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An Analysis of the Causes and Consequences of Land-Use Change in the Lowland Region

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Contents

Chapter 1
Introduction

Abstract This chapter lays the foundations for the rest of the book. It gives a brief synopsis of the main issues surrounding land-use and land-cover change studies in southern Africa within a broader context and discusses the objectives, assumptions and importance of the study within that context. A case for Lesotho is introduced. An overview of some of the existing approaches and literature surrounding land-use and land-cover change studies is briefly discussed. The chapter offers important definitions and distinctions of 'land-use' and 'land-cover' change terminology. It presents the layout for the following chapters.

Keywords Environmental change • Land-use • Land-cover • Southern Africa • Lesotho

> There is virtually no land which produces economically useful products such as crops, livestock or trees, which cannot be managed to maintain yields indefinitely. Even for the least resilient eco-systems, there are techniques of land management providing protection from degradation.
>
> (Blaikie, 1987:55)

1.1 Human-Environment Interactions and Landscape Changes in Southern Africa: Contextualizing Change

Man-made environmental change is by no means a new phenomenon. Human use of the environment and its resources causes alterations to natural systems and processes. The causes of global environmental crises remain contentious in academic research circles, international donor organizations, among national decision-makers, the media and local people. The many global and sub-regional gatherings, conventions and agreements assist these debates by airing them before the global audience and offering policy solutions which apply globally and nationally. These conventions are

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at the heart of the rationale and objectives of most development, aid, international and local NGOs and governments worldwide. Whether they are justified or based on questionable presumptions of knowledge and theoretical assumptions is the basis of much debate (e.g. Keeley and Scoones 2000).

The importance of the human dimension of land-use on environmental change is shown in the southern African case where the main land-use activity is agriculture (Abalu and Hassan 1998; Bureau of Statistics 2001; Middleton 1997), mainly rural and largely rain-dependent. It is estimated that 70% of people in Africa are rural dwellers and poor (World Bank 1999). According to the 2007/2008 official SADC[1] (Southern African Development Community) Trade, Industry and Investment Review, agriculture contributes to over 70% of employment and income; contributing about 35% to the GDP of SADC Member States. *"SADC represents a total population of approximately 200 million people, and covers an area of 9.1 square kilometres (World Bank 2001). Three countries (the Democratic Republic of Congo, South Africa and Tanzania) account for almost two thirds of the total population (64, 4%), while the six smallest members (Seychelles, Swaziland, Mauritius, Botswana, Namibia and Lesotho) comprise only 4% of the total population"* (Economic and Social Research Foundation ESRF 2003:3).

Southern Africa is characterized by unreliable rainfall and frequent droughts that have intensified over the last decade. The early 1990s experienced a 20% drop in rainfall compared with the favourably wet 1970s, and the decade 1986–1995 was declared the driest and warmest in the last century (Hulme 1996). The main environmental concerns in southern Africa are: land degradation and desertification; protection and sustainable use of forests; effective management and protection of biodiversity; water resource management; pollution problems, particularly those affecting fresh water resources, as well as urban, coastal and marine areas; demographic change and population pressure on natural resources and urban areas (Dorm-Adzobu 1997; Stringer et al. 2009; UNECA 1992; United Nations Convention to Combat Desertification UNCCD 1996). The most pressing environmental problem in the region is land degradation (Maro 1999). Some suggest that this is affected by recurrent drought, rapid population increase and pressure on land resources, poor land management practices and ineffective and inadequate land legislation/policy and tenure, leading to accelerated desertification (Maro 1999; Mbata 1997). But others have challenged such conventional arguments on the interactions between land-use, socio-economic alterations, biophysical factors and land degradation in southern Africa. For example, variations in soil type and rainfall were found to have a stronger effect on vegetation cover than human land-use (Dahlberg 2000); congestion on rural-urban fringes (e.g. Botswana) were found to result from competition between urban and rural land-use under the principle of land rents in a free market (Nkambwe and Arnberg 1996) and not the result of human use *per se*;

[1]The Southern African Development Community (SADC) was formed in 1992, with the signing of a Declaration, Treaty and Protocol on regional economic integration. The current Member States are: Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, the Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

elsewhere, conventional wisdom on the land-use-environment nexus is being challenged (e.g. Batterbury and Warren 1999; Tiffen et al. 1994; Leach and Mearns 1996; Reenberg 2001).

This book addresses the causes and consequences of land-use change in the Lowland region in Lesotho. The work, based on studies undertaken for the fulfilment of a Doctorate degree, focuses on providing an in-depth analysis of the human-environment interactions at local level, which attempt to explain their inter-relationship and the effects on land-use decisions and land-use and land-cover change.

This introductory chapter sets the scene for subsequent chapters by providing a short overview of the context of the study's analysis, aims and relevance.

1.1.1 The Complexities of Studying Land-Use Change

The dualism of 'humans' and 'environment' is complex not least because we ourselves are the reference point. The ensuing presupposed notion of 'us' versus 'it' (Simmons 1993) adds to its complexity. Most pre-1990 studies on human use of the land chose the reductionist approach, seeing 'environment' as separate from 'humans'. This approach ignores one important aspect of the human-environmental nexus. Although we are apart from nature, our culture, behaviour and interactions with natural systems are part of it (Watson and Watson 1969; Croll and Parkin 1992) and it is this behaviour and action on natural resources that result in change (Lambin et al. 2006). Indeed, population pressure and the behaviour of land managers have been suggested as the two major hypotheses of landscape change (Blaikie and Brookfield 1987). Change is alteration between land-uses over time. Development is also dynamic and dynamics change, so development can only occur in a context of change (Clark 1981). A thorough investigation of the human-environment and sustainable development interrelationships is submitted by Clark (1981); Croll and Parkin (1992). The Clementian theory of succession is not helpful in explaining land-use/cover change dynamics, for one key reason. The core of this theory suggests a natural state of equilibrium. This has been extensively questioned. A rival theory is more point-specific, non-equilibrium, event-driven descriptions of changes in vegetation and land-use patterns (Behnke and Scoones 1992; Dyer 1997; Reenberg 2001). The very nature of the natural environment and human-environment interactions also suggest a state of non-equilibrium.

1.2 Why Study Land-Use Change in Lesotho?

In southern Africa, Lesotho is often referred to as the 'prototype' on soil and land degradation. The visible gully scars, changes in natural vegetation and other soil erosion features are evidence of a perceived landscape change crisis in Lesotho. Consequently, issues of land-use, soil and land degradation feature prominently

in Lesotho's environmental agenda. But dynamic human-environment-links and their impact on Lesotho's people, socio-economics and environment at specified time and space are poorly understood. Rather, escalating human and livestock, numbers, overgrazing, bad agricultural practice and land-use, poverty and related environmental policies of the past are frequently attributed to the often quoted land-use change problem of increasing environmental degradation and soil erosion in Lesotho. But is this the case?

1.3 The Aim and Relevance of This Book

One way to understand landscape changes and their responses is to address land-use pattern dynamics. The key is to understand the various drivers of land-use changes in specific environmental, cultural and socio-economic settings (Reenberg 2001).

The aim of this book is to identify and analyze the drivers of land-use change and the consequences of these changes on the livelihoods of rural land-users/managers. To accomplish this, a combination of tools from the social sciences and environment field were developed to identify causes and consequences of land-use change at selected levels, using a 'nested' approach. These methods were then applied to a case study of villages in Maseru and Mohale's Hoek districts in the Lowland region of Lesotho (Fig. 1.1). These two districts, together with Mafeteng district, were formerly known as Lesotho's 'granary'. The focus is on selected 'hot spots' villages of land-use change in the two districts. It is argued that the understanding of rural systems through formal scientific methods and a host of participatory methods and landscape analysis techniques is a valid approach to land-use-environment research (Lambin et al. 2006) and may help in designing locally-targeted, effective management efforts (e.g. Batterbury and Warren 1999; Briggs et al. 1999; Lynam et al. 2002; Stringer et al. 2009).

A departure from popular land-use change research on southern Africa is the focus on rural land-use in an attempt to link cause-effects of land-use change and local actors' perceptions of environmental change issues with global environmental concerns. Rural land-use has been selected because of its cultural, socio-economic and political importance to Lesotho's, and southern Africa's agriculture and subsistence.

Understanding the actions of local land-users and managers, and their responses to environmental stresses, offers insight into a household's decision-making behaviour, degree of vulnerability and hence its resilience and adaptive capabilities and mechanisms. This is partly relevant to current regional assessments, monitoring and the preparation of response mechanisms to ease human suffering brought about by recent droughts and anticipated food crisis in southern Africa[2]. This study may provide knowledge to on-going national, regional and African climate change studies; land-use change and soil and land degradation and management research

[2]Similar issues were raised during the meeting *Pre-rainy Season Assessment Forum on Flood and Drought Managemen*t, in Lesotho which took place in Maseru in 2002.

Fig. 1.1 Map of Lesotho showing districts (with permission) (Source: Open Society Initiative for Southern Africa (OSISA))

and challenges in relation to sustainable development (Keeley and Scoones 2000; Tiffen et al. 1994) and also play a part in global environmental change debates about sub-Saharan Africa and semi-arid landscapes (e.g. UN 2002) and national, regional and global climate change and adaptation debates and their outcomes. The findings of this study can also form the basis for further policy-related discussions and debates, and generate dialogue between stakeholders, ministries and decision-makers in Lesotho and the wider southern African region.

This study's hypothesis is that environmental management policies, migration patterns, and intrinsic cultural and biophysical characteristics are core-driving forces of land-use change in Lesotho. One of this study's central argument is that policy constraints and opportunities, coupled with ecological uncertainty and economic imbalances in the rural farming 'subsistence' sector, and their interactions, result in differentiated rural households responding through altered actions and choices. These are manifested in part, as changes in land-use patterns, and by implication, land-cover change.

1.4 Hypotheses

There are many hypotheses on semi-arid land-use changes for sub-Saharan Africa. They range from Malthusian theories of population-degradation (e.g. Ehrlich and Ehrlich 1970), through Boserupian 'induced innovation' (Boserup 1965; Tiffen et al. 1994) and the more recent focus on climate change-desertification-land-use debates (Williams 2001). Following an in-depth review of the literature and consultation with prominent southern African experts, the following hypotheses are proposed here as being relevant to the Lesotho case, which this study sets out to prove or disprove.

Hypothesis 1: Labour migration from Lesotho to South African mines reduced the number of available men to work on agriculture and soil and land management. This led to a preference for livestock-keeping and off-farm activities, and resulted in decreased crop cultivation, increasing land degradation and a move towards food purchasing.

Hypothesis 2: Perceptions on biophysical characteristics like quality of land and drought (climate change) determine people's land-use decisions.

Hypothesis 3: Policy, legislative and institutional frameworks influence people's decision-making on land-use.

1.5 Study Objectives and Research Approach

Four objectives are proposed:

- to determine and quantify temporal land-use/cover changes for the period 1960s – 2000s
- to determine drivers of land-use change in Lowland villages of Ha Paki and Ha Maphohloane
- to determine consequences of land-use change in the villages
- to investigate possible policy options on land-use change in the villages and use the conclusions to make general recommendations for the Lowland region and Lesotho

The study was initially focused on the biophysical aspects of land-use change alone and looking at land degradation in particular. We then decided to bring in the human aspect and have a more holistic analysis of causes and consequences of land-use change, incorporating people, including socio-economic, political ecology, policy and institutional aspects of land-use change. So the study took on a multi-disciplinary nature, incorporating geographical and social science approaches. Consequently, remote-sensing data, like temporal aerial photographs and satellite images, plus socioeconomic data from national statistics, perception data and secondary data were used in the analysis.

A 'nested' approach, focusing on different levels – community/village and national levels – is used in this study (Batterbury and Warren 1999; Moran and Brondizio 1998). The first field visits were to several sites in the Lowland region. This involved meeting government officials, academics, SADC officials and officials in international organizations, in 1999, 2000, 2001, 2005 and 2007. Simultaneously, observations of sites, informal discussion with the above-mentioned people and secondary data collection were carried out in Lesotho and the University of the Witwatersrand in South Africa. The latest visit, when actual field work occurred, was between October and November 2005 and again in February–March 2007. This study principally focuses on the period 1960–2006. The site selection was based on the identification of several 'hot spot' villages of land-use change in Maseru and Mohale's Hoek districts. These 'hot spots' are based on areas showing different aspects of land-use change, like, different levels of land degradation and of land management or 'improvement'. The land-use change analysis is principally based on black-and-white photos (1961 and 1985 for Ha Paki village in Mazenod and 1980 and 1985 for Ha Maphohloane village in Mohale's Hoek); satellite image interpretations (2002 and 2006 for Ha Paki and 2002 and 2004 for Ha Maphohloane). Several geo-referenced data, like Lesotho Lowland region topographic maps (1975); Lesotho Erosion Hazard Map (1986), National land-use and land-cover change images for 1989/94 (LANDSAT 5); Lesotho Agricultural Potential map (1957); Land-use by district map (1988) were studied. Other secondary data like national household statistics, several publications and initial interviews with authorities and scientists at national and district levels were also studied.

1.6 A Review of Relevant Methods for Land-Use Change Studies: Towards an Appropriate Methodology

Previous studies have used multi-date aerial photographs to monitor land-use/cover change over time (Reid et al. 2000; Dahlberg 2000; Mwalyosi 1992). The common method used to investigate land-use has been to interpret categories of land-use on aerial photographs for different years and compare the categories on different years to detect change (Nkambwe and Arnberg 1996). The preference is now for satellite imagery and using Geographic Information System (GIS) tools and technology in land-use/cover change analyses (e.g. Nkambwe and Arnberg 1996; Mertens and Lambin 2000; Mertens et al. 2000; Serneels et al. 2001; Hansen and

Mertz 2006; Vrieling et al. 2006; Muleta et al. 2006). But aerial photos remain particularly useful in temporal studies of land-use change by providing accurate representations of land-use typologies through the use of visual interpretations and verifications through field visits and interviews with key local informants. Many observations and conclusions can also be drawn from aerial photographs using unsophisticated technology and analysis. When combined with land-use change analysis of satellite images and historical reviews through interviews and field visits, they offer a more accurate and up to-date analysis of temporal land-use changes. The results obtained through this method were used to supplement results obtained through analysis of perceptions of land-use/cover change at village level (e.g. Mapedza et al. 2003; Soini 2005).

Two general approaches are used in studies of land-use change: the 'objective' and the 'perceived' approach. Many studies have centred on the 'perceived' approach, looking at the insider's view of the problem, by taking a more 'participatory' approach in the analysis of land-use, land-use/cover change (Briggs et al. 1999; Fairhead and Leach 1996, 1998; Mortimore and Tiffen 1995; Roba and Oba 2009; Tiffen et al. 1994). This method can gather a clearer narrative of land-use activities, temporal land-use changes and may offer a better understanding of land-users' decision-making opportunities and constraints. An addition to this method is the use of 'personal narratives' or 'oral histories' (e.g.Tiffen et al. 1994; Fairhead and Leach 1996).

In this context, villagers' perspectives on causes and consequences of land-use change are studied through group meetings and semi-structured interviews, field transect walks, informal observations, historical narratives and visits to local areas. For this study, key village informants and government and non-government informants were asked to describe major historical and current changes in human and livestock populations and cultivated areas. This method has been used effectively in analysing land-use and land degradation in a socio-economically similar, semi-arid farming landscape (Batterbury 2001).

For each major change the groups were asked to explain why the change occurred, what part of the landscape was affected, and what the consequences of the changes were on the environment and their livelihoods.

The final step was to integrate the land-use/cover change analysis results with the perception data obtained from field work to test the hypotheses and draw conclusions. This was completed in consultation with key informants, academics and specialists through informal discussions and presentations.

1.7 Basic Concepts and Definitions: Environmental Change, Land-Use, Land-Cover Change and Degradation

The interdisciplinary nature of environmental change research adapts a wide range of terminology. Discrepancies exist over the use of some terms between different disciplines, like use of the word 'driver' among social scientists. Therefore, a clarifying terminology is necessary.

Sources of environmental change can be natural or man-induced. Man-induced changes can be further classified into endogenous and exogenous changes (Johnson 1997, IDS 52). Natural environmental changes can be expressed in terms of adjustments in global biogeochemical cycles and have often been associated with climate change (Mannon 1999), which is not a result of anthropogenic causes. By contrast, 'human-induced' refers to collective or individual actions or processes on the environment. This constitutes 'use' of environmental resources. Land-use has been defined as the purposes for which humans exploit the land-cover (Lambin et al. 2006:4). Since this research confines itself to land, only land-use is mentioned here, but, the use of environmental resources includes all resources. The scale of environmental change is measured in terms of duration and magnitude (Johnson 1997, IDS 52:5). Duration encompasses the interval between changes (e.g. changes within and between different classes of land-use), while magnitude refers to the quantity and quality of the changed resource.

Generally, land-use denotes human action on the land, while land-cover refers to the biophysical state of the earth's surface and immediate sub-surface (Turner II et al. 1995) or 'that what is' on the ground (van Noordwijk et al. 2001). At times, the same word can describe both a use and cover type; for example, pastures are both a land-cover and a land-use type (van Noordwijk et al. 2001).

Land-cover change denotes the state of alteration of the earth's surface from a chosen 'reference' or point of 'origin'. For this research, land-cover change is taken to encompass land-cover conversions (e.g.: deforestation and urbanization), modifications, intensification (as associated with agriculture, agro forestry and grazing), and land degradation. Land-use change, however, is associated with changing human actions. It is coupled with behaviour changes by land-users, whether individuals or groups in a given socio-economic and environmental setting (Turner II et al. 1995). Land-use influences land-cover with different outcomes, while changes in land-cover can in turn influence land-users' behaviour by determining the land's biophysical capabilities and production of land.

Driving forces, causes, drivers and factors of land-use/cover change are used synonymously in this research to refer to exogenous (e.g. climate, international policies and agreements) and endogenous (e.g. power relations, culture, behaviour, beliefs) variables of change. The term perturbation is used interchangeably with 'forces' and 'factors'. Within specified landscapes, sometimes 'environmental change' is used to refer to land-cover change.

Drivers of land-use/cover change are classified as 'proximate', 'underlying' and 'other' factors (Geist and Lambin 2001). Proximate causes of land-use/cover change refer to human actions that cause direct effects on the environment, like wood extraction (Geist and Lambin 2001). Underlying causes are the factors that predetermine the occurrence of proximate causes. Their action is on modifying and/or influencing human behaviour. Although not immediately obvious, underlying forces can operate at global, regional, national and local level and their effects may be felt within the different scales. These include economic, policy and institutional factors. 'Other' factors include land and environmental characteristics, environmental triggers (like drought and floods) and social trigger events (like war)

(Geist and Lambin 2001). For the purposes of this study, 'other' factors are also referred to as 'environ-human' causes.

Research work to-date lacks an understanding of the causal relationships between exogenous and endogenous drivers locally (Lambin, 2002, personal communication; Vogel, 2002, personal communication), especially in semi-arid and dry land research.

1.8 Structure of the Book

Chapter 2 presents a broad literature analysis on semi-arid environmental/land-use change discourses from a southern African perspective, focusing in on Lesotho's case. It begins with a broad discussion of past and current environmental and land-use debates in the SADC region, and then examines current thinking on environmental/land-use change in Lesotho. This chapter's main conclusion is that land-use change in Lesotho is a product of households' perceptions of their needs. The main influence of this is a household's socio-economic status and the opportunities and constraints it has, like access and rights to resources, institutional imbalances and environmental constraints and uncertainties.

Chapter 3 presents Lesotho in the broader context of the study. It characterises Lesotho, the Lowland region and study villages, providing a background to identifying the causes and consequences of land-use change.

To achieve the study's objectives, two research methodologies, Multi-Criteria Analysis and remote-sensing analysis, are proposed and applied. The results obtained from applying the two approaches are presented in two consecutive chapters – Chaps. 4 and 5.

Chapter 4 is a detailed analysis of the micro-level, offering an insider's perception of environmental/land-use change. It uses data from interviews with various local and national land-use actors and managers, and site visits, and submits a comparative analysis of the 'perceived' land-use change causes, consequences and perceived solutions; while Chap. 5 offers an analysis of the 'cognized' elements.

Although the previous chapters offer a detailed insight into the Lowland and to some extent Lesotho situation, there remains a need to test the various hypotheses suggested in Chap. 1 and the theories proposed in Chap. 2. This is done in Chap. 6.

This chapter ties everything together, giving a broad discussion of the identified land-use changes, their causes and consequences, actors and managers. Issues raised include what local land-use and managers say they do and what they actually do, and why. Issues of sustainability nationally and regionally are also addressed. The chapter argues that Lesotho's environmental crisis is one engraved in the 'subsistence' nature of its production capacity, coupled with the relatively 'expensive' agriculture and pressure from HIV/AIDS. These act as 'push' factors towards more attractive wage employment, as agriculture is seen here not as a means to an end, but an end in itself. However, the provision of market opportunities, transport system and increased populations, as apparent in the Mountain regions, act as a

'pull' factor towards agriculture, obviously, with its own environmental changes and implications.

Chapter 7 gives the main conclusions, policy implications and recommendations for further research, drawn from the above analyses.

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Chapter 2
The Wealth of Knowledge: Drivers and Consequencies of Land-Use Change

Abstract A review of existing literature on land-use and land-cover change is necessary to provide an understanding of key concepts and factors surrounding land-use and land-cover change research. Population-degradation-poverty accounts predominate. But these are not the only key issues. This chapter will analyse knowledge including: population narratives; the role of institutions and policy; land tenure in a gendered perspective; and climate change-degradation discourses, in the context of land-use and land-cover change in semi-arid landscapes in general, with a focus on southern Africa. Based on the analysis, a theoretical framework for the current study will be developed and put forth.

