBURG

THABABANANA

LIBONO

Police Post

MABIN

BUTHABUTHE 7800'

KHABOS

LERIBE

FICKSBURG

BEKA

PITSENG

Mt Aux Sources 10763'

Cathedral Dome

Champagne Castle

Giants Castle

Mohlesi Pass
Thabana Ntlenyana
11425'

Sani Pass
Police Post

To Underberg

NATAL

BUTHABUTHE

LERIBE

BEREA

MOKHOTLONG

LOKOENG

MOKHOTLONG 7200'

LADYBRAND

TEYATEYANENG

To Bloemfontein (90 Miles)

MASERU 5100'

Thaba Bosiu

Machacha Mt 9471'

MASERU

MARAKABEI 6600'

MAFETENG

QACHAS NEK

SEHLABATHEBE

Ramatseliso's Gate

QACHAS NEK 6300'

ORANGE FREE STATE

WEPENER

MAFETENG

MALEALEA

MELEPOORT

MPHAKANE

MOHALES HOEK

MOHALES HOEK 6400'

MAPHUTSENG

ZASTRON

QUTHING

Ongeluks Nek

MATATIELE

CAPE PROVINCE

Orange River

Tele River

Caledon River

Land 5,000 feet - 7,000 feet

" 7,000 " - 9,000 "

" 9,000 " - 10,000 "

" 10,000 " - 11,425 "

Base map derived from D.O.S. (Misc) 280 Basutoland 1:776,000 First Edition

27° East of Greenwich

28°

29°

D.O.S. (Misc) 417 A

Drawn, photographed and prepared for colour printing by the Directorate of Overseas Surveys, 1966.
Printed for D.O.S. by the Ordnance Survey.

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PART 3. THE ENVIRONMENT

PHYSICAL ASPECTS

PHYSIOGRAPHY

The relief of Lesotho is shown on Map 1. The landscape can be described in terms of two major land provinces; the Lowland Province and the Mountain Province (Map 5 facing page 28).

The Lowland Province is composed of a belt of sedimentary rocks and minor igneous intrusions of the Karroo System; it forms part of the High Veld plateau of Southern Africa. The Mountain Province consists of an accumulation of basaltic lavas known in Lesotho as the Maluti Mountains; they are the major component of the great Drakensberg range.

Lowland Province

The lowlands vary in elevation from under 5 000 ft (1 520 m) to over 6 000 ft (1 830 m) and make up less than 20% of the total area of Lesotho. They form a strip, varying from 2 to 30 mi (3 to 48 km) in width, which runs the entire length of the country's western border; its topography is mostly hilly with a series of broad valleys. These valleys consist of slightly convex spurred interfluves passing smoothly into broad, dissected and often severely gullied pediments. Towards the country's western margins the landscape is less variegated and its wide and gently undulating plains are very similar to those in the adjacent Orange Free State.

The smooth slopes of the lowlands are broken by isolated steep-sided hills. These remnants are often flat-topped and have been shielded from erosion by protective caps of sandstone or dolerite. Beds of resistant sandstone also give rise to pronounced minor scarps and ridges.

Dolerite intrusions also greatly modify the otherwise uniform lowland landscape and outcrops of narrow dykes can be traced for many miles. These dykes form rounded ridges in areas of soft shaley rocks and depressions in areas of harder rocks. In the extreme west of the lowlands, thick dolerite sills rise to over 1 000 ft (300 m) above the surrounding plains.

A series of alluvial terraces occur along the valleys of most of the major rivers and their tributaries. In some localities, such as the valley of Phuthiatsana, these terraces widen into extensive flood plains. In its lower reaches the Orange River flows through a deep narrow gorge cut in sedimentary rocks.

The eastern boundary of the lowlands is marked by a conspicuous escarpment which, apart from numerous steep-sided valleys, crosses the country virtually unbroken from the north-east to the south-west. In places the escarpment rises as much as 1 000 ft (300 m) above the lowland plains to a crest which has a general altitude of 6 000 ft (1 830 m).

Mountain Province

Above the escarpment, there are small plateaux formed on both sandstone and basalt; their broad slopes rise gently eastwards towards the steeper mountain slopes and are broken by montane spurs and river valleys. These plateaux, which are collectively termed 'foothills' in Lesotho, are between 6 000 ft (1 830 m) and 7 000 ft (2 130 m) above sea level.

Apart from the small areas of foothills which are underlain by Cave Sandstone, the Mountain Province is underlain entirely by basaltic rocks. The shape of the mountains is largely determined by the drainage pattern. The main west-facing escarpment drains to the Caledon River, while the Orange River and its tributaries drain to the south, flowing in almost parallel valleys. These two major catchments are separated by the Makhaleng River which flows in a similar, smaller, south-draining valley.

In general the major rivers are floored by broad floodplains or flanked by steep sides surmounted by a series of flats on montane spurs; both these groups of flat land lie between 7 000 ft (2 130 m) and 8 000 ft (2 440 m). Apart from these major valleys most of the Mountain Province consists of a monotonous sequence of steep ridges and deep V-shaped valleys. Some of the slopes are straight and steep with no breaks or inflexions, while others have a more complex form. From the foothills the mountain slopes rise to over 9 000 ft (2 740 m), where they level off in the north and east to an extensive rolling upland plateau.

Geology

Lesotho is underlain by sediments and basaltic lavas of the Karroo System. The occurrence of these two major rock types corresponds to the two provinces described in the previous section; their distribution is shown on Map 2 and the details of the succession are given in Table 1 (Stockley, 1947). The geological structure is simple and major faulting or folding is uncommon. The sedimentary rocks of the lowlands were laid down in a shallow basin and the component strata rarely dip more than five degrees. These sedimentary rocks were then covered by several thousand feet of basaltic lava. Most of the boundaries between formations are sharp and are often marked by prominent scarp faces.

TABLE 1 The geological succession in Lesotho

Series	Formation	Lithology	Age
Stormberg Series	Drakensberg Beds	Basalt	Lower Jurassic
	Cave Sandstone	Sandstone	Triassic - Rhaetic
	Red Beds	Sandstones; shales	
	Molteno Beds	Sandstones; grits	
Beaufort Series	Upper Beaufort Beds	Shales; sandstones	Triassic
		Dolerite	Rhaetic + L. Jurassic

MAP 2

LESOTHO GEOLOGY

Scale 1:1,000,000

Miles 0 10 20

REFERENCE

Roads
Bridle Paths
District Boundaries
District Headquarters
Townships
Villages
Trading Station

27° 28° 29° East of Greenwich

29°S 30°

ORANGE FREE STATE

FOURIESBURG
THABANA MORENA
LIBONO
Police Post
MABIN
Mt Aux Sources 10763'
BUTHABUTHE
KHABO
LERIBE
FICKSBURG
Cathedral Dome
Kraai River
Champagne Castle
LADYBRAND
TEYATEYANENG
BEREA
MOKHOTLONG
OTLOKOENG
NATAL
To Bloemfontein (90 Miles)
MASERU
Thaba Bosiu
Machonchu Mt
Giants Castle
Caledon River
MARAKABEI
NTAOTES
Mohlesi Pass Thabana Ntlenyana 11425'
Sani Pass
Police Pass
To Underberg
WEPENER
MAPHAI
MAFETENG
Semonkong Falls 630'
QACHAS NEK
SEHLABATHEBE
Ramatseliso's Gate
MOHALES HOEK
QACHAS NEK 63cb'
ZASTRON
Seaka Drift
QUTHING
Ongeluks Nek
MATATIELE
Orange River
CAPE PROVINCE

ORANGE FREE STATE
NATAL
LESOTHO
CAPE PROVINCE
Indian Ocean

Drakensberg Beds : Basalt lavas
Dolerite sills and sheets (dykes omitted)
Cave Sandstone
Red Beds : Sandstone and shales
Molteno Beds : Grits, sandstones and shales
Upper Beaufort Beds : Shales and mudstones

Base map derived from D.O.S. (Misc) 280 Basutoland 1:776,000 First Edition

This map is based on a Geological Map of Basutoland at 1:380,000 scale, produced by Stockley (1947).

D.O.S. (Misc) 417B

Drawn, photographed and prepared for colour printing by the Directorate of Overseas Surveys, 1966.
Printed for D.O.S. by the Ordnance Survey.
800/4/67/3493/OS.

The Upper Beaufort Beds Red and purple shales and mudstones with some buff sandstones. They only outcrop in small areas, mostly forming almost flat plains along the western border in Mafeteng and Leribe districts.

The Molteno Beds Massive coarse white grits, yellow sandstones and bluish or grey shales. They outcrop mainly in the western lowland area of Mafeteng and Mohales Hock districts, where they underlie extensive plains.

The Red Beds These consist of red and buff sandstones with purple, red and blue shales. They occur throughout the lowlands, except in the south-west, where only scattered outliers are found. The topography associated with these rocks is characteristically broken and irregular.

The Cave Sandstone A whitish, massive and unbedded, fine-grained rock of aeolian origin. It forms a cap to the major lowland escarpment; it also caps isolated plateaux and hills in the lowlands and is exposed in the steep gorges of the Orange River valley.

Dolerite Intrusions Very numerous in the lowlands, they are mostly dykes with a north-east or north-west strike. Thick and extensive sills or inclined sheets occur in the western part of the Mafeteng district.

The Drakensburg Beds This series of basaltic lava flows, in places over 4 000 ft (1 220 m) thick, underlies the whole of the Mountain Province. In the south of the country thin beds of tuff, ash, agglomerate and tuffaceous sandstone occur locally towards the base of this formation.

GEOMORPHOLOGY

Level areas of land separated by steep slopes can be traced through each of the major river valleys of Lesotho. Several authors have discussed the origin of these levels and various attempts have been made to explain their origin and to assign them to erosion cycles recognised elsewhere in southern Africa.

During the present investigation four levels have been recognised in the Mountain Province and a further two in the Lowland Province. None of these levels are at the same altitude throughout the country but they always occur in the same position relative to each other.

In the Mountain Province the highest and oldest level is represented by the concordant summits of the rolling high plateau. These summits rise to over 10 000 ft (3 050 m) above sea level in the east along the Drakensberg escarpment, but are bevelled to 8 500 ft (2 590 m) in the west. They are interpreted as the late Jurassic Gondwana erosion surface (Dixey, 1942; King, 1962).

There are extensive level areas near Sani Pass, 9 000 ft (2 740 m) above sea level on the edge of the Drakensberg escarpment. These contain the headwaters of the Sehonghong and Linakeng rivers and are bounded to the north and south by steep slopes rising to the high plateau. These level areas have been assigned by King (1962) to the post-Gondwana erosion cycle.

Flat valley floors at 7 500 ft (2 290 m) occur in the headwaters of the the Orange and its tributaries. Downstream these flats merge on either side of the main valleys with flat-topped spurs with a general altitude of 7 500 ft

(2 290 m). Where flat-topped spurs do not occur at this altitude there is a marked increase in slope (inflexion) giving rise to a 'compound' slope form.

Mountain spurs between 7 500 ft (2 290 m) and 8 000 ft (2 440 m) above sea level have also been recognised on the lower slopes of the Drakensberg escarpment in Natal by Dixey (1942) and Sparrow (1964). The present investigation has shown an extensive sandstone plateau at 7 500 ft (2 290 m) within Lesotho at Sehlabathebe and that this also merges downstream with flat-topped spurs at the same altitude. King (1944) regards the flat spurs in Natal as remnants of a shelf which is wholly structural in origin and Sparrow (1964) proposes that they have been formed by glacial action. King claims that the valley flats and spurs at the same altitude within Lesotho are 'at best a number of inter-montane valley floodplains (straths) which may not even have been cyclic in origin'. However Stockley (1940) and Dixey (1938) refer these flats to a Cretaceous erosion cycle, and it seems unlikely that they are wholly structural in origin as they transgress from Beaufort sediments in Natal to Stormberg sediments and lavas in Lesotho.

A lower series of flats occurs in Lesotho between 5 800 ft (1 770 m) and 6 200 ft (1 830 m) above sea level. These lie immediately above the escarpment which throughout the country marks the boundary between the Mountain and the Lowland Province. They follow closely the boundary between the Drakensberg lavas and the Cave Sandstone and have been considered by both Stockley and Dixey to be structural in origin.

Most of the lowlands in Lesotho lie between 5 000 ft (1 520 m) and 6 200 ft (1 830 m) above sea level and have been ascribed by King (1962) to the African or mid-Tertiary surface. In the west of the country a gently rolling landscape with broad, shallow valleys and many low residual hills occurs below 5 000 ft (1 520 m) above sea level. Although this surface is not differentiated by King it is probable that it represents part of the late Tertiary erosion cycle.

Headward stream and river erosion is active throughout the lowlands of Lesotho and the pediments produced by this process appear to be coalescing to form gently undulating pediplains. The wall-like scarp of the Cave Sandstone escarpment seems to be retreating independently of the drainage lines, in the manner suggested by King (1962).

A notable feature of the geomorphology of the Lowland Province of Lesotho is the levelling and covering of pediments by many feet of erosional products. These 'pedisediments' accumulated under strongly eroding conditions, possibly during a pluvial stage in an interglacial period. It appears that what was essentially a depositional landscape is now being denuded. The main gullies or 'dongas'*, so characteristic of the lowland landscape seem to represent the re-opening in the pedisediment of buried former drainage channels. The widespread distribution of these erosional mantles has important consequences in soil formation. Because creep and other colluvial processes are also active on slope crests, soil formation in the lowlands is governed by the nature of the underlying waste mantle and is only indirectly influenced by the bedrock.

* Dongas are deep, narrow, steep-sided gullies. See Plates 9 and 10, page 46.

CLIMATE

The climate of Lesotho is mostly sub-humid and varies from semi-arid to humid, with warm summers and cool winters.

The average annual rainfall for the country is about 29 in (737 mm): Map 3 shows that it varies from less than 20 in (500 mm) in the Orange Valley, to 25-35 in (635-900 mm) in the lowlands to over 40 in (1 000 mm) in the mountains. Most of this rain falls between October and April and there is little rain in the winter from May to September. This seasonal distribution is illustrated by the figures for Maseru and Qacha's Nek given in Table 2 and by the histograms on the rainfall map.

TABLE 2 Seasonal distribution of rainfall
(Rainfall normals in millimetres, 1921-50)

Town, and elevation in metres (feet)	Quarter				Season	
	Dec.-Feb.	Mar.-May	June-Aug.	Sept.-Nov.	Oct.-Mar.	Apr.-Sept.
Maseru 1571(5150)	286.5 42%	190.5 28%	37.9 5%	172.2 25%	542.3 79%	144.8 21%
Qacha's Nek 1972(6500)	467.7 50%	199.6 21%	47.7 5%	219.8 24%	778.1 83%	156.6 17%

The annual amount of rainfall is also very variable, and high and low rainfall years may follow with no apparent regularity. As a rough guide to the extreme range of variation, the minimum annual rainfall is over half the average and the maximum nearly double the average. The rainfall records for stations in Lesotho and adjoining parts of the Republic of South Africa, published by the South African Weather Bureau, are given in Appendix 2.

The low rainfall of the Orange River Valley is caused by the rain-shadow effect of the surrounding high mountains. The climate of the mountain tops is distinctly alpine in character. There is a mist-belt region over a width of a few miles along the eastern Drakenberg escarpment from Qacha's Nek to Mont Aux Sources. Dry mist and convection current storms are common in the mountains and orographic rain contributes a smaller proportion of the total precipitation than it does on the lowest mountain slopes.

Snow may occur at any time of the year in the mountains and some may fall in the lowlands during the winter months, although it rarely lies there for any length of time. The higher mountain grazing lands are usually snow-bound for much of the winter and snow may lie for many months on south-facing slopes or in deep valleys. The annual melt is of great importance in adding to the water supplied to Lesotho's major rivers. Hail is a summer hazard in all parts of the country. Thunderstorms occur frequently and are associated with high rainfall and lightning.

There is little detailed information on the humidity of Lesotho, but it is generally low. Mean relative humidities vary with location and show both a seasonal and a marked diurnal variation. They are least in the winter months (May-September) and greatest in the summer months (October-April) and are of

the order of 25-45% at 1400 h and 55-80% at 0800 h for the lower altitudes. Relative humidity figures are given in Table 4 Appendix 2.

Mean temperatures over Lesotho vary according to altitude and probably decrease by 3°F (1.7°C) for each 1 000 ft (300 m) increase in height (Great Britain Air Ministry, 1962).

The mean temperature in the lowlands during June is about 45°F (7°C) with average maxima and minima of about 60° and 30°F (15° and 0°C) respectively. In January the mean temperatures are around 70°F (21°C) with average maxima and minima of about 80° and 60°F (25° and 15°C). Extreme temperatures as high as 98°F (37°C) and as low as 14°F (-10°C) have been reported.

Figures 1 and 2 illustrate the variation in daily maximum and minimum temperatures for Maseru in the lowlands and Mokhotlong in the mountains. Values for stations are tabulated in Appendix 2.

Frost incidence is erratic, but the first frosts are normally experienced towards the end of April. The lowlands usually have some 150-170 frost-free days, while the corresponding period in the mountains is appreciably shorter. The average duration of frost periods for several stations are given in Appendix 2, Table 6.

There is little information on evaporation in Lesotho but it is probably more than 70 in (1778 mm) per annum for the lowlands, 65-75 in (1651-1905 mm) for the foothills and 50-65 in (1270-1651 mm) for the mountains (from a map in Goosen, 1959).

The mountainous nature of the country's topography greatly affects winds and the moisture they carry. Most winds blow from the north or north-east, but cold winds from the south or strong, dry winds from the west are sometimes experienced. The frequency of calms at Maseru is relatively low, being about 5-10% over the year. The mean annual cloud cover at Maseru rises from three tenths at 0800 h to four tenths at 1400 h. The least cloudy period is June to August (Appendix 2, Table 5).

VEGETATION

Lesotho is a grassland country and there is an almost complete absence of natural tree growth. Acocks (1953) has suggested that conditions are too dry and frosty for tree growth and that most of the grasslands of Lesotho are therefore 'climax' types; other Southern African botanists have preferred to regard them as 'fire sub-climax' grasslands (Rattray, 1960). A sub-climax successional to shrub may occur, in a sufficiently sheltered spot, at any altitude if fire is excluded.

Many years of overpopulation, overgrazing and veld fires have greatly influenced the development of the present vegetative cover and most of the shrubs that now occur are unpalatable to stock. Encroachment by Karroid bush has replaced much of the original grass vegetation. The two main species of this kind of low shrub in the lowlands are *Chrysocoma tenuifolia* and *Aster fillifolius*. These species, with *Euryops* spp. and *Helichrysum* spp. are found at higher elevations associated with probably relict communities of *Passerina montana* and *Erica* spp. The ragwort, *Senecio retrorsus* is a toxic weed with wide distribution.

MAP 3

LESOTHO RAINFALL

Scale 1:1,000,000

Miles

0 10 20

REFERENCE

Roads

Bridle Paths

District Boundaries

District Headquarters

Townships

Villages

Trading Station

27° 28° 29° East of Greenwich

29°S 30°

ORANGE FREE STATE

FOURIESBURG THAKABANNA LIBONO Police Post MABIN

BUTHABUTHE 5800′ KHABOS LERIBE FICKSBURG PEKA PITSENG

BUTHABUTHE Hotse River Kau River Khubelu River Orang River

Mt Aux Sources 10763′ Cathedral Dome Champagne Castle

LERIBE Maubamatsoku River Matsoku River

LADYBRAND TEYATEYANENG BEREA

MOKHOTLONG OTLOKOENG MOKHOTLONG 7200′ Senqunyane River

NATAL

To Bloemfontein (90 Miles)

MASERU 5100′ 800 Thaba Bosiu THEKO'S Machache Mt 9471′ St Michaels Roma

MAZENOD 600 Caledon River MARAKABEI 6600′ MASERU Senqunyane River Manonyane River

Giants Castle Mohlesi Pass Thabana Ntlenyana 11425′ Sani Pass Police Post To Underberg

NTAOTES Linakeng River

ORANGE FREE STATE

MATSIENG MORIJA TSAKHOLO WEPENER MAFETENG MALIMALEA HELLSPOORT MAFETENG Semonkong Falls 630′ Senqunyane River Matsunyane River Lesibeng River

MASHAI MAFETENG 800 QACHAS NEK Orange River

SEHLABATHEBE Tsoelike River

MPHARANE MOHALES HOEK SEKAKE'S TSOELIKE KANKATALA Ramatseliso's Gate

MOHALES HOEK 5400′ Makhaleng River Orange River

QACHAS NEK 6300′

MAPHUTSENG ZASTRON PHAMONG Mt Moorosi TOSING Seaka Drift

800 Ongeluks Nek MATATIELE

QUTHING

QUTHING

CAPE PROVINCE

Orange River Tele River

27° East of Greenwich 28° 29°

ORANGE FREE STATE NATAL LESOTHO CAPE PROVINCE Indian Ocean

—800— Isohyets (in millimetres)

Histograms show average monthly rainfall starting in January and ending in December

Compiled from data published by the South African Weather Bureau, *Pretoria* and from Lesotho Government records.

Base map derived from D.O.S. (Misc) 280 Basutoland 1:776,000 First Edition

D.O.S. (Misc) 417C

Drawn and photographed by Directorate of Overseas Surveys, 1966
Printed for D.O.S. by the Ordnance Survey.
800/4/67/3495/OS

AIR TEMPERATURE VARIATION

Maseru
(Lowlands)
1571m.

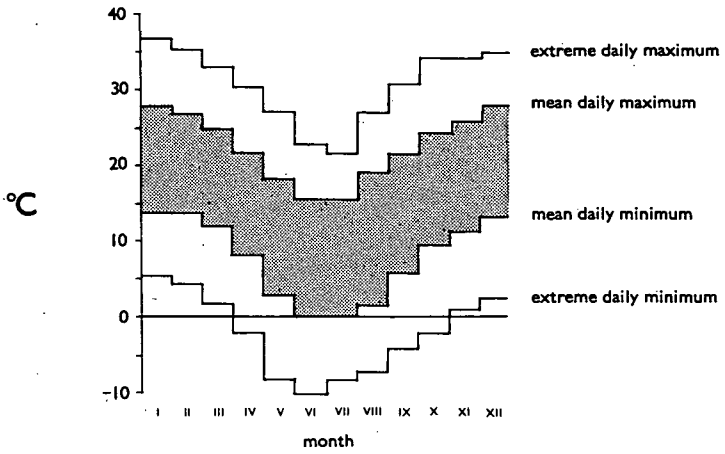

Fig.1

Average frost duration	18th May - 6th August
Average number of frosty days within this period	80
Extreme limits of frost duration	2nd April & 4th October

Mokhotlong
(Mountains)
2377m.

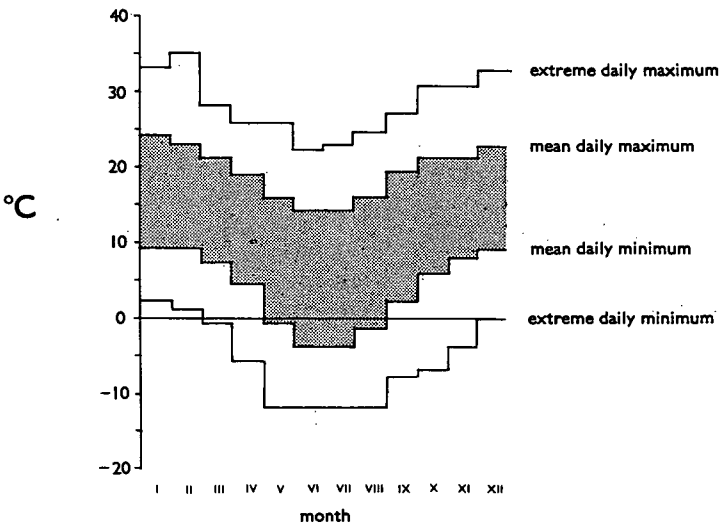

Fig.2

Average frost duration	19th April - 13th October
Average number of frosty days within this period	177
Extreme limits of frost duration	9th March & 30th November

D.O.S.(Misc)451

FIGURES 1 and 2 Air temperature variation in the lowlands and in the mountains.

Acocks (1953) mapped five vegetation types in Lesotho and Staples and Hudson (1938) mapped three in the mountain areas. In the present survey, these types have been combined to give six vegetation mapping units for Lesotho. The distribution of these units is shown on Map 4 and they are discussed in the following paragraphs.