Keywords Population • Institutions • Land tenure • Gender • Land degradation • Land-use change • Desertification • Climate change • Theoretical framework

> The explosive growth of the human population is the most significant terrestrial event of the past million millennia. Three and a half billion people now inhabit the Earth, and every year the number increases by 70 million. No geological event in a billion years – not even the emergence of mighty mountain ranges, nor the submergence of entire subcontinents, nor the occurrence of period glacial ages – has posed a threat to terrestrial life comparable to that of human overpopulation.
>
> (Ehrlich and Ehrlich, 1970:1)

2.1 A Critique of Land-Use-Environmental Change Debates in Africa: Towards a Theoretical Framework

The range of theoretical literature on land-use change is broad. Theories explaining the "whys and wherefores" of land-use and land-cover change abound. A thorough classification and treatment of land-use change theories is offered by Brissoulis (2000). Land-use change theories are classified according to the different theorization

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tradition to which they belong: the urban and regional economics, sociological (and political economy), and the nature-society (or, human-nature) theorization traditions (Briassoulis 2000). Wunder (2000) offers another theorization approach, with reference to changing humid tropical landscapes. Three schools of thought, neoclassical, impoverishment and political ecology, are identified. Many texts and studies address processes of land-use change in agricultural systems in the context of intensification and spatial aspects of land-use patterns (Reenberg 2001). Semi-arid or dry land land-use change research is dominated by human ecological perspectives, entitlement theories, political ecology approaches and crisis and conflict theories (Bohle 2002).

Theorization or the formulation of theories is compounded by various constraints; not least the complexity of core subject-categories nor the kaleidoscopic set of different sub-groups within each theorization tradition; and possible overlaps between the different groups and sub-groups. But theories are not laws: they are enlightened statements used to explain observed phenomena (Chapin and Kaiser, 1979 in Briassoulis 2000), in this case land-use change patterns, processes, driving forces and their effects. Difficulty and complexity notwithstanding, it is proposed here to discuss land-use change debates in Africa as a basis for the construction of a theoretical framework for the current study. The factors discussed here are suggested as possible drivers of land-use change in Lesotho.

This chapter critically analyzes many past and present land-use change theories so as to distil critical points of discussion and form a basis for formulating a theoretical framework for this study.

2.1.1 Population-Degradation Narratives: More People Less Degradation?

A key debate about land-use and land-cover changes is the role of population pressure on natural resources. Malthus's ideas take precedence in examining population trends vis-à-vis land-use and associated landscape changes. Although often subject to intense and widespread criticism, the core of his *Essay on the Principle of Population* in 1798 is the contention that populations grow in an exponential curve. This growth is checked by nature (in the form of malnutrition, starvation, disease and migration), but with improvements in technology and health, populations continue to grow and put pressure on finite natural resources, to the point where the pressure and increased demand on the land lead to unsustainable use of the resource base, and eventually land degradation (Hudson 1992).

Along these lines, the neo-Malthusian school sees population growth as leading to the irreversible degradation or depletion of resources exemplified by the quotation at the start of this chapter (Ehrlich and Ehrlich 1970); another is the perspective taken by *A Blueprint for Survival* (Goldsmith et al. 1972). The population-pressure-environmental degradation interrelationship is marred by contradictions. Historical studies elsewhere have identified different civilizations' pathways adjusting

to natural resource crisis: technological change, a cyclical return to sustainable agricultural practices (Boserup 1965; Clark 1985; Solow 1971; Udo 1982), or a permanent decline in ecosystem productivity (Diamond 1997, in Wunder 2000), and migration. Recent empirical evidence abounds to dispel the neo-Malthusian orthodox views of population pressure on land resources, for example: Maro (1988) (*Agricultural Land Management under Population Pressure: the Kilimanjaro experience*, *Tanzania*); Tiffen et al. (1994) (*More People Less Erosion* in Machakos, Kenya); Mortimore and Tiffen (1995) (*Population and Environment in time perspectives*: *the Machakos story*); Fairhead and Leach (1996) (*Misreading the African Landscape* on forest-savannah mosaics of Guinea).

A more optimistic theoretical view concerning the relationship between population growth and agricultural change is offered by Boserup (1965). The Boserupian theory holds that population growth *"… is an independent variable which in its turn is a major factor determining agricultural developments"* (Boserup 1965:11). Boserup's concept of technology generally refers to a wider range of agricultural tools (e.g. tractors) and inputs (e.g. fertilizers). In view of the existing technological state, an increase in population density reaches a particular environmental degradation potential, at which point the introduction of new technology and land improvements reduces the potential for an environmental crisis (Unwin 1987). This is contrary to the crisis theories suggested by the Malthusians. The theory that introducing different farming technologies and innovations in rural sub-Saharan Africa can reduce the 'pressure of needs', allowing the same amount of land to sustain a high population density, has been expressed by other scholars (e.g. Maro 1974). Elsewhere, environmental degradation is perceived to be a necessary condition for technological advances in agriculture (Diamond, 1997 in Wunder 2000) and for promoting investment both in conservation, and yield-enhancing improvements (Mortimore and Tiffen 1995:86), sustainable use and rehabilitation of land (Nyssen et al. 2009) and for surplus production. This 'induced innovation' is thus prompted by necessity or by the 'pressure of needs' (Maro, 2000, 2001, personal communication), including the need for food, living space and energy. It has been noted that neither Malthus nor Boserup specifically addresses 'population', 'environment' and 'technology' *per se* but rather the topics of land-use or food production (Marquette 1997:3). As such, it is suggested that population-driven changes in land-use are manifested in various forms, including changes in land tenure arrangements, intensification of agriculture and extension of agricultural land (Bilsborrow and Ogendo 1992; Reenberg 2001).

Agricultural production has been defined as a function of land, labour, capital and technology (Kang 1982). Intensifying agriculture would thus require a manipulation of one or more of these factors. A population increasing along Malthusian lines means more people working the same amount of land more intensely, mainly to increase the food supply (Solow 1971). Land-use in this demographic context is said to result in greater availability of labour, lower wages and rent; and over time, reduced soil fertility and agricultural production. This is the basis of the impoverishment theory. Conversely, the optimistic view argues that an increase in population provides surplus labour that can be absorbed into land-rehabilitation techniques, improved farming technologies and sustainable soil and land management techniques (Boserup 1965).

This view is supported by research findings. A growing body of literature shows dynamism in agricultural innovations of low-income rural farms in changing savannah environments (an in-depth treatment of this topic is given by Maro 1974; Fairhead and Leach 1996; Tiffen et al. 1994). Moreover, rural land-users are neither rigid nor ignorant in their management of natural resources, but are resilient and adapt to changing environmental, socio-economic, political situations and cultural forms (examples: McIvor 1985; Oba and Kaitira 2006; Scott 1984; Scoones 1996; Silberfein 1984; Stringer et al. 2009).

Theories that migration occurs in over-populated, degraded and intensively cultivated areas remain tentative. Surveys in the three largest sources of migration to South Africa: Lesotho, Mozambique and Zimbabwe, which are considered to have severe environmental degradation and endemic poverty, challenge this notion and *"… the conventional wisdom in South Africa that Africans from neighbouring countries are lined up at the border to try and get in"* (Mc Donald 1999:22). Out-migration ascribed to similar conditions, as is seen in some parts of Ethiopia, is considered as *"… a positive response to the opportunities of population growth"* (Mc Dowell and de Haan 1997:18), and not negative consequences of population growth. Recent analysis in Gutu district in Zimbabwe's Masvingo Province indicates that although increasing population density has in part negatively impacted on the environment in various forms, the inequitable distribution of land during the colonial period is the major cause of current land–population imbalances (Hamandawana et al. 2005). The Machako study (Tiffen et al. 1994) points to the role played by the migration of Akamba men as providers of necessary remittances, and off-farm employment and earnings potentials, without which the 'more people, less erosion' scenario would perhaps have been difficult to envisage (Mc Dowell and de Haan 1997).

Female migration and response to male-out migration are poorly represented in research, despite their importance to agriculture, food provision and changes in land-use patterns and livelihood strategies. Recent writing on gendered migration points to women receiving the support of the extended family in the absence of their husbands, and in continuing to occupy the husband's land, despite not being in a position to undertake any 'male' decision-making e.g. on land-use and agriculture (David 1995, in Mc Dowell and de Haan 1997). In contrast, in Lesotho, some half of the male population works as migrant labour in South Africa, *de facto* women-headed households are among the poorest. Another notable feature is how frequently land and stock are absent among migrant households. General issues related to labour migration from Lesotho to South Africa will be discussed in Chap. 3. It is important to emphasise that labour migration has been an integral part of Lesotho's economy.

Despite population increases in Africa, agricultural food production continues to decline, and hunger and famines are becoming more widespread. This suggests that increasing population and advances in agricultural techniques worldwide do not automatically deliver increased agricultural productivity. Thus other variables may impede the theorized pathway to agricultural intensification and changes in land-use patterns (Williams et al. N.D.[1]). Equally important sources

[1]N.D. stands for 'no date'.

of change in land-use are changes in the demand of agricultural products and natural resources brought about by urbanization and income, and improved market infrastructure and regional trade (Gass and Sumberg 1993). Economic factors have been found to lead to more land-use intensification (e.g. Angelsen et al. 1999; Mertens et al. 2000; Ringrose et al. 1996), but these factors are said to result in outcomes that differ in space and time. In conclusion, the response to an increase in population depends on various factors, and is time and space-specific. In Lesotho's case, population pressure has been historically responsible for opening-up Mountain areas for animal grazing and human settlement (Chap. 3). However, there is no writing indicting the occurrence of a Malthusian or a Boserupian effect.

2.1.2 Land-Use, Tenure and Access Rights: A Gendered Perspective

Another major debate relevant to the discussion of land-use and landscape changes in Africa is that of land tenure, rights and access. Gender-specific aspects of household responsibilities and obligations in rural Africa have a considerable bearing on land-use decisions and consequently on changing land-use patterns and subsequently environmental changes. Existing land rights and access rules often determine these. Traditional tenure systems were considered adequate as long as there was surplus land. With an increasing population, changes in politics and tenure regimes, the introduction of new farming technology and development, economic and social policies, came increased demand and 'needs pressure' for and on, land resources, and with this, increased competition and conflict. In the Kenyan fisheries on Lake Victoria, for example, customary restricted access mechanisms protected fish stocks and ensured resource responsibility (Geheb 1995). A change in the access laws and population increase saw increased fishermen in the area, increasing pollution and a decrease in the lake's fish stocks. This is a classic example of Hardin's (1968) theory of the 'Tragedy of the Commons' popularized in the 1970s in explaining the discord in managing natural resources (Wunder 2000). This theory asserts that as population increases and population pressure on natural resources increase, commonly-held natural resources will eventually be overexploited and degraded because there is no individual incentive to use them carefully. Recent studies on land tenure security and agricultural productivity in sub-Sahara Africa show mixed associations between tenure security and land investments: generally positive effects, no effect, and reverse causality (Place 2009).

In Africa today, different types of land ownership have been identified, private ownership (land acquired through purchase); family land (to which only the eldest is entitled); stool land (by virtue of chieftainship); communal land (belonging to a village or clan); state land (belonging to government); and unoccupied land, including nature reserves and wasteland, which also belong to the state (Udo 1982:52).

Popular writing on the topic often clusters these land tenure types in Africa under the umbrella of 'communal tenure'.

The *de rigueur* use of the term 'communal tenure' in reference to traditional agrarian societies increases confusion. First, "how communal is communal tenure?" (Bruce 2000:7). Different categories of rights to use land are recognized in Africa: to acquire, use, dispose of, inherit and exclude (White 1953, in Bruce 2000:7). Literature on various parts of Africa suggests that *"inheritance is the chief mode of land acquisition and is accompanied by strong, long-lasting private rights"* (e.g., Bruce and Migot-Adholla 1994 in Place 2009:1327). Tenure is defined generally as a 'bundle of rights' including formal and informal constraints a society places on itself (Module II 1995:5). Research, for example from as far back as the 1950s in Zambia, and more recently in Zimbabwe, Nigeria, the Central African Republic (Danagoro et al. 1999); and in local predominantly dry-land areas of Kenya's Kajiado district, Botswana's Central district, Mali's Mopti region and South Africa's Limpopo district (Woodhouse 2003) points to the existence of a dual land-use system within 'communal' tenure: strong individual property rights which may amount to private ownership, and the common property rights with undertones of open resource tenure arrangements (Bruce 2000). Current theories on rural land-use under traditional tenure stress the spatial and temporal variability of the environment, and are often in agreement with local opportunistic management strategies (examples: Geheb 1995:92–93; Melmed-Sanjak and Lastarria-Cornhiel 1998:5; Oba and Kaitira 2006; Runge 1981 and Wade 1987 in Forni 2000; Scoones 1995:26). Others point out that an emphasis on private property rights over communal land may hinder diversifying measures to risks and compromise access to common resources like grazing lands (Williams et al. N.D.).

In terms of gender, to speak of 'communal' land is misleading. There is a clear distinction between the right of men and women to use land resources. Traditionally, women's access to land, for the most part, is based on the right to use but not own land (Crowley 1999). Female land ownership in the subcontinent ranges from 3% in Zimbabwe's smallholdings, to 25% in the DRC and Tanzania (FAO 1995). In both cases women cultivate less than one hectare of the total available land in a community. In most of rural Africa, women are responsible for household food security. Thus a household's ability to feed itself and the link with national food security (FAO 2001) depends on women's access to land. Female-headed households are the worst affected by land inequalities (Module II 1995:5). Women's land access is impeded by user rights and ownership rules which deny women tenure, ownership and inheritance rights. If security of tenure is defined as a "process through which rights are protected", security of tenure is essentially a social constraint through which a community bestows the rights to cultivate land on an individual or household (Module II 1995:7).

Given the gender disparity over land access and land-use, and inadequate credit and other facilities in most rural areas of Africa, land titling and land-pricing become improbable. Women *de facto* heads of household lack the power to determine how land is used, even in the absence of a male head of household (David, 1995; FAO 2001). This has led to a break-down in rural agriculture among female-headed

households (personal observation of the Lesotho situation) Despite this, women farmers in Africa do invest energy, time and scarce financial resources on their land to improve productivity, both to feed their families and for small-scale commercial agriculture (examples: African Farmer[2] 1990). With education, most rural women are moving away from land-based activities to different off-farm employment, as a livelihood strategy (Maro, 2001, 2005, personal communication).

Security of tenure in Africa is often guaranteed by using land. Failure to use land results in its confiscation and return to the community. Thus the need to clear more land for agriculture or settlement or the need to expand fields may be partially driven by security of tenure and not population pressure alone. This has been highlighted as a major reason behind the conversion of forests into agricultural land (Wunder 2000).

2.1.3 Institutional and Policy Mediation on Land-Use and Change

Also relevant to this discussion is the structure of historical land allocations and policy in the context of present-day land-use and reform in Africa. A justification of much colonial land-use conservation strategy and restrictions was based on Malthusian degradation narratives and the assumption that rural dwellers were incapable of sustainable land-use (e.g. Keeley and Scoones 2000; Murray 1995). However, the pivot of these policies was the protection of European settlers' interests. Such land-use policies comprised different restrictions imposed on African farmers; land-use access and user rights, and exclusion from institutions like land credits and markets. Land alienation policies formed the core of these polices. In South Africa, a combination of the 1913 Land Act and the 1936 Native Land Act resulted in the division of the nation along colour lines. The outcome: some 80% of South Africa's population restricted to homelands that comprised less than 10% of the country's total area (Murray 1995:1) of which only 2% was arable. The land-use implications included widespread land degradation in the dry, 'un-arable' homelands, a shift in 'black agriculture' from sharecropping with their white neighbours, to labour tenants, and finally into wage-labourers (Murray 1995).

In Zimbabwe, African agriculture was compromised and most Africans turned into wage labourers following prohibitive laws and policies. These include the introduction of subsidies for white farmers and the exclusion of Africans from credit and markets. The 1930 Land Apportionment Act formalized African land dispossession through the division of land between freehold farms for whites and 'communal' reserves for Africans (Alexander 2006). The Maize Control Act of 1931 and the

[2] African Farmer magazine was founded in 1988 to create a policy environment that would provide Africa's farmers with what they need to feed Africa's people. During 1995, the decision was made to end publication of the magazine in order to devote more of The Hunger Project's financial resources to expanding on-the-ground action in Africa.

Cattle Levy Act of 1934 were designed to undercut African competition and subsidize white agriculture production, which subsequently pushed more Africans into reserves (Alexander 2006). Widespread land degradation in African reserves and diminishment of African agriculture ensued. In Kenya, the Resident Labourer's Ordinance of 1937 – which restricted the amount of stock and land of Kikuyu labourers, together with restrictions on the Kikuyu to plant coffee, caused widespread uprising among rural people (Sorrenson 1967) and contributed to the success of the Mau-Mau movement. Criticism of these and other policies of the past is rife (e.g. SADC 1997; Carley 1996; Sorrenson 1967; Keeley and Scoones 2000; Murray 1995; Letsoalo 1987). In part, this forms the backdrop to much of today's reform policies in most regions in Africa.

Traces of colonial influence on land-use laws and regulations are still common in most southern African countries. The evidence is in policies on maximizing agriculture by using marginal land and capital-intensive methods (Moorsom 1982). The 1977 Villagization policy in Mozambique, for example, although initially voluntary, led to the enforced villagization of citizens onto state land, justified by the theme of rural development through increased agriculture and provision of services. Yet the state policy of preferential allocation of resources between state, cooperatives and peasant farmers resulted in economic insecurity, frustration of government collectivization schemes and acceleration of a material crisis which culminated in a political and ideological crisis in 1982 (Roesch 1984:307). The prevalence of state authoritarianism, exemplified in a case study of the Thaba Tseka rural development scheme in Lesotho, is an example of a residual colonial influence among rural areas and peasants.

Apart from the 'colonial-undertones' in most land-use and conservation policies, the concept of 'borrowed interventions' is another factor in much of the reform policies of present- day southern Africa, which damage land-use and land-cover. One of these is the now-infamous soil conservation technique of terracing, practised extensively in most arid and semi-arid regions of sub-Saharan Africa (Hudson 1992). Its universality results from its success in soil conservation in Tennessee, USA, which has dissimilar bio-climatic, cultural, social-political and socio-economic properties and social-institutions, to those of the cash-strapped governments of Africa's arid regions (Sorrenson 1967). Standardized intervention like restricting use of steep lands and the formation of restricted 'ecological areas' like national parks are land-use policy interventions which have been criticized for being 'universally inapplicable' in Africa (SADC 1997; Hudson 1992). In Lesotho, for example, initial fieldwork showed that mountainous land and foothills are being used for mixed agriculture despite being forbidden by law (2001, personal observation). Reliance on particular market mechanism when implementing land reform policy is another 'borrowed intervention', which is being promoted by various donors and 'western researchers', (for example: Trivelli 1997; Penalosa 1982). Yet their unacceptability is already evident among rural land-users and administrators in Africa, for example the issue of land tax in Lesotho (1999, personal participation).

The dual nature of African land-use institutions – traditional and 'modern' – is implicated in much of the failure of land-use and conservation policy to protect

environmental resources and change land-use patterns into sustainable use. However, policy and institutional reforms are making progress in their acknowledgement of past imbalances in land access, user rights and land-use restriction policies (SADC 1997). Examples include: various tenure reform policies which address the gender imbalance in land-use, access, and inheritance laws – like the Mozambique Land Law of 1997, the Eritrea land tenure legislation of 1994, Uganda Land Act of 1998 (Cotula et al. 2004) and Rwanda's Organic Land Law of 2005 determining the use and management of land in Rwanda (Organic Law N° 08/2005; 2005). Similar efforts have also occurred in Tanzania (Maro, 2001, personal communication). South African ambitious land restitution, redistribution and reform are another example of the government's commitment to providing equal access and security of tenure to all citizens, especially the previously excluded masses. Such reform policies, indirectly affect land-use/cover change patterns, by changing the behaviour of resource users on different temporal and spatial scales.

2.1.4 Climate Change Links with Land-Use, Land Degradation and Landscape Changes

It is imperative to explain climate change debates in relation to land-use in Africa. Central to this debate is the notion of climate change as a cause or consequence of temporal land-use changes. Linked to climate variations are degradation discourses, which are major topics at the heart of many environmental and natural resources policy debates in sub-Saharan Africa (e.g. Scoones 1996; Mortimore 1998; Tiffen et al. 1994; Maro, 2000, 2001, personal communication; Tiffen 1995).

Land degradation is generally a result of natural phenomena or human-induced actions on the land. Reduced agricultural production in sub-Saharan Africa (Muchena et al. 2005); and loss of biodiversity, for example in the arid shrub lands of South Africa (Rutherford and Powrie 2010) have been attributed to land degradation. This forms the core of the leading narrative on soil erosion and degradation which attributes land degradation to poor agricultural and livestock practices (Mortimore and Harris 2005). In the Karoo semi-arid lands of South Africa, for example, a key debate is whether land degradation is a consequence of over-stocking and poor management or whether desertification is a causative process or natural phenomenon (Nel and Hill 2008). In Botswana, livestock farming is the main income source for about 40% of the population, yet is cited as a major causative factor of increasing land degradation (Stringer et al. 2009). Recent research challenges the land degradation narrative (e.g. Mortimore and Harris 2005; Muchena et al. 2005). Studies in dry land villages of Mali, Kenya and South Africa have found that changes in resource-use resulted in a net increase in overall production in these areas, with little apparent evidence of environmental degradation, concluding that: *"The evidence of environmental change in these studies does not support the conservationist emphasis on environmental degradation in crisis narratives often promoted by development agencies in Africa"* (Woodhouse 2003:11710). A recent International

Symposium 'HighLand2006' on land degradation and land rehabilitation recognized that rehabilitation of degraded lands was occurring in parts of the East African Highlands (Nyssen et al. 2009). Despite research evidence to the contrary, orthodoxies about land degradation persist and continue to form the basis for many current policies (Stringer et al. 2009). This is compounded by the difficulty in defining, measuring and mitigating land degradation (Rutherford and Powrie 2010; Stringer et al. 2009).