1. Themeda - Cymbopogon - Eragrostis Grassland

Most of the lowland grasses are sweet or semi-sour ('sweet' grasses are those which remain nutritious after their first few months growth, while 'sour' grasses become unpalatable and indigestible at this stage. Some of the most important members are: *Themeda triandra, Cymbopogon plurinodis, Setaria flabellata, Elynurus argenteus, Heteropogon contortus, Tristachya hispida* and *Eragrostis* spp. The dominant grass is a short form of 'redgrass', *Themeda triandra,* which is free-seeding and flowers in late spring. It has an upright habit of growth, but tillers freely and forms a dense sward. If ungrazed, its leaves grow to about a foot in height. In heavily grazed areas this grass tends to be replaced by the more xerophytic *Eragrostis,* particularly *E. chloromelas.*

2. Themeda - Dominant Grassland

Themeda triandra is dominant, almost to the exclusion of all other grasses, on the black soils derived from dolerite in the south-western lowlands.

3. Themeda - Festuca Grassland

The lower mountain slopes are covered by a short, dense alpine grassveld, which has been described by Staples and Hudson (1938). Many of the species found in this grassland are also characteristic of the lowlands. It includes: *Themeda triandra, Eragrostis* spp., *Microchloa caffra* and *Andropogon* spp. These species are joined at elevations of over 7 000 ft (2 130 m) by *Festuca* spp. and *Danthonia disticha,* but *Themeda triandra* remains dominant. It is replaced, when overgrazed, by *Eragrostis* spp. and shrubs. Pioneering species of *Aristida* occur widely on poor or eroded soils, and because they are unpalatable to stock and not heavily grazed, form a useful protection against erosion. The somewhat more palatable *Harpechloa falx* appears to withstand close grazing very satisfactorily.

4. Predominantly Alpine Grassland

Much of the higher mountain area consists of bare ground and the percentage of palatable species in the plant cover is quite low.

On north-facing slopes above an elevation of about 8 500 ft (2 590 m) and on much lower sites on the colder, moister south-facing slopes, the short alpine grasses become dominant, particularly *Festuca rubra, F. caprina,* the coarse *F. costata* and *Danthonia disticha.* All these grasses are of a tussocky habit and are not suited to continuous grazing. The fescues are best developed on soil-covered slopes, while the taller *Danthonia* is usually associated with rockier, immature soils. *Themeda triandra* is still a common component of the vegetation, but is usually of minor importance. Some of the most useful grasses of the higher mountains are *Koeleria cristata, Poa binata, Pentaschistis* spp., *Agrostis* spp. and *Bromus* spp.

MAP 4

LESOTHO VEGETATION

Scale 1:1,000,000

Miles 0 10 20

REFERENCE

Roads
Bridle Paths
District Boundaries
District Headquarters
Townships
Villages
Trading Station

27° 28° 29° East of Greenwich

29°S 30°

ORANGE FREE STATE

FOURIESBURG THAKABANNA LIBONO Police Post MABIN

BUTHABUTHE 5700'

KHABOS LERIBE FICKSBURG PEKA PITSENG

BUTHABUTHE

Hlotse River Caledon River Khubelu River Orange River Kau River

Mt Aux Sources 10763'

Cathedral Dome

Champagne Castle

LERIBE

LADYBRAND TEYATEYANENG BEREA

Maumalatsoana River Matsoku River

MOKHOTLONG LOKOENG

NATAL

To Bloemfontein (90 Miles)

MASERU 5100'

Thaba Bosiu Machache Mt 9471' MOKHOTLONG 7200'

Giants Castle

MAZENOD THEKOS St Michaels Roma

Sehonghong River

Mohlesi Pass Thabana Ntlenyana 11425'

ORANGE

Caledon River

MARAKABEI 6600' NTAOTES

Sani Pass Police Post

MASERU

Senqunyane River Mantsonyane River Linakeng River

MATSIENG MORIJA

TSAKHOLO

To Underberg

FREE

WEPENER

MASHAI

Lesobeng River

MAFETENG

MALEALEA Senqunkong Falls 630'

MAFETENG QACHAS NEK

HELLSPOORT

Orange River

SEHLABATHEBE

STATE

MPHARANE

Malibamatso River

MOHALES HOEK

SEKAKE'S TSOELIKE RANKAKALA Tsoelike River Ramatseliso's Gate

Makhaleng River

MOHALES HOEK 5400'

QACHAS NEK 6300'

MAPHUTSENG

ZASTRON

PHAMONG Mt Moorosi

Seaka Drift TOSING Ongeluks Nek

QUTHING

MATATIELE

QUTHING

CAPE PROVINCE

Orange River Tele River

27° East of Greenwich 28° 29°

ORANGE FREE STATE NATAL LESOTHO CAPE PROVINCE Indian Ocean

GRASSLAND TYPES

1. *Themeda-Cymbopogon-Eragrostis*
2. *Themeda* dominant
3. *Themeda-Festuca*
4. Alpine grasses dominant

TRANSITIONAL SCRUB TYPES

5. Highland sourveld
6. Grassland-highland sourveld transition

Base map derived from D.O.S. (Misc) 280
Basutoland 1:776,000 First Edition

Based on maps by Acocks, 1953 and Staples and Hudson, 1938.

D.O.S. (Misc) 417D

Drawn and photographed by Directorate of Overseas Surveys, 1966
Printed for D.O.S. by the Ordnance Survey.
800/4/67/3496/O.S.

Boggy vegetative sponges occur in the upper mountain regions. They contain many highly palatable grasses as well as sedges and aquatic plants.

5. Highland Scrub

Patches of bush and small evergreen trees occur on the rocky slopes of sheltered valleys. By far the most prevalent species in the mountains are the bushes *Leucosidea sericea* and *Rhus;* the wild olives *Olea* spp. and the stinkwood *Celtis kraussiana* are also found. These relics are few and badly mutilated; they are replaced by tall grasses of Highland Sourveld type.

6. Grassveld - Highland Scrub Transition

A high proportion of sour grasses is found in the wetter northern lowlands and part of the foothill and lower mountain areas. *Tristachya hispida* becomes a co-dominant with *Themeda triandra. Eragrostis* spp., *Digitaria tricholarnoides* are among the most palatable of the remaining species while a number of others such as *Andropogon* spp., *Elyonurus argenteus, Harpechloa falx* and *Monocymbium cereisiforme* become unpalatable at maturity. The tall *Hyparrhenia hirta,* common on warmer north-facing slopes in this zone, is much used as a thatching grass. On rocky slopes in these areas patches of bush occur.

SOILS

The soils of Lesotho have not previously been investigated in any detail and very little information has been published about them. The range of soils found in the country and their distribution is shown on the 1:250 000 scale soil map; fuller pedological details can be found in a separate bulletin (Carroll and Bascombe, 1967). These soils are described below in terms of the C.C.T.A./C.S.A. classification (d'Hoore, 1964). Appendix 3 summarises the more important agronomic properties of the commoner soils.

Raw Mineral and Weakly Developed Soils

(a) Lithosols and litholic Soils (mapping units 1 - 8). These are stony and shallow soils without genetic horizons. They have a widespread distribution and are formed over basalt, dolerite or sedimentary rocks.

(b) Juvenile soils on recent alluvium (mapping unit 9). These are medium - to coarse-textured soils without clear horizon differentiation forming over alluvium of the major rivers. They are often deep, with a neutral reaction and a good base supply.

Calcimorphic Soils (Mapping Units 10 and 11)

These are shallow black calcareous clays with well expressed granular structure, forming under a grass cover on moderately steep basaltic lava slopes. These soils are rich in 2:1 lattice clays and their exchange complex has a high content of bivalent cations, mostly calcium. Their reaction is alkaline and they usually contain some free calcium carbonate.

Vertisols

These are dark coloured heavy clay soils. The thick surface horizon is often deeply cracked. It is poorly permeable and possesses a blocky or prismatic structure. The clay fraction mostly consists of expanding lattice minerals. Cation exchange capacity is high and reaction is alkaline. Calcareous accumulations may occur. There are two sub-divisions:

(a) Vertisols of lithomorphic origin are derived from dolerite material in the drier south-western lowlands (mapping unit 12) or from basalt in the Mountain Province (mapping unit 13).

(b) Vertisols of topographic depressions (mapping unit 14) are found over level sites in: (i) the foothills, associated with reddish eutrophic brown soils; (ii) the lowlands, associated with clay-pan soils; (iii) lowland terraces of fine-textured alluvium.

Claypan (Highveld Pseudopodsolic) Soils (Mapping Units 15 - 20)

Claypan soils are the most common lowland soils. They are found on the lower slopes of pediments and develop over both bedrock and pedisediment, passing upslope into fersiallitic soils and sometimes passing downslope into vertisols. Their profile consists of a loose to friable loamy fine sand changing abruptly at about 15 in (38 cm) to a mottled, poorly permeable fine sandy clay with firm blocky or prismatic structure. The topsoil is moderately acid and the lower horizons almost neutral.

Eutrophic Brown Soils (Mapping Unit 21)

These freely draining soils are derived from basaltic material and cover planed surfaces in the foothills; they appear to have been colluvially reworked: The profile shows no marked horizon differentiation and consists of reddish-hued friable clays with weakly developed blocky structure. The whole profile soil is acid with only moderate base saturation.

Fersiallitic Soils (Mapping Units 22 - 25)

This important group of freely draining soils is derived from sedimentary rocks and covers crests and the upper portion of slopes in the lowland area. There is usually a sharp junction between the base of their solum and weathered bedrock and they are probably formed by creep and other colluvial processes; they can only rarely be shown to be residual in origin. They have only weakly horizoned profiles. The colour varies from red to yellowish brown and is usually related to the nature of the local bedrock. The surface texture is sandy and the subsoil is commonly a fine sandy loam. Structure is lacking or only very weakly developed and the soil has a friable consistence throughout its profile. The whole profile is acid, but the base saturation is moderate, although the total content of exchangeable bases is low.

Ferrallitic Soils (Mapping Unit 26)

Soils of this type cover gently undulating plateaux of Cave Sandstone in the northern portion of the foothill region, where the rainfall is about 35 in (889 mm) per annum. These are deep, weakly horizoned, virtually structureless

soils. Their surface horizons are brown fine sandy loams and subsoil horizons are yellowish-brown sandy clay loams or sandy clays. Soil reaction is strongly acid and base saturation values are low throughout the profile.

DRAINAGE AND WATER SUPPLIES

Lesotho is a well watered country which has three main river systems: the Orange, Makaleng and Caledon Rivers. The Orange is the largest and most important river in southern Africa. The ultimate source of the rivers are pans or seepages covered with vegetative sponges in the level parts of the high mountains. These sponges are very vulnerable to overgrazing and can easily be destroyed, thereby greatly increasing runoff and erosion in the lower reaches of the river. The water is normally pure and clear wherever the river drains basaltic areas, but where the lower reaches of rivers traverse the more easily eroded sedimentary rocks, they carry large quantities of silt when in flood.

The river discharge follows the rainfall pattern; it is low between June and September and high in the period December to February. The mountain streams are mostly perennial, although their level falls in the winter. By contrast the lowland streams are often dry during the winter. There is no general watertable level in the lowlands. Usually the static water level in boreholes is found to be considerably higher than the level at which water is struck when boring.

Most villages depend on natural springs for domestic water supplies. In densely populated areas such sources have proved inadequate and an increasing number of wells are now being sunk. Many lowland dams are used to store water, which is then used for supplementary watering of garden plots and for watering stock.

Water is the most valuable of Lesotho's resources and its exploitation is of the greatest economic importance. A scheme has been proposed to divert water from the mountain catchments through tunnels in the mountains to the Caledon River and to regulate the Caledon's flow. About 30% of this water would be retained for use in Lesotho; the use of the surplus is a matter for negotiation with the Republic of South Africa. Lesotho has no water law at present but experience elsewhere suggests that legislation of this kind will eventually have to be introduced.

HUMAN ASPECTS

POPULATION

Nearly all the inhabitants of Lesotho are of African origin; they are mostly born in Lesotho and owe allegiance to a chief. The 1960 Agricultural Census gave an estimate of 888 258 Africans in Lesotho for that year; the rate of population growth is rapidly increasing and is estimated to be 1.7 per cent per annum. Much of the male population works in the mines and on the farms of the Republic of South Africa and about 150 000 Basotho are working in the Republic at any time; much of the farming in Lesotho is thereby left to women. There are no European settlers in Lesotho; the 1 926 Europeans listed in the 1956 population census are mainly in Government service, traders and missionaries. There are also several hundred people of Asiatic or mixed racial origin.

The bulk of the population lives in the lowlands and foothills; apart from Mokhotlong there is no permanent settlement in the higher parts of the mountains. The rapid growth of population has resulted in population densities of over 300 per square mile in many parts of the lowlands. Urban and village development is not controlled and villages encroach on valuable arable land thereby forcing cultivation into the mountain grazing areas.

ADMINISTRATION AND LAND TENURE

Before independence all local Government duties were controlled by nine District Councils. These were elected bodies of which all Principal and Ward Chiefs were *ex officio* members. District Commissioners provided liaison between the District Councils and the Central Government and also acted as advisors and departmental co-ordinators. This form of local Government may be modified within an independent Lesotho.

At the present time the Basotho Chiefs are responsible for the allocation of land and, in co-operation with the District Councils, for grazing control. There are 22 Principal and Ward Chiefs, who owe allegiance to the Paramount Chief. All Chiefs and major headmen are recognised and paid by the Central Government. They are given legal powers in addition to those exercised by custom. There are also many unrecognised minor headmen and village heads with varying degrees of authority.

The country is conceived to belong to the Paramount Chief in trust for his people, and by delegation of powers the land is allocated by Chiefs and Headmen to the people. A typical family cultivates four to six acres and this allotment is, by tradition, divided into three non-contiguous 'lands', so divided as to ensure a reasonably fair division of the available arable areas. Grazing is communal. In addition to their 'lands' a family may have a small vegetable plot near their kraal. An individual has the usufruct to his land as long as he makes no changes in its use or it is not deemed to exceed what is necessary for his subsistence. Chiefs and Headmen also have the power to set aside special areas for tree planting and rotational grazing.

It has been estimated that 150 000 out of 160 000 families have land holdings. As population pressure increases, families cultivate smaller acreages and may be allocated only one or two 'lands'; the number of landless families is increasing. Chiefs and Headmen may sometimes have more than the customary allotment of land.

There are several objections to the present system of land tenure. The most serious is that, as the individual has no rights of enclosure or inheritance, there is little effort to improve the land. The 'lands' themselves are often too small and so widely spaced that the people spend a considerable time travelling from one area to another. Also allegations of improper allocation or reallocation of land arise. A further objection is that selective breeding, which is essential for the improvement of the livestock industry, is impossible with communal grazing.

A detailed examination of the land tenure problems has been made by a team from the University of Chicago.

COMMUNICATIONS

One class 'A' main road, running entirely in the lowlands, connects Maseru with Butha Buthe in the north and Quthing in the south. This road is connected across the western border to towns in the Orange Free State and Cape Province. Several feeder or 'B' roads lead to the main road from the foothills and mountains. All these roads are unsurfaced earth roads (Pollard, 1964 and 1965), but it is hoped to provide a bituminous surface for the main road from Leribe to the Little Caledon Bridge (about eight miles south of Maseru).

Most of the roads into the mountains are described as class 'C' roads or access tracks, but one new road, rising to over 8 900 ft (2710 m), runs some 80 miles into the mountains from Maseru. The mountain District Headquarters are not directly connected by road with Maseru, although four-wheel drive vehicles can travel from Mokhotlong to Butha Buthe. Qacha's Nek is served by a road from Matatiele in Cape Province and Mokhotlong by a jeep track from Natal.

Class C roads are mostly of poor quality, but they are heavily and constantly used as they provide the major export route for mountain produce. These roads are maintained by traders and missions with the aid of a Government subsidy. The rest of the country is supplied by pack animals using bridle paths. The District Councils maintain about 1600 miles of the major bridle paths. In 1964, there were 241.7 mi (388 km) of class A roads, 332.4 mi (535 km) of class B, 414.0 mi (666 km) of class C and 186.5 mi (300 km) of access tracks.

The traffic density on the present main road averages about 150 vehicles a day and most roads have a good bus service. A regular air service of over 50 flights a week is provided by Basutair Ltd. There are a total of thirty-four airstrips of varying quality, including ones at Mokhotlong and Qacha's Nek. Air freight costs up to 5 cents a pound depending on the distance flown and the aircraft used. This important service is vital to the administration and the economy of the Territory.

Heavy goods traffic into Lesotho is conveyed by a branch of the Bloemfontein-Durban railway, which terminates at Maseru.

LAND USE

Cultivation

Most of the crops of Lesotho are grown for subsistence. There is a small export of wheat, peas and sorghum.

The Agricultural Department estimates that there are a little over one million acres available for cultivation in Lesotho. A quarter of this amount is probably in fallow during any one year. At present, nearly all the land suitable for cultivation is worked as well as much unsuitable land. The total acreage cultivated increases every year as virgin land, particularly in the mountains, is ploughed.

The range of crops with their estimated average yields is shown in Table 3. In addition to the staple crops of maize, wheat, sorghum and pulses, some oats and potatoes are grown in the lowlands and some barley in the mountains.

TABLE 3 Average yield of the crops of Lesotho

Region	Crop	Planting season	Harvest season	Average yield	
				200 lb bags/ac	kg/ha
Lowland	Maize	Oct.-Dec.	May-June	3-4	660-880
	Winter wheat	Mar.-June	Nov.-Jan.	2-2½	440-550
	Sorghum	Oct.-Dec.	June	3-4	660-880
	Beans	Oct.-Dec.	Mar.-Apr.	2-3	440-660
Foothill	Maize	Oct.-Nov.	Apr.-June	2-4	440-880
	Sorghum	Oct.	May	unknown	unknown
	Wheat	Sept.	Mar.-Apr.	4-5	880-1100
	Beans	Oct.-Nov.	Mar.-Apr.	2-3	440-660
Lower Mountain Flats	Maize	Oct.-Nov.	Mar.	3	660
	Peas	Sept.	Mar.	4-5	880-1100
	Wheat	Sept.	Apr.	4-6	880-1320

Yields are generally low throughout Lesotho. Most lowland soils are of low fertility and, as animal and crop wastes are not returned to them, deteriorate further with long-continued monoculture and accelerated erosion. Yields can be greatly increased by the substitution of modern for traditional methods, as evidenced by 'Progressive Farmers' and others using fertilisers and improved seed.

A relatively small amount of fertiliser is imported at present. No response to potash application has yet been demonstrated, but crops respond very readily to phosphatic fertilisers. Nitrogen raises the yield of some crops, particularly maize. Most lowland and foothill soils would benefit from periodical liming.

The success of each year's crops is largely dependent on the climatic conditions through the growing season. If the rainy season starts later than usual, ploughing is delayed and the risk of early frost damage increased. Drought after planting or at flowering can harm fertilisation and seed development, while drought in the growing season may seriously reduce crop yields or may even cause total failure.

High summer temperatures cause high transpiration rates and when these coincide with a relatively dry summer, the crops show marked symtoms of moisture stress. The growing season is limited by low winter temperatures and frost. Early frosts may kill or retard the flowers of wheat and peaches and late frosts may damage maize.

Other frequently occurring climatic hazards are very cold winds, hail and lightning, which may damage crops or harm livestock.

Much damage is done to crops by seed-eating birds and pests such as cutworm, peaworm and stalk borer. Young plants often suffer from severe weed competition. There is little use of insecticides or herbicides.

The best form of tillage for most soils appears to be a winter ploughing with one or two spring harrowings. Ploughing is still mostly done by oxen, although there are some 200 privately owned tractors and the Mafeteng District Council runs a tractor ploughing and planting scheme. Mechanisation is difficult to introduce under the present land-tenure system.

There is very little central grain storage and supplies are imported when they are required.

Irrigation farming is not generally practised in Lesotho although water is usually plentiful, and it is doubtful whether any intensive irrigation project would be profitable as climatic limitations preclude the cultivation of valuable cash crops. Most soils, however, would benefit from careful supplementary watering. Surveys of potentially irrigable soils have been made and an Irrigation Officer has been appointed to undertake preliminary investigations on irrigation practice in Lesotho.

Vegetables are mostly grown in communal gardens, some of which are irrigated. These gardens are popular with women and over 500 have so far been established. Cabbages, carrots, potatoes and spinach are favoured, whereas tomatoes, cauliflower and turnips have proved hard to sell.

Ordinary yellow cling and freestone peaches are grown throughout the country. Apricots are also grown, but are more susceptible to drought and frost. Quinces do well, but have not proved popular.

Livestock

The natural vegetation of Lesotho is grassland and it is well suited to the livestock industry, which is now one of the main sources of the country's cash income.

The major part of the country's exports consists of the wool and mohair obtained from Merino sheep and Angora goats. A 33½ per cent subsidy is paid by Government to encourage the import of high quality smallstock, but, inferior rams still lower the quality of many flocks.

The country's cattle are generally of poor quality. Improvement is hindered by the communal grazing system and the difficulties of preventing the import of poor stock. Many of the Basotho still measure a man's wealth by the number of his cattle rather than by their quality, and the custom of offering cattle as a 'bride-price' encourages the retention of poor stock. The Brown Swiss breed, recommended by the Department of Agriculture, is slowly finding favour and some are now produced within the country. There are great possibilities for rearing largestock particularly for 'store cattle'.

Horses are used for transport in the mountains. The once famous Basotho pony is now almost extinct and an Arab pony stud has been established, with stallions at all Improvement Centres. Oxen, donkeys and mules are used as draught or pack animals.

Most animals spend much of the year in the mountains, but they are generally overwintered in the lowlands and foothills. They are brought down after harvesting and allowed to graze in the arable lands. They soon exhaust this grazing and, as little or no fodder is grown for them, they are in poor condition by the end of the winter. The animals with their attendant herd-boys trek back into the mountains with the start of the spring rains and the disappearance of the snows.

The climate of Lesotho is healthy and there are few serious enzootic diseases. The most trouble is caused by internal parasites and keds. There have been no serious epizootic diseases over the past 50 years. Livestock Improvement Centres are being established throughout the country to give advice and veterinary help to stock owners.

Livestock totals are given in Table 4.

TABLE 4 Livestock totals (1965)

(The Agricultural Department regards these figures as underestimates)

Cattle	329 587
Horses	72 000
Mules	3 300
Donkeys	48 000
Sheep	6 500 000
Goats	806 000

SOIL CONSERVATION

The marked and often spectacular erosion so characteristic of the Lesotho landscape results from natural processes, which have been accelerated by human mismanagement of the land. Lesotho is naturally very prone to erosion as much of its terrain is steep, many of its soils are highly erodible and its rainfall is very intense and concentrated in part of the year.

There is a lack of understanding among the Basotho of the necessity of devising and maintaining simple soil conservation measures. Erosion is accelerated by poor cultivation practices such as ploughing steep slopes and alongside dongas. The general lack of grazing control results in overstocking and large areas are often selectively grazed and trampled. Indiscriminate veld burning has also helped to accelerate erosion.

The need for adequate soil conservation measures has long been realised by the Government of Basutoland and from 1935 onwards the land has been protected by mechanically constructed graded contour furrows ('terraces'), grass strips at 6 ft (2 m) intervals ('buffer strips'), grassed runways ('meadow strips') and by specially planted trees. Small dams have also been built as part of this programme, either as silt traps or to provide a local water supply for stock. The record of this work is presented in Table 5.

TABLE 5 Soil conservation record (to 1963)

Area protected	518 958 ac	(210 200 ha)
Length of terrace	27 295 mi	(43 670 km)
Buffer strip	688 064 ac	(278 600 ha)
Diversion furrows	3 996 mi	(6 395 km)
Dams constructed	690	
Weirs and inlets	25	

Most of these works are not adequately maintained. Grass strips are ploughed out, diversion furrows are allowed to silt up and trees are not protected against livestock depredation. It is particularly difficult to control erosion at its source as river catchments and vegetative sponges are overgrazed and unwise ploughing and burning commonly occurs. The population

is also spreading into the mountains, destroying the vegetative cover and increasing the runoff into the croplands below.