Desertification is often considered to be the final stage of land degradation through land-use and is also believed to critically affect land-use in Africa:

> Desertification directly affects, or puts at risk, the livelihoods of more than one billion people. In Africa alone, an estimated further 5–6 million hectares of productive land are affected by land degradation each year. (Masinde 2003:28).

Desertification is not a new concept in natural resources writing. Reports of desertification in West Africa date back to 1922 (Mortimore 1998), although evidence is hard to come by. More recently, the question of desertification, as either a cause or effect, of land-use and climatic variations is being debated (e.g. Behnke and Scoones 1992; Mortimore 1998; Scott 1984). Such arguments are not without cause. Perhaps the most obvious is the very definition of the term desertification. Earlier definitions cited 'biological agencies' as responsible for desert-like conditions which lead to the degradation of soil, plant, animal and water resources (Mortimore 1998). The emphasis was on human overexploitation of natural resources. A common definition of desertification is based on the United Nation Convention to Combat Desertification (UNCCD 1996):

> Desertification means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic and human activities.

Although a rather loose definition, it nevertheless brought into focus the role of climate and climate change in drought, desertification, soil erosion and land degradation debates. This is arguably relevant for southern Africa where soil erosion and desertification are central land degradation issues, and core environmental change issues.

In climate terms, moisture, wind and sunshine are crucial factors. Rainfall or the lack of it has long been blamed for low yields (WMO 1986), generally poor agricultural performance, soil erosion, drought and desertification. That an association exists between agricultural performance and rainfall has been identified in many studies of pastoral systems in Ethiopia, Kenya and Zimbabwe (e.g. Behnke and Scoones 1992). A lack of rainfall is associated with low crop yields and poor pasture performance, while good rains are associated with an abundant crop yield and the availability of enough high-quality pasture for animals. Timing is critical in crop production, for too-little-too late or too-much-too-late/soon in the planting season has been found to result in a poor harvest (Sechaba Consultants 1995). Recent studies in several smallholder farming economies in Nigeria, Senegal and Niger identified policy rather than soil constraints or rainfall as the main determinants of observed trends in crop yields and agricultural production (e.g. Mortimore and Harris 2005). The African farmer has long adapted to the region's rainfall nuances. Adaptation mechanisms include but are not limited to, seasonal migration – serving

both to find 'greener pastures' for livestock and a strategy for 'resting' the land, ensuring vegetation re-generation (Oba and Kaitira 2006; Scott 1984). Most of southern Africa is considered dry land savannah or temperate, except for a few wet spots towards the Equator. As such most rural farmers are engaged in small-scale/peasant agriculture punctuated with crop/livestock farming systems.

However, in land degradation terms, the duration and intensity of rainfall is vital. Sporadic heavy showers, especially after dry spells, are highly erosive (Rydgren 1988). Rainfall intensity and land-use were identified as the major causes of soil erosion in a study of land-use and soil erosion in Lesotho's Maphutseng area (Rydgren 1988). Notwithstanding, claims that drought and famine have resulted in the expansion of the Sahara or desertification in the Sahel, and the demise of nomadic peoples in Mali, Mauritania, Chad and Sudan, have been disputed (Mc Ivor 1985; Scott 1984). The Sahelians have been found to be resilient and their environments less fragile than previously thought (Scott 1984:2). The proof is their historical success as pastoralists and traders in spite of the arduous climatic and ecological conditions. Their abandonment of pastoralism, the collapse of staple food production in that region, and disintegration of tribes is now seen as the result of government indifference and antagonism, through political and cultural factors, and developed countries' policy of exporting fish protein to developing countries at the expense of their local nutritional status and population pressure (Scott 1984:5; McIvor 1985:3). Climate and its consequences (e.g. drought), are seen here as neither a cause nor a consequence of land-use and cover change. Rather, the land-use changes observed (i.e. moving from pastoralism to crop production) and land-cover change (desertification in arid areas), are believed to be driven by social-politics, culture, and ignorance. This specifically relates to the respective governments' role in managing Sahelian land-use and users.

The issue of carrying capacity and its relation to overgrazing, overstocking and the general overexploitation of African dry lands merits attention, not least because subsistence agriculture and pastoralism form the backbone of the economies, but also because these two activities, together with poverty, are the causal links most often associated with soil erosion and desertification in drier lands, and water-logging and salinization in wetter tropical regions (UNEP 2002). The concept of carrying-capacity, with its roots in the Clementian theory, is often misused and hardly helpful when talking of land degradation in southern Africa for several reasons. First, carrying capacity on its own is not a useful measure of land degradation in the absence of clearly defined management objectives associated with different forms of animal exploitation (Behnke and Scoones 1992:3) (e.g. subsistence farming, game ranching, commercial ranching). Second, research in parts of Ethiopia, southern Zimbabwe, parts of Botswana, and Australia, has shown that the fluctuating physical properties of rainfall and temperature have a far more pronounced effect on vegetation growth than the number of animals and stocking densities on different grazing lands (Behnke and Scoones 1992:9). In relation to the vegetation of grazing lands, rainfall has the greatest impact on the quality and quantity of available vegetation and not the stocking rates or densities of these areas, so the notions of overgrazing and overstocking are somewhat redundant when dealing with these systems.

Research in eastern Botswana also showed there were no direct economically beneficial results to destocking in communal areas (to government recommended stocking rates) and only a very slight degradation reduction (Abel, 1990 in Behnke and Scoones 1992:26). Third, on indicating irreversible rangeland degradation, rates of soil loss and other changes in the chemical and physical properties of soils may prove more reliable than vegetation changes as used in the carrying capacity concept (Behnke and Scoones 1992:26; Ringrose et al. 1996).

Based on the considerations in this chapter, a summary of the probable key factors influencing land-use changes in southern Africa and a conceptual framework for land-use change, linking these factors, is presented below.

2.2 Towards a Theoretical Framework for Land-Use Change in Lesotho

A review of the vast regional, national and community-level literature and studies on land-use change in sub-Saharan Africa indicates the following factors as the key candidate forces driving land-use change in Lesotho:

- Population, population pressure/population needs and wants (e.g.Salopek 2001; Mortimore and Tiffen 1995; Tiffen et al. 1994; Meyer and Turner II 1992 Hamandawana et al. 2005; Nel and Hill 2008);
- Climatic variations (especially rainfall) and other biophysical constraints like topography, other land characteristics, soil quality and vegetation cover (e.g. Burgos and Baier 1986; Reid et al. 2000; Scoones 1996; Tiffen 1995; Hulme 1996; Muchena et al. 2005; Nyssen et al. 2009; Stringer et al. 2009);
- Migration and settlement policy (e.g. Petit et al. 2001; Mc Donald 1999); and household attributes, assets and labour relations (e.g. Richard et al. 2005; Reenberg 2001; Batterbury and Warren 1999);
- Policy and institutions; including, international environmental and other related policies and agreements (e.g. Muriuki, et al. 2005; Roddick 1994; Stringer et al. 2009; Mortimore and Harris 2005), agricultural pricing policies (e.g. Angelsen et al. 1999; Mertens et al. 2000) international aid and trade policy (e.g. Abdulai et al. 2005), land policy, land-use tenure and tenure regimes and institutions (e.g. Serneels et al. 2001; Mariko 1991; Geheb 1995; Mbata 1997; Leach and Mearns 1996; Peters and Kambewa 2007; Place 2009);
- Technology and technological change; (e.g. Kwesiga et al. 1997; Macucule and Ribiero 1997);
- Culture, historical beliefs, ethnicity and behaviours (e.g. Briggs et al. 1999; Reenberg 2001); and perceptions of land degradation and management (e.g. Solomon et al. 2007; Kessler 2006; Oba and Kaitira 2006; Roba and Oba 2009);

The links between the key probable factors influencing land-use change in Lesotho's semi-arid environments are based on insights derived from the literature reviewed above and are presented in Fig. 2.1

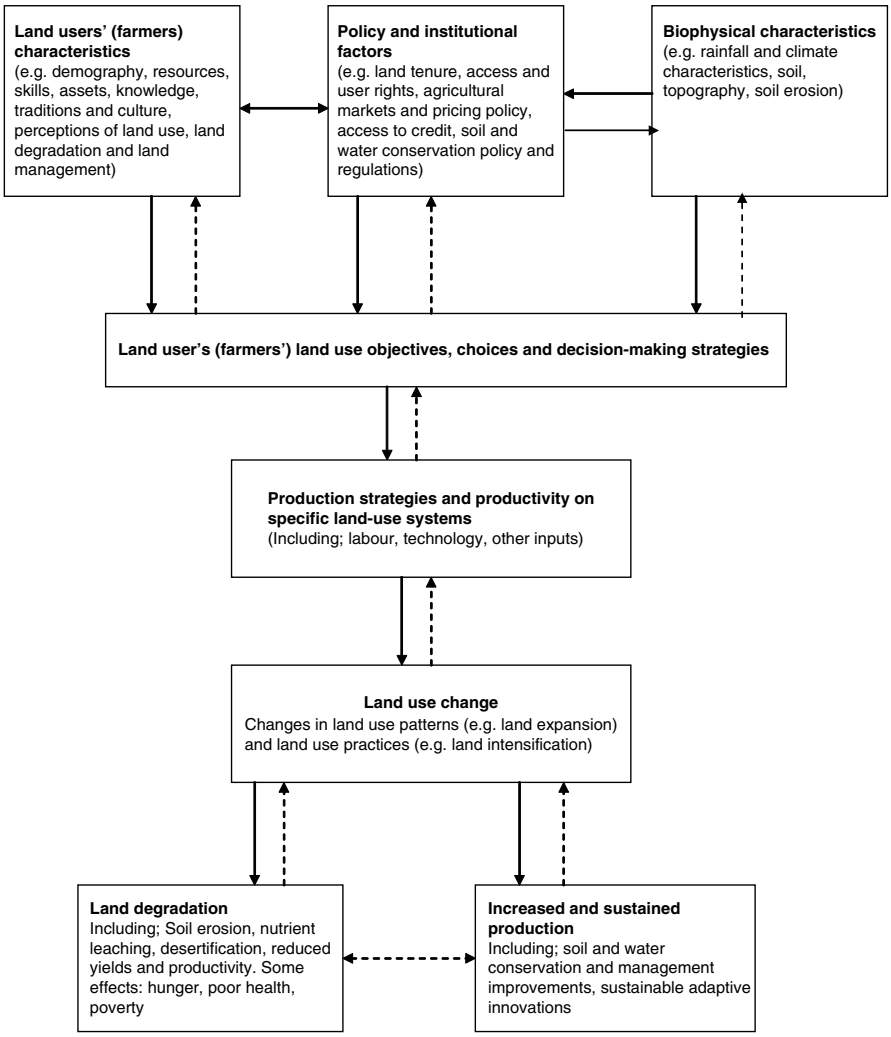

Fig. 2.1 A tentative conceptual framework for the Lowlands region based on theoretical reviews

Land-users' characteristics directly and indirectly influence their land-use objectives, choices and decision-making strategies. Underlying this are policy and institutional factors, like tenure and access rights, that act as constraints or opportunities on land-users' land-use objectives; providing incentives or disincentives on land-users' production strategies and thus productivity on specific land-use systems. The resulting land-use changes can be expressed as changes in land-use patterns, land-use practices or a move away to off-farm income strategies. This may lead to an improvement in soil and water conservation, and land management techniques, with a resulting increase in sustained production. Alternatively, given limitations in

production strategies on specific land-use systems (e.g. low input, labour scarcity, lack of resources), underlying biophysical characteristics and land-users' characteristics (like perceptions of land-use and conservation), the pathway of change may lead to land degradation. Such a pathway is determined by a combination of prevailing political and institutional factors and land-users' objectives on the land. Changes in land-use and the resulting consequences, in turn, influence land-cover patterns, as well as other biophysical characteristics and land-users' resources, other characteristics, and in turn, livelihood strategies. Changes in livelihood strategies will influence land-users' characteristics, land-use objectives and consequently have an impact on land-use choice.

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Chapter 3
Lesotho: Macro to Micro Perspectives of Land-Use Change

Abstract Lesotho is a country whose lowest point is 1,000 m above sea level. It is completely surrounded by the Republic of South Africa. Its extraordinary geographical position, relief and latitude contribute to its particular biophysical and socio-economic landscape. These features simultaneously affect and are affected by land-use choices and decisions. Historical and socio-political contexts are among other important factors in the human-environment interrelationship. This Chapter examines specific environmental, social, political and economic characteristics of Lesotho with reference to land-use and landscape changes in the country, highlighting the Lowland region. It outlines the macro and micro level context within which the case study will take place.

Keywords Geography • Agriculture and marketing • Labour migration • Socio-economics • History • Socio-politics • Land policy • Land-use • Land-cover • Lesotho • Lowland region • Study villages

Kingdom in the sky

(unknown)

3.1 Overview of Land-Use, Agriculture and Political Economy

Lesotho is a mountainous land-locked country with an area of 30,355km^2 (11,718 square miles) completely surrounded by the Republic of South Africa. The 'Kingdom in the sky' owes its name to its altitude, with its lowest point lying at least 1,000 m above sea level. Mountains cover about three-quarters of the total land surface. The country is divided into four agro-ecological zones or regions: Lowland, Foothill, Senqu River Valley and Mountain (Fig. 3.1). Lesotho is a grassland region, better suited for livestock, despite the existence of mixed farming (Mc Leod 1998). Rangelands occupy the largest percentage of Lesotho's total

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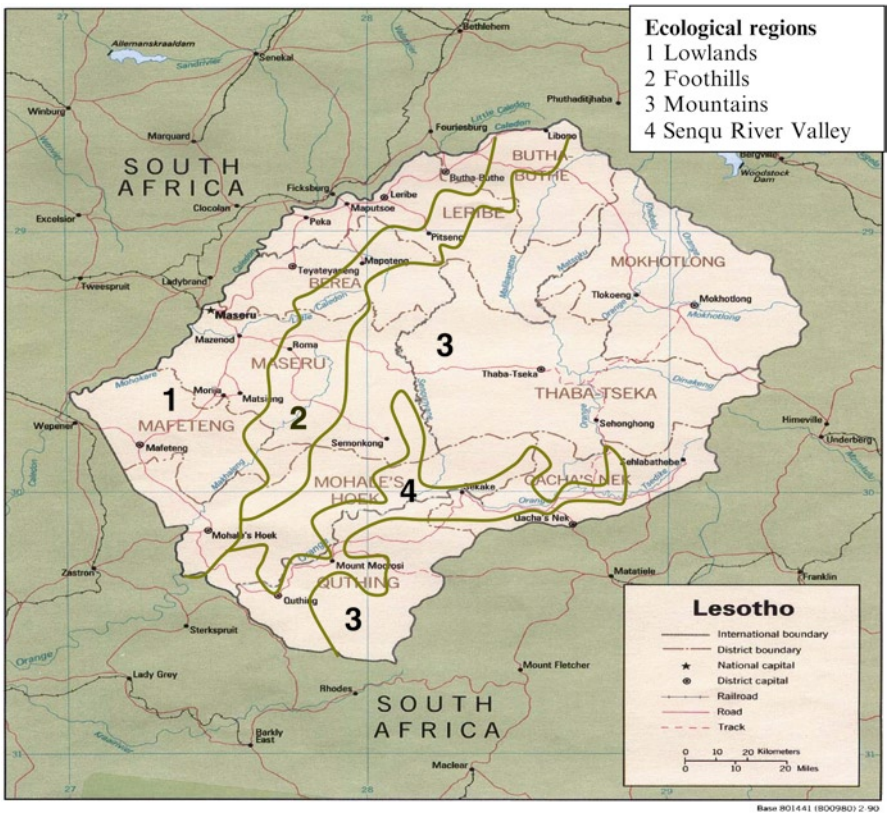

Fig. 3.1 Lesotho–ecological regions/zones (with permission) (Source: Open Society Initiative for Southern Africa (OSISA); with own additions)

geographical area (National Resource Inventory of Lesotho 1988). Lesotho's mountain terrain and its farming culture are factors which favour stock grazing more than crop growing. The Lowland region, with its short, mild winters and long, hot summers, is the most densely populated with about 57% of the population of Lesotho residing there (Lesotho Statistical Yearbook 2010). The Mountain region experiences long, harsh winters and short, cool summers. The Senqu River Valley region is characterized by mild winters and warm summers and is highly suited to growing winter wheat.

The Lowland region has an altitude of about 1,388–1,800 m above sea level (m.a.s.l) on a narrow strip along the country's western and south-western portion. It forms part of the 'breadbasket of Lesotho' (FAO 2005). It covers an area of about 17% of the total land surface. The capital and principal centre of commerce and industry, Maseru, is located here. Recent figures show a 19% population increase compared to the 46% living in the Lowlands in 1976; while the population in the Foothill region the population has fallen from 23% to 13%; and in the Mountain zone the population has been fairly stable at about 20% over the last 30 years

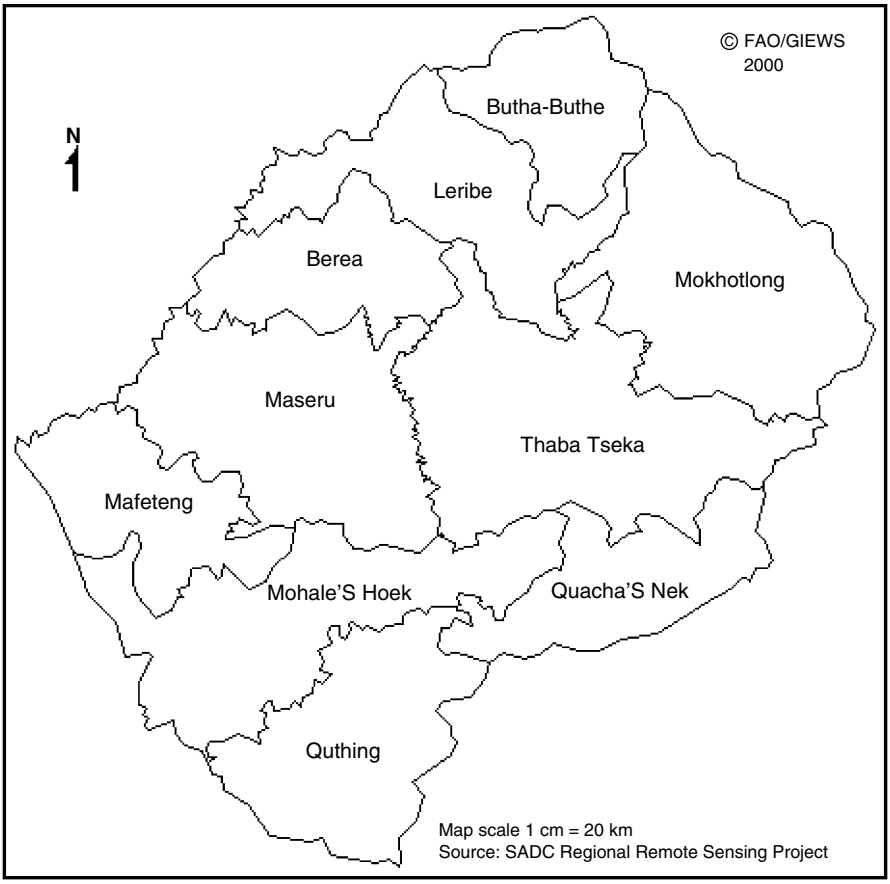

Fig. 3.2 Lesotho administrative map (FAO/GIEWS 2000) (with permission)

(Lesotho Statistical Yearbook 2008). Change is also evident in the growth of new settlements on the outskirts of big commercial centres (e.g. Maseru) (Personal observation, 2005, and 2007).

At an altitude of 1,800–2,000 m above sea level (m.a.s.l.), the Foothills occupy about 15% of the total surface area, while the Senqu River Valley, lying at 1,388–2,000 m.a.s.l., occupies only 9% of the total land area (National Report on Climate Change 2000). The Mountain region, 2,000–3,482 m.a.s.l., occupies about 59% of the total surface area. The lush Highland region, with its many fresh-water rivers and streams, is endowed with the country's "white gold". Through the Lesotho Highland's Water Project (LHWP), Lesotho is expected to export about 70 m^3/s of water (Association for International Water Studies (FIVAS) 2007) to the water-thirsty industrial heartland of South Africa's Gauteng Province.

There are ten administrative districts in Lesotho, each headed by a district administrator (Fig. 3.2).

Human factors are important for land-use change and land degradation. Seventy-five percent of Lesotho's land surface, with a population density of 53 people per km^2 is considered severely degraded, while 25% of the land with a population density of 93 people per km^2 is very severely degraded land (Chakela 1999, Table 7A: 95). These last areas are in the arable lands, mostly in the Lowland region. Land-use activities characterized by poor agricultural practices and overstocking/overgrazing are core factors of rill and gully erosion and land degradation in Lesotho (Chakela, 1999, personal communication). Preliminary observations and analysis of a topographic map of Lesotho (1:50,000, 1987) suggest a pattern of land-use which starts with built-up areas in the centre of town and the peri-urban areas and squatter settlements with very little or no agricultural activity. In the surrounding rural areas about 30 km out of town, sheep farming becomes more prevalent, with subsistence crop farming, mainly of maize, vegetables and fruit trees, on small plots of land.

3.1.1 Agriculture

The people of Lesotho are known as Basotho. About 80% of Basotho are rural dwellers whose main economic activity is subsistence agriculture (Drimie 2002). Rural life is generally characterized by lack of basic infrastructure, including electricity and pipe-borne water (Omole 2003). Agriculture in Lesotho consists of crop farming and animal keeping. The main crops are maize, wheat, sorghum, peas and beans. Crop cultivation is done principally on Lowlands. About 51.0% of the total cropland is used for maize, 23.5% for sorghum, while small grains and pulses account for 8.7% and 5.2% respectively (National Resource Inventory of Lesotho 1988). The reminder, 8.5%, is left fallow, while 'other' uses occupy 3.0%. The main agricultural implement is the ox-drawn plough used mainly for tilling the ground and sowing. Other agricultural implements like the hand-held hoe, pick and spade and, to a lesser extent, tractors are also used. The planting season in the Lowland is August to January, while in the Foothills and Mountains it is August to November. Fertilizers, and traditionally animal manure, are sometimes applied; hybrid seeds are also used. Men (often household heads) are traditionally responsible for employing an ox-drawn plough for ploughing and sowing. In their absence ploughing is carried out by boys, male relatives, neighbours or hired male labour (Mosenene, N.D.). Women and children are generally responsible for using the hand-held hoe, for weeding. Men, women and children are involved in harvesting. Social-cultural events where food is the focus, like initiation school graduation, take place just after harvesting at the end of June.

Recent trends in Lesotho's cereal production, like those for the agricultural period 1999/2000–2004/2005 (FAO 2005), show a steady national decline in cereal production (FAO 2004, 2005). The central region, comprising the districts of Butha-Buthe, Berea and Maseru, and contributing about 57% of the national cereal production, show the steepest decline in cereal production (Fig. 3.3). According to the Special Report on Crop and Food Supply Assessment Mission to Lesotho

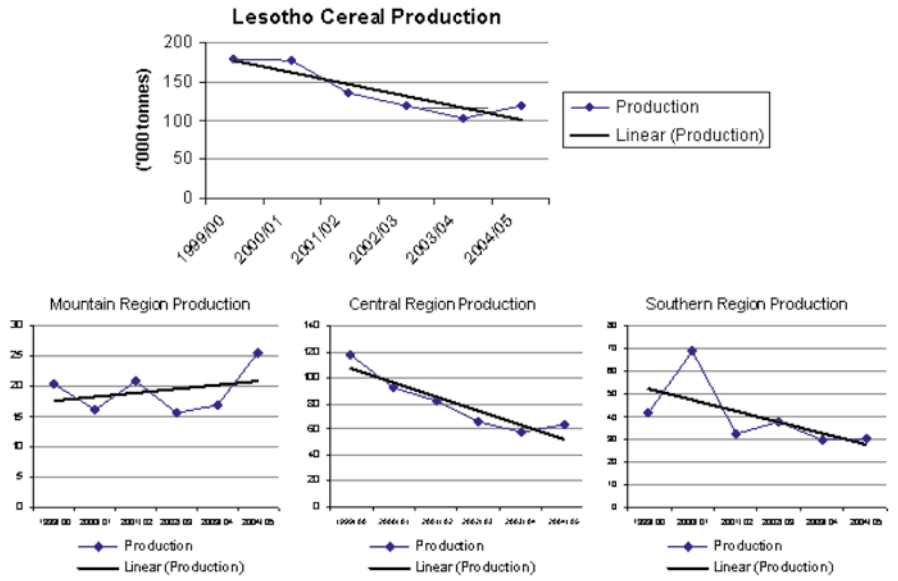

Fig. 3.3 Lesotho: Trends in Cereal Production, 1999/00–2004/05 (with permission) (Source: FAO/WFP Crop and Food supply assessment mission to Lesotho; 20 June 2005)

(FAO 2005): *"The southern region (Mafeteng, Mohale's Hoek, Quthing, Qacha's Nek) contributes 29 percent while the mountain region consisting of only two districts (Mokhotlong, Thaba-Tseka) contributes 14 percent. The declining production, particularly in the important central region, should be of great concern and needs to be fully investigated."* Factors attributed to the decrease in cereal production in the Lowland region, and indeed nationally, include: soil erosion, 'weather disasters' and the impact of HIV/AIDS (e.g. FAO 2005). The agricultural year 2006/2007 was a drought year, resulting in severe crop failures. For example; the average yield for maize for the year was only 381 kg/ha compared to 1,142 kg/ha in 1999/2000 (Lesotho Statistical Yearbook 2008). Similar trends were recorded for the two other major cereal crops, sorghum and wheat. Production figures for maize, sorghum and wheat for the agricultural year 2008/2009 are encouraging, showing a 19% increase compared to 2007/2008, but district figures show significant crop failures for maize and sorghum in Mohale's Hoek, Mafeteng and Maseru districts (Lesotho Crops 2008–2009:7): *"Mohale's Hoek recorded the largest area failed under maize with 3,394 ha followed by Mafeteng with 1,424 ha, while sorghum had the largest area failed in Maseru with 718 ha."*

The main animals kept in Lesotho are cows, sheep, goats, horses, donkeys and chicken. Cows are traditionally kept for prestige, used as a dowry and often a measure of wealth. Animal products like wool and mohair are an integral part of the traditional art of weaving and tapestry, but the main production is for export. There are mainly three types of grazing areas: mountain cattle posts, grazing lands near settlements and those between settlements and mountains which are essentially on

mountain slopes (Maseru District Council official, personal communication 2007). Cattle, as well as sheep and other animals, are taken to Mountain cattle posts once planting is complete, often in January, and return in April. Permission to graze in cattle posts is granted by principal chiefs, who often live kilometres away from the sites (FAO Investment Centre Socio-economic and Production Systems Studies. N.D). Local chiefs do not have authority over those lands. Principal chiefs acted under advice from the Range Management Office, which is responsible for managing stocking rates of rangelands. Grazing areas near settlements are reserved for winter grazing, while those between settlements and mountains are used for grazing year-round (Maseru District Council official, personal communication 2007). Grazing areas near settlements are divided according to chieftainship boundaries and are generally shared by communities falling within different chiefs. Local Council officials together with communities decide which area is to be reserved or used, timing and length of grazing in an area, while the Rangeland Officer advices on the number of animals per grazing area (Maseru District Council official, 2007, personal communication). Year-long grazing areas are controlled in a similar manner. The District officer confirmed that there were no grazing lands in the two study villages.

Several main points can be drawn from the discussion on grazing lands. The type of grazing control practiced in Lesotho with its multiple actors and shared responsibility is prone to lack of accountability and can contribute to land mismanagement. Scarcity of grazing lands in the Lowlands results in animal grazing on crop fields or feeding animals animal feed often bought from South Africa. The practice of winter grazing and grazing on crop fields is considered problematic in terms of sustainable land-use and management. This is because, since arable land cannot be fenced, some farmers are said to be reluctant to cultivate grass layers, legumes or other winter crops which might help improve the soil's structure and help prevent soil erosion (Morojele 1963d). In addition, animals treading on these rather bare soils reduce their water-retention capacity and makes them powdery; making it easier for the soil to be removed by water and wind, leaving hard surfaces that are difficult to cultivate (Morojele 1963d; personal observation, 2005).

3.1.2 Agriculture Marketing

Before independence, Lesotho's agricultural marketing system was characterized by a free market system, dominated by private traders (Mokitimi 2000). The post-independent marketing system is regulated by the 1967 Agricultural Marketing Act (Foulo and Quentin 1998). About half of domestic agriculture production is sold at government-controlled prices, and the rest through informal marketing channels (Foulo and Quentin 1998). Some have criticized the lack of an effective agriculture marketing system as a leading cause of the failure of many large-scale agricultural projects because increased production was not matched by means of distribution (IDRC Report 1992). In 1996 the government adopted an Agriculture Sector Development Programme aiming at "*comprehensive agricultural reforms.*"

This policy is praised as having paved the way for *"commercialization and divestiture of eligible agricultural parastatals, and allowed the government to complete remaining marketing policy reforms and liberalization of commodities"* (SADC Trade, Industry and Investment Review 2006).

Recently, others have argued that import controls have resulted in high consumer prices, urging the government to let private organizations and individuals run agriculture marketing while the government should regulate, monitor and facilitate efficient operation of the agriculture marketing system (Mokitimi 2000). However, the debate on market liberalization and privatization remains unresolved with some insisting that free markets should not replace government functions in remote areas (ODI, N.D.).

Agriculture is considered the 'backbone of the economy'. Yet in economic terms, the largest source of government revenue, particularly before 1990s, was remittances from Basotho men working in South African mines (Gausset et al. 2005). Agriculture's contribution to the GDP was estimated at 30% in 1980s, declining to less than 20% in 2005 (SADC Trade, Industry and Investment Review, 2006). *"The average farmer in Lesotho grows 30% of their household food requirements and buys the other 70%. Most rely on remittances from family members, selling piece labor, or government labor programs"* (FAO 2007). Lesotho's agriculture continues to face major challenges like changes in weather patterns, declining arable land and increasing landlessness, with about 40% of the population considered to be landless (ODI, N.D.).

3.1.3 From Agriculture to Labour Migration and a Changing Political Economy

During the second half of the nineteenth century the Basotho were prosperous and self-sufficient (Gausset et al. 2005). Basotho were semi-pastoral, herding cattle and small stock and cultivating land for food-stuffs (Morojele 1963c, Part 4:8).

Early reports indicate that an increase in demand for arable land in the Lowlands and increasing stock numbers led to movement towards the Mountain region where grazing land was plentiful and better. A combination of lifestyle changes, drought, declining crop production and pressure on arable lands and need for money to pay for many expenses including tax were partly responsible for labour emigration to South Africa. The Colonial government imposed a Hut Tax in 1870, which became one of the major push towards a money economy for the Basotho (Foulo and Quentin 1998). Although estimates differ and figures should be treated with caution, it is estimated that in 1891 the population was 218,342 people, 30,000 of whom were reported to be migrants working mainly in Kimberly Mines and the Port Elizabeth Railway (Morojele 1963a).

A marked shift from agrarian to labour reserve occurred in the 1930s. Several factors led to this. An important one was the introduction of protectionist measures in South Africa that prevented the sale of agricultural goods from Lesotho and a hut

tax introduced earlier by British colonial rulers. In 1935 Lesotho's agriculture was characterized by soil erosion and stock theft (Morojele 1963c, Part 4: 9). These were considered *"the greatest obstacles to the improvement of land and stock in the territory"* (Morojele 1963c, Part 4: 9) and efforts on anti-erosion measures and control of grazing were intensified. In tandem with these changes, there were droughts and plagues which caused food shortages and livestock diseases (e.g. rindpest) (Gausset et al. 2005). In need of money to pay the hut tax and to supplement income from agriculture and declining food production, Lesotho became a labour reserve. The number of Basotho working in South African mines was estimated at 78,604 in 1936 (Gausset et al. 2005). Remittances from miners working in South Africa became the largest source of income to the Lesotho government until the 1990s.

Since the beginning of the nineteenth century, contract labour migration to South Africa has been an important part of the Basotho way of life and a major source of employment for Basotho men, employing about 40% of the male labour force (Bureau of Statistics 2001). Male labour migrants maintained their traditional role as household heads while absent, and their spouses, *de facto* household heads in their absence, ran households day-to-day. Decisions pertaining to land, for example, are traditionally made by men. Despite recent decreases in labour migration, more than one in three men had either worked in South Africa or was currently working in South Africa, demonstrating the Basotho economy's dependence on labour migration to South Africa (Bureau of Statistics 2001). The on-going retrenchments of Basotho miners in South African mines have resulted in losses of household income and increased unemployment in Lesotho. *"The World Bank (1995) estimated the unemployment rate to be in order of 35% to 45% due to on-going retrenchment of workers at the South African mines"* (Omole 2003: 3). Another contributing factor to current high unemployment rates in Lesotho is the political crisis of 1998, resulting in economic losses in some sectors and increased unemployment (Omole 2003). Since the end of apartheid in South African and the relaxation of laws precluding female migration to South Africa, female migration in search of employment opportunities, particularly women with a tertiary education, is said to be increasing (Bureau of Statistics 2001). Compared to men, women mainly dominate short-distance and internal migration.

Socio-political changes in Lesotho were largely influenced by economic and political conditions in South Africa and to some extent changes in the global economy. A fall in gold prices in the world market in the 1980s, together with the collapse of apartheid and changing political structures in South Africa, led to reduced employment of Basotho miners in South African mines and reduced remittances into Lesotho. It is estimated that remittances from labour migration made up 67% of Lesotho' GDP in 1989 and employed 129,000 people (Lesotho Ministry of Communications, Science and Technology, N.D.). By 1996 remittances contributed only 33% of GDP; while in 2002 the number of miners in South Africa had fallen to about 50,000 people (Gausset et al. 2005). In 1979, 49.7% of households in Lesotho had at least one member working as a miner in South Africa, by 2002, that figure was 11.9% (Gausset et al. 2005). The socio-economic effects of changes in the labour market were compounded by changing biophysical conditions, with

the period 1979–1996 experiencing the highest incidents of drought in almost 200 years (Chakela 1999). Effects of these and later droughts in the early 2000s are discussed later.

The decline in agricultural productivity and increasing unemployment has led to several government initiatives, contributing to changes in the political economy. One such initiative aimed at the agro-industry focuses on cannery of agriculture products, milling and production of small scale leather goods (SADC Trade, Industry and Investment Review, 2006).

In 2001, Lesotho signed a preferential trade agreement with the USA, promoting duty-free exports of textiles into the USA under the African Growth and Opportunity Act (SADC Trade, Industry and Investment Review 2006). This has contributed to the industrial sector's growth. The textiles sector accounted for 16.4% of the county's GDP in 2006, compared to agriculture's contribution of 14% and the services sector's contribution of 41.8% (SACU-Kingdom of Lesotho, N.D.). Removal of textile quotas in 2005 damaged the textiles and clothing industries; while the opening of two diamond mines in 2004 and 2005 increased the mining sector's contribution to GDP from 0.6% in 2003, 4.4% in 2006 to 9.1% in 2008 (Lesotho Statistics Yearbook 2008). Most employees of the textile industry are women. The mining sector, together with the manufacturing and telecommunication sectors are expected to be the largest contributors to economic growth in 2010, projected at 3.6% growth compared to 2.1% in 2008 (Minister of Finance and Development Planning Budget Speech to Parliament 2010). Following the 1998 civil unrest, construction of Maseru and surrounding infrastructure development also led to an increase in employment in Maseru, and together with the Lesotho Highland Water Project construction phase, considerably increased the construction sector's contribution to real GDP (Lesotho Statistics Yearbook 2008). Another initiative was the country's introduction of a Value Added Tax (VAT) in 2002, which aims to boost government revenues (SADC Trade, Industry and Investment Review 2006) and reducing dependence on customs duties (from the Southern African Customs Union). Sales of water from the Lesotho Highlands Water Project (LHWP) since 1998 also generate royalties to Lesotho.

Despite such developments, agriculture remains central to Lesotho's economy. *"The irony is that, while wages are relatively low, meaning that farming continues to be necessary for survival, farming outputs are so low that wages are necessary"* (Gausset et al. 2005:31).

Other factors potentially influencing land-use/cover and changes include historical and socio-political context, biophysical and demographic characters. A brief description of Lesotho's socio-political context is given next.

3.2 Historical Socio-Political Context of Land-Use Change

The Basotho nation was founded in 1818 by King Moshoeshoe I. Inter-tribal wars and a severe drought had hit the region in early 1800 and fuelled conflicts between tribes (kingdoms) for prime pasture lands and fertile cropping areas. The severe drought,

compounded by an increase in cattle and grain theft, resulted in severe famine and even cannibalism in parts of Lesotho (Lesotho Ministry of Communications, Science and Technology, N.D.). Moshoeshoe I formed the Basotho nation by bringing together scattered clans and chiefdoms of southern Sotho people. The Basotho were essentially warriors, hunters and herdsmen. Their traditional occupations included: leather, metal, glass works, pottery and weaving (Morojele 1963c, part 4: 7). They kept cattle and cultivated land mainly in the Lowlands, which extended to today's Free State region of South Africa. Socio-economic changes resulted from the arrival of early European settlers and missionaries. Horses were first introduced in the 1820s. They were brought by early Dutch-speaking people who came with horses and guns. Early changes in land-use were brought about by French missionaries who arrived in Basutoland in 1833. They introduced potatoes, wheat and fruit trees, and agricultural tools. They also started book printing in the Sesotho language. A money economy soon followed, with the Basotho using their agricultural produce of maize, wheat, and cattle in exchange for guns, merchandise, clothing and other goods (Morojele 1963c).

Basutoland became a British Protectorate in 1868 (Lesotho Ministry of Communications, Science and Technology, N.D.), leading to the Convention of Aliwal North which laid down Lesotho's current boundaries. As a result of the 'new' border-line, Basutoland lost most of its land to the west, in Orange Free State, to South Africa.

In 1884 the British Resident Commissioner together with the Paramount Chief formed a system of dual government (Lesotho Ministry of Communications, Science and Technology, N.D.). The British administration was in charge of external relations, tax collection and punishment of serious crimes and settling boundary disputes between rival chiefs. The principal chiefs consulted people on national issues through annual open assemblies (*pitso*) and used the court of village elders (*lekhotla*) to settle minor disputes. Population increase and rivalries between chiefs soon made it difficult to use *pitso* to reach a consensus on national issues. The British Commissioner proposed an alternative, the formation of a National Council, comprised mainly of chiefs. It was implemented in 1903 to advise the British Commissioner and Paramount Chief (Lesotho Ministry of Communications, Science and Technology, N.D.). Not everyone supported this structure. It may even have sparked off the political parties and activities which probably continue to influence Lesotho's contemporary politics. By 1960 the National Council was composed equally of appointed chiefs and elected members chosen from District Councils, which had been in existence since 1950. Moshoeshoe II became king of Basutoland in 1960 and on October 4, 1966 Lesotho became independent.

The first post-independence elections were held in 1970, but were annulled by the ruling party. A state of emergency ensued, leading to an Interim governing Assembly formed by the ruling party and some break-away figures from the opposition (winning) party. From 1973 to 1986 there was expansion of school and health systems, upgrading

of road and communication infrastructure, training of government officials, an inflow of foreign aid, programmes and projects (Lesotho Ministry of Communications, Science and Technology, N.D.). In 1986, South Africa closed its borders and raided the homes of some political exiles in Lesotho. The border blockade and political situation partly exaggerated an already tense situation leading to a military take-over and military rule which lasted from 1986 to 1993. During this time Village Development Councils were reformulated and chiefs were allowed only as members and not chairs of the Councils. Divisions between supporters and opponents of the monarchy in the military partly led to the exile and dethronement of Moshoeshoe II; his son Prince Mohato was crowned Letsie III. Return to democracy in 1993 was marked by elections where the opposition (which was denied power in 1970) won; and a revision of the 1966 Constitution. However, these elections were contested (by the former governing party which had now lost), resulting in a 'Palace Coup' in 1994. Letsie III suspended the Constitution and created an Interim Government; South African and Botswana forces were asked to intervene and the coup collapsed. Moshoeshoe II was reinstalled as king and ruled until his death in 1996, when Letsie III was reinstated.

Further changes to the government structure occurred with the adoption of the Local Government Act of 1997. It was to replace the District and Village Development Councils with District and Community Councils. The Act removed powers of land allocation and management from chiefs and left this to the jurisdiction of District and Community Councils for urban/district level and rural/village level respectively. The first local elections were held in April 2005, but the functioning of Community Councils is still hampered by financial and human resource constrains. These new structures could still potentially lead to confusion in responsibility to manage and administer land-use.

Later elections followed in 1998. They were contested, resulting in civil unrest, division in the army, death and destruction of infrastructure. Much of the centre of Maseru was burnt down and many buildings were looted (personal observation, 1998). The Prime Minister called for intervention by the South Africa, Botswana and Zimbabwe armies (part of the SADC forces) which ended the unrest. Peaceful elections were held in 2002 and more recently in February 2007. The recent elections were marred by allegations by an opposition party of unfair allocation of seats in parliament. The result has been attacks on top government figures and fear of unrest, culminating in a curfew which ended in June 2007. The former Botswanan President Masire has acted as mediator between the disputing parties.

Political and institutional changes potentially influence changes in land-use/cover. Political instability can generally contribute to economic slow-down and lack of business/investor confidence. Policy and institutional factors can also influence people's decision-making on land-use. As described earlier, biophysical changes have fundamentally contributed to socio-political and economic changes in Lesotho. A description of Lesotho's biophysical characteristics follows.

3.3 Biophysical Characterization of Land-Use Change

3.3.1 Climate

Lesotho has a single rainy season from October to April (Chakela et al. 1986) (Fig. 3.4); and two planting and two harvesting seasons (Fig. 3.5). Mean annual rainfall is about 700–800 mm in most parts of the Lowlands. The summer rains coincide with the summer planting season, which favours maize and sorghum, while wheat is planted in winter. High temperatures, attaining up to 30°C also characterize summer in the Lowlands, while cold winter months in both Lowlands and Highlands are associated with slightly lower temperatures in the former. The Lowland region has an annual temperature of 15°C (Chakela et al. 1986). Variable climatic conditions, with frost in winter, are characteristic of Lesotho and common in the Lowlands. The changing climate and relief of the country, undoubtedly constrains the scope for agriculture. Amount, intensity and timing of rainfall are some relevant factors determining agricultural production.