As some success has been achieved in containing erosion, the emphasis in conservation planning is changing from mechanical operations to agro-ecological appraisal. This approach requires the redistribution of both cultivation and grazing to the most appropriate sites in terms of the physical environment and social and economic factors.

Tree planting is part of the Soil Conservation Service. There is no professional forester in Lesotho and there are no commercial plantations. About 50 million trees have been planted, but only about 10% have survived. Some of these trees cannot withstand harsh climatic conditions, but the death of many others is caused by neglect or even wilful damage by people who do not yet realise the important role of trees in soil conservation.

Trees are used for fencing poles, firewood and for building purposes. Grass gives a more economic return as the growth rate of trees in Lesotho is very slow because of the long, dry winters.

Exotic trees such as eucalypts and Australian wattles used to be planted, but the practice has been discontinued as these trees are demanding on the soil and provide such a sparse litter that erosion continues even under their cover. Trees are now planted to stabilise gullied areas and badly eroded hillslopes and the present planting practice is:

Site	*Vegetation*
Donga (gulley) bottom	*Salix alba;* reed mace *Typha* sp.
Donga side	*Populus canescens*
Poorer, wetter soils about dongas	*Populus serotina* and *P. wislizenii*
Deeper, wetter soils	*Populus deltoides* and *Salix* spp.
Shallower, drier soils	*Pinus insignis* and *P. patula*

In addition to the needs of conservation, many pines, deodars, cypresses and oaks have been planted about Government buildings and near trading and mission stations.

Two possibilities have been suggested for an economic return from tree planting; an osier willow industry and a matchwood industry based on a poplar belt along the Caledon River.

PRODUCTION AND MARKETING

There are about 25 registered Co-operative Societies and about 200 trading stores in Lesotho. There is much room for improvement in the marketing of agricultural and livestock products and Biggs (1965) has recently completed a marketing survey and submitted his recommendations for the development of marketing to the Government.

Most of the country's trade is with the Republic of South Africa; there is little trade within the country itself. There is little cash cropping, and the export of agricultural products amounted to only R 150 000 in 1958. Wheat and pulses accounted for nine-tenths of this figure. Exports are usually

approximately balanced by imports, mostly of maize. Import and export figures for some recent years are given in Table 6.

TABLE 6 Exports and imports of grain and pulses (measured in 200 lb (90.7 kg) bags)

Exports							
	1957	1958	1959	1960	1961	1962	1963
Wheat	101 077	51 741	18 344	39 348	25 673	22 764	13 919
Peas/beans	38 608	47 300	25 904	13 129	5 701	7 403	3 618
Sorghum	10 003	11 864	608	5 826	1 592	1 343	1 105

Maize imports							
1956-7	1957-8	1958-9	1959-60	1960-61	1961-2	1962-3	13 yr av.
90 903	98 089	135 777	231 306	153 350	163 307	240 334	145 267

Much of the mountain-grown wheat is retained for local consumption. The better quality wheat grown in the lowlands is mostly exported, but this is more than compensated for by the importation of wheat flour. The country is normally self-sufficient in sorghum and a levy is charged only on malting sorghum. Maize is imported as maize meal and whole maize and the purchaser is required to refund the subsidy currently payable in the Republic of South Africa.

Peas are in great demand as they are hand selected and there is little export potential because they can all be used internally and resold as seed. The export of beans is negligible as too many varieties are grown.

Wool is slowly increasing in quantity and value. In 1965 the production of 8 289 634 pounds was valued at R 1 728 000. In the same year 2 225 016 pounds of mohair was valued at R 817 000. Shearing takes place at Government-certified centres and the wool is sold on a free market to traders or co-operatives who are responsible for its classing. The wool is finally sold, through brokers, at South African ports.

Cattle imports are greater than exports. Much of the exported stock is still bought by speculators from the Republic of South Africa, although a system of central buying by H. Hides, Ltd. (controlled by the Department of Co-operatives) is rapidly increasing. All cattle are sold on the hoof and marketing is therefore immediate and selective.

Hides and skins are a local by-product of the death of animals from starvation, old age and other natural causes or their slaughter for human consumption and are in consequence only mediocre in quality. All are exported; traders sell through brokers at the coast, but H. Hides, Ltd. are allowed to export directly in bond. In 1965, 91 838 hides and 39 627 skins were exported.

PART 4. LAND SYSTEMS

LAND CLASSIFICATION

The technique of using *land systems* to describe and classify land was developed in Australia by the Division of Land Research and Regional Survey of the Commonwealth Scientific and Industrial Research Organisation and has since been used successfully by a number of other organisations.

This technique is based on the concept that units of the natural landscape occur in patterns, which can be mapped from aerial photographs. Each unit of the pattern will have its own characteristic association of topography, climate, soils and vegetation, which will govern the optimum use of the land. A grouping of like units will thus bring together areas with similar land use potential.

The most detailed unit used in this survey is the land system. A land system is 'an area or group of areas throughout which can be recognised a recurring pattern of topography, soils and vegetation' (Christian and Stewart, 1953). As these patterns are often complex, the mapping unit is composite and some simplification and combination is inevitable when assessing large areas of land. The complexity of a pattern is in no way related to its geographical area and more land systems may be mapped in a small area of diverse scenery than in a larger, more homogeneous area.

The land systems have been grouped into six *land regions;* each of which has a distinct landscape pattern produced by similar climatic and geomorphological processes acting on similar rocks. Some regions may be composed of only a few land systems, while other more complex regions are a combination of many. Broad differences in land use can most easily be seen at this level of classification and the regions closely resemble the *agroecological zones* established by the Lesotho Ministry of Agriculture (1963).

To emphasise this resemblance, regional names have been chosen which closely resemble those of the agro-ecological zones (Table 7).

TABLE 7 Comparison of regions and agro-ecological zones

Land province	Land region	Land systems	Agro-ecological zone
Mountain	Higher Mountain	1 - 3	Upper Mountain Grazing
	Lower Mountain Slopes	4 - 6	Lower Mountain Grazing
	Lower Mountain Flats	7 - 9	Mountain Village
	Foothill	10 - 12	Foothill
Lowland	Lowland	13 - 24	Lowland
	Orange River	25 - 27	Orange River Valley

The broadest grouping used is the *land province* which is a group of land regions with similar geological structure and lithology. Lesotho can be divided into a mountainous area of basaltic rocks and a hilly area of sedimentary rocks. These two areas are the Mountain and Lowland Provinces.

The land provinces and land regions mapped in Lesotho are shown on Map 5, and the land systems are shown on two 1: 250 000 scale maps. The most important characteristics of each land system are described here. The area of each system is given under the appropriate heading and also tabulated in Appendix 1.

HIGHER MOUNTAIN REGION

LAND SYSTEM 1. HIGH PLATEAU — 1 175 mi^2 (3 042 km^2)

The High Plateau land system describes the rolling upland plateau extending westward of the great Drakensberg escarpment which runs from Sehlabathebe in the south to Mt. Aux Sources and beyond in the north. An extension or remnant of this plateau forms the central divide, which runs in a north to south direction through the mountain area. Another small remnant, found in the most southerly part of the country, is also included in this system. The system is everywhere bounded by a sharp convex break of slope and is entirely underlain by basaltic rocks.

Physiography The terrain consists of hilly and stepped land, interspersed with a few open rolling valleys. The hill tops are flat with concordant summits at about 10 500 ft (3 200 m) above sea level and are ascribed by King (1962) to the Gondwana surface; the highest peaks rise to over 11 000 ft (3 300 m). The valley floors have an elevation of 9 500 - 10 000 ft (2 900 m - 3 050 m).

Soils The rigorous alpine climate of the high plateau severely limits soil formation and development. Its soils are thin, black, gritty clays with a high content of weathering material. There are many outcrops of bare rock.

Vegetation Grass cover at this elevation is poor and the species have distinctly alpine affinities. Sour varieties predominate. Various species of fescue and similar grasses are found on the slopes, while the tall, tussocky *Danthonia* species are more common on damper, flatter ground. Level, pan-like areas on the plateau are covered by vegetative sponges, which provide the ultimate source of the major rivers of Lesotho.

Land use The plateau is snowbound for much of the winter, and the ground is generally frozen in the winter and waterlogged in the summer. There is no permanent habitation within this system, although herdboys live there in rude shelters throughout the summer. The alpine grasses have short stems and leaves and provide a lower fodder potential than the grasses occurring at lower elevations. They are more suitable for grazing small stock, and sheep are sent to graze on the plateau during the summer months. Goats have not been found hardy enough for these high altitudes. Serious overgrazing of the sponges by sheep has occurred in places and runoff has consequently been greatly increased.

LAND SYSTEM 2. HIGH MOUNTAIN FLATS — 172 mi^2 (446 km^2)

The High Mountain Flats land system describes two flat-floored valleys above the edge of the Drakensberg escarpment separated by steep slopes rising to the High Plateau. These flats are cut at a lower level than the surrounding High Plateau and have been ascribed by King (1962) to the post-Gondwana surface. The soils, vegetation and land use of this system are very similar to those in the High Plateau.

MAP 5

LESOTHO
LAND PROVINCES & REGIONS

Scale 1:1,000,000

Miles
0 10 20

REFERENCE

Roads
Bridle Paths
District Boundaries
District Headquarters
Townships
Villages
Trading Station

27° 28° 29° East of Greenwich

29°S 30°

ORANGE FREE STATE

FOURIESBURG
MABIN
Police Post
Mt Aux Sources 10763'
BUTHA-BUTHE
LERIBE
KHABE
FICKSBURG
PEKA
LITTENS
Cathedral Dome
LADYBRAND
TEYATEYANENG
To Bloemfontein (90 Miles)
MASERU 5100'
Thaba Bosiu
THEKOS
MAZENOD
St Mi
Roma
Champagne Castle
NATAL
MOKHOTLONG
Giants Castle
Mohlesi Pass
Thabana Ntlenyana 11425'
Sani Pass
Police Post
To Underberg
Caledon River
MORIJA
TSAKHOLO
WEPENER
MAFETENG
MANKALEA
HELLSPOORT
MPHARANE
SEKAKE
TSOELIKE
RANKAKALA
Ramatseliso's Gate
QACHAS NEK 6300'
SHILABATHEBE
Orange River
Senqu River
Makhaleng River
Malibamatso River
ZASTRON
PHAMONG
TOSING
Senqu River
Ongeluks Nek
MATATIELE
QUTI
Orange River
Tele River

ORANGE FREE STATE
NATAL
LESOTHO
CAPE PROVINCE
Indian Ocean

MOUNTAIN PROVINCE
Higher Mountain Region
Lower Mountain Slopes Region
Lower Mountain Flats Region
Foothill Region

LOWLAND PROVINCE
Lowland Region
Orange River Region

CAPE PROVINCE

Base map derived from D.O.S. (Misc) 280
Basutoland 1:776,000 First Edition

27° East of Greenwich 29°

D.O.S. (Misc) 417 E

Drawn, photographed and prepared for colour printing by the Directorate of Overseas Surveys, 1966.
Printed for D.O.S. by the Ordnance Survey.

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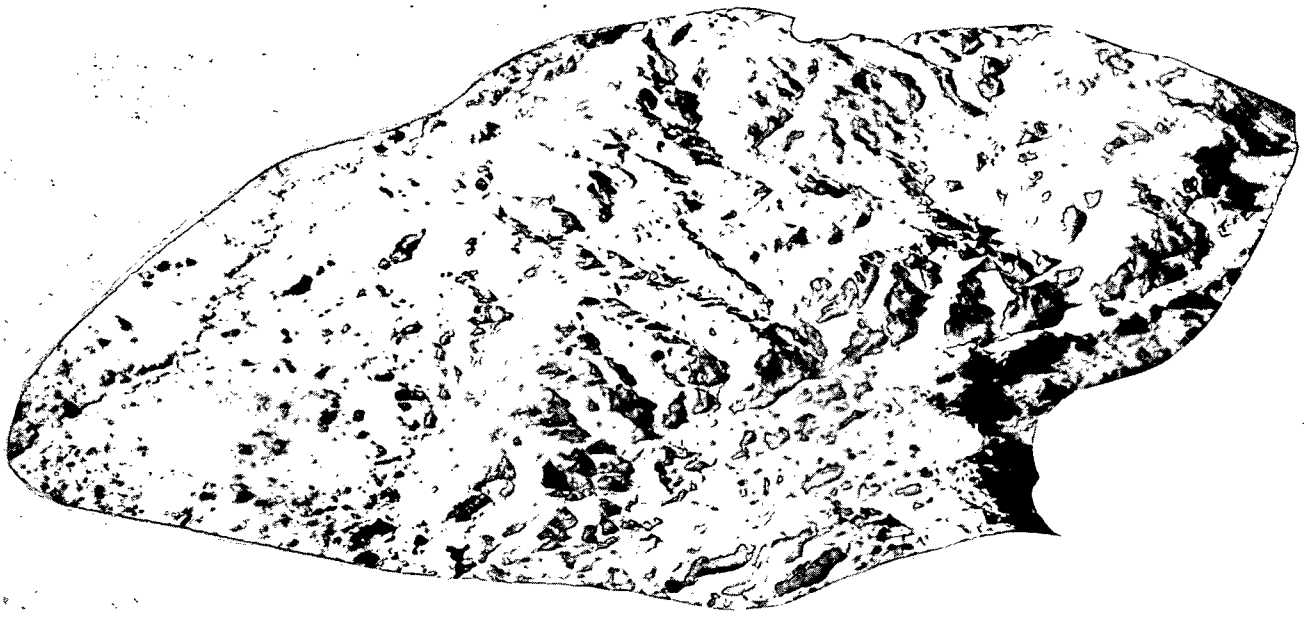


PLATE 1 Oblique view from the south of a model of Lesotho; the vertical scale is four times greater than the horizontal scale

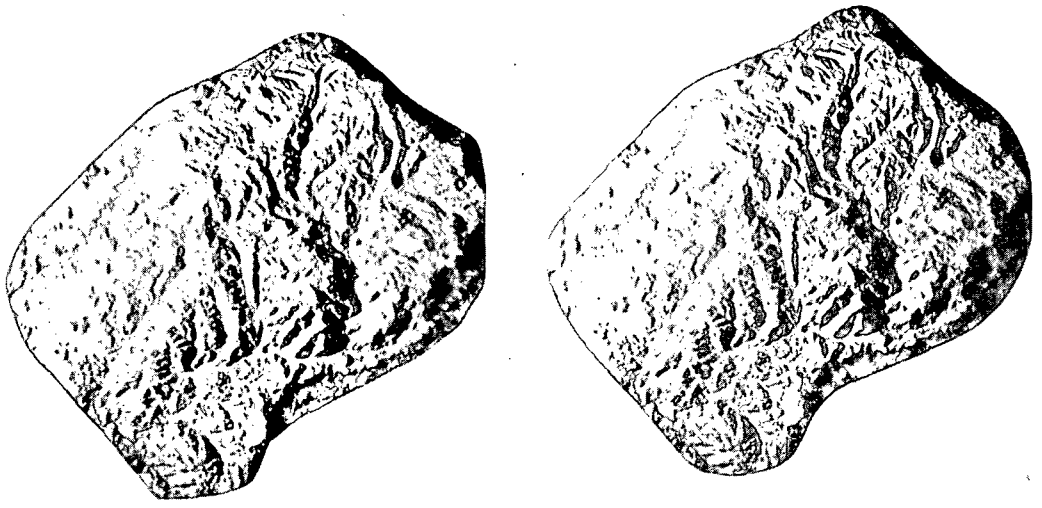
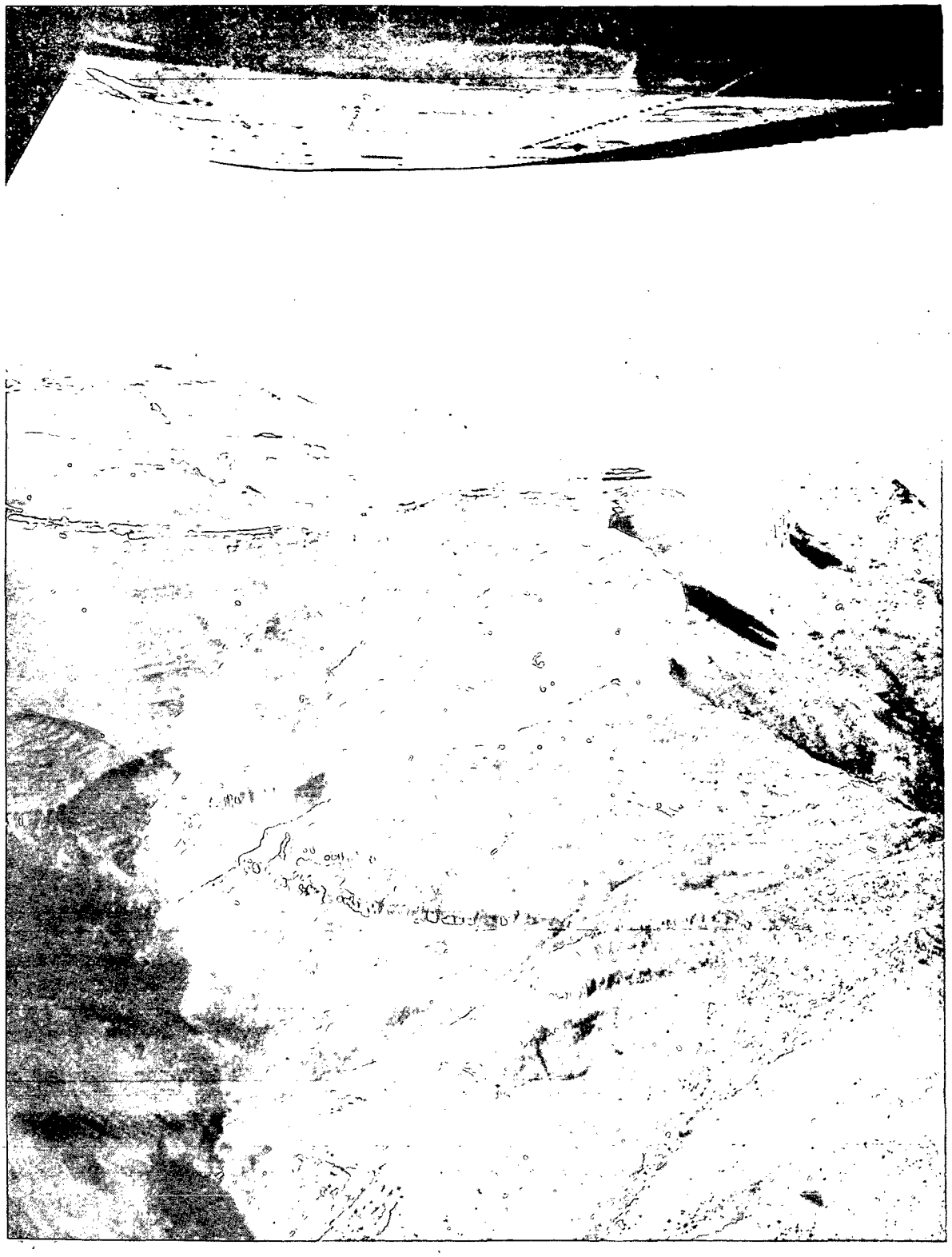


PLATE 2 A vertical stereoscopic pair of photographs of the model of Lesotho. Note that when viewed stereoscopically the relief is greatly exaggerated



Central Office of Information

PLATE 3 The Mountain Province from the air showing the concordant summits of the High Plateau (land system 1) rising to about 10 500 ft (3 200 m) and the steep slopes of land systems 3 and 4 below

LAND SYSTEM 3. HIGHER SLOPES 1 625 sq mi (4 210 km^2)

The Higher Slopes land system contains the steep slopes descending from the High Plateau, which merge into topographically similar slopes characteristic of the Lower Mountain Region. The system is distinguished from those below it by its peculiar soils-vegetation complex the lower limit of which is commonly found at about 8 500 ft (2 600 m).

Physiography The system largely consists of straight simple basaltic slopes falling from about 10 500 ft (3 200 m) to about 8 500 ft (2 600 m) with a grade of 1 in 4 or 5. At the 1:250 000 scale some small remnants of the High Plateau are included in this system.

Soils The soils covering these steep slopes are shallow, stony and only very weakly developed.

Vegetation The grass in this system is thin and alpine grasses predominate. The transition from alpine to mixed grassland is often relatively sharp, and the boundary can usually be fixed at about 8 500 ft (2 600 m). The change may occur at much lower elevations, however, on south-facing or very steep slopes.

Land use These slopes provide only rather poor grazing for sheep. Even at these high altitudes bush encroachment follows overgrazing, and the system is therefore becoming of even less use for grazing.

LOWER MOUNTAIN SLOPES REGION

LAND SYSTEM 4. SIMPLE SLOPES 1 047 mi^2 (2 711 km^2)

The Simple Slopes land system describes steepland covering much of the eastern portion of the mountains. These slopes usually pass smoothly upwards into the Higher Slopes land system which has a more alpine soils-vegetation complex. At its lower limits, the system is bounded by a concave break of slope which passes into nearly flat mountain valley floors at about 7 000 ft (2 130 m). In the south-east, these valleys are absent and the steepland passes directly into steep-sided sandstone cliffs at about 6 000 ft (1 830 m).

Physiography The slopes are steep and without inflexion, although they are occasionally broken by broad, flat-topped montane spurs in the south and east. These spurs are described under land system 7. Some small isolated flats and valley floors are included in this system.

Soils The soils of this system are shallow and vary quite widely with the slope's aspect. They are mostly uniform black clays with a marked nut-like or granular structure. On these steep sites, the clays are moderately freely draining. They are very fertile as their pH is about 7.0 and their base status and organic matter content are high. On the warmer north-facing slopes, freely draining friable brown clays with weaker structure are more common than the black clays. These brown clays are more easily eroded than the black and are also less fertile.

Vegetation The grasses of the mountain slopes are a mixture of the sweet and semi-sour varieties found in the lowlands and the alpine types characteristic of the upper mountain slopes. The grass cover is thicker than

that of the higher regions and there is a larger proportion of palatable species. The strong structure of the associated soils is caused by the dense rooting of the grass sward.

Land use The lower mountain slopes provide good pasturage for both largestock and smallstock. Overgrazing is common on the warmer north-facing slopes as the snow melts more quickly and they support more palatable species that the southern slopes. Severe erosion and karroid bush encroachment often follow this denudation of the grass cover. Attempts have been made to cultivate the gentler slopes, but erosion, often in the form of large land-slips, has resulted.

LAND SYSTEM 5. NORTH-WEST ESCARPMENT 325 mi^2 (842 km^2)

The North-west Escarpment land system describes the north-west facing escarpment of the Maluti mountains, in the north of the country, which separates the upper catchment areas of the Caledon and Orange Rivers.

Physiography The system is composed of a series of steep simple slopes with a north-east to south-west trend descending from about 10 000 ft (3 050 m) to foothill flats at 6 500 ft (1 980 m). These slopes form an escarpment, which is dissected by many streams and rivers into parallel V-shaped spurs and valleys.

Soils and vegetation The soils of this system are mostly rather shallow, well structured black clays similar to those described under land system 4. The grasses of the system are a mixture of lowland and upland types. Alpine grasses, even at relatively high altitudes, appear to be less common than in other lower mountain systems, possibly because of the escarpment's warmer northern aspect.

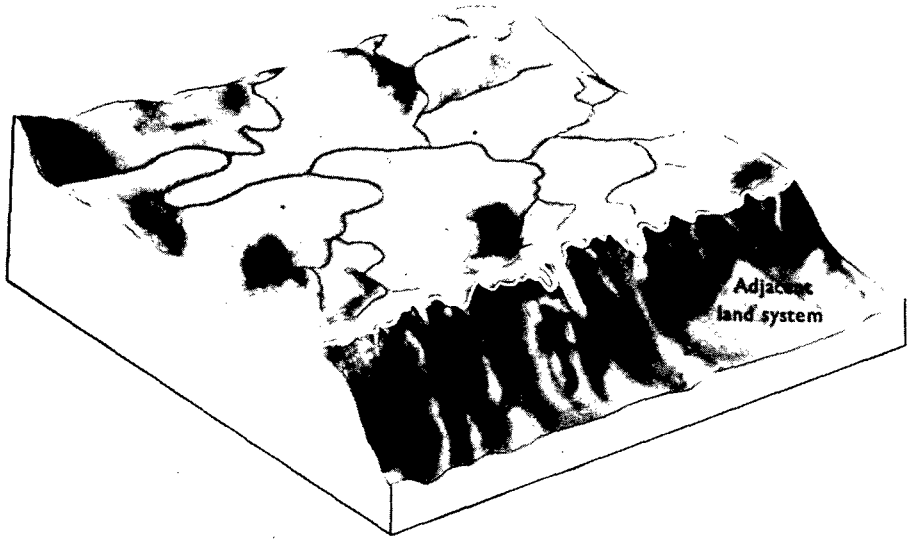
Land use The escarpment is used for grazing cattle and goats and also provides winter grazing for sheep. The density of the stock population is often high as the area is easily reached from the adjacent foothills and lowlands. Overgrazing and consequent bush encroachment is increasing.