Dry spells marking hydrological droughts are characteristic of climatic conditions of the two districts Maseru and Mohale's Hoek, as in all of Lesotho. Historically, these are reflected in the 1886–1973 recorded droughts (Chakela 1999:122). The marked effects of these droughts are in poor agricultural performances and marked food shortages. The years 1933, 1946, 1949, and 1951 were some of the

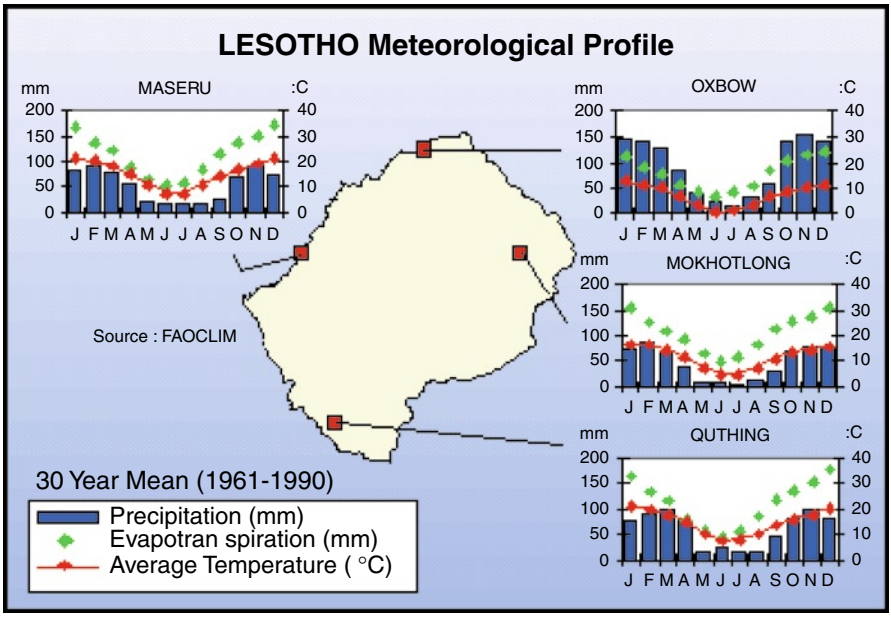

Fig. 3.4 Lesotho meteorological profile (FAO 1997) (with permission)

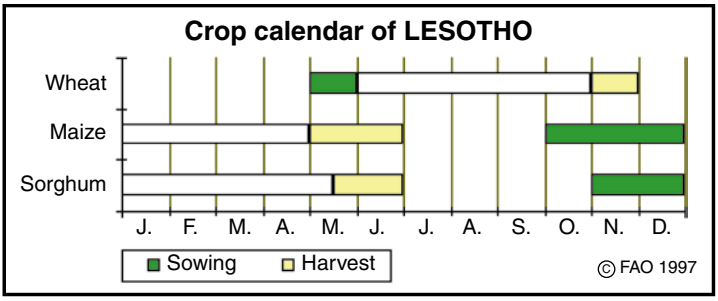

Fig. 3.5 Lesotho planting seasons (FAO 1997) (with permission)

driest pre-independence years (Basutoland Department of Agriculture Annual Report, 1942/43–1957). By 1951, severe food shortages were recorded, and an increase in food imports from South Africa was evident (Basutoland Department of Agriculture Annual Report, 1942/43–1957). In recent years, the longest recorded drought was between 1991 and 1995 (Chakela 1999; Sechaba Consultants 1996), given that some drought periods are marked by 1 or 2 years of below-average rainfall, this period was marked mainly by dry years. The impetus of drought and food shortages is also found in recent agricultural years, notably 2001/2002, 2002/2003 and 2006/2007 (FAO 2003; Lesotho Statistical Yearbook 2008).

An analysis of Lesotho and southern Africa's meteorological data reveals a pattern of dry spells preceded by wet years (IRIN 2004; SADC Food Security Early Warning System, Monthly updates 2004; Rook 1997). The length of droughts roughly corresponds to the length of rainy periods. The length of each of the two periods appears longer between the 1930s and 1970s. This shows evidence of an increased frequency of dry spells over the past two decades, compared with earlier times.

3.3.2 Vegetation

Empirical evidence showing explicit trends of vegetation changes for Lesotho is lacking (Marake et al. 1998). But historical accounts by missionaries, colonists, locals and others have documented differing, often startling, observations of vegetation changes in Lesotho. (Ellenberger 1992; Marake et al. 1998). The vegetation of the Lowland is composed of grasslands of *Themeda-Cymbopogon-Erograstis* type (Chakela et al. 1986). The south-facing slopes are covered by indigenous trees and shrubs with species like *Podocarpus latifolius, Cussonia spicate, Euclea ramosa, Ocotea bulleta and Aloe capensis* (Marake et al. 1998); while the valley bottoms, river banks and depressions are covered by trees, reeds and bushes, referred to locally as *mokhoabong* (wetland) and *mohlakeng* (Reed bed).

3.3.3 Soils

The major soil types of Lesotho originate from sediments and basaltic lavas of the Karoo Supergroup form. *"The sediments of the Karoo Supergroup in this region comprise the Clarens Formation, Elliot Formation, Molteno Formation and Beaufort Group."* (Marake et al. 1998: 29). The soils of Lesotho are deficient in phosphorus and have low organic matter content and a low base saturation (Ranthamane, 2005 in Sivakumar and Ndiang'ui 2007). The Lowland region is dominated by Karroo sedimentary rocks with igneous intrusions, formed by Clarens Formations, covered by alluvium, colluvium and aeolian deposits. Lithosols are found on steep slopes and river terraces; ferrasiallic and ferrallitic soils are found on the plains and lowlands; while claypan soils and vertisols are found on topographic depressions (Chakela et al. 1986). Soils found in Lowlands and Foothills are considered acidic, with pHs of 5.3 and 4.4 respectively, while those in the Highlands are considered neutral (Ranthamane, 2005 in Sivakumar and Ndiang'ui 2007). Acidic soils are generally deficient in phosphorus; and have several other problems that potentially limit productivity (Cregan 1981): aluminium toxicity; manganese toxicity; molybdenum deficiency; legume nodulation failures; increase in plant disease and calcium and magnesium deficiency.

Climate, relief of the land and soil characteristics (Appendix 1) are important factors in land degradation and soil erosion. A majority of croplands in Lowland region are covered by infertile and vulnerable alfisols (National Report on Climate Change 2000). These are highly erosive and greatly contribute to gully erosion in the Lowlands. Young and shallow soils and young and deep vertisols, which are clayey are found all around Lesotho. The vertisols are generally prone to erosion because of steep slopes, low organic content and poor structures with high potassium content (National Report on Climate Change 2000: 56).

3.4 Land-Use and Land-Cover Perspectives

Data on land-use/cover change for Lesotho are generally out-dated, fragmented or otherwise unavailable and should be treated with caution. The national land-cover change data 1989/94 for Lesotho give prominence to land-cover types like 'mines and quarries' and 'shrub land and low Fynbos' which were otherwise obscure in the National Inventory classification system. These data reveal an increase in urbanization and a notable increase in mining activities between 1989 and 1994. Internal migration figures indicate that *"… 56.7% of the total population that changed residence by employment status during the period 1986–1996 are females, whilst males constitute 43.3%. A large percentage, 68.7% are females who moved to Maputsoe urban centre which attracts migrants because of its industrialisation and proximity to the South African border …."* (Bureau of Statistics and UNFPA 1996: 92). The 1989/94 land-cover change data show a 52.4% decrease in wetlands, with most bogs and marshlands of environmental importance occurring in the

mountain region where much of the Lesotho Highlands Water Project activities take place. The Lesotho Highlands Water Project (LHWP) is an ambitious dam construction project started in 1986; with the aim of 'mining' Lesotho's water resources from the mountain region into South Africa to satisfy its major economic and industrial centre of Gauteng Province. This project provides revenue and general development of the mountain remote areas of Lesotho, providing employment for large numbers of Basotho. Royalties from the project make up 27.8% of all government revenues (Sechaba Consultants 2000, in Hoover 2001:1). Its downside includes the displacement of large numbers of rural people from their land and resources – an estimated 20,000 people have been affected by the first phase of the project (Hoover 2001).

From the 1989/1994 land-cover data, an increase in land degradation as shown in the 'degraded: unimproved grasslands' may be supported by erosion figures of 1988 (e.g. National Resource Inventory Report 1988). The differences in soil erosion rates and coverage on specific land-use types, like cropland and rangeland are important. The different types of erosion – sheet, rill and gully, cause varying rates of soil loss according to different land-uses. The largest share of sheet and rill erosion was from rangelands, at 59.13%, croplands resulted in a 39.02% share of sheet and rill erosion; while gully erosion accounted for only 1.84% of the total soil lost for 1988 (National Inventory Report 1988). Gullies (or *dongas)* are in a more stable state, thus contributing only marginally to soil loss. In some cases they start acting as nutrient traps, trapping lost soil from highlands and hilly sheet and rill erosion. But the scars they form on the landscape make it impossible for crop-farming; and further constrain land-use.

Research findings elsewhere in the Lowlands show that areas used for crops are more erosion-prone than those used for livestock (Rydgren 1985). These results may be explained in the light of the very nature of dry-land agriculture that clears the soil surface for crop-planting, leaving little or no vegetation to anchor the soil. However, the causes, processes and rates of soil erosion in (Eastern) Lesotho are still inadequately understood (Grab 1996). In total, 39, 573, 170 tons of soil were lost through sheet, rill and gully erosion in Lesotho in 1988 (National Inventory Report, 1988).

In developing countries, data on the environmental characteristics and dynamics of arid and semi-arid areas are not always readily available (Adamo and Crews-Meyer 2006: 69). As can be seen from the discussion above, land-use/cover change data for Lesotho are fragmented and should be treated with caution.

3.5 Socio-Economic Profile

The population of Lesotho, at the 1996 census, was estimated at 1,862,000 inhabitants with an annual growth rate of 1.5%. The most densely-populated district is Mafeteng, between Maseru and Mohale's Hoek. The majority of the population (51%) is female (Marake et al. 1998). Population figures for 2007 estimate Lesotho's population at 2.13 million (Table 3.1). Selected social indicators show that the

Table 3.1 Selected social indicators[a]

Social indicator	1995	2000	2003	2004	2005	2007
Population (million)	1.86	2.14	1.86	1.87	1.87	2.13
Population growth rate (% annual)	1.5	0.7	0.0	–0.1	0.1	0.1
Life expectancy at birth (years)	59.0	41.2	36.0	35.6	34.5	39.9
Infant mortality rate (per 1000 births)	73.0	75.5	–.	80.0	67.0	79.9
Adult literacy rate, total (% of people aged 15 and above)	75	62	84.8	82.2	–	–

Sources: Omole 2003; Rural Poverty Portal, IFAD; CIA World Factbook 2007

[a] This table is composed of data from different sources. Social data on Lesotho is patchy at best and its accuracy cannot be guaranteed. Taking this into account, the table is used here to show selected social indicators and how they have changed over the past 12 years

annual growth rate and life expectancy has decreased in recent years (Table 3.1). Average life expectancy has decreased from an estimated 59.4 years in 1996, 52.5 years in 2001 to 39.9 years in 2007 – with a marked increase in mortality among the economically active population age group of 15–49 years (FAO 2005). This decline is generally attributed to HIV/AIDS (Omole 2003), whose impact on population growth and life expectancy was mostly felt in 2004 and 2005.

As elsewhere in southern Africa, most people are rural dwellers. Fewer than 20% live in towns (Bureau of Statistics and UNFPA 1996). The rural population is often assumed to comprise subsistence farmers, earning their livelihoods exclusively through agriculture. But this is debatable. Many site visits in various urban and rural areas in different biophysical areas of Lesotho indicate the existence of other possible income sources (personal observations). This often includes livestock farming, small-scale commercial vegetable farming, arts and crafts, and small-scale business ventures, mostly female-run.

Another indicator of alternative income sources is the increasing prevalence of street vegetable sellers and food sellers in major commercial centres like Maseru, Butha-Buthe, Leribe, Mafeteng and Kao, as well as prostitution. Women generally dominate such activities. But men are involved in other activities like bus and mini-bus driving and conducting, shoe repairs and selling clothes, telephones, and watches on the streets of commercial centres e.g. Maseru, plus begging. The people involved in these alternative sources of income are mainly those living on the edge of the cities, and nearby peri-urban villages. National statistics indicate more men than women taking part in informal employment: about 53.0% for men compared to 47.0% for women (Integrated Labour Force Survey preliminary report 2009). Another important source of income is remittances from miners (Fig. 3.6). Recent figures indicate the numbers of migrant miners have decreased from about 80,000 in 1998 to about 53,000 in 2007 (Lesotho Statistical Yearbook 2008).

A preference for living in the capital is evident in the population figures, with the type of labour activity being a decisive factor (Maro 2001). Over twice as many people live in the northern Lowlands (e.g. Maseru) compared to the southern Lowlands (e.g. Mohale's Hoek) – about 429,823 people versus 174,924 people (Lesotho Statistical Yearbook 2008). There are also variations in the number of

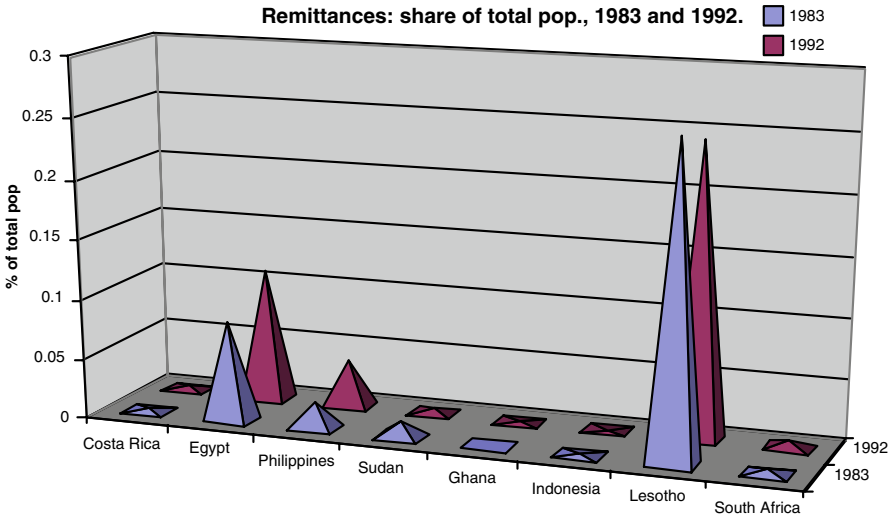

Fig. 3.6 Remittances as a share of the total population (Maro 2001) (with permission)

stock – 15 cattle/km^2 in the northern parts versus 10 cattle/km^2. Maseru has the most sheep and goats – which can be attributed to the presence of a market for selling these animals.

In general, urban people are better educated than rural ones. Primary school attendance is common among both urban and rural dwellers, as indicated by the 10–15 age group. Secondary and tertiary education is markedly lower for rural residents. Analysis reveals the dominance of educated females in contrast to popular beliefs on the education status of African women (e.g. Bureau of Statistics 1961; Ministry of Labour and Employment 2001). Of the men, 77.8% never attended school, only 22.2% of women never attended school. In 1994: *"The UNDP (1997) reports a literacy rate of 60.9 percent for females and 80.3 for males. The combined primary and secondary enrolment rate for the same year stands at 60 percent for females and 51 percent for males"* (Marake et al. 1998:30). But there have been more male than female graduates in recent years (Fig. 3.7). This is despite the fact that slightly more females enjoy basic education. Very few men and women have a post-high school diploma, yet slightly more men undergo graduate training (Fig. 3.7). Female education in Lesotho is partly a result of male out-migration and the strong emphasis on education – mainly basic education – initially by missionaries and later by government and donor agencies. In addition, youth education, especially in rural areas, favours women. Male youths are often seen herding livestock, while most of their female peers attend school. The situation changes in later years when women start raising families.

A key characteristic of the population is absenteeism. "*The 1996 population census recorded 128 131 Lesotho citizens as being somewhere outside the country, 77.0% of them males, while females constituted 23.0%"* (Bureau of Statistics and UNFPA 1996). A slight decrease in absenteeism is noted between 1976 and 1996 (Fig. 3.8). This is

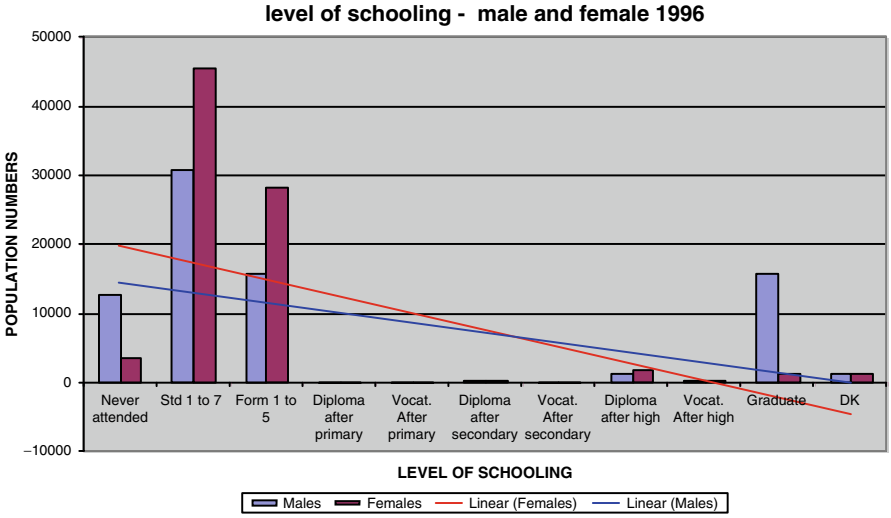

Fig. 3.7 Lesotho: Level of schooling by gender, in 1996 (Maro 2001) (with permission)

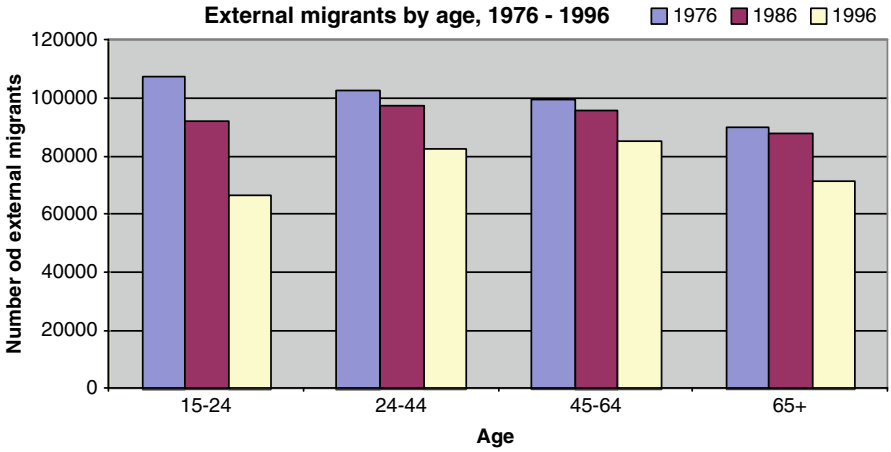

Fig. 3.8 Education level of migrants, 1986 compared to 1996 (Maro 2001) (with permission)

generally attributed to changes in migration and labour policies of post-apartheid South Africa after 1994, resulting in retrenchments of Basotho miners. As a result, a rise in population densities between 1975 and 1995 was seen in rural areas across Lesotho: in 1976 there were between 40 and 306 people for total and arable areas, while in 1995 the number of people per square km had increased to between 68 and 760 people (Marake et al. 1998). The education status of the labour force outside Lesotho is given (Fig. 3.9). Unemployment is another feature of the population. In 2002, 45% of the labour force was estimated to be unemployed (CIA World Factbook 2002). The number of people in the labour force was estimated at 838,000 in 2000; with 86% of the

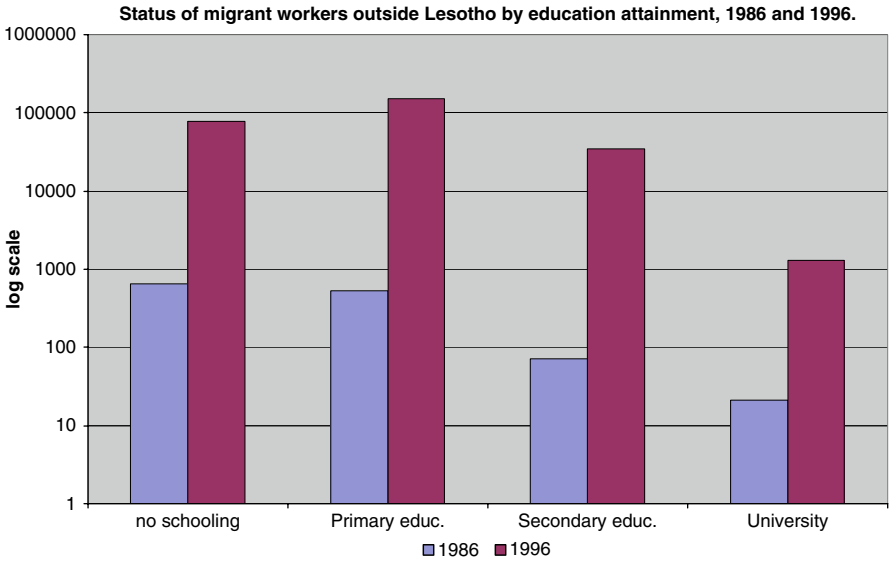

Fig. 3.9 Lesotho – external migrants by age in 1976, 1986, 1996 (Maro 2001) (with permission)

resident population practising subsistence agriculture, compared with 35% of active male wage-earners working in South Africa (CIA World Factbook 2005). The current unemployment rate for Lesotho is estimated at 22.7%, slightly higher for rural areas at 23%; with 22.1% in Mohale's Hoek (rural men: 19.7%, women: 26.4%), and 23.4% in Maseru (rural men: 22.1%, women: 26.7%) (Lesotho Integrated Labour Force survey preliminary report 2009; Lesotho Statistical Yearbook 2008).

Rural-urban and rural-rural migration is also common. This is indicated by numerations of people outside their districts of birth in both rural and urban locations (e.g. Bureau of Statistics 1961; Lesotho Statistical Yearbook 2008), with women dominating internal migration. The division of labour indicates a predominantly male-force in subsistence agriculture, while female labour is concentrated in small business activity (Fig. 3.10).

Further scrutiny of employment figures reveals a gender bias, with more men than women employed in the formal sector (Figs. 3.10 and 3.11). The majority of women, especially rural ones, are employed in the informal sectors, but these figures are often missing in national data (Maro 2001), while in towns a majority of women are employed in manufacturing (Bureau of Statistics and UNFPA 1996).

Another interesting feature of Lesotho's employment data is its classification of subsistence agriculture as an 'informal' sector. Subsistence agriculture is often termed 'informal sector' employment, raising difficulties in assessing this sector's actual contribution to the overall rural and national economics. Agriculture is referred to as the 'backbone' of Lesotho's economy – yet it contributes an average of only 14% of Gross Domestic Product (GDP) (FAO 2004), with subsistence agriculture employing 41% of all employed people compared to the private sector

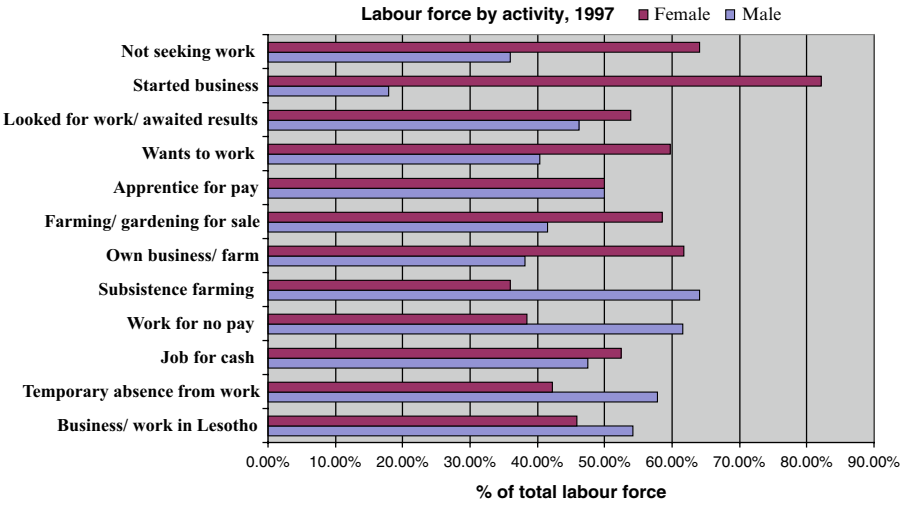

Fig. 3.10 Lesotho: Gendered labour force by activity 1997 (Maro 2001) (with permission)

Fig. 3.11 Lesotho informal sector employment by gender, 1987, 1996, 1997 (Maro 2001) (with permission)

which employs 30% of people (Lesotho Statistics Yearbook 2008). About 70% of Basotho people in rural areas depend on agriculture for part of their income; at the same time approximately 40% of the population is landless (SADC Trade, Industry and Investment Review 2006). So why is agriculture referred to as the country's

economic 'backbone'? One assumption relates this discrepancy to the need for external aid: by giving subsistence agriculture a privileged position in economic terms, a country can obtain foreign funds to develop or improve its rural 'agricultural' sector. Whether this is the best land-use option for the particular biophysical, cultural, historical and socio-economic conditions is debatable. Part of this study explores the question.

3.6 Policy Information

There is no definite answer to the question "What is policy?" At best it is user-defined. A precautionary approach is to define policy in broad terms, to encompass its dynamic perspective and complexity (Pasteur 2001). Policy issues range from contextual factors that shape and condition policy, the policy-making process, institutions and organisations that connect and influence people and/or policy, and historical factors, to policy impacts like governance of access to assets and provision of services. Policy analysis in the context of this research aims to identify which land-based policies exist and attempts to understand the relationship between policy and livelihoods and rural people's land-use options. As such, it borrows heavily from tools of policy analysis for sustainable livelihood approaches (e.g. Pasteur 2001). Table 3.2 shows an example of a policy analysis tool using the checklist approach. This research uses this checklist to carry-out macro-level policy analysis in Lesotho. However, for the micro-level analysis, the research suggests questions which might be used in interviews and discussions. The sustainable livelihoods approach recognizes that *"there are no simple rules and methods that will provide a full and clear understanding of any policy"* (Pasteur 2001).

Table 3.2 An example of a policy checklist used in sustainable livelihood research (with permission)

A: The policy context

1. What is policy in the land-based sectors?
2. Who makes policy in those sectors?
3. What is the macro policy context?

B: Policy measures

1. What measures have been put in place to implement each policy?
2. What are the characteristics of these policy measures?
3. Through what institutions and organisations are these measures channelled?

C: Policy in the local context

1. In what shape do these institutions and organisations exist locally?
2. What other institutions and organisations affect local responses to policy?
3. What other local institutions and organisations might policy affect?

Source: adapted and modified from (Shankland 2000, in Pasteur 2001) (with permission). Analysing Policy for Sustainable Livelihoods. IDS Research Report 49. IDS: Brighton. This Table is used to show the different ways in which policy-relevant information can be obtained. For this study, the macro level analysis borrowed heavily from sections A and B. For the local context of this study, a set of questions has been developed and used to gather policy-relevant information at village level (Chap. 4)

3.6.1 Policy Context and Measures: Macro Level Analysis

Land tenure and ownership in Lesotho are generally prescribed by Lesotho's constitution. There are many land-based policies in Lesotho, each with its own objectives and effects, and they are governed by many government institutions (Kumar and Maro 1996). The result has often been unsustainable land-use, landlessness, chaos and lack of implementation (Government of Lesotho Land Policy Review Commission 2000). Land tenure in Lesotho has been governed by a dual customary and statutory system. Statutory tenure, under Roman-Dutch law was governed by the Land Act of 1979. The Act applies to both rural and urban areas, but in practice, land administration in rural areas was based on customary law, while in towns a formal system of land-holding is generally used (Kingdom of Lesotho National report 2006). The tenure system determines access to land, livelihood assets and natural resources. It affects peoples' land-use and livelihood options, and influences their vulnerability to changing biophysical and socio-economic conditions. Both tenure systems discriminate against female land ownership and inheritance is considered another way to access land, although it discriminates against women.

The customary land tenure system, or Laws of Relotholi 1932, provide for communal ownership, with an emphasis on subsistence farming, and no allowances for selling or buying land. Allocation power lay with the chiefs. Land administration and settlement of disputes is generally governed by customary tenure in most rural areas. This tenure system has been reported to have resulted in self-allocation by the chiefs, landlessness and insecurity of tenure – with resulting effects and changes on land-use patterns and consequently, changes on the landscape. The statutory tenure system is governed by the constitution, which in turn stipulates that all land belongs to the Basotho nation and allocation power is conferred upon the head of state, in this case, the King. Lesotho's Parliament, as empowered by the 1966 (independence year) constitution, makes all laws covering allocation and use of land and land resources. The administration of land in rural areas is under the chief or headman in consultation with village development councils (VDC), or the district development council (DDC) for commercial land-use purposes. In urban areas land allocation is under the principal chief in consultation with urban land committees. Conflicts of interest between councils and responsible chiefs are common and have often led to mismanagement of land resulting *inter alia*, in illegal land-use, conflicts between individuals, and harm to land resources (Government of Lesotho Land Policy Review Commission 2000).

Two key policy recommendations that were raised by the Land Review Commission (2000) are: *"that land reform should promote the effective, efficient and economical operation of a land market in Lesotho. Another was that the gender discrimination inherent both in customary and statute land law be abolished"* (Adam and Turner 2005:16). Following the Commission's work, a Land Bill to replace the 1979 Act and consolidate land administration and management into one document has since been drafted (Adam and Turner 2005; Kingdom of Lesotho National report 2006) and became law in March 2010. Apart from the obvious

decentralization of land management, some important features of the Bill are that: it retains the provision that all land in Lesotho belongs to the nation and that rights to land are granted by the King, it abolishes gender discrimination in land tenure; it introduces a system of land disputes resolution through courts and mediators; it introduces a land market and provides for the automatic conversion of all rural land allocations legally made or confirmed under the 1979 Act, as well as extra-legal allocations made by chiefs and public officers, into primary leases (Adam and Turner 2005; Selebalo, N.D.).

Three types of leases are introduced by the Bill and administered at different levels of local government structures and central government. These are (Selebalo, N.D.:8–9):

- Primary lease: replaces former allocations of land under the Land Act 1979 which in turn were meant to replace customary law land tenure system provided for by Laws of Lerotholi;
- Demarcated lease: obtained through a process of adjudication of customary law interests in land held for a primary lease; land under this lease can be marketed and used as collateral for loans. It is governed by Roman-Dutch law
- Registrable and qualified lease: is the existing lease of Land Act 1979; it is called 'registrable' as it has to be registered in the Deeds Registry. The difference with the existing lease is the introduction of a qualified lease. A qualified lease is a registrable lease which has/is still undergoing surveying before registration.

The introduction of a land market may hopefully curb illegal land conversions. The government's challenge will be to implement the new law, given current institutional and human resource constraints and disgruntles about the Land Bill. Chiefs have no legal role in the Bill, a situation which may lead to conflicts and further hinder implementation (Selebalo, N.D).

3.7 Land Problem, Land Management and Land Tenure Overview

Soil erosion and the loss of land productivity are age-old problems facing Lesotho. Many literature sources on Lesotho point to the Lowland region as the most highly degraded by soil erosion and the land's reduced productive capacity. Below are some examples:

> *…in the Lowlands the soils are largely exhausted and the absorptive capacity very low and run-off high…* (Basutoland Department of Agriculture Annual Report, 1942/43 – 1957:1).

> *Gully erosion leading to the formation of dongas is common within the Lowlands of Lesotho…* (Witzsch and Ambrose 1992:14).

> *Almost everywhere in the Lowlands and Foothills there are rills, gullies denuded soil, and badlands where gullies have joined to create a wasteland where only pinnacles of subsoil still remain.* (Sechaba Consultants 1995:53).

Leading experts on Lesotho also echo the above sentiments (Chakela, 2000, personal communication; Maro, 2000, 2001, personal communication).

Evidence of anti-soil erosion measures dates back to the colonial period (pre 1965) and include grass strips, buffer strips, meadow strips, silt dams, *Popla* tree plantation in dongas, and controlled grazing and rotational grazing on the Foothills and Mountain regions (Basutoland Department of Agriculture Annual Report, 1942/43; 1958 – 1961), and later on, to tree planting within the Woodlot Project dating back to 1973 (Witzsch and Ambrose 1992). Another initiative is the Soil and Water Conservation and Agroforestry Programme (SWCAP) under the Department of Agricultural Research (1989–1998), which concentrated on four main stations at Mahobong, Thaba-Tseka, Siloe and Maseru. Despite positive crop responses through the 'crop ripping' technique, for a variety of reasons, farmers' acceptance of soil ripping has been low.

The need for comprehensive soil conservation measures was first highlighted by Sir Alan Pimm in his 'Commission Report on Financial conditions of Basutoland 1935', the now famous 'Pimm's Report' (Marake et al. 1998). The soil conservation policy resulting from this document centred on mechanical anti-soil erosion measures, which in the 1940s were considered too expensive to maintain. This, coupled with the collective failure to arrest soil erosion, biological measures soon followed.

The soil conservation scheme from 1946 to 1956 resulted in 80% of the Lowland being planted by grass-strips (Basutoland Agriculture Annual Report, 1955–57). Failure of the soil conservation scheme was officially acknowledged in 1958 and reorganization of the land-use system was sought to end soil erosion (Basutoland Department of Agriculture Annual Report, 1958–1961). The result was many legal documents to control soil erosion by regulating land-use. These have formed the basis of much of the land-based policy in force today.

Reductionist approaches in Lesotho's conservation policy view people as the source of the 'problem', thus proposed solutions focus on formal education and tougher legislation – much of it linked to development assistance and other borrowed interventions (Mokuku 1996). The failure of many of these solutions to understand and address the causes of land degradation has led some to challenge this 'classical' approach to degradation in Lesotho (Chakela, 2000, personal communication; Sechaba Consultants 1996; Maro, 2003, personal communication; Mokuku 1996).

The Land Procurement Act of 1967 allocated land along traditional lines and introduced land titling. Registration of all the land-used (land-use types were: commercial, industrial, religious, benevolent) in Lesotho was contained in the Deeds Registry Act of 1967. The Land Act of 1973 and the Administration of Land Act 1973 controlled land allocation and administration. The latter introduced a leasehold title that was repealed by chiefs (National Settlement Policy 1989). The Local Government Act of 1997 gives newly elected (2005) local authorities power to allocate and manage land. *"They should currently be administering the 1979 Land Act, but under the new Bill they would take over the allocation of leases*

under the supervision of the Commissioner of Lands" (Adam and Turner 2005: 16). Below is a highlight of other laws regulating land-use and management:

- Mining Rights Act 1967
- Forest Act 1978
- National Parks Act 1975
- Historical Monuments, Relics, Fauna and Flora Act 1967
- Roads Act 1969
- Water Resources Act 1969
- Range Management and Grazing Control Regulations Act 1980
- The Land Husbandry Act 1969
- Land Act of 1979
- National Settlement Policy, 1989
- Environment Act 2001
- Land Bill 2009.

The Land Act of 1979 and with the Land Regulations of 1980 formed the two legal documents controlling land tenure in Lesotho. Two types of tenure are identified, allocation and lease. These documents provide full individual rights on holdings through inheritance, with agricultural land, or through leaseholds and land titling, as is the case of non-agricultural land (National Settlement Policy 1989). The emphasis on soil conservation is evident in Sec.3 (h) of the Land Regulations 1980, whereby termination of allocation is to be enforced in the event of overgrazing, failure to combat soil erosion and failure to cultivate arable land. Allocation allows for inheritance of land while a lease can be sold, sublet or mortgaged. Between 1981 and 1996, the Government initiated the Production through Conservation (PTC) Programme, with Swedish donor's technical and financial assistance. The aim was to help land-users improve productivity by conserving natural resources (Marake et al. 1998:36). Thus the focus was slightly shifted from purely conservation to focusing on production. This 15 year project was considered a success, encompassing several novel ideas and realities like farmer participation, training of extension workers and other officials, and the incorporation of various ministries and different disciplines (Marake et al. 1998). As stated earlier, the Land Bill 2009 repeals the Land Act of 1979 and places land administration and land tenure under one law. It is yet to be seen how implementation of the Bill will affect land-use and land management on the ground.

3.8 Study Areas: Setting the Scene

The villages selected for the study lie in two districts: Mazenod (in Maseru district) and the southern Lowland district of Mohale's Hoek (Fig. 3.2, Lesotho administration map). The villages were chosen to represent 'hot spots' of land-use change. The southern Lowland regions have experienced increasing population growth and

a reduction in food production over the last few decades; during which important land-use changes have occurred. Crop and food supply assessments for 2003/04 found that Maseru district had been affected by a *"cumulative impact of years of drought, the retrenchment of mineworkers and HIV/AIDS"* (IRIN 2004). The result is that people in villages on the outskirts of the city have no access to land to cultivate crops, no remittance income and no other means of employment, leaving them dependent on food aid or internationally-run food-for-work programmes (e.g. the World Food Programmes' food-for-work project operating on the outskirts of Maseru). Mohale's Hoek district was declared hardest hit by the 2001/2002 drought period and needed emergency food assistance to cope (FAO 2002). Additionally, the district was also declared as one of three southern districts most vulnerable to climatic shocks (FAO 2002). Emergency food aid amounting to 2,200 tonnes was set to be distributed to 36,000 poor people in Lesotho due to the 2001/2002 drought-induced crop failure (SADC Food Security update 2002).

The phenomenon of combined 'El Niño' with the Southern Oscillation, form ENSO is implicated in rainfall abnormalities and drought (e.g. severe droughts of 1982/1983 and 1991/1992, 1997/1998, 2001/2002, 2003/2004, 2006/2007) in southern Africa (e.g. Chimhete 1997; SADC Food Security Early Warning System 2004; Glantz et al., N.D., downloaded 2005; Rook, N.D.). Early estimates in March 2004 for Lesotho indicated an expected *"49 000 tonnes of cereal production for 2003/04, representing 48% of the below average production in 2002/03 crop season of 94 000 tonnes and 21% of the 5-year average"* (SADC Food Security Early Warning System 2004a). Rainfall figures for November 2004 indicate 60% below normal rainfall for the agricultural year 2004/2005 for Lesotho, with negative implications for seed germination and seedlings (SADC Food Security Early Warning System 2004b). A combination of low rainfall and high temperatures in the Lowland region has resulted in severe moisture stress for crop production (SADC Regional Food Security Programme, 2005). This has direct implications for land-use and cover changes. Favourable rain conditions are predicted for the 2010 planting season. However, given that crop production in 2009 was below average for a second consecutive year, about 450,000 people are estimated to require food assistance in 2009/10, "… *an increase from 353 000 people in the previous year"* (GIEWS Lesotho Country Brief 2010).

The erosion hazard map of Lesotho (1980) shows both Mazenod and M'Hoek to be in the index of 'high' to 'very high' erosion index for different reasons: Maseru owing to soil erodibility and rainfall erosivity, and to a much lower extent, slope. For M'Hoek, the reasons are: slope, soil erodibility and cover. In Lesotho, soil erosion has a strong impact on land-use. Abandonment of cultivated land and productivity decline owing to soil erosion are factors often associated with soil erosion and land degradation (Bakker et al. 2005). Recent findings on semi-arid, erosion-prone areas indicate that slope and soil depth are the major factors which influence abandonment of grain cultivation on eroded soils (Bakker et al. 2005). Preliminary informal interviews with agriculture extension officers in the Lesotho Ministry of Agriculture point to similar observations. Accordingly, although the size of field does not decrease *per se*, the area under production decrease in places affected by

soil erosion, especially *dongas*, which make it impossible to cultivate (Department of Agriculture, Statistics Division, 2000, personal communication). The result is a general decline in productivity and the eventual abandonment of cultivation in affected areas.

3.8.1 Selected Villages

After consultations with key local informants, the villages of Ha Paki in Mazenod and Ha Maphohloane in Mohale's Hoek were selected for the field research. An official at the Ministry of Natural Resources, Energy and Minerals, kindly provided expert advice on the choice of villages, as well as logistical assistance – an introduction letter to the two village chiefs explaining the purposes of visit and requesting permission and assistance from the chiefs to carry out/facilitate the field study; a driver (who doubled as field-guide, aide and translator) and an appropriate vehicle for the terrain.

3.8.2 Mazenod: Ha Paki

Ha Paki is located about 2 km north of Mazenod centre, at an average altitude of 1, 582 m[1] above sea level. Located about 20 km south of the capital Maseru, off the Main South Road, and about 5 km from the international airport, the village lies on the peri-urban fringes of Maseru, with busy commercial centres along the main road. However, the village itself is served by a network of dirt-tracks and no metalled roads. The village lies in the watershed area of the Phuthiatsana-Ea-Thaba Bosiu River. The study area covers an area of approximately 5.89 km^2. The predominant land-use type here is settlements. Most households have a small vegetable garden, but according to the key female informants in the village, most had no agricultural land. The main reason seems to be the village's proximity to Maseru, making it attractive and affordable for people who want to live outside the sprawling capital, while still enjoying 'village life'. Regular public transport linking Maseru and Ha Paki is available and affordable,[2] to most. Field visits and initial investigation of the village indicate a recent population increase in the area, with resulting land-use and cover changes, and their socio-economic and environmental consequences. The village was selected to represent 'rural' Maseru.

[1]GPS recording made at the chief's house; the rest of the village is generally above 1510 m above sea level.

[2]Transport prices start at 4 Maloti, for a one-way trip in a 'mini-bus' compared to 2.50 Maloti for a regular trip within Maseru.

3.8.3 Mohale's Hoek: Ha Maphohloane

Ha Maphohloane is located about 10 km north of Mohale Hoek centre, about two-and-a-half hour drive (approximately 190 km) from Maseru, off the Main South Road. The village lies close to the Makhaleng River, at about 1,500 m above sea level. However, it suffers from severe water shortages, with key local informants describing the entire district as desertified, and suffering from a severe 2 year drought (Personal communication, 2005). Wind storms are common in the village, and site observations and discussions with key village informants indicated a decline in food production, with some areas not having been planted since *"the current drought period that started in 2002"*[3] Field observations of some grazing lands showed them to be bare, with dry compact soils, dongas, some evidence of sheet erosion, and hardly any vegetation in sight. Water in the village is provided by taps, located at about 500 m intervals – according to the village chief and other key informants there, the taps often run dry during the day, until midnight when some water returns. The study area covers an area of approximately 19.38 km^2. Towards the West, and North-west of the village, closer to the Kolo-La-Pere River, the researcher observed black wet soils supporting some irrigated cropped lands. The village also shows signs of expansion, with several newly constructed settlements visible. Some horses, cows and sheep were also observed in and around the village.

3.9 Summary

To summarize, biophysical, social-economic, social-political, policy and health characteristics of the landscape and population stand out as factors with a potentially marked influence on land-use, land-use changes and decisions on land-use at macro and micro level in Lesotho. Drought, soil erosion, soil characteristics are examples here; as are population dynamics, income sources and health status. It is expected that interactions between the above and other biophysical and social-economic characteristics will have a strong influence on the direction of land-use change at village level. Its effects on the land-use and rural households/livelihoods in turn also have an impact on the national economy. A case study at an appropriate micro-level using a combination of complementary research methods is imperative to understand such interrelationships. The succeeding Chapter will undertake a detailed micro-level analysis of perceptions of land-use/environmental change in the Lowland region, and submit an insider's perspective of the causes, consequences and solutions to land-use and cover change in the region.