LAND SYSTEM 6. COMPOUND LOWER SLOPES 2 649 mi^2 (6 862 km^2)

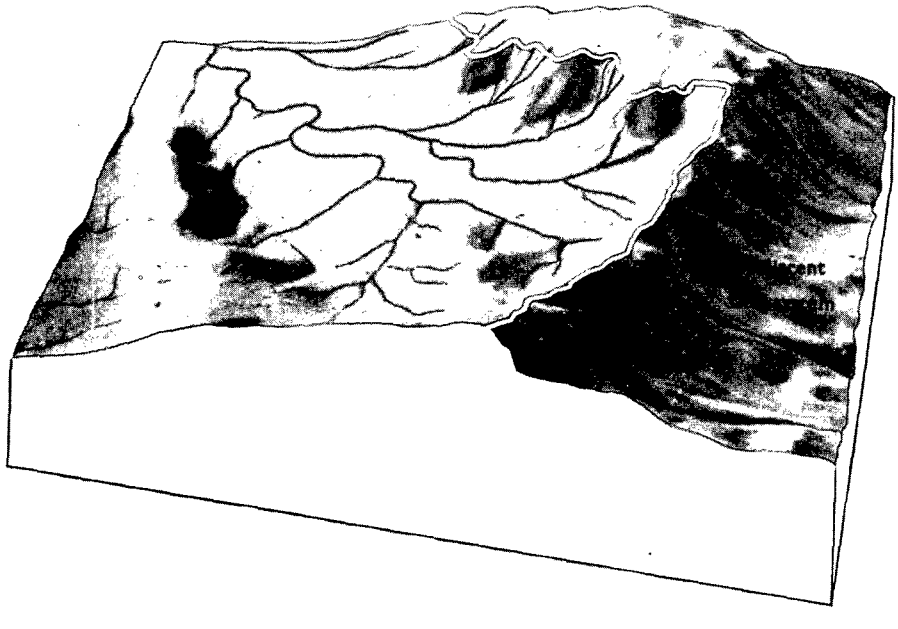
This land system describes the dissected steep terrain of much of the southern half of the mountains.

Physiography Most of the slopes in this system are compound and are either broken by valley and spur flats or show marked inflexions in their profile. A group of flats at about 8 000 ft (2 440 m) is included in this system. These flats are the only extensive areas of relatively level land within the Lower Mountain Slopes Region. The other spur and valley flats are described separately as they occur as scattered areas throughout the mountains and have a marked land use pattern of their own (land systems 7 and 8).

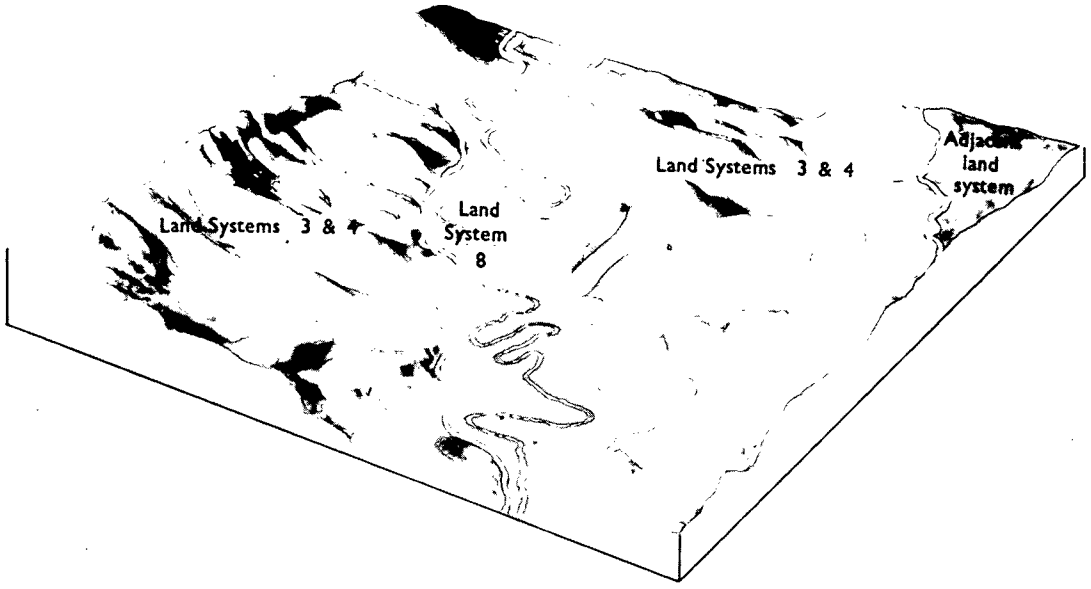
Soils and vegetation Most of the steep slopes are covered by shallow black clay soils and their soils-vegetation complex is similar to that described under land system 2. Soils on some of the 8 000 ft (2 440 m) flats are often deeper as they accumulate colluvium from the surrounding hillslopes. Other flats, particularly those with southern aspects, have thin soils, sparse vegetation and even outcropping bedrock.



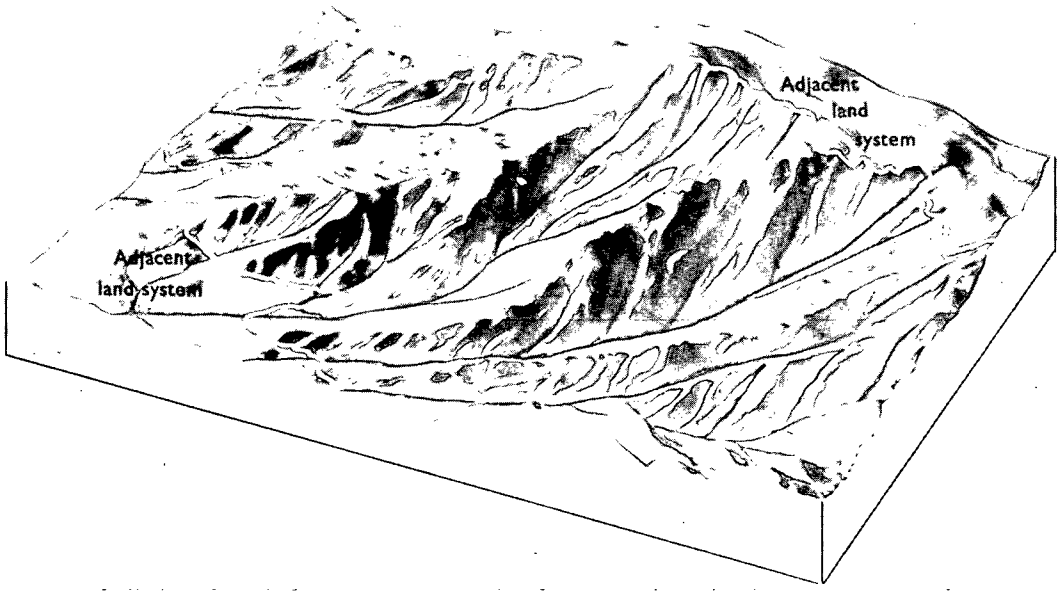
LAND SYSTEM 1 High Plateau



LAND SYSTEM 2 High Mountain Flats



LAND SYSTEMS 3, 4 and 8 Higher Slopes; Simple Slopes; Mountain Valleys



LAND SYSTEM 5 North-West Escarpment

Land use. Both the slopes and the flats are primarily used for grazing. Some cultivation is possible on the flats, but the general shallowness of the soils greatly limits yields.

LOWER MOUNTAIN FLATS REGION

LAND SYSTEM 7. MOUNTAIN SPURS 380 mi^2 (984 km^2)

The Mountain Spurs land system includes many isolated flats occurring at elevations of about 7 500 ft (2 290 m) throughout the Mountain Province.

Physiography These flats usually occur on mountain spurs flanking river valleys. They are generally more extensive on north-facing valley sides, and are probably dissected remnants of valley floodplains.

Soils Most of the soils of this system are shallow to moderately deep black clays with strong granular structure, but deeper clays with poorer drainage and a coarser blocky or prismatic structure often occur on the gentlest slopes.

Vegetation The grasses of these flats are a mixture of the sweet and semi-sour types of the lowlands and those characteristic of the alpine uplands.

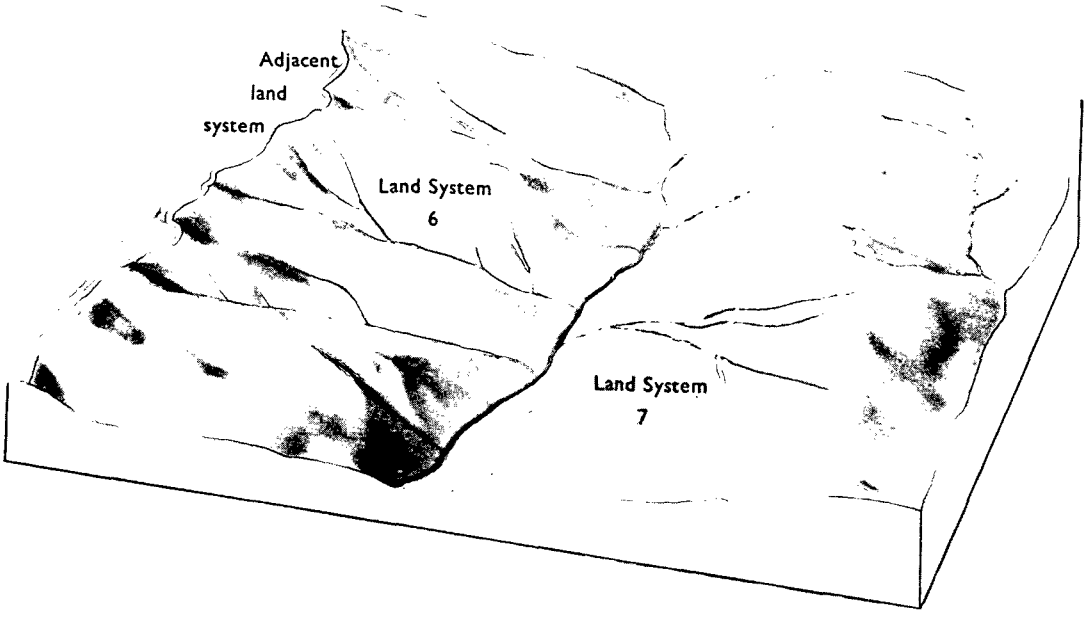
Land use This system resembles the Mountain Valleys system (land system 8) in being a mixed farming area with a considerable population. Crops are mostly wheat and peas with some sorghum or maize. Water can be obtained from small streams on the adjacent mountain-sides, but there are no great irrigation prospects. The stock graze on the surrounding mountain slopes, but are often kept in cattleposts within villages sited on the flat-topped spurs. Nearly all the produce in this area is exported by pack animals. As with land system 6, communications and marketing facilities are poor.

LAND SYSTEM 8. MOUNTAIN VALLEYS 342 mi^2 (886 km^2)

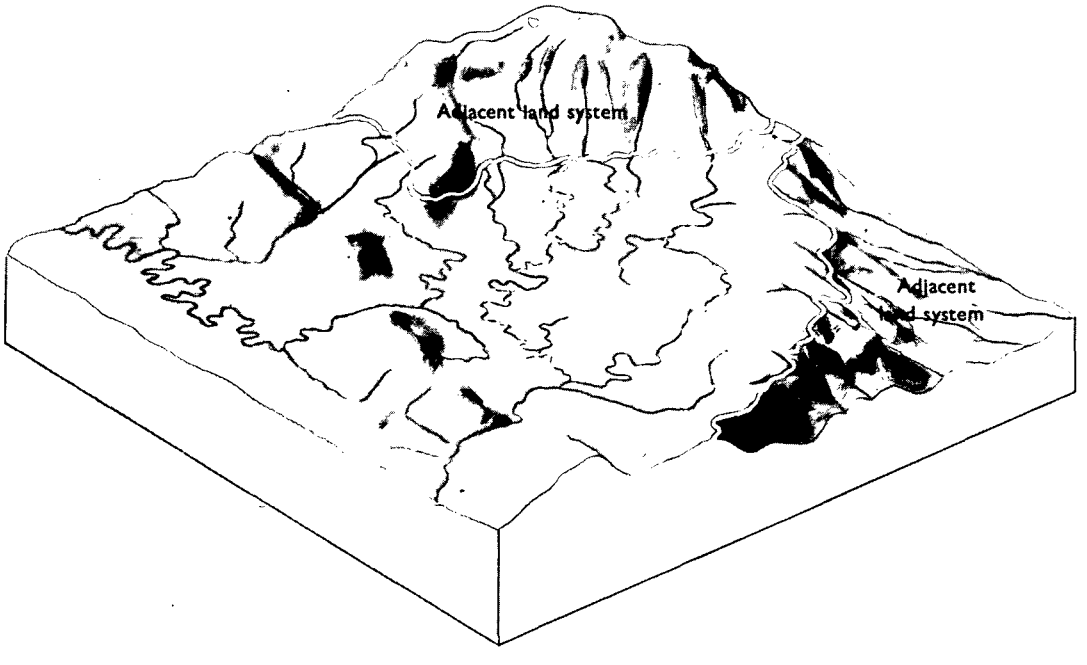
The Mountain Valleys land system includes valleys distributed throughout the whole of the Mountain Province. The largest occur in the upper reaches of the Orange and Makhaleng Rivers.

Physiography The valleys have flat floors, about 7 500 ft (2 290 m) above sea level, which gradually descend as unbroken flood plains with incised meanders. They are completely surrounded by steep mountain slopes.

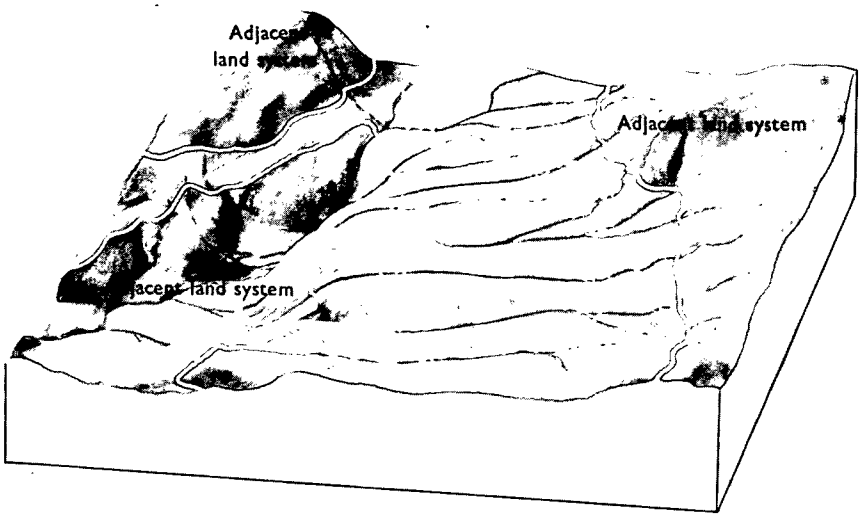
Soils The soils of this system are mostly strongly structured black clays of shallow to moderate depth. The deeper and less well drained soils forming on the flattest portion of the valley floor are vertisolic. Although the pH and base status of these vertisols is high, their aeration and permeability is poor. Most of the black clays' parent material is formed by colluviation from the surrounding hillsides, but alluvial deposits also occur, particularly near the present river channel. These alluvial deposits are long thin strips of stony and gravelly silt.



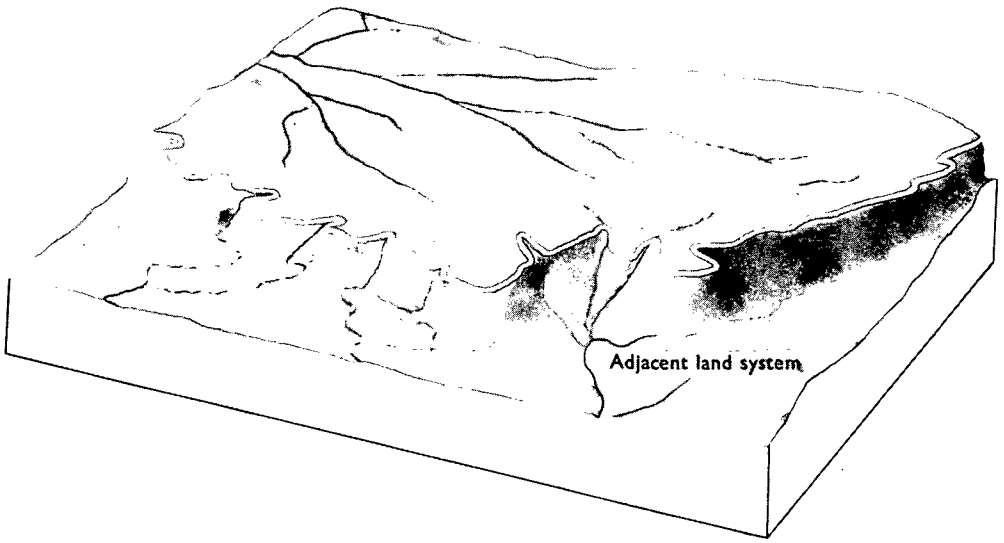
LAND SYSTEMS 6 and 7 Compound Lower Slopes; Mountain Spurs



LAND SYSTEM 9 Sandstone Plateau



LAND SYSTEMS 10 and 11 Northern Basaltic Foothills;
Southern Basaltic Foothills



LAND SYSTEM 12 Sandstone Foothills

Vegetation The vegetation contains only a small proportion of alpine grasses, but there are many sour grasses. *Eragrostis* species are common in overgrazed areas. Some relicts of bush and scrub forest survive in the more sheltered valleys.

Land use Much of the population in the mountains live along the major river valleys which make up this land system. Most of the cultivable land is also found here, and although the climate prevents winter cropping, wheat, peas and some barley are grown. Maize and sorghum are also grown in the more sheltered spots. Fodder crops are rarely planted. Many valleys could easily be irrigated. There are only small isolated pockets of grazing land in the valleys and animals graze mainly on the surrounding slopes in land systems 4 and 6 although many are brought back during the winter. Communications and marketing facilities are poor in most of the mountain valleys.

LAND SYSTEM 9. SANDSTONE PLATEAU 60 mi^2 (155 km^2)

This land system consists of a plateau cut on Cave Sandstone in the vicinity of Sehlabathebe.

Physiography The plateau is composed of broad and planed valleys above the Drakensberg escarpment; their general elevation is 7 500 ft (2 290 m). The plateau is surrounded in part by steep basaltic mountain slopes and deeply incised on its western margin by the Tsoelike River.

Soils There is much bare ground in this system. The soils are mostly shallow with a sandy texture; deeper fersiallitic soils occur on the gentler valley slopes. The external drainage in this system is poor and large areas of soil are waterlogged throughout the summer.

Vegetation The grasses are mostly tall, sour types; some scrub occurs on steeper slopes. There are also some alpine grasses.

Land use The system is used mostly for cattle grazing, but there is some cultivation where the soil is deep enough.

FOOTHILL REGION

LAND SYSTEM 10. NORTHERN BASALTIC FOOTHILLS 570 mi^2 (1 476 km^2)

The Northern Basaltic Foothills land system describes a series of gentle north-west-facing slopes cut in basaltic rock at an elevation of 6 000 - 6 500 ft (1 830 - 1 980 m), which are known as 'foothills' in Lesotho. They pass upwards into the steep north-west-facing escarpment in the Maluti Mountains (land system 5) and downwards to sandstone plateaux or cliffs (land system 9 or 13).

Physiography The broad and relatively undissected slopes of the foothills rise gently from a planed Cave Sandstone surface. These slopes are divided by mountain spurs of land system 5, some isolated remnants of which are included in this system.

Soils The mature soils of this region are reddish clay loams to clays with a pH of 5.3-6.0. They are usually deep and freely draining. A heavy, imperfectly drained black clay of vertisolic type with pH 7.8-8.0 occurs

along drainage lines and in other low-lying sites and passes rapidly upslope into the normal reddish soil through a dark brown soil with intermediate properties. The acid reddish soils have a low base content and a relatively high cation exchange capacity. Their organic matter content is moderate. The reddish soils are mostly the product of colluvial reworking; they are deeper on gentle slopes and the steeper, more broken foothill country is most commonly associated with shallow, poorly developed soils.

Vegetation The grasses of the northern foothills are a mixture of typical lowland grasses and taller sour species. *Themeda triandra* and *Tristachya hispida* are normally co-dominants. Sheltered areas with a warm, northern aspect often have a good stand of tall grass.

Land use The foothills are densely populated and both cropping and stock farming are practised. Maize, sorghum, wheat and beans are the major crops and the livestock largely consists of cattle and goats. Communications and marketing facilities vary; in general they are good and the system is fairly accessible from the main centres of population in the lowlands. A new road linking this valuable agricultural area has been suggested and would be highly desirable.

LAND SYSTEM 11. SOUTHERN BASALTIC FOOTHILLS 371 mi^2 (961 km^2)

The Southern Basaltic Foothills land system contains the southern extension of the foothill belt. It is generally similar in its physiography and land use to the Northern Basaltic Foothills system, but differs from it in having a lower rainfall and a much higher proportion of sweet grasses. The soils are drier for much longer periods of the year.

LAND SYSTEM 12. SANDSTONE FOOTHILLS 12 mi^2 (32 km^2)

The area covered by the Sandstone Foothills land system on the map is relatively small but its description also covers many small areas of similar type, which occur above the escarpment separating the foothills from the lowlands and are too small to differentiate at this scale of mapping. These isolated fragments have been mapped as part of land system 13.

Physiography The system consists of relatively undissected sandstone plateaux with broad gentle slopes, which still retain a fair soil cover.

Soils The mature soil of this system is yellowish-brown and has a pH of about 5.5 throughout its profile. The clay content increases from a loamy fine sand topsoil to a fine sandy clay loam at depth. The soil usually lacks structure and in places has a concretionary horizon, which limits root development. Its content of exchangeable bases is low; it has been largely reworked and the depth is very variable, but it is often greater than three feet. The loose sandy topsoil is easily eroded, both by water and wind.

Vegetation The grasses found in this system are similar to those found in the Northern Basaltic Foothills except that the cover is sparser and there are fewer palatable species.

Land use The soils are derived from sandstone and are both more erodible and less fertile than those in the Basaltic Foothills. The better areas of this system are grazed and cropped, but much good land has been spoilt by overgrazing. Erosion has quickly stripped the soil from the bared surface and bush encroachment has followed. This ruined land is now mostly abandoned.

LOWLAND REGION

LAND SYSTEM 13. LOWLANDS ESCARPMENT — 752 mi^2 (1 948 km^2)

This land system describes both the steep escarpment separating the lowlands from the foothills and also remnant steep-sided plateaux of sedimentary rocks now separated from the main escarpment. To simplify the land system map some small valleys formed behind this escarpment have been included in this system.

Physiography The escarpment consists of steep debris slopes of Red Beds capped by the more resistant Cave Sandstone. Above the escarpment, there are often gently sloping flats at about 6 000 ft (1 830 m), which are described under land systems 10 - 12. The horizontally bedded Cave Sandstone capping the remnant plateaux forms an almost level structural platform.

Soils The soils of the escarpment are shallow and stony, as are the soils overlying the remnant plateau caps.

Vegetation The grass cover of this system is poor and the vegetation of the steep slopes consists mostly of xerophytic grasses mixed with karroid bush.