[3] Statement by community council members, later confirmed by the village chief and other key informants at the Ministerial level

Appendix 1: Lesotho – Geographical Context

Lesotho is often described as the 'kingdom in the sky', with a lowest point of at least 1,000 m above sea level. It is located between latitude 28°S and 31°S and longitude 27°E and 30°E, with a size of 30,340 km^2 (Mbata 1997). The country is divided into four agro-ecological zones based on elevation and climate, containing ten administrative districts. The Lowland region ranges between 1,500 and 1,800 m above sea level and covers a narrow 20–50 km wide belt along the western boarder of the country. The Foothills region ranges between 1,800 and 2,000 m above sea level, along the northeast to southwest of the country, adjacent to the lower mountain range. The Mountain region ranges between 2,000 and 3,400 m above sea level, and contains the Maluti mountain ranges, with their African Alpine and sub alpine habitat of the Drankensberg's type. The fourth region, Senqu River, rangers between 1,500 and 1,800 m above sea level in between the Mountain and Foothill region. Of interest to this study is the Lowland region, initially the nation's 'bread basket'. The Köppen symbol for Lesotho's climate is BWh (Barry and Chorley 1998).[4] The four seasons are: summer (November–January) with high temperatures and precipitation; autumn (February–April), winter (May–July) with clear skies, dry air, sunny days and cold, freezing nights; spring (August–October). Precipitation is highest in the Mountain region and lowest in the Senqu River and 85% of the annual total falls between October and March (Chakela 1999). Average temperatures are between −20°C and 36°C, with 310 sunshine days a year (Chakela 1999). Snow is common in the mountains and may occur throughout winter. Variable rainfall and drought characterize the climate. Grasslands and occasional shrubs are typical vegetation. Bogs are found in the mountains. Three vegetation belts exist in Lesotho; montane, sub-alpine and alpine (Chakela 1999:57). The montane belt extends up to 2,400 m, with subtropical grass species like Erograstis, Hyparrhenia and Cymbopogon. Between 2,400 and 2,900 m, both subtropical species and temperate species are evident: Themeda triandria and Harpochloa flax (subtropicals); and Pentaschistst species and Merxmuellera species are the temperate dominant type.

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[4] According to Strahler's climatic classification, a Köppen symbol BWh falls under the low latitude climates (controlled by equatorial and tropical air masses. The climate name is: tropical desert and steppe climates 15–35° N and S lat. (Strahler, 1971) And according to Barry and Chorley (1998): *"Source regions of continental-tropical (cTs) air masses in high-pressure cells at high level over lands astride the Tropics of Cancer and Capricorn give arid to semi-arid climate with very high maximum temperatures and moderate annual range."*

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Chapter 4
Village Perceptions of Land-Use Change

Abstract The previous chapters reviewed existing literature on land-use change in southern Africa and provided a theoretical framework and a characterisation of Lesotho, its historical, biophysical and social-political contexts. This chapter assesses local perceptions of land-use change in the two Lowland villages of Ha Paki and Ha Maphohloane. It proposes and discusses a Multi-criteria Analysis method developed and used for this assessment. Analysing perceptions of local land-users and managers provides an in-depth view of local actors' knowledge and decisions on land-use, land-cover and their changes. The results from this case study show that understanding local knowledge in a relatively small area can shed light on the actions and behaviour of local land-users and managers, the discrepancies between local knowledge and common narratives on land-use change, and also contribute towards developing sustainable land-use and management policies and actions.

Keywords Land-use case study • Perceptions • Ha Maphohloane • Ha Paki • Multi-criteria Analysis (MCA) • Drivers and effects of land-use change • Policy options

> *Whosoever wishes to know about the world must learn about it in its particular details […]. In searching for the truth be ready for the unexpected […]. Change alone is unchanging. The same road goes both up and down […]. And yet everything comes in season.*
>
> (Heraclitus of Ephesus; Greek philosopher of the late sixth century BC)

4.1 Brief Introduction

People are at the heart of land-use change. Understanding land-use and changes in land-use and cover require an understanding of people and their societal situation – their priorities, livelihood strategies, views on the land, and the wider implications of social, political, cultural, biophysical and institutional factors, among others.

P. Maro, *Environmental Change in Lesotho: An Analysis of the Causes and Consequences of Land-Use Change in the Lowland Region*, DOI 10.1007/978-94-007-1881-4_4,

Several recent studies have used qualitative social science methods in an attempt to understand land-use and land-cover change trends and processes. These have drawn attention to the importance of local knowledge and perceptions to offer an understanding of how local environments have changed. Kessler and Stroomsnijder (2006) used historical assessments and a 'farmer perspective' methodology to assess land degradation in Bolivian mountains. Field research based on farmers' knowledge and perceptions was used to assess the dynamics of environmental change and food production in northern Nigeria (Maconachie and Binns 2006). Participatory Rural Appraisal (PRA) techniques and a questionnaire survey were used to understand the perception of land degradation and impact and success of indigenous-based interventions on land conservation in a case study of soil conservation and agroforestry in Arumeru district, Tanzania (Kajembe et al. 2005). According to the findings, land degradation in the area was perceived as rather severe. Cheap, low-labour, indigenous land management interventions were widely used with notable successes, and contributed to increasing yields and improved soil fertility (Kajembe et al. 2005). To understand how farmers perceived drought in semi-arid central Tanzania, Sledges (2008) used open-ended questionnaires, in-depth interviews, group discussions, field visits, and picture assignment with farmers, extension workers, government officials and scientists. The findings (Sledges 2008) show that farmers had intricate knowledge on local biophysical, socio-cultural and other conditions and recognized local environmental changes. As in the current study, their perception of drought matched the scientific concept of drought. They also knew some land management options for adaptation. Klintenberg et al. (2007) used individual semi-structured interviews with local farmers in central Namibia to understand whether national and local perceptions of environmental change in central Northern Namibia were related. The findings (Klintenberg et al. 2007) show that local knowledge supported conclusions from national monitoring, shedding light into the intricate endogenous and exogenous factors causing environmental change locally. Generally speaking, these and other similar studies show that a combination of local and scientific knowledge can lead to more useful assessment of land-use change and its implications for local land-users and managers (Klintenberg *et al*. 2007) As Maconachie and Binns (2006) explain: *"…a more critical evaluation of how the knowledge, understanding and perceptions of local actors drive behaviour and affect land-use decisions at the micro-level is essential if sustainable environmental policies for the future are to be initiated."*.

One of the merits of using qualitative research, social science and survey research methods to understand local perceptions of land-use change is the obvious contribution to answer the questions 'why is change occurring?' and 'so what?' By shedding light on the views, perceptions, behaviour and conditions underlying the decisions of land-users and managers, social surveys can reveal the root causes of land-use change at different levels. Using social surveys potentially allows for the collection of current and past micro-level (and macro-level) data through various social-science instruments like household and village surveys, discussions, personal histories and interviews with key informants. These can be further enriched by, for example, field experiments and field visual analysis depending on the study. Another advantage in

using social surveys lies in their practicability and reproducibility. As the above examples show, various standard social survey data-gathering tools exist, like open and closed questionnaires that have been used and proved suitable for use in land-use change studies. These are applicable at different macro or micro scales of analysis, relatively easy to use, can be used to gather qualitative and quantitative data, which can be analyzed to offer a robust understanding of the processes and decisions on land-use change.

In the current study, semi-structured interviews involving individual and focus group discussions with key informants in the study villages and at sub-national level were used to gather perception data. A previously prepared questionnaire was used only as a guide in the interviews and discussions, and later used as an aid to categorize the ranked responses. The interview format was conversational, informal and exploratory. Face-to-face group interviews and discussions at village level and a combination of group and personal interviews and discussions at sub-national level were considered the most appropriate techniques for this study for several reasons, in addition to those previously mentioned. First, the preferred, traditional Basotho way to discuss land-use issues is in a group setting or *pitso* (open village assembly). Such a setting allows for better observation of people, their interactions and their actions '*in situ*' and the observation of non-verbal cues, producing a more enriching discussion. Second, field visits allowed for confidence-building and established trust, making it easier to communicate. Third, triangulating information is also made easier using a face-to-face group or individual interview. The current study thus takes a holistic view of land-use change – acknowledging local culture, knowledge, and inclusion of local actors' perceptions in policy debates; integrates principles like triangulation of data, optimising tradeoffs, off-setting biases and learning directly from rural/local people and flexibility in its approach (Chambers 1997).

Three groups of key informants were consulted for the interviews and discussions (Appendix 1, Table 4.15):

- Government: comprised eight people employed in various government departments and Ministries. The age-range was 40s–60s; two of them were women
- Non-government (these are mainly residents of the Lowland regions or farmers in the Lowland region but are not villagers): comprised 14 people who live in Maseru, with origins in Lowland villages, and/or who were engaged in land-use activities in or involving the Lowland region. The age-range was 40s–60s; two of them were women.
- Villagers: comprised 52 people living in the study villages of Ha Paki and Ha Maphohloane. These villages were chosen after initial field visits in the Lowland region coupled with consultations with key experts in Lesotho. The main selection criterion was that they represented 'hot spots' of land-use change in the Lowland region, showing different aspects of land-use change like land degradation and changes in settlements, yet differed in their proximity to the main city.

Perception data obtained from the interviews and discussions were analysed using a multi-criteria analysis (MCA) method developed for the purposes of this study.

4.2 Multi-criteria Analysis of the Lowland Region of Lesotho

MCA is a useful, albeit less-commonly-used method in land-use/cover change analysis. It is a particularly relevant analytical social science method used to understand perceptions of local land-use actors and managers on causes and consequences of land-use change, and also in policy planning and identifying options for various land-use change scenarios which would benefit people affected by the land-use change. MCA is a process which uses several techniques and tools for processing, weighting and aggregating complex, multifaceted data that describe an issue (Jeffreys 2008). It is used as a decision-making tool, to analyze multifaceted qualitative and/or quantitative aspects of a problem in the decision-making process (Mendoza et al. 1999: 18). Multi-criteria analysis methods require the use of decision rules, which dictate how to decide the preference order of different alternatives, so as to analyze complex multi-criteria problems or compare impacts (Malczewski 2002; Marttunen and Suomalainen 2005). Decision rules are based on specified objectives. *"The extent of achievement of these objectives is then assessed by the established criteria but no one option will obviously be best in achieving all objectives"* (Zhu et al. 2001, in Zhu et al. 2005: 3). Using MCA techniques, the different criteria are weighted according to their relative importance and analyzed (Zhu et al. 2005: 3).

MCA techniques and tools have been used in several studies to evaluate multi-faced land-use/cover change problems (Marttunen and Suomalainen 2005; Sharifi et al. 2002; Joubert et al. 2003; Zhu et al. 2001, 2005). A common feature of these studies is that they all deal with issues with a multi-dimensional nature, incorporating, for example, environmental, economic, political, and social interests. One of the main advantages of the MCA approach is its ability to reconcile data with varied criteria and differing measuring scales (Diakoulakis and Mavrotas 2004).

In the current study, the data collected through discussion and interviews were **analysed using a multi criteria analysis (MCA) method we adopted for the purpose of this study.** The method incorporates a qualitative and quantitative variable-oriented research adopted from that used by Geist and Lambin (2004). The aim is to identify causative factors, their pathways, consequences of land-use change and identify ways of addressing the effects of change. The analysis took four steps (Mendoza et al. 1999). These are presented in detail in Appendix 2. There follows a summary of the steps involved:

- Identify dimensions of land-use change: based on our study objectives, we chose the following dimensions of land-use change: causes, consequences, responsibility and proposals. These are basically the study's broad themes or principles of land-use change under investigation (Appendix 2, Table 4.16)
- Define criteria and indicator: The current study proposes 10 criteria and 86 indicators. These were arrived at after extensive literature review (studies by Geist and Lambin (2004), and Olson et al. (2004), were particularly influential), content analysis of the field data and discussions with key informants. The criteria are tentatively put forward as the possible root causes of land-use change in Lesotho's

Lowland region. These criteria are demographic factors, economic factors, social political/societal/institutional factors, cultural/historic factors, climatic/hydrological/biophysical factors, biological factors, vegetative factors, formal institutional/policy structures, informal institutional/policy structures, international organizations/NGOs. Essentially, indicators are made-up of phrases/words from perception data, used to describe perceived causes and/or consequences of land-use change in the Lowland region. Examples of indicators include: population pressure, internal migration, lack of credit, land mismanagement, stock theft, soil erosion, and others used to describe causes and consequences of land-use change (Appendix 2, Table 4.17).

- Ranking and weighting data: weighting is a general calculation of the relative importance of each element. Three equations were developed to determine the weight of each criterion within a dimension (Eq. 4.1), weight of indicator within criteria (Eq. 4.2), weight of indicator within dimension (Eq. 4.3). The resulting weights, which are actually numbers, do not represent actual quantities but give the positional importance of data with reference to the equation used.

  To calculate the relative weight of each criteria under each respective dimension;

$$W_x = \left(S_x / S_d\right)100 \tag{4.1}$$

  Where:
  W_x is the weight of criteria x under dimension d
  S_x is the sum of all rankings r for criteria x under dimension $d = r_1 + r_2 + r_3 + \ldots r_{nth} \ldots$
  S_d is the sum of all rankings for ALL criteria under dimension $d = S_x + \ldots S_{nth}$

  To calculate the relative weight of each indicator under the respective criteria:

$$W_i = \left(S_{ix} / S_x\right)100 \tag{4.2}$$

  Where:
  W_i is the weight of indicator i under criteria x in dimension d
  S_{ix} is the sum of the rankings for indicator i under criteria x in dimension d

  To calculate the relative weight of each indicator i, in dimension d relative to the total weight of all criteria under d (the overall weight if indicator i relative to all other indicators):

$$W_{id} = \left(S_{ix} / S_d\right)100 \tag{4.3}$$

  Where:
  W_{id} is the weight of indicator i relative to dimension d

- Descriptive analysis of perception data. The purpose of this step is to identify causative pathways of land use change for Lesotho, their interactions, consequences of the change and viable solutions, as part of the fulfilment of the objectives set out by this study.

4.2.1 Policy/Governance Analysis

To understand perceptions of policy/institutional factors for the Lowland, four questions were raised during interviews and discussions with key informants. The replies were analysed using the study's MCA method. The questions are:

- What is the main land-use/agricultural problem(s)/issue in the village/Lowland?
- What are the possible solutions (policy responses) to land-use/agriculture and management?
- Who is responsible for land management and good (sustainable) land-use/agriculture practices in your village?
- Who should be responsible for land management and good (sustainable) agriculture/land-use practises in your village?

Using the MCA method, content analysis was carried out on the information obtained through informal interviews and discussions with key informants, to identify meaningful words (indicators or variables). These were clustered grouped into one of the broad categories of 'factors' (Appendix 2) to find meanings which emerge from clustered content. This involved placing the indicators under the formally determined criteria corresponding to the relevant dimensions, then ranked and weighted using Eqs. 4.1 and 4.2. In the second instance, the indicators were not clustered. Instead, after being placed under each dimension, each indicator was ranked and weighted in relation to the other indicators (Eq. 4.3). The research thus attempted to find clusters from the meanings of content instead of imposing clusters on the content. The effects of clustering content were also evaluated by analysing the consistency of the results obtained from the clustered and non-clustered content – to see whether the clustered meanings corresponded to the meanings of the content. The clustered findings (Appendix 3, Tables 4.19–4.28) were used as a control to test the MCA method and are not presented here.

For the purposes of this research and similar analysis of qualitative perception data, it is recommended that the un-clustered approach (Eq. 4.3) be used with the aim of finding clusters in the content instead of imposing artificial clusters, which perhaps do not reflect the 'natural' interactions of factors. Such interactions are often space and time-specific and depend on the local setting and interactions with other external factors. This chapter (Sect. 4.2.2) presents the results of the un-clustered approach, referred to as 'results'.

4.2.2 Results of MCA Analysis

Tables 4.1–4.12 show the results of the perception analysis. The results of MCA represent the responses' positional importance and are not actual figures of quantity.[1] Tables 4.1–4.8 provide a detailed breakdown of the perceived causative factors

[1] All weights have been rounded-off to the nearest figure.

Table 4.1 Causes of land degradation

Causes[a]	Rel-w[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Government (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Drought	**20**	**30**	**7**	**8**	**6**	
Poverty	**13**	**20**	**8**	**7**		**5**
Ignorance	**12**	**18**		**9**	**9**	
Dependence syndrome	**9**	**14**			**5**	**9**
Heavy rains/*sefako*	**6**	**9**	**9**			
Lack of implementation	**5**	**7**			**7**	
Lack of credit	**5**	**7**				**7**
Poor agricultural practices	**4**	**16**			**8**	**8**
Lack of ownership	**4**	**6**				**6**
Overgrazing	**3**	**4**				**4**
Rocky terrain	**3**	**4**			**4**	
High agricultural inputs	**2**	**3**				**3**
Population pressure	**2**	**4**			**4**	
Fires/burning grass	**2**	**3**			**3**	
Breakdown local land administration	**1**	**2**				**2**
Monoculture	**1**	**1**				**1**
Total	**100**	**148**				

[a] Causes = Causes of land degradation or land-use change. Rel-w = Relative weight of each indicator, in comparison to all others under dimension (Eq. 4.3, Chap. 4; Sect. 4.2) (Same equation is used to calculate all the other un-clustered results). All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.2 How do you recognize land degradation?

Signs[a]	Rel-w[a] (%)	All_rank[a]	Ha_Paki (n = 32)		Ha_Map (n = 20)		Government (n = 8)	Non-Govt (n = 14)
Weighting		Ranking	C	G	C	G	Not asked	
Donga formation	**50**	**11**	**3**	**3**	**3**	**2**		
Scarce vegetation	**27**	**5**		**2**		**3**		
Drop in crop yields	**14**	**3**	**2**		**1**			
Visibility of plant roots	**9**	**2**			**2**			
Soil erosion	**55**	**1**	**1**					
Total	100	22						

[a] Signs = How do you recognize land degradation? Rel-w = Relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

of major changes. Tables 4.1–4.3 show perceived causes of land degradation and land-use (cover) change, respectively. Tables 4.4–4.8 show perceived causes of major changes in crop production, livestock quantity and human population. Table 4.9 provides a detailed insight into the perceived effects of land-use change. Tables 4.10 and 4.11 identify perceived responsibility for land management. Table 4.12 offers perceptions of solutions to sustainable land-use and management. The last three tables also identify perceived governance issues and policy options as they relate to

Table 4.3 Major causes of land-use change

Causes[a]	Rel_w[a] (%)	All_rank[a]	Ha_Paki (n=32)	Ha_Map (n=20)	Govt (n=8)	Non-Govt (n=14)
Weighting		Ranking				
Drought	**11**	**34**		**13**	**10**	**11**
Lack of water	**8**	**25**	**13**	**12**		
Mismanagement	**8**	**25**			**13**	**12**
HIV/AIDS	**6**	**19**	**11**		**8**	
Dependency syndrome	**6**	**19**			**6**	**13**
Soil erosion	**6**	**18**		**11**	**7**	
Hail storms	**6**	**18**	**9**	**9**		
Frost	**5**	**16**	**8**	**8**		
Theft	**4**	**14**	**7**	**7**		
Lack of implementation	**4**	**12**			**12**	
No jobs	**4**	**12**	**12**			
Land tenure	**4**	**11**			**11**	
No access to credit	**3**	**10**	**10**			
Lack of knowledge	**3**	**10**		**10**		
Lack of ownership	**3**	**10**				**10**
Conflict of responsibilities	**3**	**9**			**9**	
Colonial past	**3**	**9**				**9**
Modern education	**3**	**8**				**8**
No crop rotation	**2**	**7**				**7**
Don't know	**2**	**6**	**6**			
Fires	**2**	**6**				**6**
Poor soil fertility	**2**	**6**		**6**		
Fragmentation	**2**	**5**			**5**	
Population pressure	**1**	**4**			**4**	
Fertility decline	**1**	**3**			**3**	
Rocky terrain	**0**	**1**			**1**	
No proper structural plans	**0**	**2**			**2**	
Total	100	299				

[a] Causes = Causes of land-use change. Rel_w = Relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

sustainable land-use and land management. The results are not statistically normalized as often occurs in quantitative analysis, because the ranks represented here refer to positional relationships and not actual figures of quantity.

4.2.2.1 Main Causes of Land-Use (Cover) Changes in the Lowland Region

The main perceived causative factors of land-use change are divided into causes of land degradation and causes of land-use/agricultural change (referred to hereafter as land-use change). Major land-use changes are broken down into changes in crop production, livestock population and human population, corresponding respectively to possible land-cover changes on croplands, grazing lands and settlements.

Table 4.4 Causes of changes in crop production

Causes[a]	Rel-w[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Drought	**19**	**19**		**8**	**6**	**5**
Crop farming too expensive	**12**	**12**			**8**	**4**
Expansion of settlements into agricultural lands	**10**	**10**			**7**	**3**
Land mismanagement	**8**	**8**				**8**
HIV/AIDS	**8**	**8**	**8**			
Strange weather/*sefako*	**7**	**7**	**7**			
Land degradation	**7**	**7**		**7**		
Reduction in field sizes	**7**	**7**				**7**
Lack of credit	**6**	**6**				**6**
Lack of rainfall	**5**	**5**			**5**	
Reduction in field size	**4**	**4**			**4**	
Soil erosion	**4**	**4**			**3**	**1**
Reduced soil fertility	**2**	**2**			**2**	
WFP/food aid	**2**	**2**				**2**
Industrial expansion	**1**	**1**			**1**	
Total	100	102				

[a] Causes = Causes of changes in crop production. Rel_w = Relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.5 Causative factors of changes in livestock population

Causes[a]	Rel_w[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Stock theft	**37**	**24**	**6**	**6**	**6**	**6**
Drought	**16**	**10**	**5**	**5**		
Frost	**14**	**9**			**4**	**5**
Climate change	**8**	**5**			**5**	
Strange weather	**6**	**4**		**4**		
Inferior grazing	**6**	**4**				**4**
Food shortages	**5**	**3**			**3**	
Livestock disease	**5**	**3**				**3**
Death	**3**	**2**				**2**
Selling	**2**	**1**				**1**
Total	100	65				

[a] Causes = Causes for changes in livestock population. Rel_w = Relative weight of each indicator in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.6 Summary of livestock theft and recovery, 2000–2004 (With permission)

Agricultural year	Number of animals stolen	Number of animals recovered	% Recovery
2000/2001	33,950	11,150	33
2001/2002	30,105	11,074	36
2002/2003	26,678	13,369	50
2003/2004	18,442	7,847	43
Total	109,268	41,862	38

Source: Dzimba and Matooane (2005: Appendix, Table 2)

Table 4.7 Causes of population increase

Causes[a]	Rel_w[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Migration (internal)	**48**	**10**	**3**	**2**	**3**	**2**
Increasing births	**43**	**9**	**2**	**3**	**1**	**3**
Retrenchments	**10**	**2**			**2**	
Total	100	21				

[a] Causes = Causes of population increase. Rel_w = Relative weight of each criteria and each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses ($n = 74$)

Table 4.8 Lesotho population chart by year

Year	Population	Rank	Percent change (%)	Date of information
2003	1,861,959	146		July 2003 est.
2004	1,867,035	146	0.27	July 2005 est.
2005	2,031,348	144	8.80	July 2005 est.
2006	2,022,331	145	−0.44	July 2006 est.