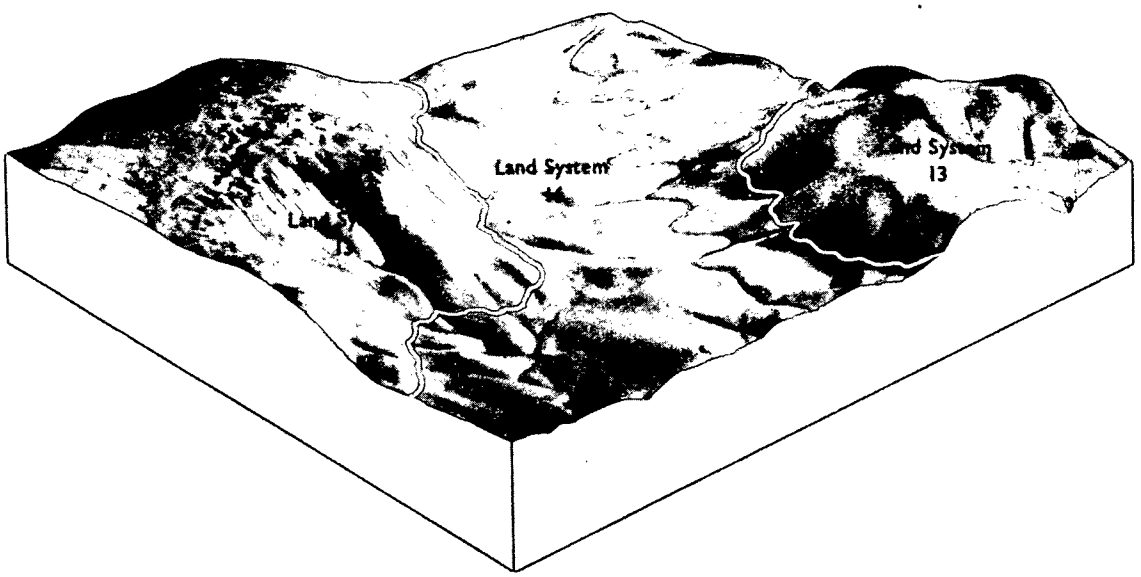
Land use The steep slopes of the escarpment and plateaux provide a certain amount of poor grazing, but the bare, rocky surfaces of the plateaux are not used.

LAND SYSTEM 14. CALEDON LOWLANDS — 284 mi^2 (736 km^2)

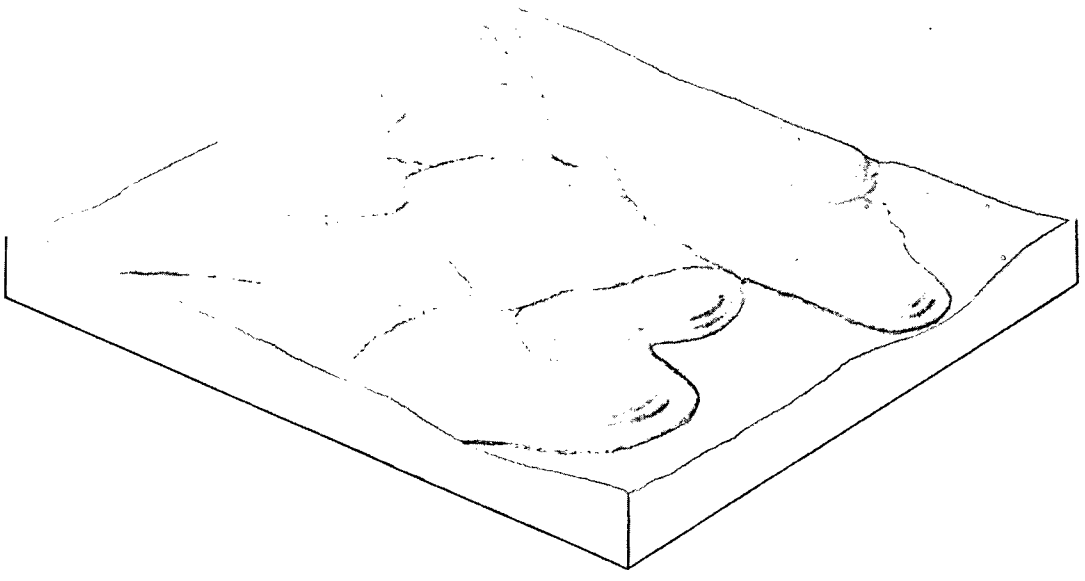
The Caledon Lowlands land system describes a long strip of undulating to hilly, rather broken land, which extends from Lesotho's north-west border to the southern boundary of the Maseru district and is mostly bounded to the west by the Caledon River.

Physiography The system consists of a succession of valleys, underlain by Molteno and Red Beds, which are composed of dissected pediment slopes merging smoothly into convex spurred hilltops. Small, isolated remnant hills of dolerite and sandstone occur throughout the system. Small, steep scarps often mark the boundary between the Molteno and Red Beds.

Soils The pediments are covered by claypan soils with sharply separated A and B horizons. The A horizon is moderately acid with loose consistence and coarse texture. The B horizon is a firm and impermeable sandy clay with a pH of 7.0-8.0. The soils of the hilltops vary with the nature of the underlying rock. Most of them are developed from Red Beds and are moderately acid, almost structureless fersiallitic soils ranging in colour from red to yellowish brown. The texture of the topsoil is commonly loamy fine sand; the subsurface horizons vary from fine sandy loam to fine sandy clay loam.



LAND SYSTEMS 13 and 16 Lowlands Escarpment;
Central Lowlands



LAND SYSTEM 14 Caledon Lowlands

A yellowish-brown soil with similar horizon arrangement occurs in some areas underlain by Molteno Beds, but its texture is much coarser throughout the profile. In other areas of Molteno Beds, the hilltops and upper slopes are covered with a stiff, brown calcareous clay.

The composition of the alluvial soils along the Caledon River varies depending on the distance of the river from its mountain source. The narrow flats in the upper reaches of the river are covered by a mixture of black clays and gravelly and silty floodplain deposits, often overlain by sandy wash from the surrounding sedimentary rocks. Further downstream, the terraces are broader and covered with dark, medium to fine textured soils of pH 7.0 - 8.0. Farthest from the mountains these heavy soils give way to coarse and medium textured soils of pH 5.5 - 6.5 in the Teyateyaneng and Maseru districts, where the river flows through an area of sedimentary rocks.

Vegetation The usual lowland mixture of sweet and semi-sour grasses occurs over most of this land system but there is a higher proportion of sour grasses in the wetter northern part. Tall grasses commonly occur in warmer, sheltered spots.

Land use The area covered by this system has a dense population and is well served by major roads and tracks; it is the major internal market of Lesotho. The relatively high rainfall allows semi-intensive cultivation of maize, sorghum, beans and winter wheat. There is, as yet, little interest in growing fodder crops but more vegetables are being grown, often in communal gardens. The Government maintains a trial irrigation plot on alluvial soils at the Maseru Research Station. The isolated rocky koppies* and scarps are used only for grazing.

The claypan soils have very erodible subsurface horizons and gully easily. The fersiallitic soils are less susceptible to this type of erosion, but their loose sandy topsoil is easily removed by strong winds.

LAND SYSTEM 15. PHUTHIATSANA LOWLANDS 156 mi^2 (404 km^2)

The Phuthiatsana Lowlands land system describes the broad valley of the Phuthiatsana River. The valley sides are composed of broad, dissected pediments passing into smoothly convex spurred hilltops. Small rocky scarps and isolated koppies* occur throughout the system. (See page 50).

Soils The pediments are covered by claypan soils and the hilltops by reddish fersiallitic soils. The alluvial soils are dark firm clays with a pH of 7.5 - 8.0. They are very fertile, with a high base status and a moderate content of organic matter, but they are only slowly permeable.

Vegetation The grasses are mostly of the *Themeda-Cymbopogon* grassveld type.

Land use Nearly all the possible arable areas of this system are cultivated. The black alluvial clays produce very good crops and are much sought after.

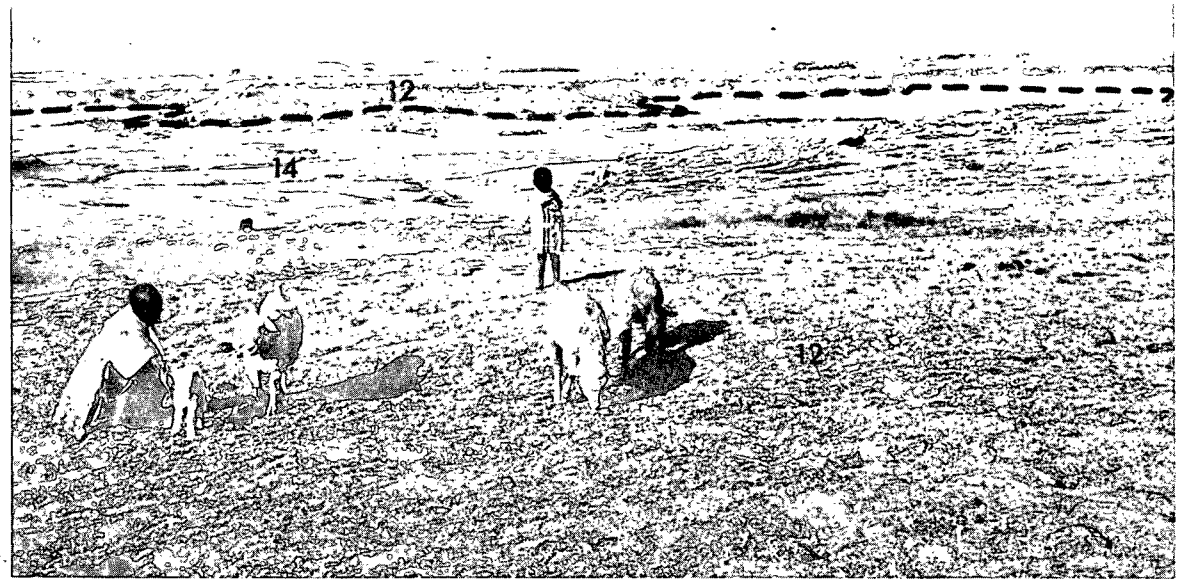
* Small isolated hills.

Central Office of Information

PLATE 4 Cultivation on Mountain Spurs (land system 7) with the steeper slopes of land systems 3 and 4 in the background

Central Office of Information

PLATE 5 Flat-floored Mountain Valley flood plain (land system 8) bounded by steep compound slopes with marked change of slope and minor spurs in the middle distance (land systems 6 and 7)



Central Office of Information

PLATE 6 View over the Caledon Lowlands (land system 14) to the Sandstone Foothills (land system 12) with the steeper slopes of the Mountain Province in the background

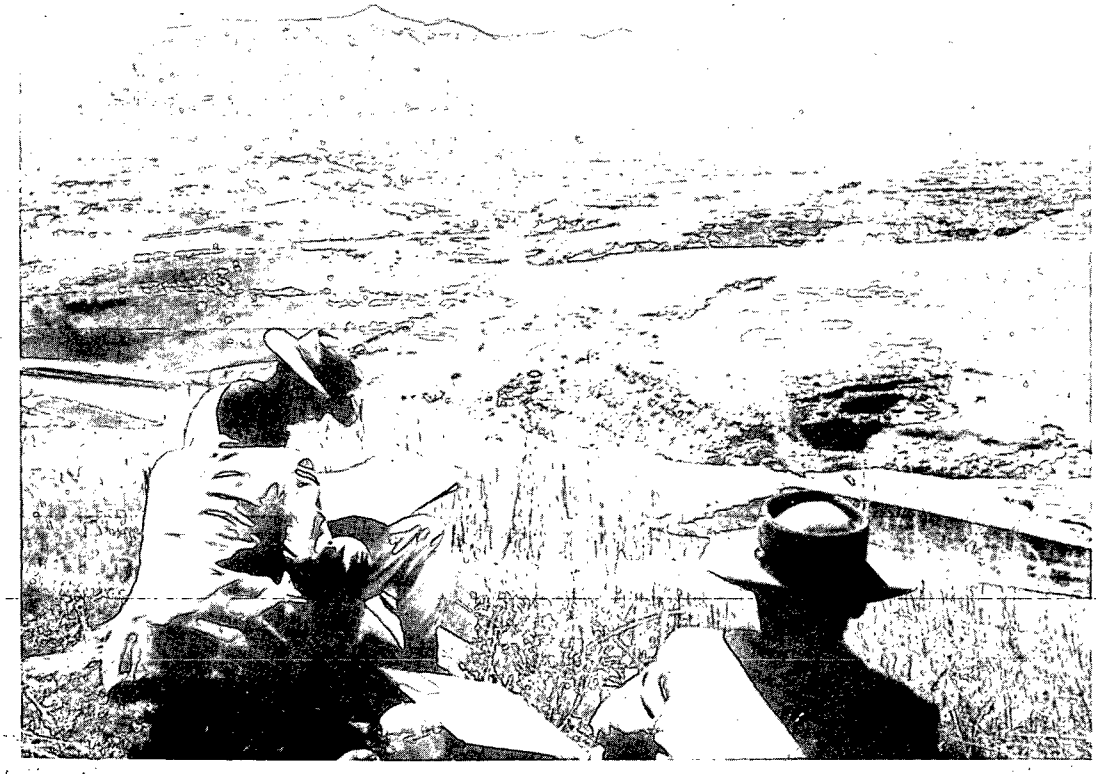


PLATE 7 The Sandstone Foothills (land system 12) with the Basaltic Foothills and North-West Escarpment slopes in the distance (land system 5). Note the light coloured areas of exposed Cave Sandstone and the contrasting darker tone of the overlying basalt

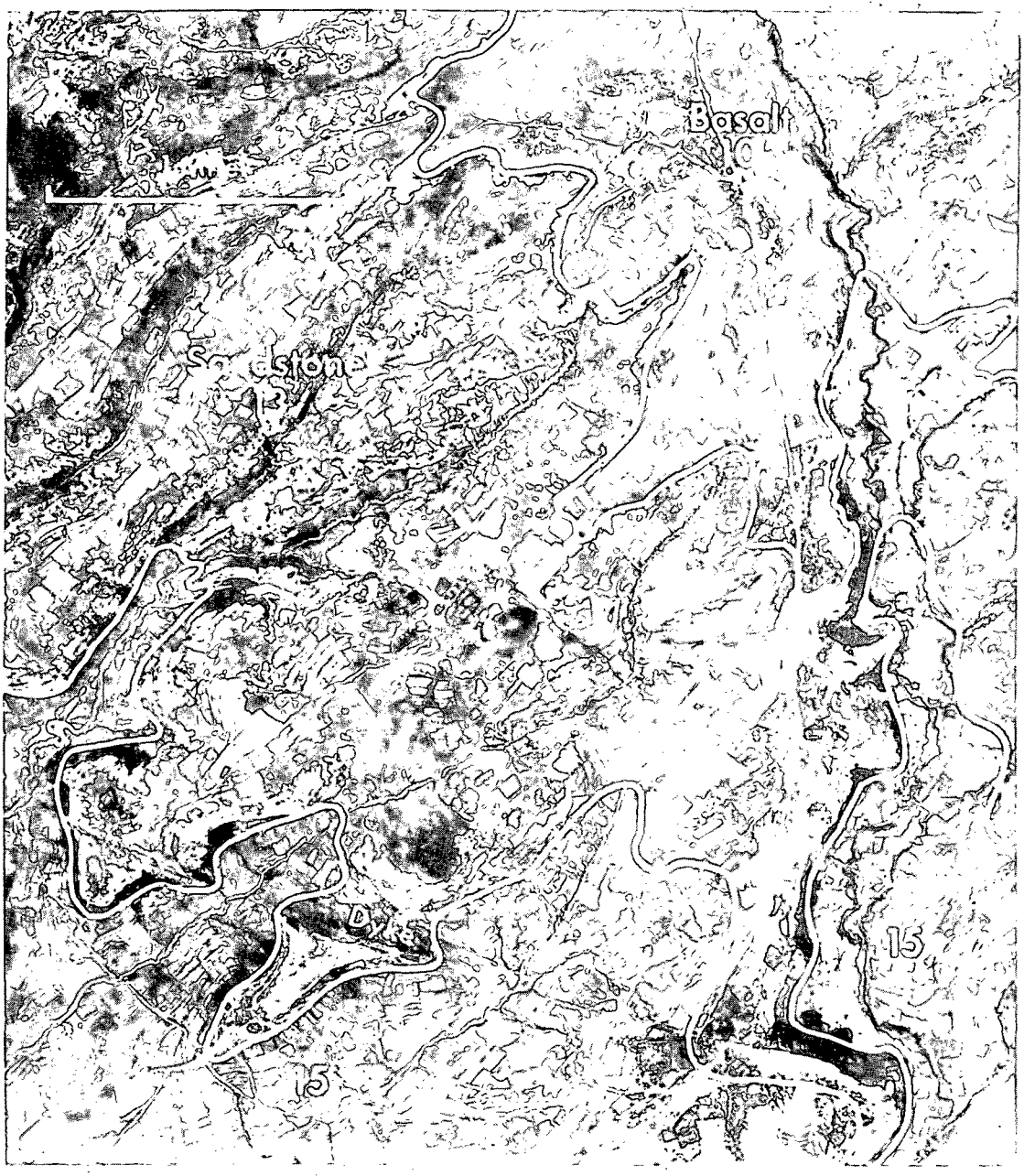


PLATE 8 Vertical aerial photograph showing the junction between the basalt (land system 10) and the underlying Cave Sandstone. Note the extensive areas of exposed sandstone in the Lowlands Escarpment (land system 13) and the badly eroded stream lines in the Phuthiatsana Lowlands (land system 15)

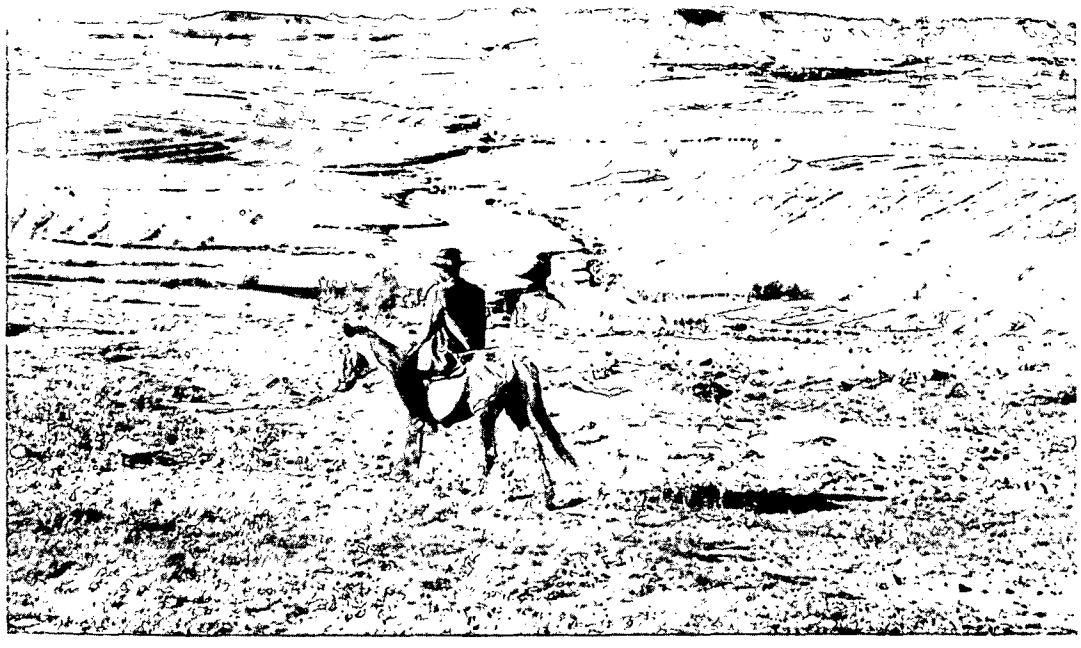


PLATE 9 View across the Phuthiatsana Lowlands (land system 15) with a spur of the Lowlands Escarpment (land system 13) in the distance showing a distinct cap of Cave Sandstone. Note the typical donga development along the stream lines

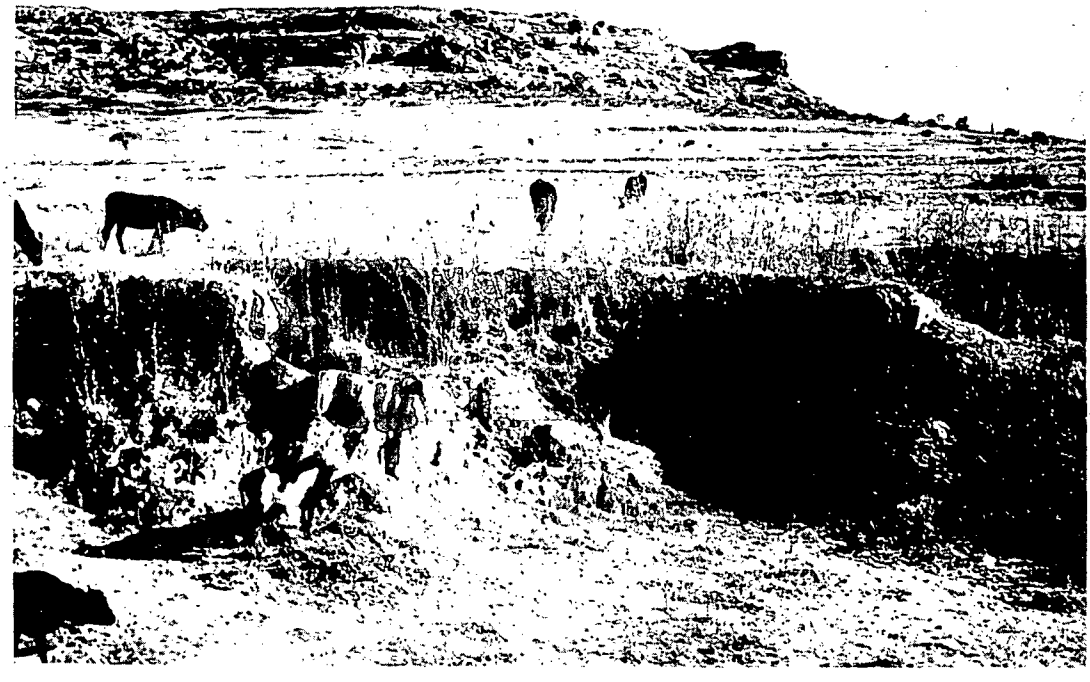


PLATE 10 Donga erosion typical of the lowland plains

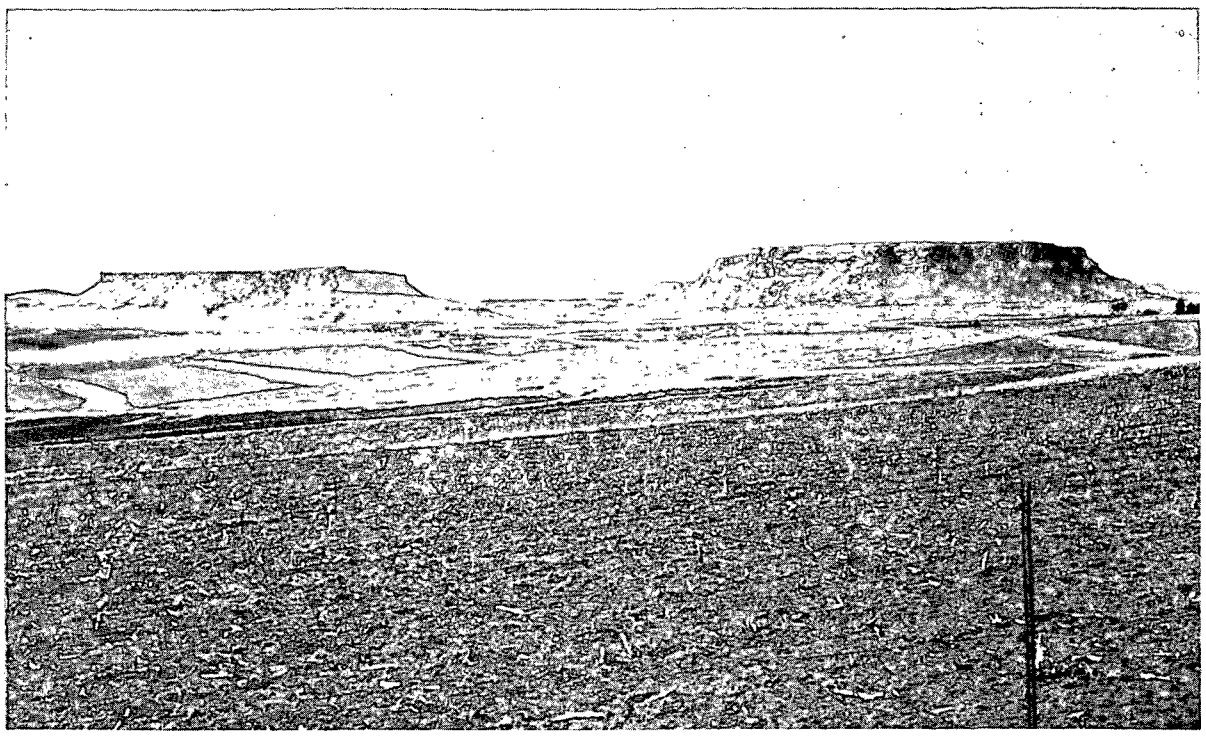


PLATE 11 The Red Beds Plains (land system 18) with remnant plateaux capped by Cave Sandstone (land system 13)

PLATE 12 View over the Central Lowlands (land system 16) bounded by spurs of the Lowlands Escarpment (land system 13)

LAND SYSTEM 16. CENTRAL LOWLANDS 222 mi^2 (575 km^2)

The Central Lowlands land system describes hilly, broken country in Maseru and Mafeteng Districts, which drains to the Caledon River in the west. This system has a higher general elevation than the adjacent plains and valley systems.

Physiography The system mainly consists of broad valley forms cut in Red Beds, but also includes some areas of Molteno rocks. The valleys are made up of broad, dissected pediments merging into slightly convex spurred interfluves. Small isolated koppies of dolerite and sandstone occur throughout the system. Alluvial terraces are found in some of the broader valley bottoms.

Soils The soils of the interfluves are reddish brown or yellowish brown, moderately acid fersiallitic soils. The texture of their topsoils is loamy fine sand and passes in lower horizons to fine sandy clay loam. Interfluve soils in areas of Molteno rocks are rarely finer in texture than fine sandy loam and are usually yellowish-brown. The claypan soils have a moderately acid, loose loamy fine sandy topsoil changing abruptly at about 15 in (38 cm) depth to a firm and impermeable mottled fine sandy clay with a pH of over 7.0 and a coarse blocky structure. The soils of the alluvial terraces are mostly black clays of high pH.

Vegetation The grasses are of the *Themeda-Cymbopogon* grassveld type.

Land use Most of the possible arable areas in this system are cultivated. The rocky scarps and koppies are usually grazed.

LAND SYSTEM 17. MAKHALENG LOWLANDS 136 mi^2 (352 km^2)

This system describes undulating, broken country which drains to the Orange River in the south, via its tributary, the Makhaleng.

The physiography, soils and vegetation of this system generally resemble those described under land system 16 but it has a drier climate.

The Makhaleng Lowlands, however, have more extensive pediments and the corresponding interfluves are more strongly reduced. They also have a higher content of xerophytic grasses and karroid bush.

The present land use also differs considerably in that only extensive cultivation is practised. Much of the land in this system is badly eroded, particularly by the strong spring winds.

LAND SYSTEM 18. RED BEDS PLAINS 165 mi^2 (427 km^2)

The Red Beds Plains land system describes an extensive planed and only weakly dissected surface in the Leribe District.

Physiography The broad and gently sloping plain lies at an elevation of about 5 200 - 5 600 ft (1 590 - 1 710 m). Occasional remnant koppies stand above the level of the plain. The stream courses are usually narrow and deeply incised. A small scarp marks the lower boundary of the system.

Soils The soil profile on the gentle slopes of this system consists of a reddish-brown fine sandy loam passing smoothly to an almost structureless red fine sandy clay loam. The whole soil is acid with low contents of both bases and organic matter. Its physical properties, however, are more favourable and it supports good crops. This soil changes rapidly to a claypan type near drainage lines. The soils of the beds of the narrow incised valleys are usually shallow and stony, but in some localities, a mixture of black fine textured alluvial soils and claypan soils occurs.

Vegetation The grasses consist of an approximately equal mixture of sweet and sour types.

Land use Most of the possible arable land in this system is cultivated. The deep reddish soils are among the best soils for dryland cropping in the lowland region.

LAND SYSTEM 19. MOLTENO PLAINS 101 mi^2 (262 km^2)

These are extensive plains along the western border of Lesotho at an elevation of 5 000 - 5 500 (1 520 - 1 680 m).

Physiography The landscape in this system consists, for the most part, of a monotonous series of dissected pediments with very gentle grade separated by senile, weakly convex interfluves. The general flatness of this area of Molteno rocks is broken by small dolerite sills and dykes and remnant koppies of Red Beds and Cave Sandstone strata. Small scarps of resistant Molteno sandstone form step-like features. There are small alluvial deposits along some of the valley floors.

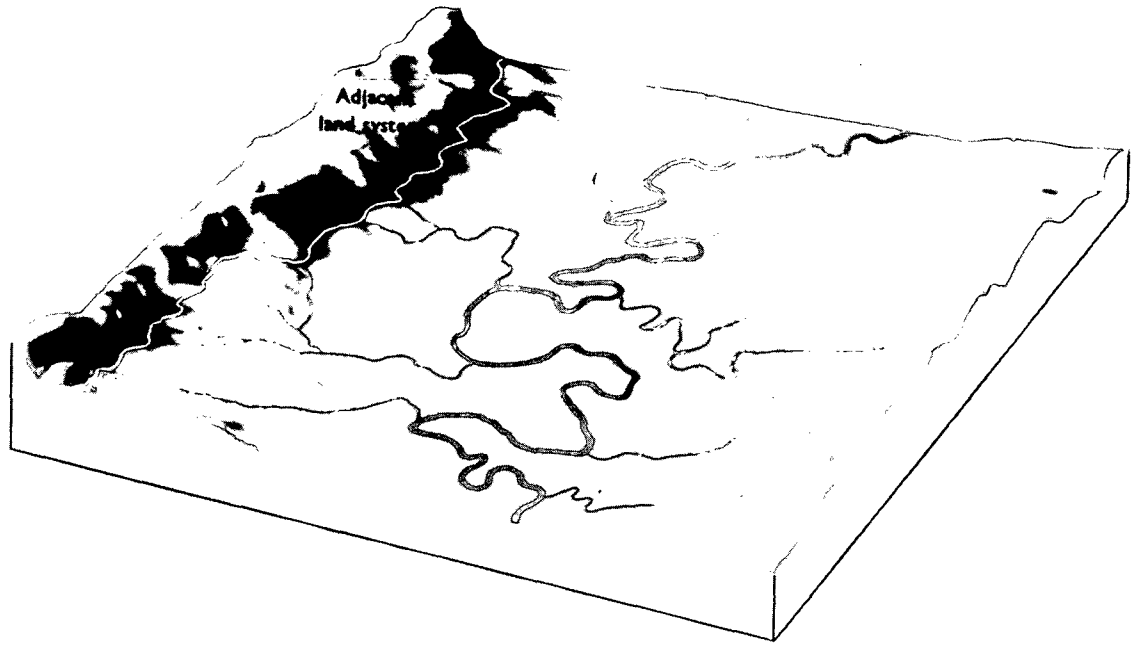
Soils The soils are of claypan type and there is a gradual variation across a pediment from black clays in the valley floor through claypan soils on the pediment slope to a more sandy variant on the reduced interfluves. The doleritic intrusions and the remnant hills are covered by shallow and stony soils. Black clays form over the stream alluvium.

Vegetation The grasses are of the *Themeda-Cymbopogon* type, but an increased number of xerophytic species reflects the rather dry soil climate.

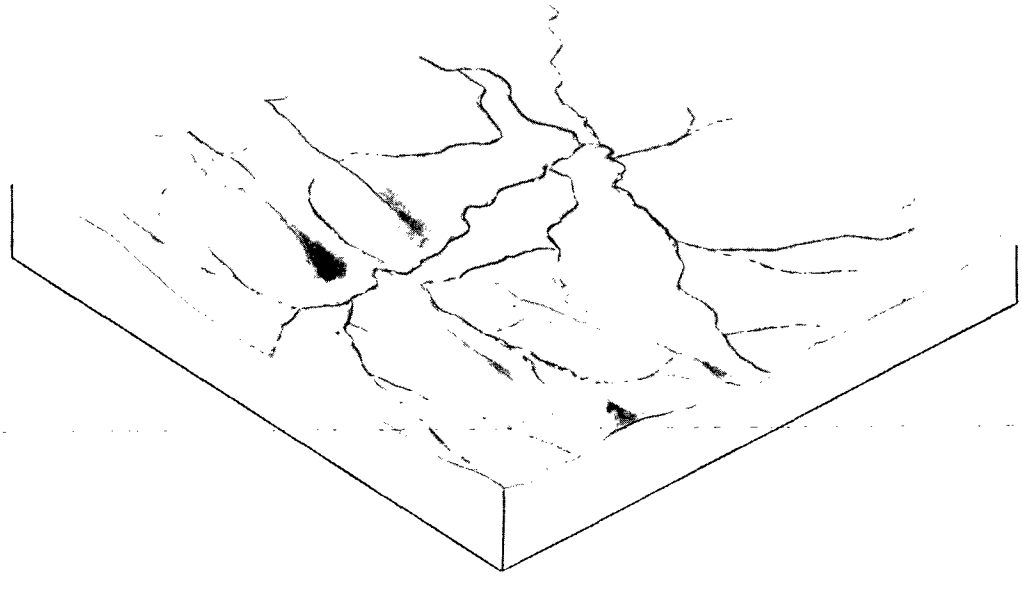
Land use Most of the land in this system is cultivated and because of its general flatness it is less liable to erosion than many other systems in the lowland region. The northern portion of the system was selected by the Mafeteng District Council for its Farm Mechanisation Scheme principally because of its easy terrain. Nevertheless, the lower horizons of the claypan soils are extremely erodible and thoughtless cultivation and neglect of conservation structures has resulted in the loss of much valuable land.

LAND SYSTEM 20. DISSECTED MOLTENO PLAINS 145 mi^2 (375 km^2)

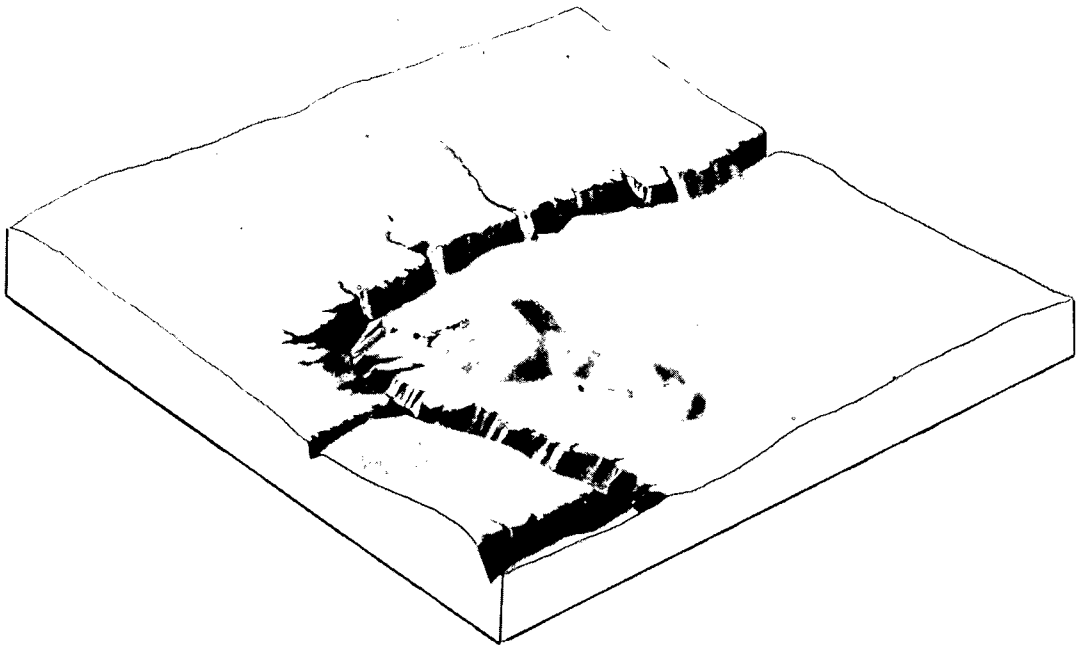
The Dissected Molteno Plains land system resembles the Molteno Plains land system and appears to be a dissected outer portion of the same planed surface.



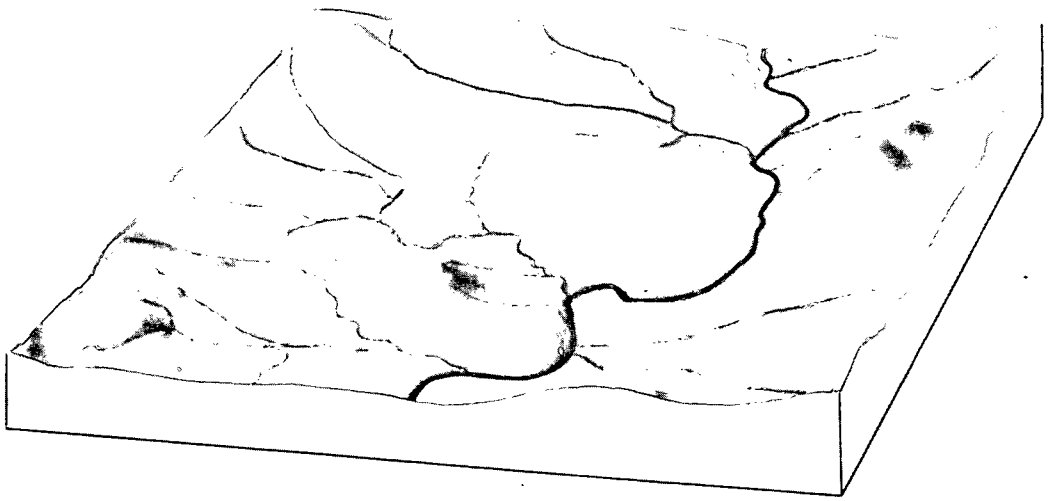
LAND SYSTEM 15 Phuthiatsana Lowlands



LAND SYSTEM 17 Makhaleng Lowlands

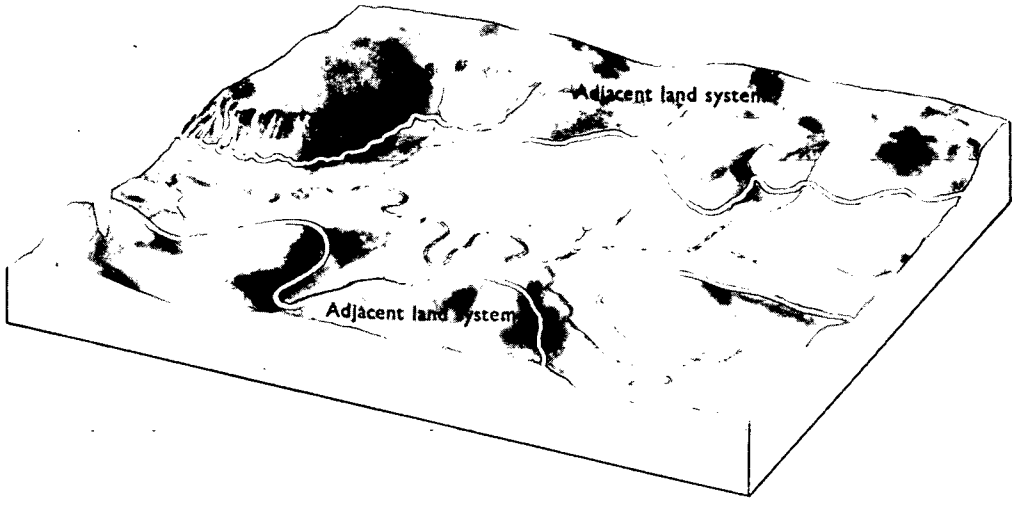


LAND SYSTEM 18 Red Beds Plains

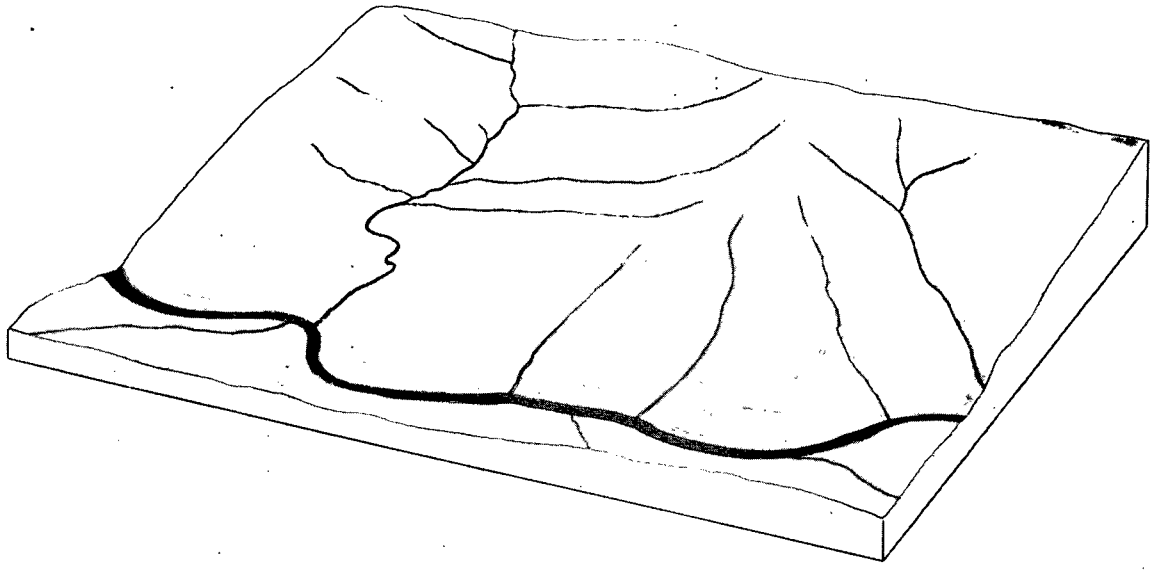


LAND SYSTEM 19 Molteno Plains

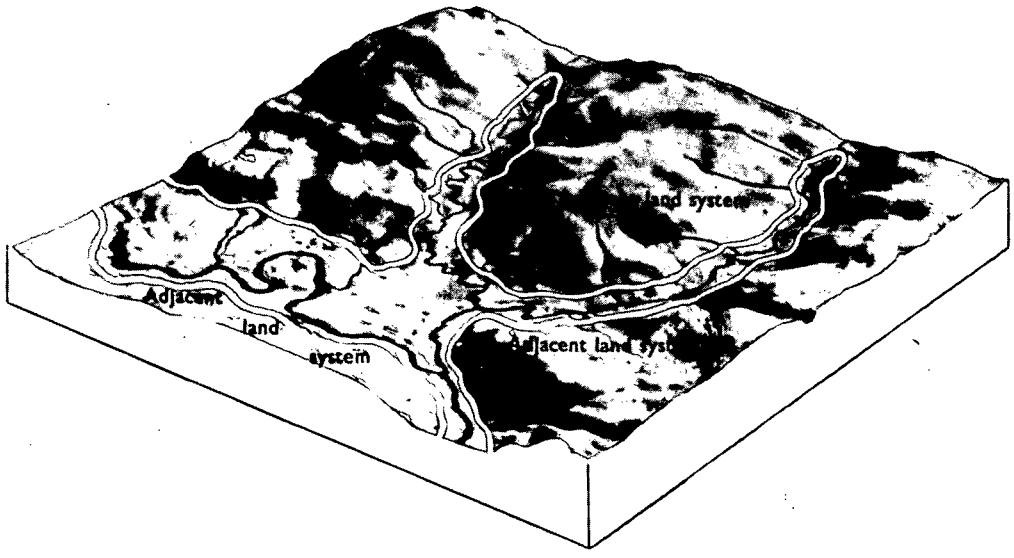
LAND SYSTEM 20 Dissected Molteno Plains



LAND SYSTEM 21 Little Caledon Valley



LAND SYSTEM 22 Southern Beaufort Plains



LAND SYSTEM 23 Northern Beaufort Plains

Physiography The planed surface is oomposed of flattish pediments and low interfluves, but headward river erosion is much more active, producing steep rocky scarps in Molteno rocks and uncovering in some places the underlying Beaufort Beds. This system also includes rocky dolerite and sandstone outcrops and fine-textured stream alluvium. Some small strips of sandy alluvium are found along the banks of the Caledon River.

Soils The soils are mostly very similar to those of the Molteno Plains land system, but there is a greater proportion of shallow soil and bare rock. Some hilltops, particularly in the south-west portion of the system, are covered by yellowish-brown, acid sandy soils without marked horizons.

Vegetation The grasses are mostly of the *Themeda-Cymbopogon* grassveld type and there is much encroachment of karroid bush on overgrazed areas.

Land use Most of the flatter land in this system is cultivated. The shallow, rocky soils of the steep scarp slopes are used for grazing.

LAND SYSTEM 21. LITTLE CALEDON VALLEY 22 mi^2 (57 km^2)

The Little Caledon Valley land system describes the valley cut by the Little Caledon, which flows from east to west across the country to meet the Caledon River.

Physiography The valley sides have steep scarp faces, marking the boundary between the Molteno and Red Beds. The valley floor consists of pediment slopes falling to broad alluvial terraces.

Soils The soils of the valley sides are shallow and stony. The pediment slopes are covered by claypan soils, but deep, dark clays of pH 7.5 form over the flat river terraces.

Vegetation The grasses are mostly of the *Themeda-Cymbopogon* grassveld type.

Land use Much of the valley floor is cultivated, but the valley sides only provide poor grazing.

LAND SYSTEM 22. SOUTHERN BEAUFORT PLAINS 78 mi^2 (202 km^2)

The Southern Beaufort Plains land system describes gently undulating valley plains in the south-west of Lesotho at an elevation of about 4 700 - 5 000 ft (1 430 - 1 520 m).

Physiography Most of the system consists of broad, dissected pediments with gentle slopes merging into gently convex interfluves. Small dolerite sills and dykes rise from the plain. The system is bounded on the west by the Caledon River and narrow strips of alluvium are found along its bank.

Soils These plains are floored by Beaufort shales, but soil formation is influenced more by the deep pedisediments overlying them. The profile of the claypan soils of the pediments consists of a sandy, loose and structureless acid topsoil passing abruptly to a clay-rich, impermeable subsurface horizon. On the gentler slopes these claypan soils pass into black clays with a strongly structured surface horizon and a pH of 7.5 - 8.0. Soils of

claypan type are found on the interfluves, but the boundary between horizons is not abrupt and the subsoil's texture is rarely finer than sandy clay loam. The soils developed over Caledon River alluvium are deep, freely draining and of coarse to medium texture throughout their profile. Pockets of finer textured alluvial soils occur in some valley bottoms. The soils associated with dolerite intrusions are generally very shallow. Outcrops of bare rock are unusual in this system.

Vegetation The grasses are mostly of the *Themeda-Cymbopogon* grassveld type, but in addition some species characteristic of the adjacent drier regions of South Africa occur.

Land use Nearly all the available arable land of this system is under cultivation at present. The claypan soils are extremely erodible and, wherever conservation work has not been maintained, severe gullying rapidly occurs. The soils over the dolerite intrusions are mostly too shallow for cultivation, but provide excellent pasture as the base-rich parent rock is a good source of nutrients.

LAND SYSTEM 23. NORTHERN BEAUFORT PLAINS 12 mi^2 (31 km^2)

The Northern Beaufort Plains land system describes three small valley plains in the north west of Lesotho, which have a general elevation of about 5 000 ft (1 520 m).

Physiography The almost flat surface of these plains is made up of broad pediments, which merge into almost completely reduced interfluves. The very gentle pediment slopes pass into wide pockets of alluvium along the Caledon River.

Soils The pediments are covered by claypan soils morphologically similar to those described under land system 22. They are, however, moister than their southern equivalents for longer periods of the year. The vertisols over Caledon alluvium are dark and of medium to fine texture.

Vegetation The grasses are mostly of the *Themeda-Cymbopogon* grassveld type, but in places there is a considerable increase in the percentage of sour grasses.

Land use Almost all the land in this system is cultivated. The fertile black alluvial soils are highly regarded as they produce good crops even after many years of monoculture.

LAND SYSTEM 24. DOLERITE HILLS AND PLAINS 54 mi^2 (140 km^2)

This land system describes the thick sills or sheets of dolerite rising from the plains in the west of Mafeteng District.

Physiography The dolerite intrusions have steep, rounded slopes and rise to over 1 000 ft (300 m) above the plains derived from Beaufort and Molteno Beds. The intrusions are surrounded by broad, gently sloping pediments.

Soils The soils of the steeper slopes are shallow and stony. The more gentle pediment slopes are covered by strongly structured black clays with a pH of about 8.0. These clays are very fertile, but are dry for much of the year and are often stony.

Vegetation Sweet grasses predominate and almost pure stands of *Themeda triandra* are found in areas that have not been overgrazed. In overgrazed areas the sweet grasses are partly replaced by *Eragrostis spp.* and other xerophytic grasses.

Land use The black clays are cultivated, if they are deep enough and not too stony. Even the shallow soils provide better grazing than that provided by soils of equivalent depth derived from sedimentary rocks.

ORANGE RIVER REGION

LAND SYSTEM 25. ORANGE VALLEY FLATS — 128 mi^2 (331 km^2)

The Orange Valley Flats land system contains both the almost level shelves surrounding the Orange River gorge and the gorge itself. It occurs around Mashai and near the confluence of the Orange and Senqunyane Rivers.

Physiography These flats are cut in basalt at an elevation of about 6 000 ft (1 830 m). They are broad with a relatively gentle slope, except where they have been dissected by stream action, and merge upslope into steep lower mountain slopes. Below the flats, steep slopes of Cave Sandstone form the gorge of the Orange River.

Soils The soils of the flats are moderately acid clay loams or clays with a reddish hue. They are moderately deep, but are associated with shallow soils on the more dissected or steeper slopes. The steep slopes in the Orange Gorge have shallow and stony soils and many rock outcrops, as in land system 26.

Vegetation The grasses are mostly of the *Themeda-Cymbopogon* type, except in badly overgrazed lands where *Eragrostis* spp. are more common, Thick bush is found in the Orange River gorge and on other protected areas.

Land use Much of the land in this system is cultivated, but stock farming is also practised. Communications and marketing facilities are poor throughout the system, although its population is quite large.

LAND SYSTEM 26. ORANGE GORGE — 684 mi^2 (1 772 km^2)

Physiography The Orange Gorge land system mostly consists of the steep sides of the Orange River Valley. This gorge is cut in Karroo sedimentary rocks; mostly in Cave Sandstone but in some areas through both Cave Sandstone and Red Beds. The system also includes some small areas of spurred hilltops and dissected hillslopes.

Soils The soils on the steep valley sides are shallow and stony and rock outcrops are common. Within the valley itself, there are a few narrow strips of sandy alluvial soils.

Vegetation The vegetation is markedly influenced by the dry climate of the valley, and tends to thick bush where sufficiently protected. The grasses are mostly sour types.

Land use This system is of little agricultural value and is not greatly used. It provides a limited amount of grazing.

LAND SYSTEM 27. ORANGE LOWLANDS 143 mi^2 (370 km^2)

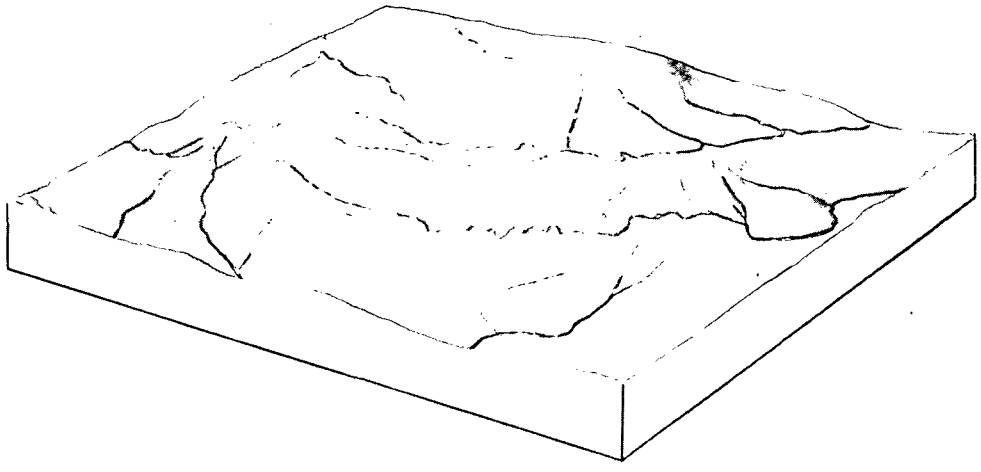
The Orange Lowlands land system describes areas where the gorge of the Orange River valley widens and the exposed Molteno or Red Beds give rise to an undulating to hilly terrain more characteristic of the lowlands.

Physiography The system is underlain by sedimentary rocks and comprises a number of broad valley forms made up of dissected pediment slopes and spurred interfluves. Minor scarps frequently occur, particularly in areas of Molteno rocks. The valleys are surrounded by steep slopes.

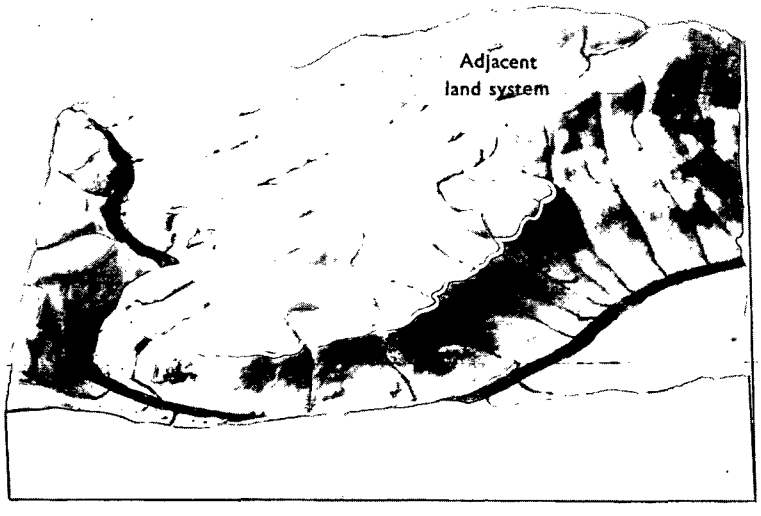
Soils Reddish medium-textured acid soils cover spurs of Red Beds. Spurs of Molteno rocks give rise to sandier, yellowish brown soils. Claypan soils are found on the pediment slopes and dark clay alluvial soils form along some valley floors. There are some small strips of sandy alluvial soils along the Orange and Tele Rivers.

Vegetation The grasses are mostly of the *Themeda-Cymbopogon* grassveld type, but are being replaced by *Eragrostis* spp. and Karroid bush, particularly in overgrazed areas and on shallow and eroded soils.

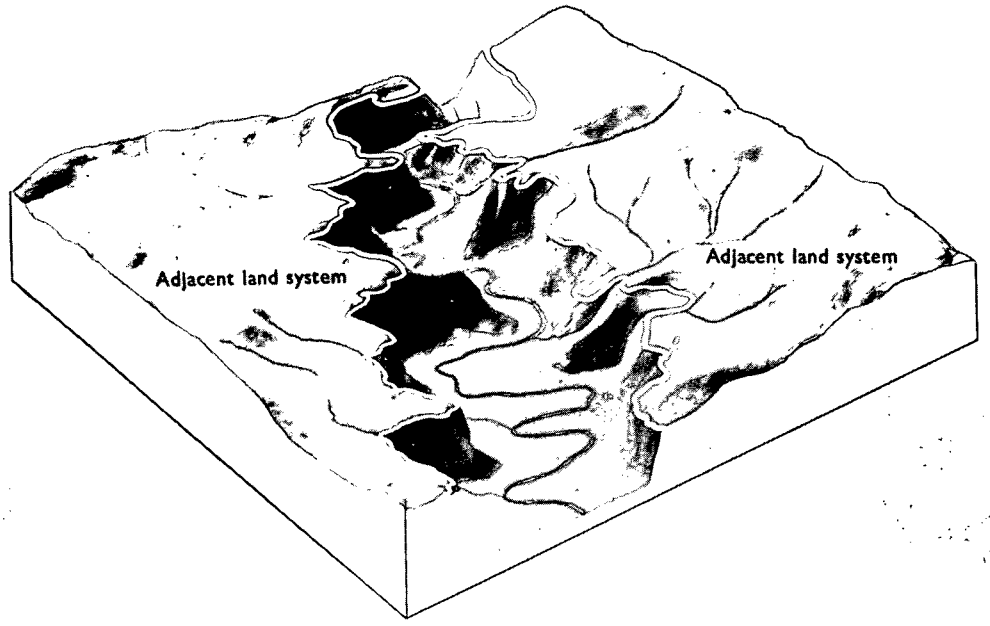
Land use Nearly all the land which could be cultivated in this system is cultivated, although some of the poorer fields have been abandoned and have reverted to grazing land. This area supports a relatively high population in many villages and is reasonably well provided with roads and tracks.



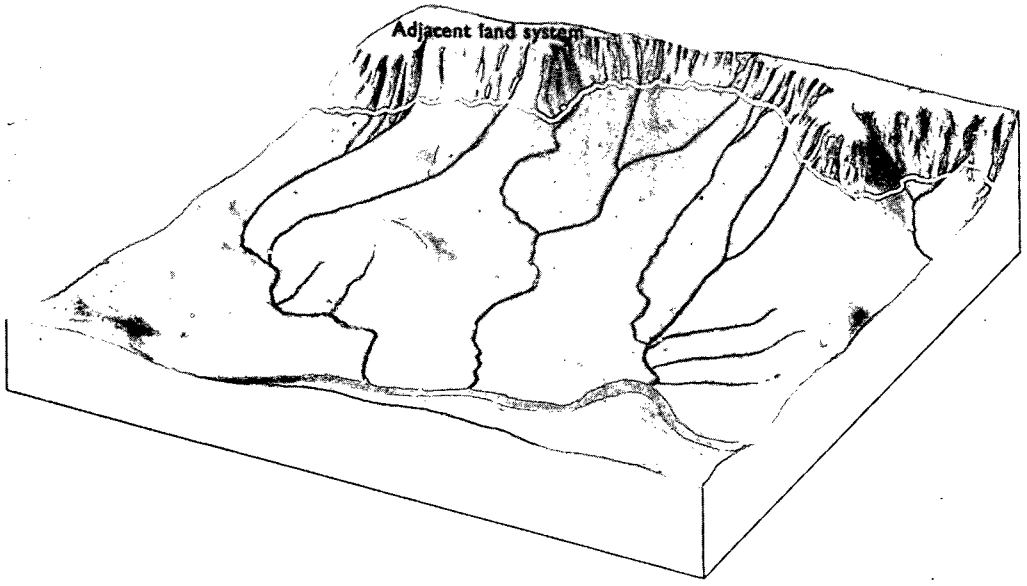
LAND SYSTEM 24 Dolerite Hills and Plains



LAND SYSTEM 25 Orange Valley Flats



LAND SYSTEM 26 Orange Gorge



LAND SYSTEM 27 Orange Lowlands

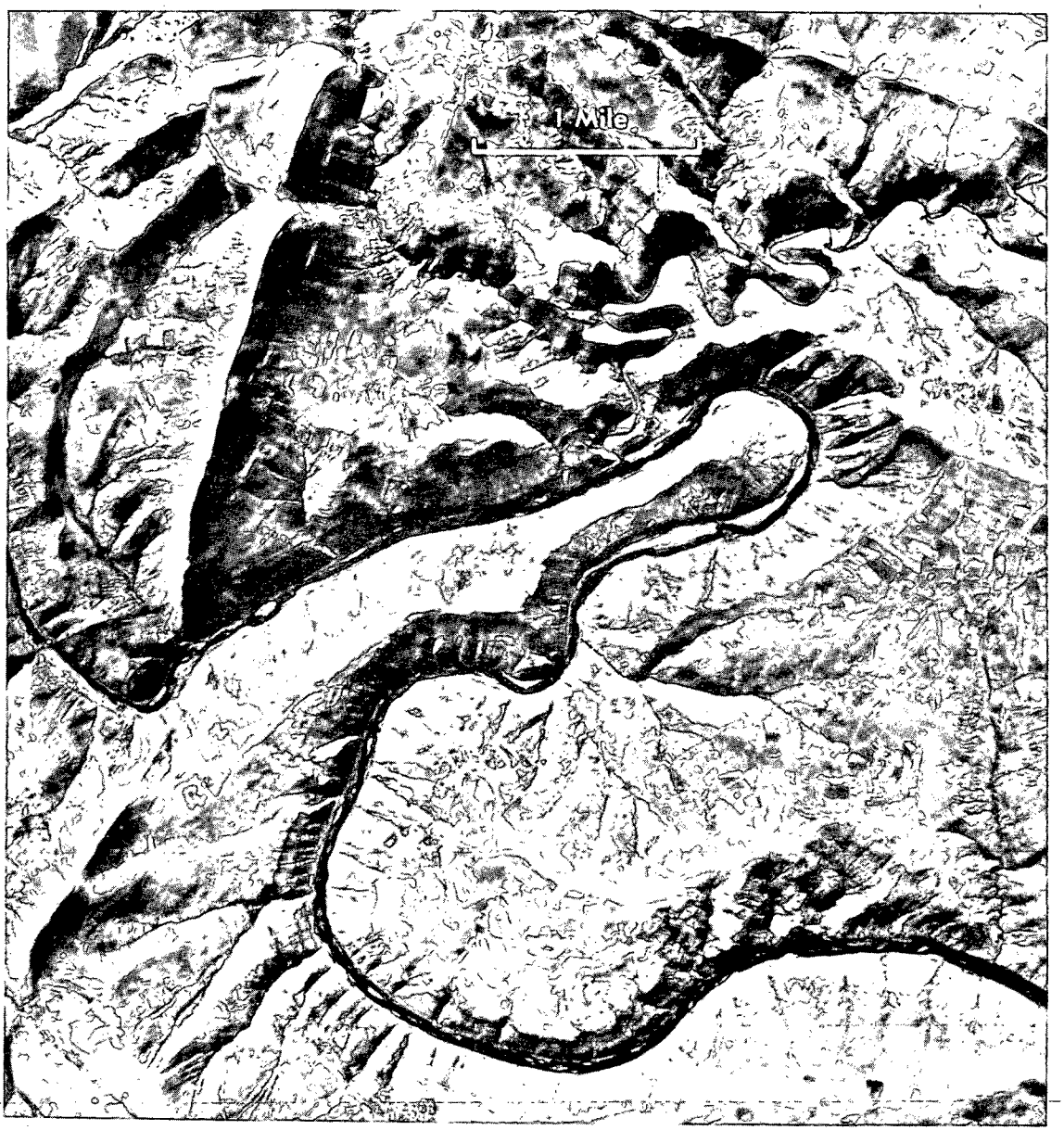


PLATE 13 Vertical aerial photograph showing the gorge of the Orange River and cultivation on the Orange Valley Flats (land system 25) with, in the upper half, the steeper slopes of land system 6 crossed by dykes which form prominent linear features

PART 5. AGRICULTURAL POTENTIAL

CLASSIFICATION

Each of the land systems into which Lesotho has been divided has a characteristic association of landform, soil and vegetation. None of these factors is necessarily uniform throughout a single system, but the variations occur in regular and repeated patterns. The general variations in climate are known and the water resources of each area can be assessed. The range of conditions within any system is therefore known and it is possible to consider the uses to which the land can best be put. This has been done for each system and the results are shown on the Agricultural Potential map. The system of classification used is shown below; the numbers in brackets correspond with those in the map key.

Land suitable for cultivation

- Land primarily suitable for semi-intensive cultivation (1)
- Land suitable for extensive cultivation (2)

Land suitable for grazing

- Grazing land primarily suitable for smallstock (3)
- Grazing land primarily suitable for largestock (4)

Land suitable for both cultivation and grazing

- Land suitable for cultivation and grazing; poor access (poor communications and marketing facilities) (5)
- Land suitable for cultivation and grazing; good access (good communications and marketing facilities) (6)

Land unsuitable for agriculture (7)

Each land system has been allocated to one of the four major categories shown and a more specific allocation of the land within the first three of these categories has also been made. The assessment is based primarily on the physical environment, as described in the previous parts of this report, and it has been assumed that existing agricultural practices will continue. In making this assessment, the authors relied mainly on information contained in a memorandum 'The Agro-Ecology of Basutoland' produced by the specialist staff of the Lesotho Ministry of Agriculture (1963).

Land under cultivation can be recognised on the aerial photographs and is shown on the series of 1:50 000 maps produced by the Directorate of Overseas Surveys; the photographs on which these maps were based were taken in 1952. Although some land has gone out of cultivation and some new areas have been ploughed since then, comparison of the 1952 and later aerial photography shows that the distribution pattern of cultivation in Lesotho has not greatly changed during this period. The larger areas of more or less permanent cultivation are shown on the 1:250 000 Agricultural Potential map.

The different categories of agricultural potential are discussed in the following paragraphs.

1. **Land Primarily Suitable for Semi-Intensive Cultivation** (land systems 14, 15, 16, 18, 19, 21, 23, 24)

The land described under this heading has soils which are suitable for cultivation. Most of the land systems grouped into this category have a rainfall of over 24 inches (600 mm) a year. Land systems 19 and 24 have a somewhat lower average rainfall but are included as they have other characteristics which allow higher yields than those common in the zone of more extensive cropping. Land system 19 has gently sloping terrain and is not greatly eroded. It is therefore suitable for mechanised cultivation. Land system 24 in part contains areas of highly fertile black clays.

This is the main crop-producing zone of the territory and stock farming should be confined to a secondary role within it. Cropping systems should aim at a five-crop rotation to include summer and winter cereals for cash, local consumption and fodder, legumes for cash and, if possible, an annual grass hay crop. In areas where dairying is possible the emphasis should be slightly altered to the production of supplementary feed.

Summer crops should consist of maize, sorghum, summer wheat, beans, potatoes, cowpeas, lucerne, teff *(Eragrostis tef)* and *Eragrostis curvula.* Winter crops should consist of winter wheat, peas, oats and barley.

All lowland soils have been shown to require phosphatic fertilisers. Maize and wheat should receive nitrogenous fertilisers for optimum production. The Agricultural Department advises on suitable varieties and the grade of seeds. The importance of weed control should be emphasised and suitable insecticides used to control various pests.

Although this is primarily a category of crop-producing land, there are localised possibilities for dairying, stock fattening and domestic production of pigs and poultry.

Rotational grazing should be practised in the available grazing areas so that they can support the largestock population required in the lowlands throughout the year. Smallstock farming should be discouraged as this seriously reduces the amount of grazing available to largestock which are more suited to the land in this category.

Conservation measures for the mechanical stabilisation of the land against erosion should continue and the urgent need for maintaining these structures should be fully explained to the population. Areas unsuitable for cultivation should be closed and designated reclamation areas for alternate use such as tree planting, water conservation, reedbed establishment or grazing. Villages and communications, at present often erosion hazards, could be replanned. Water resources could be controlled and developed with a view to using them for increasing production in certain areas that are suitable for irrigation.

Some of the land in this category can be irrigated and even more intensively farmed. These areas cannot be adequately represented on the Agricultural Potential map, but an estimate of their extent can be obtained from the soils maps. The most suitable soils for all types of irrigation

farming are deep, well drained and of medium texture; soils of this type in Lesotho include some alluvial soils, fersiallitic soils and eutrophic brown soils (units 9, 21, 22, 23, 24, 25 and 26 on the soil map). Although all these soils are suitable for irrigation, their irrigation may present problems as they are often confined to sites which it is difficult to water.

An investigation of this nature can indicate areas of soil suitable for irrigation. Detailed surveys, and considerable research on economics and soil-moisture relationship will be necessary before major irrigation schemes can be contemplated. A semi-detailed survey of Lesotho's alluvial soils (Carroll, 1965) has shown that less than 9 500 ac (3 845 ha) of the over 25 000 ac (10 120 ha) mapped were suitable for intensive irrigation schemes.

Of more immediate importance to the farmers of Lesotho is the possibility of supplementing the rainfall at critical times during the planting and growing seasons. Lesotho is a well watered country and it should prove possible to extend the work done by the Pilot Irrigation Scheme, which has already aroused much local interest. High value crops such as lucerne and vegetables can be produced. Great care, however, will always be required with the watering of relatively impermeable claypan soils and vertisols.

2. Land Suitable for Extensive Cultivation (land systems 17, 20, 22, 27)

The land systems grouped into this category occur in low rainfall areas that are overgrazed and badly eroded. There are soils suitable for cultivation in this category but they constitute a lower percentage of the whole land system than those found in areas suitable for semi-intensive cultivation and their crop production potential is also lower.

Cultivation practices in these areas should aim at long-ley rotations with relatively short cropping periods. A range of crops similar to those already listed under category 1 can be grown; in addition, sunflowers, groundnuts and soya beans might prove useful. There is much less opportunity for irrigation in this category.

Much of the poorer land should be put into permanent pasturage. Xerophytic grasses form a large proportion of the vegetative cover in these relatively dry areas and the carrying capacity of their pastures is probably only a half to a third of those of the wetter northern lowlands. The possibilities for establishing a dairy industry are poor.

Intensive protective measures for soil and water conservation are necessary to overcome the severe erosion hazards that exist in these dry areas. Wind erosion often occurs in land systems 17 and 20 as well as normal sheetflood erosion on overgrazed areas with poor grass cover. More land in this category should be designated as temporary or permanent reclamation areas. In many places, the local farmers still fail to realise the importance of maintaining conservation structures and not interfering with reclamation areas.

3. Grazing Land Primarily Suitable for Smallstock (land systems 1-3)

This category includes all the upper mountain areas normally used for grazing merino sheep; its rigorous winter climate prohibits permanent human habitation and its soils are too shallow for cultivation. The grass cover is sparse and the grasses themselves are short-leaved and short-stemmed,

providing a low fodder potential. The upper mountain areas seem therefore especially suited to the grazing of sheep. Angora goats have been found less hardy than sheep in these conditions and are best kept at lower altitudes.

These areas are liable to overstocking and overgrazing. Grazing can be controlled by using the three-camp system (explained in Appendix 4) and stock-owners should be encouraged to site their stations in accordance with the system. Stock should, if possible, be moved out of the upper mountains during the winter months.

Sheep often destroy the boggy vegetative sponges that form the source of the major rivers of Lesotho by selective grazing. The area around the sponges should therefore be closed to stock by beacons or fences and silt traps constructed. A zone, three or four miles in width extending westwards from the edge of the Drakensberg escarpment, should be demarcated and closed to stock to safeguard the flow of the Orange River.

4. Grazing Land, Primarily Suitable for Largestock (land systems 4, 5, 6, 9)

This category comprises the lower mountain slopes and also the boggy mountain flats with poor soil cover in land system 9. These areas are most suitable for the grazing of cattle and Angora goats, but can also supply reserve winter grazing for sheep from the upper mountain areas. Most of the lower mountain slopes are steep and unsuitable for either cultivation or village development. The slopes bordering the Mountain Flats Region, where communications are poor, should be used for breeding beef animals; those bordering the Foothill Region, with much better communications, should be used to fatten young beef animals for the market.

Cattle remain on the slopes throughout the year. Mating should take place during the months of February and March so that the cows will calve down in December and January.

The mountain grasslands are generally overstocked and stockowners still need to be instructed in the need for reducing the number and improving the quality of their animals. The widespread introduction of the Brown Swiss breed should be encouraged as well as strict enforcement of the regulations governing the import of livestock.

Grazing control should, initially at least, be operated on a three-camp system (see Appendix 4). Cattle posts should be sited in accordance with the system used or, where conditions permit, the stock may be housed in nearby villages, being driven out to graze on the mountain slopes each day.

Smallstock may be overwintered by closing part of the grazing lands in summer and reserving them for smallstock in the winter. Mating should take place between May and July so that ewes can lamb in the spring. Winter lambing should be discouraged because of the intense cold and poor level of nutrition.

5. Land Suitable for Cultivation and Grazing; Poor Access (Land Systems 7, 8, 25)

This category includes all the level areas of land in the mountains with cultivable soils; the bulk of the population of the mountains is in these areas.

Communications and marketing facilities are generally poor within the mountains and the possibility of cash cropping is consequently reduced. The economy should therefore be based on the production of a mixture of cash, edible and fodder crops and the breeding and rearing of livestock.

The harsh winter climate prevents winter cropping. Suitable summer crops include wheat, peas, potatoes, oats, barley, lucerne and teff; maize and beans should not be grown. At least a third of the cropland should be used for fodder production. The planting of fruit trees in suitable areas should be encouraged. Most soils in this zone are naturally very fertile, but their productivity should be maintained by the regular application of manure, ash and, wherever possible, phosphatic fertilisers. These soils, except for the reddish clays (eutrophic brown soils) in land system 25, are poorly permeable and unsuitable for irrigation.

Very little of the land in this category is available for grazing, although the mountain flats are everywhere surrounded by slopes suitable for the grazing of largestock. The emphasis on livestock production should be placed on the breeding and rearing of calves and lambs. The only other stock that should be allowed to remain permanently in these areas are draught animals, dairy cows, horses, pigs and poultry; the three-camp system of grazing should be used (Appendix 4).

Mechanical equipment for anti-erosion measures cannot be used in the mountains and conservation structures must be built by hand labour or with the aid of oxen. Operations are confined to the construction of grass buffer strips, meadow strips, diversion furrows, silt traps and small dams. Ploughing steep land or shallow soils or in the vicinity of drainage lines should be discouraged. Villages should be replanned to ensure adequate water supplies, correct aspect and suitable proximity to arable and grazing areas. Communications should also be replanned to afford the maximum convenience to the people and to reduce the erosion risk to a minimum. As far as possible, all roads and paths should be on the contour and protected by a diversion furrow on the uphill side.

6. **Land Suitable for Cultivation and Grazing; Good Access** (land systems 10, 11, 12)

This category is composed of areas of level land, on the western margin of the mountains, known as 'foothills' in Lesotho. They have a dense human and stock population and are fairly well provided with roads and tracks connecting them with the centres of population in the lowlands.

Land in this category should be used for the production of cash crops, fodder crops and livestock. The predominance of any one of these activities will depend on local circumstances.

All the normal crops of Lesotho can be grown in this zone. At least a third of the arable area should be used for the production of fodder crops to provide supplementary feed for overwintering stock, fattening rations for steers and dairy rations for milk cows. This is essentially a summer cropping zone, but in some localities the production of winter cereals should be possible. Fertilisers and manures must be used in these heavily cropped areas to prevent further depletion of the soil. All crops should receive phosphatic fertilisers at recommended rates; in addition nitrogenous

fertilisers should be used on maize and wheat. All the foothill soils would benefit from liming. Most soils are suitable for irrigation.

Land in this category is not as close to the upper mountain grazing areas as that of the previous category; the bulk of the adjacent grazing area occurs in the lower mountain slopes. The livestock programme should therefore be more concerned with largestock than smallstock. The foothills are well suited to the fattening of young beef animals for market and small-scale dairy farming, but proper supplementary feeding must be provided throughout the winter months. Winter calving down should be encouraged. Grazing should be managed on a three-camp basis (Appendix 4). The keeping of domestic poultry and pigs should be developed in the more populous areas.

Heavy earth-moving equipment can generally be used in this category for construction of conservation structures. Diversion furrows, field contours and dams should be built where necessary for the control of erosion in the arable areas, for flood control in streams and for conservation of water for stock and irrigation. Ploughing into or close to drainage lines should be discouraged, as should ploughing steep land or shallow soils underlain by rock.

Areas in need of reclamation should be removed from grazing or cultivation and used for tree planting, water conservation or reed-bed establishment. Village sites and communications should be replanned to afford the local people the maximum convenience in the management and eventual export of their produce and to reduce the risk of erosion.

As many soils in the foothills are potentially suitable for irrigation, it is particularly important to control and develop the water resources of the area. Catchments supplying water for irrigation should receive special attention to ensure their protection against erosion and the development of excessive silt loads in the streams. The water supplies for domestic consumption should be protected from possible contamination.

7. **Land Unsuitable for Agriculture** (land systems 13, 26)

Most of the land in this category is steep or rocky with very poor soil cover; it cannot support even extensive cultivation or grazing. It is important to conserve the natural vegetative cover of this land and to reduce the rate of runoff from it, thereby reducing the rate of erosion in adjacent more productive areas. Although any exploitation must be secondary to the need for conservation, some areas could be used for producing timber for local needs and some for reserve winter grazing. As the scenery is varied and attractive these lands have potential value for the tourist industry and for wild life conservation.

DISCUSSION

This survey was undertaken to assess the Agricultural Potential of Lesotho and to indicate areas which offer the greatest possibilities for future development. During the course of the survey, however, several factors limiting the development of Lesotho's agriculture were recognised; these are discussed in the following paragraphs.

Cultivation is restricted, throughout the country, by low temperatures and frosts during the winter; the growing season and the choice of available crops is therefore limited. Much of the country is only suited to a subsistence crop economy and there is no great opportunity for cash cropping, although high-yielding varieties of wheat and pulses should form part of any planned rotation.

Much can be done to increase crop yields in Lesotho, which would help the country to feed itself and reduce its dependence on imported basic foodstuffs. Average crop yields are only a fraction of those achieved by careful farmers in the adjacent Republic of South Africa or by Progressive Farmers within Lesotho. Much of the country is too steep to permit successful cultivation and most of the arable land is found in the lowlands and foothills. Nearly all of this land is already farmed and there is a great pressure on all potentially cultivable land. As little new land is available, it follows that increased crop production can only be brought about by the improved use of existing cropland. Much unsuitable land is ploughed; if this were removed from cultivation and attention concentrated on the better land, higher yields would be obtained and the total crop production increased.

Most topsoils are sandy and have a low capacity for moisture retention. Crops suffer from high evapo-transpiration and erratic rainfall distribution and the wrong choice of sowing time can greatly depress yields. Methods of land preparation that conserve moisture and the use of mulches and chemical weed control require further study. Although Lesotho is well watered, not all its soils are suitable for irrigation farming. Fully intensive irrigation schemes are costly and it is doubtful whether the present crops would repay such expenditure, even if unlimited water supplies could be provided by the Oxbow and other major schemes. Supplementary watering would appear to be more useful to farmers at present, although close supervision will still be necessary as there is little experience of 'water farming' in Lesotho.

Changes in cultivation will take a long time to effect. The advantages of adopting modern methods of husbandry can be shown by success of the Progressive Farmer scheme and the Farmer Training Centres, which provide standards and an example to less knowledgeable farmers.

There is a traditional lack of understanding in Lesotho of the need to make the keeping of livestock part of a fully integrated farm economy. Far too few fodder crops are grown and grass leys have yet to become part of a rotational system.

There are great possibilities of a future export trade in high-grade beef cattle. This cannot be developed, however, until the still prevalent attitude that cattle are status symbols and not marketable products is broken down. The restriction of the importation of inferior stock from the Republic of South Africa and the development of the Brown Swiss breed are essential. Systems of rotational grazing control with periodic rests will do much to improve the overall grass cover. Controlling overstocking to increase the quality of beasts at the expense of their quantity, will also help to improve grazing lands.

The opportunities of developing the smallstock industry are more limited, but attention should be concentrated on improving the quality of flocks by the culling and castration of poor stock and on problems of pests and diseases. There is still room for improvement in the handling of wool and mohair.

A major obstacle to the development of many parts of Lesotho is the poor quality of many of the access tracks and roads. Additional minor roads running into the foothills and more accessible mountain areas and then branching out into a network of feeder tracks would do much to increase the productivity of these areas.

The question of land tenure is complex. Some of its purely agricultural drawbacks have already been discussed; but it should be emphasised that little advance can be made until the farmer has some clear understanding on the title to his land and some say in the management of the veld on which his animals graze.

If schemes for improving the efficiency of crop and animal husbandry are to succeed, the fine work already carried out by the Soil Conservation Service must be continued and, where necessary, expanded. Lesotho, with its steep terrain, erodible soils and irregular and heavy rainfall is naturally prone to erosion on a large scale and the activities of man have greatly increased this danger. Unfortunately, many farmers still do not appreciate the need for the construction and continued maintenance of conservation structures. Badly eroded or steep land, shallow soils and waterways are still ploughed; overgrazing, overstocking and the destruction of mountain sponges is still permitted; the fences about reclamation areas have been torn down and young trees have not been protected from depredations by animals. Unhappily, the grave warning in the Economic Survey's Report of 1960 is still true: 'Unless the farmers of the lowlands, foothills and the mountains are educated to understand the implications of the present and the proposed practices for the rehabilitation of the soil, the holding of water where required and its diversion where not, and the general raising of the efficiency of arable and pastoral farming, there can be no true and no lasting success in the Administration's efforts to save Basutoland from further accelerated erosion and general deterioration of her natural resources of vegetation, soil, crops and livestock'.

Lesotho is essentially an agricultural country; its basic food production and the largest part of its exports depend on the thrifty and intelligent use of its land resources. Great emphasis should be placed on the necessity for conservation in community education and development programmes. Each Mosotho, from the heads of Government to the youngest schoolchild, should be aware both of the ravages that erosion can bring to his country and also of the prosperity that wise land use can bring.

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APPENDIXES 1-4

APPENDIX 1. AREA DATA

TABLE 1 Areas of land systems

Land system	Area	
	mi^2	km^2
1. High Plateau	1 175	3 042
2. High Mountain Flats	172	446
3. Higher Slopes	1 625	4 210
4. Simple Slopes	1 047	2 711
5. North-West Escarpment	325	842
6. Compound Lower Slopes	2 649	6 862
7. Mountain Spurs	380	984
8. Mountain Valleys	342	886
9. Sandstone Plateau	60	155
10. Northern Basaltic Foothills	570	1 476
11. Southern Basaltic Foothills	371	961
12. Sandstone Foothills	12	31
13. Lowlands Escarpment	752	1 948
14. Caledon Lowlands	284	736
15. Phuthiatsana Lowlands	156	404
16. Central Lowlands	222	575
17. Makhaleng Lowlands	136	352
18. Red Beds Plains	165	427
19. Molteno Plains	101	262
20. Dissected Molteno Plains	145	375
21. Little Caledon Valley	22	57
22. Southern Beaufort Plains	78	202
23. Northern Beaufort Plains	12	31
24. Dolerite Hills and Plains	54	140
25. Orange Valley Flats	128	331
26. Orange Gorge	684	1 772
27. Orange Lowlands	143	370

TABLE 2 Areas of land of different agricultural potential

Category	Area		% of total area
	mi^2	km^2	
Land suitable for cultivation			
1. Land primarily suitable for semi-intensive cultivation	1 016	2 631	8.6
2. Land suitable for extensive cultivation	502	1 300	4.2
Land suitable for grazing			
3. Grazing land primarily suitable for smallstock	2 972	7 697	25.3
4. Grazing land primarily suitable for largestock	4 081	10 569	34.4
Land suitable for both cultivation and grazing			
5. Land suitable for cultivation and grazing; poor access	850	2 201	7.2
6. Land suitable for cultivation and grazing; good access	953	2 467	8.1
7. Land unsuitable for agriculture	1 436	3 723	12.2

APPENDIX 2. CLIMATIC DATA

Tables 1 and 2	Rainfall
Table 3	Temperature
Table 4	Humidity
Table 5	Cloud
Table 6	Frost

The information in these tables was obtained from *The Climate of South Africa*, Parts I and II, (Schumann, 1954 and 1955).

TABLE 1 Rainfall normals (1921-50) in millimetres

Station	Monthly values												Annual average
	Elevation, m (ft)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Wepener *	1 440(4 720)	103.6	86.1	102.6	47.7	28.7	11.4	11.2	14.2	20.3	47.2	71.9	75.7	620.6
Maseru	1 571(5 150)	107.7	91.2	104.7	57.1	28.7	10.2	12.7	15.0	21.1	61.7	89.4	87.6	687.1
Mohales Hoek	1 600(5 250)	107.2	95.5	109.5	54.9	39.6	10.7	13.5	15.0	29.1	58.7	85.3	100.3	714.3
Mafeteng	1 615(5 300)	117.1	110.7	102.9	61.2	37.1	13.2	12.9	16.3	29.5	51.8	73.9	99.3	725.9
Leribe	1 737(5 700)	135.6	117.1	124.2	56.9	32.5	12.9	12.5	15.0	32.5	73.1	118.1	120.7	851.1
Mpharane	1 752(5 720)	104.4	113.3	112.0	65.5	37.6	10.9	13.7	19.8	30.5	70.4	87.9	113.5	779.5
Ladybrand *	1 780(5 840)	100.6	89.7	108.2	54.4	31.0	11.9	12.2	16.0	24.1	66.5	100.6	93.0	708.2
Qacha's Nek	1 972(6 470)	161.3	157.0	131.6	42.9	25.1	14.2	15.2	18.3	40.9	67.6	111.3	149.3	934.7

* Orange Free State

TABLE 2 Average rainfall, in millimetres

Station	Elevation m (ft)	Average	Max.	Min.	No. of years
Maseru	1 571(5 150)	637.5	1 119.4	428.5	49
Botsabella	1 585(5 200)	964.7	1 622.6	614.6	14
Mohales Hoek	1 600(5 250)	715.8	1 142.2	458.2	55
Mafeteng	1 615(5 300)	755.7	1 056.4	515.1	47
Roma	1 646(5 400)	809.8	1 201.9	561.3	13
Thaba Bosigo	1 669(5 480)	735.8	1 146.8	437.8	10
Thaba Morena	1 676(5 500)	670.0	901.2	465.1	11
Leribe	1 737(5 700)	845.0	1 343.2	563.1	53
Quthing	1 737(5 700)	791.7	1 197.6	443.0	45
Teyateyaneng	1 752(5 720)	706.6	1 102.4	439.7	54
Mpharane	1 752(5 720)	779.5	1 149.1	547.6	25
Tosing	1 768(5 800)	753.1	1 114.6	410.2	23
Butha Buthe	1 768(5 800)	818.6	1 153.2	545.1	33
Tsoelike	1 821(5 970)	571.8	852.2	356.9	18
Thaba Thelle	1 829(6 000)	630.4	1 017.3	434.8	7
Mashai	1 829(6 000)	529.8	769.1	374.4	18
Repases	1 844(6 050)	501.9	818.1	339.6	22
Sehonghong	1 905(6 250)	578.1	908.6	373.9	15
Qacha's Nek	1 981(6 500)	927.9	1 426.7	574.0	55
Marakabie	1 981(6 500)	910.6	1 196.8	540.2	12
Bokong	1 981(6 500)	668.0	1 097.0	463.6	18
Lelingoanas	2 012(6 600)	562.4	814.3	414.5	17
Makheka	2 057(6 750)	677.2	821.7	534.2	16
Motheresoane	2 255(7 400)	662.7	931.2	469.9	15
Mokuiniki	2 286(7 500)	605.0	830.3	450.3	16
Meno	2 347(7 700)	769.4	1 438.7	539.0	14
Mokhotlong	2 377(7 800)	560.3	705.6	406.7	21

TABLE 3 Mean temperatures in degrees centigrade

Station	Elevation m (ft)	Monthly values												Annual values		
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean	Extreme	No. of years
Wepener *	1 440(4 720)	a 29.4 b 14.7	28.3 14.2	26.2 11.9	22.7 7.2	19.1 2.6	16.5 -1.5	16.3 -1.2	19.7 1.2	22.6 5.0	25.4 9.0	26.8 11.3	28.9 13.5	23.5 7.3	37.7 -7.6	20
Maseru	1 571(5 150)	a 28.0 b 14.3	27.0 14.1	24.9 12.3	21.8 8.1	18.1 3.3	15.6 -0.2	15.5 -0.1	18.9 2.3	22.2 5.9	24.6 9.6	25.7 11.6	27.7 13.6	22.5 7.9	36.7 -10.0	20
Mohales Hoek	1 600(5 250)	a 28.1 b 13.4	27.2 13.1	25.4 11.5	22.0 7.7	17.9 3.7	15.7 0.8	15.5 0.6	18.9 3.3	21.3 6.3	24.3 9.5	25.7 11.0	27.5 12.5	22.5 7.8	38.3 -10.0	20
Mafeteng	1 615(5 300)	a 27.2 b 13.7	25.9 13.2	23.3 11.7	20.8 8.1	17.3 4.6	14.3 1.4	14.0 0.8	17.3 3.4	20.3 6.2	23.6 9.2	24.2 11.1	26.7 13.1	21.2 8.0	35.6 -7.8	31
Leribe	1 737(5 700)	a 27.3 b 13.1	26.2 12.2	24.4 10.9	21.4 7.4	18.7 2.2	15.5 -0.8	15.4 -1.3	18.5 1.4	21.6 5.6	24.4 9.5	25.2 11.3	27.0 12.6	22.2 7.0	40.6 -11.7	35
Teyateyaneng	1 737(5 700)	a 26.8 b 13.7	25.6 13.4	23.7 11.9	20.7 8.6	17.8 5.2	14.6 1.9	14.3 1.7	17.7 3.8	20.9 6.9	23.7 10.2	24.6 11.4	27.1 13.2	21.4 8.5	36.7 -8.3	29
Butha Buthe	1 768(5 800)	a 26.7 b 12.9	26.2 12.1	24.4 10.4	21.8 7.1	18.4 1.8	15.6 -1.8	16.0 -1.9	19.1 0.1	22.1 4.1	24.6 7.8	25.6 10.3	27.1 11.7	22.3 6.2	41.7 -12.2	29
Ladybrand*	1 780(5 840)	a 27.3 b 13.3	26.2 12.8	24.4 11.3	21.7 7.8	18.4 3.9	15.5 0.6	15.4 0.1	18.3 2.5	21.2 5.9	24.2 9.5	24.7 10.9	26.8 12.7	22.0 7.6	35.8 -8.3	30
Fouriesburg*	1 783(5 850)	a 25.8 b 12.7	25.0 12.5	23.3 11.3	21.1 7.8	17.8 3.9	14.7 1.3	14.8 0.8	17.8 3.4	20.5 6.5	22.8 9.2	23.6 11.1	25.8 12.6	21.1 7.8	32.8 -8.3	20
Qacha's Nek	1 981(6 500)	a 25.3 b 11.8	24.2 11.9	22.2 10.7	19.9 7.8	16.6 4.7	13.9 1.2	13.6 1.3	16.4 3.3	19.3 6.1	21.7 8.2	22.5 9.4	24.2 10.9	19.9 7.3	33.9 -10.0	38
Mokhotlong	2 377(7 800)	a 23.9 b 9.3	23.3 9.1	21.6 7.2	19.3 3.9	15.5 -0.8	13.9 -4.1	13.9 -4.3	16.2 -1.6	19.5 2.2	21.4 5.8	21.7 7.1	23.2 8.6	19.5 3.5	35.0 -12.5	20

* = Orange Free State
a = Mean of daily maximum
b = Mean of daily minimum

TABLE 4 Average relative humidity as percentage

Station	Local time	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average	No. of years
Wepener*	0800	58	66	72	74	76	76	72	60	52	54	55	54	64	20
	1400	28	35	39	35	35	32	28	25	23	24	24	24	29	12
Maseru	0800	66	72	77	78	79	80	73	65	57	60	63	60	69	20
	1400	35	40	46	40	39	34	33	32	27	31	31	31	35	10
Mohales Hoek	0800	61	65	70	71	74	69	67	59	56	57	59	60	64	20
Mokhotlong	0800	66	74	77	76	78	82	83	73	62	66	67	66	73	20

* Orange Free State

TABLE 5 Average cloud amount in tenths

Station	Local time	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average	No. of years
Wepener*	0800	3.8	3.8	4.1	3.5	3.4	2.6	2.7	2.3	2.9	3.9	4.1	3.5	3.4	20
	1400	6.1	6.4	5.2	4.7	3.9	3.2	2.6	2.8	3.9	5.1	5.2	5.4	4.5	12
Maseru	0800	3.0	3.4	3.2	2.7	2.4	1.8	1.6	1.7	2.4	3.3	3.3	3.1	2.7	20
	1400	5.1	5.6	5.2	4.1	3.3	2.0	2.0	2.3	3.2	4.7	4.9	4.9	3.9	10
Mokhotlong	0800	4.2	3.9	4.3	3.0	2.8	2.1	2.0	2.0	2.4	4.0	4.7	3.8	3.3	20

* Orange Free State

TABLE 6 First and last frost dates

Station	Elevation m(ft)	Average first date	Average last date	Average duration of frost period (days)	Extreme first date	Extreme last date	No. of years
Wepener*	1 440(4 720)	1.5	3.10	155	8.4	17.12	27
Maseru	1 571(5 150)	18.5	6.8	80	2.4	4.10	29
Mohales Hoek	1 600(5 250)	11.5	26.9	138	6.4	1.12	28
Mafeteng	1 615(5 300)	19.5	20.9	124	23.4	13.11	25
Thaba Tseka	1 618(5 310)	3.5	21.10	171	9.4	25.12	11
Imperani*	1 639(5 380)	11.5	10.9	122	21.4	18.10	30
Teyateyaneng	1 737(5 700)	2.6	29.8	83	5.4	2.10	28
Leribe	1 737(5 700)	10.5	14.9	127	7.4	1.12	29
Fouriesburg*	1 783(5 850)	25.5	24.8	91	8.4	16.9	19
Mokhotlong	2 377(7 800)	19.4	13.10	177	9.3	30.11	21
Sehlabathebe	2 438(7 800)	16.2	19.11	276	1.1	13.12	27

* Orange Free State

APPENDIX 3.

AGRONOMIC PROPERTIES OF THE MAJOR SOIL GROUPS

TABLE 1 Agronomic properties of the major soil groups in Lesotho

Soil group	Predominant slope range	Overall drainage	Moisture-supplying capacity	Limitations of the root zone	Stoniness	Erosion hazard	Natural fertility	Major management problems
Weakly-developed soils over dolerite/sandstone/basalt	0°-25° +	Free	Low	Shallowness of profile	Often very stony	High (on average slopes)	Low (sandstone); low to moderate (basic rocks)	Shallowness; stoniness
Juvenile soils over riverine alluvium	0°-6°	Free	Low to medium	Nil	Nil	Low	Moderate	Droughtiness in sandier soils
Calcimorphic soils	10°-25° +	Moderately free	Medium	Shallowness of profile	Often stony	Moderate	High	Steepness; shallowness
Vertisols	0°-6°	Imperfect to poor	Medium to high	Firmess + impermeability	Sometimes stony	Moderate (often severe stream bank errosion)	High	Low permeability
High veld pseudopodsolic soils (claypan soils)	2°-15°	Imperfect	Low to medium	Firmness + impermeability of subsoil	Low	Moderate to high	Low	Erodibility; impermeable, stiff subsoil; low fertility
Fersiallitic soils over sedimentary rocks	2°-10°	Free	Low	Bedrock from 2 ft plus (0.6 m)	Rare stones	Low to moderate (more liable to wind erosion)	Low	Droughtiness; low fertility
Eutropic brown soils over basalt	2°-10°	Free	Medium	Bedrock from 2 ft plus (0.6 m)	Rare stones	Low to moderate	Low to moderate	Low fertility

APPENDIX 4.
THE THREE-CAMP SYSTEM OF ROTATIONAL GRAZING

This system of rotational grazing control is used in southern Africa to make the best possible use of overgrazed land and eventually to rehabilitate it.

The area selected is divided into three camps (A, B and C) of equal size. Rivers and streams are used as the inter-camp boundaries.

Years of rotation	Camps		
	A	B	C
1st	ES	LS	W
2nd	LS	W	ES
3rd	W	ES	LS

ES = early summer, October - December
LS = late summer, January - March
W = winter (rested during summer and grazed in winter when grass is available).

The diagram above shows the season at which each camp is grazed during the first, second and third year. On completion of the third year the cycle is repeated.

PUBLICATIONS OF THE LAND RESOURCES DIVISION

The Division makes a report on each completed project. The report is published as a *Land Resource Study* or *Technical Bulletin* only with the consent of the government concerned. The abbreviated titles of the reports in the 'World List of Scientific Periodicals' are *Land Resour. Stud.* and *Tech. Bull. Land Resour. Div. Dir. Overseas Surv.*

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