Source: CIA World Factbook (2006), Country profile Lesotho

4.2.2.1.1 What Causes Land Degradation?

Land degradation was specifically selected because it is one of the land-cover changes often visible in Lesotho, which literature ascribes as the cause and sometimes the effect of land-use change. The aim here is to understand whether land degradation is perceived as a cause or consequence of land-use change by local land-use actors and managers. As will be seen, the results are mixed. There are variations in responses from the three groups of key informants (Table 4.1). These show that the highest-ranking perceived driver of land degradation in the two villages and by implication, the Lowlands, is drought (20%), followed by poverty (14%) and ignorance (12%). Based on these findings, the main assumption is that land degradation is essentially viewed as a climate-driven (externally-driven) process, thus not directly attributed to land-use change.

Common wisdom on land degradation in Lesotho (Chaps. 1 and 2, Sects. 1.1, 2.1.1) dictates that land degradation is caused by overgrazing, often implying an (in) direct

effect of labour migration. Conversely, the current research results refute that view, pointing instead to drought as the main driver of land degradation, along with poverty and ignorance.

These results are echoed by two government officials. One called the myth an "*oversimplification of reality"* and the other refuted it, saying instead that "*mismanagement and half-measures are the real causes"*. Mismanagement as a term can include overgrazing, as can ignorance, although in this sense, overgrazing can be seen more as a consequence of mismanagement and/or ignorance (the cause) and not a cause of land degradation *per se.* A response by one non-government key informant illustrates: "*Historically, the Lowlands had cattle first. So grazing may have started there, resulting in the intensified degradation and dongas that we see today; in Mountain areas outcrops of rocks showed up immediately after the beginning of summer grazing."*

Government key informants perceive ignorance, poor agricultural practice and lack of implementation as the main drivers of land degradation in the Lowland region, possibly pointing to local land-users as the main agents of land degradation and not its victims. Thus they do not perceive land degradation to be a climate-driven process, but rather a consequence of human action on the land. Yet non-government key informants point to 'dependency syndrome[2]', poor agricultural practices and lack of credit (e.g. cash loans for agriculture) as the main causative factors of land degradation. These factors perhaps point more to the failure of institutions and governance than to local internal conditions, actors and climate as the causative agents.

In Ha Paki, poverty was ranked as the second main cause of land degradation, after heavy rains (*sefako).* The third cause was drought. In contrast, in Ha Maphohloane, ignorance was identified as the first main cause of land degradation, followed by drought and poverty. Its location on the peri-urban fringes of Maseru, and features such as shortages of land and employment, might partly explain the positional importance of poverty in Ha Paki compared to the more rural Ha Maphohloane. The positional importance of ignorance in Ha Maphohloane perhaps shows that villagers there were aware of the possible causes of land degradation but for various reasons perhaps did not know, were not able to, (or did not want to) prevent it. One non-government key informant explained that poverty is sometimes measured in terms of lack of access to land or lack of cattle. "*Cattle is used as drought power, so if one has no animals one is dependent on others' animals to cultivate own land. Trouble is that if you have some animals (composition or numbers not important) then another person will lend you his animals to use as draught power. If you have no animals at all, no one will lend you theirs!"* The importance of lack of access to land or cattle

[2] 'dependency syndrome' or 'dependence syndrome'– this is a term used by respondents to denote a situation whereby people have become accustomed to receiving assistance from most notably government, donor and other organizations. This has resulted in a general tendency away from self-reliance, towards a situation whereby people believe they are incapable of handling their own, land-use and management issues. It has generally contributed to increased inertia and dependence on outside intervention to address local (land-use) issues or problems.

and its implications in terms of land-use, food self-sufficiency and socio-economic situation of the villagers is shown by the villagers' responses in Ha Paki.

The ramifications of land degradation, which contributes to poverty, are perhaps best reflected in the desire for a wage economy, as stated by one government key informant: "*Lowland people need jobs to survive. The land is already degraded. In the Highlands they have animals. Lowlands are semi-arid, with rainfall averages of 500 mm, for example Mohale's Hoek.*" As described in Chaps. 1 and 2, literature identifies Lesotho as the most degraded country in the SADC region. Soil erosion features like *dongas* and rills are evident in the two villages and in the Lowland region generally, particularly in the foothills. Loss of arable land is seen as another consequence of land degradation. One government informant illustrated: *"in 1988, arable land consisted of about 13% of the total land, now it is about 9%"*. Another key government informant elaborates*: "the situation for 1990s–2005 is that there are about 300 000 hectares of arable land, a decrease from 400 000 hectares in the 1980s."* This statement has been found in literature*: "Arable land has shrunk to a mere 9%* (in 2005) *from 13% in 1996. Landlessness is becoming a serious threat to the livelihood of the rural folk. The proportion of landless households is estimated to have grown from 12.7% in 1970 to 25.4% in 1986. In 1990 it rose further to 40%. This trend, combined with various other factors, has accentuated the incidence of poverty in rural Lesotho"* (OSSREA, N.D.). Yet when asked whether there was enough land for everyone in Lesotho, all key informants, without exception, agreed that there is enough land for everyone in Lesotho.

In summary, land degradation is perceived to be driven by interaction between drought, poverty and ignorance, to bring about changes on land-cover. So it is clear from our findings that land degradation is a result of natural climatic factors interacting with human-driven factors. Factors such as drought, lack of water or irregular rainfall affect crop yield and in turn food production. Low crop yields and food shortages can contribute to poor health, poverty; abandonment of agriculture, among others, and can also affect a farmer's willingness to invest in land management given a perceived poor output. Ignorance and poverty perhaps partly constrain a land-user's capacity or willingness to invest in sustainable land management practices. Yet local land-users and managers are aware of land degradation and acknowledge its existence, but action to prevent or remedy the problem is often perceived to be the responsibility of 'others', often implying a stronger need for government intervention. Despite this, there is a strong belief that the quantity of land available in Lesotho is enough for all. Perhaps the notion and figures showing that arable land is decreasing, although acknowledged by some key respondents, are viewed more as academic writings than reality on the ground. However, the reflection on arable land availability may illustrate that people are not so concerned about the quantity of arable land as about its quality.

Respondents in the two villages were asked how they were able to recognize land degradation. They generally rely on biophysical (55%) and vegetative factors (45%). The presence of dongas was the most highly rated biophysical indicator (92%) while scarcity of vegetation (50%) was the most highly rated vegetative factor (Table 4.2).

Fig. 4.1 Ha Maphohloane: (**a**) showing cultivated fields with no crops and compact soil surface. In the background are ploughed fields with dark soils, near the Makhaleng River. (**b**) Showing cultivated land/field with compact, chalky soil (Photos by Maro, October 2005)

Perceptions in the two villages were nuanced. In Ha Paki, land degradation on crop lands was identified through *donga formations, drop in crop yields* and *soil erosion*, in that order; while degradation of grazing lands was identified through donga formation and scarce vegetation respectively. In Ha Maphohloane, cropland degradation was perceived to be marked by *donga*[3] *formation, visibility of plant roots* and *drop in crop yields* respectively, while rangeland degradation was perceived to be marked by scarce vegetation and donga formation. These results indicate that villagers can identify the manifestations of land degradation on the land, crops, and implicitly, on the socio-economic and food security situation. As such, they were not as ignorant as other respondents often asserted. The section below highlights the major land-use changes shown in our study. It concentrates on identifying causes of general land-use changes, focusing specifically on identifying causes of perceived changes in crop production, livestock numbers and human population.

4.2.2.1.2 Main Causes of Land-Use Change

According to the findings, the overall perceived driver of land-use change (Table 4.3) is drought (11%), followed by lack of water (8%), mismanagement (8%) and HIV/AIDS (6%), dependence syndrome (6%). The impetus of drought is best captured by the situation in the two villages: in Ha Maphohloane the agricultural fields surrounding the village did not contain any crops during the first field visit (spring/summer of October, 2005). During the second visit (autumn of March, 2007), the crops were small while the grazing lands seemed bare. The soils in most places looked compact, dry and chalky, with one key informant explaining; "*we are not able to plough the land since the drought that started in 2002/3*" (Fig. 4.1a, b).

[3] 'Donga' is a word commonly used in southern Africa to refer to gully erosion features. Gullies are often narrow or wide, steep-sided channels, sometimes over two meters deep, formed mainly by water erosion.

The effects of these droughts had further socio-economic implications. An estimated 30% of the total population suffers from food insecurity and in need of food aid (Mukeere and Dradri 2006). In Ha Paki, where wilted vegetable patches around the houses were visible, a similar story was told.

Land mismanagement has been linked to what one non-government key informant called *"the mind-set of the Basotho,"* which was explained as: "*not tilling the land because waiting for subsidies from the government"*. Other government and non-government key informants have referred to this as *"dependency syndrome.*" Other explanations of this terminology as used by key informants point to cases whereby people use agricultural land without bothering to properly manage it because "*it is not my problem"*, preferring to "*wait for the government to solve our problems"* So agricultural land is used until it is degraded then abandoned. The colonial past and modern education are factors often associated with this sentiment, as seen in the results (Table 4.3). The issue of land mismanagement in relation to overgrazing has been explained in the previous section.

Results of village interviews and discussions show a difference in perception in the two villages (Table 4.3). In Ha Paki local climatic/economic/health factors dominate as the main drivers of land-use changes, while in Ha Maphohloane a combination of ecological factors are dominant. Specifically, in Ha Paki key informants point to *lack of water, no jobs, human disease (HIV/AIDS) and no access to credit*, in decreasing order, as the main drivers causing land-use change in the village. In Ha Maphohloane main drivers are listed, in decreasing order of importance, as: *drought, lack of water, soil erosion and lack of knowledge.* The importance of water in a predominantly rain-fed agriculture is self-evident. The notion of *no jobs* can be taken to imply a lack of wage-earning employment, or as previously explained, a consequence of a combination of drought, land degradation and poverty.

Diseases, specifically HIV/AIDS-related, are a health factor with economic implications – once people get sick, they have an increased need for health care services, medication and support. They generally work less or cannot work (either formally or informally, on land-based activities). Consequently, under such conditions, a community might be expected to depend more on outside assistance and become more vulnerable to stress and shock factors, like drought. In Ha Paki key informants told of an increasing need for access to money to use for: burials, specified as for HIV/AIDS-related deaths; to support the (old) people and orphans left behind; and for women to use for start-up of small self-help projects mainly to support AIDS-orphans who were increasingly seen as an economic burden to the family members in charge. It became apparent that even though lack of water was the first immediately perceived cause of land-use change, the combination of HIV/AIDS and a lack of wage income had a more marked effect on the village population, their livelihood options, constrains and opportunities. This may be one of the push factors causing land-use change away from agriculture, in this case towards more settlements – with agricultural land sold to generate income from the land.

In Ha Maphohloane, key informants pointed out that although there was no farmer organization, people were organized into *letsema* (a system where labour is organized into partnerships), so a group of labourers can come together as an entity

and hire their services out, particularly at harvest times. This provided an alternative source of income generation in the village.

Asked why lack of knowledge is an issue in the predominantly farming village of Ha Maphohloane, key informants explained that in most cases, although villagers could identify soil erosion, for example, and felt the effects of land degradation in terms of field size reduction, the majority felt they lacked the necessary knowledge to specifically address land-use changes and degradation. It might also have been that they had the necessary knowledge but remained passive. They strongly expressed a need for outside intervention. As one key informant pointed out: "*in the 1990s the government ran a programme to counter soil erosion in the village, using grass strips, which was well accepted in the village, but now the government has stopped, and no-one is continuing.*" This echoes sentiments of 'dependency syndrome' where people have been crippled by aid and perhaps confused about their own ability and knowledge instead of being motivated to continue the work.

Changes in agricultural land-use, where agricultural land is converted to other uses like settlements, often lead to abandonment of agricultural land, either temporarily or permanently. This phenomenon is most common in Ha Paki.

It can be concluded that, in the Lowland region, land-use changes are primarily driven by drought, acting chiefly through abrupt changes in rainfall patterns, shortages (drought, lack of water) or too intensive and often disruptive as in the case of hail storms, in conjunction with or parallel to land mismanagement and implications of HIV/AIDS. Dependency syndrome is an important element reinforcing the more obvious causes.

This study also investigated two major changes in agricultural land-use: changes in crop production and changes in livestock production. Additionally, changes in human population were investigated. The results are presented below.

4.2.2.1.3 Changes in Crop Production

A decrease in crop production was reported by all key informants over a 20-year period. Yet the reasons given for the changes differ between the villages. In Ha Paki human illness and *sefako* (strange weather phenomena) were the leading reasons reported by key informants, while in Ha Maphohloane drought and land degradation were implicated. The magnitude of HIV/AIDS was evident in the number of widows and orphans at the discussions in Ha Paki – a majority of the women interviewed were AIDS widows, a total of 20 women. At the time of the informal interviews and discussions, there was a census run by the Ministry of Health going on in the village of Ha Paki. One key informant said the aim of this census was to count the number of AIDS orphans, affected households and the general HIV/AIDS and food situation in the village. Some official figures indicate that the numbers of HIV/AIDS have risen sharply between 1992 and 2001, with estimations of up to 31% infection in the adult population (ODI, N.D.). In contrast, in Ha Mphohloane, the cause for a decrease in crop production was believed to be more a result of a combination of climatic influences and land degradation, hampering crop production.

Half the key government informants pointed out that the leading cause for the noted decrease in crop production is that agriculture is not economically viable. Hence there was a preference to change to other economically-attractive options. According to one government key informant *"agriculture is becoming too expensive, so people prefer to either leave the land unplanted and get negative returns, or use it for other purposes."* Another pointed to *"disaggregated fields, being scattered, make investment in, for example, irrigation, economically prohibitive for most people to afford"*. Another government official highlighted some subtle changes within agricultural land-use: *"Farmers favour potatoes because they are drought resistant; these are seen planted along the Masianokeng River, being irrigated from the river. They earn a lot…."*

Expansion of settlements into agricultural lands is another widely quoted reason for a decrease in crop production, as stated by a government key informant *"In Mazenod, settlement encroachment is the major land-use change."* In contrast, non-government key informants quote land mismanagement (*"people just don't care"),* reduction in field sizes and lack of credit, as the three leading causes of the perceived reduction in crop production. Surprisingly, the World Food Programme (WFP) is also implicated by some government and non-government key informants (Table 4.4).

So whereas government officials perceive settlement encroachment into agricultural lands to be the principal cause leading to decreasing crop production, non-government informants recognize the role of people's attitudes to land and constraints/opportunities for investments on land, as the main drivers of such changes. The perceived reduction in field sizes is perhaps best viewed as a factor of land degradation, peoples' attitudes to land-use/management and cultural divisions of land.

In general, the analysis identified drought (19%), agriculture being too expensive (12%) and expansion of settlements into agricultural lands (10%), as the main reasons for a reduction in crop production in the Lowland region. Part of the reason why settlements are encroaching onto agricultural land, reducing the area available for agricultural production, is that agriculture has become too expensive, so people prefer either to abandon crop production or sell agricultural land for settlement, gaining an economic advantage.

Since agriculture is mainly rain-fed, drought is believed to have a direct negative effect on crop production. As one government official explained*: "in mid-60s there were droughts, but not as frequent. They did not result in as much damage because there was more cover and good crops. Now, over the last 20 years, we see remarkable changes on the impacts of climate – more frequent droughts are experienced, coupled with a shift in seasons. The Basotho planting season is August/September, but now people start planting in November as a direct response to rainfall shifts. But this is a shortened planting season and winter catches the crops at vulnerable stages."* These results mirror official reports which have identified some of the effects of the 2002/2003 food crisis in Lesotho as being a result of drought-induced weather conditions resulting in very low food production, a steep increase in staple food prices, loss of income, and widespread poverty and economic weaknesses (Lesotho Vulnerability Assessment Committee and SADC FANR Vulnerability Assessment Committee 2003).

4.2.2.1.4 Changes in Livestock Population

According to all informants, livestock numbers have been decreasing over the last 20 years. There is one exception. One non-government respondent mentioned a situation of increasing cattle and decreasing agriculture over the past 10–15 years. He admitted that in their family's case, they had both livestock and croplands*: "my family had eight fields, and in a period of 10–15 years we lost three fields due to soil erosion, leaving five usable ones. We did nothing to counter the degradation because it did not make any economic sense to us as we had other resources in the form of livestock. So we simply beefed up our livestock production."* However, this was the only case where an increase in livestock was noted.

Increasing stock theft over the last 20 years was cited as the main reason for the noted decrease in livestock numbers, by key informants in the two villages and by government and non-government officials. The second leading cause in both villages was drought, followed by strange weather/*sefako* (in Ha Paki) and frost, in Ha Maphohloane.

An assessment of the results (Table 4.5) identified stock theft (37%) as the leading driver for the decrease in livestock population in the Lowland region, which acts together with local climatic factors of drought (16%), and frost (14%) to cause a reduction in the number of livestock.

The risk of stock theft has spurred a preference for selling livestock instead of risking their theft or death from lack of food or weakness (perceived as being the result of drought and frost). These results are apparent in the perceptions in the two villages (Table 4.5). According to a non-government respondent*, "the preference is to steal beef cattle. One beef cattle costs R4000 to R5000, they need flat lands and are less sensitive to disease compared to dairy cattle which are delicate and more prone to disease."*

Another study investigating livestock population in the Lowland region, found similar results to the current study (Table 4.6). Subsequently, when asked what type of crime occurs most in their area/village*, "64.6% of the respondents said livestock theft"*. When asked which crime they were most afraid of, the majority (53%) said stock theft. This is evidenced by the increase in stock theft in the country (Dzimba, and Matooane 2005). An interesting feature of the study is that: *"The majority of the respondents (82.3%) do not feel that poverty is the motivating factor for committing crime. They consider the motivating factors to be unemployment (21.7%), jealousy (19.7%) and drugs (5.6%), among, others"* (Dzimba and Matooane 2005). The importance of unemployment in relation to agricultural changes was particularly emphasized in Ha Paki, as has been shown in Sect. 4.2.1.1.1, and underlined by the sentiment expressed by one government official: "*Lowland people need jobs to survive. The land is already degraded. In the Highlands they have animals. Lowlands are semi-arid, with rainfall averages of 500 mm, for example Mohale's Hoek."*

Selling livestock becomes an alternative source of income and also prevents animals being lost – either through stock theft or drought /frost (food shortages). As one non-government respondent explained: *"livestock is used as a measurement of wealth and status in Lesotho, and also a source of money on the sale of an animal. If you lose cattle, you lose wealth and status."* Following this logic, stock theft could

be seen as an alternative income-generating source by some (the thieves), but it could lead to less wealth in cases where people lost livestock.

4.2.2.1.5 Changes in Human Population

Results show an increase in the size of the human population in the Lowland region (Table 4.7). Internal migration (48%) was ranked as the most probable causative factor, followed by increasing births (43%) and retrenchments (10%). In Ha Maphohloane, *increasing births* followed by *internal migration*, respectively, were the main perceived causes of an increase in population. This was similar to the perceptions of non-government key informants. *Retrenchment*[4] was not mentioned by respondents in the two villages. In Ha Paki *migration* and *increasing* births were given in that order. Government key informants, however, ranked *migration, retrenchment* and *increasing births* in that order. It is possible that in this case, population increase is seen as a consequence of both retrenchment-induced migration and internal migration, with a limited role for increasing births.

Most recent available national population figures estimate the population of Lesotho at 2,022,331. These estimates "*explicitly take into account the effects of excess mortality due to AIDS; this can result in lower life expectancy, higher infant mortality and death rates, lower population and growth rates, and changes in the distribution of population by age and sex than would otherwise be expected* (CIA Factbook, July 2006). Consequently, Lesotho's population growth rate is estimated as −0.46%; birth-rate as 24.75 births/1,000 population; death rate as 28.71 deaths/1,000 population and net migration rate as −0.68 migrant(s)/1,000 population (CIA Factbook, July 2006). Looking at Table 4.8 it is obvious that in recent years Lesotho has seen a population increase, with a slight exception. There is a noted population decrease between 2005 and 2006 which is perhaps not immediately visible. One possible explanation for this decrease is that, taking into account the effects of AIDS, these figures may indicate an increase in HIV/AIDS-related deaths between 2005 and 2006. It should be noted that these figures describe the national situation, so may not have a direct relationship to people's perceptions which are more locally-focused. The figures are used here to assess the population in the rest of Lesotho and not to confirm or refute local perceptions in the two villages.

The current study investigated perceived effects of the identified land-use changes. Findings on these are presented in the following sections.

4.2.2.2 Effects of Land-Use Changes in the Lowland Region

As a general observation, respondents saw the effects of land-use change as negative. Even in cases where it was possible to gain financially from changing land-use activities, the general perception of the effects of change was negative.

[4]Returning of miners from South Africa into Lesotho (hereafter referred to as retrenchments).

Table 4.9 Effects of land-use change

Effects[a]	Rel_w[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Increase land degradation	**15**	**10**			**4**	**6**
Shift to off-farm employment	**13**	**9**			**5**	**4**
Increase in soil erosion	**9**	**6**		**6**		
Unable to produce food	**9**	**6**	**6**			
Selling agricultural lands for use as settlements	**9**	**6**			**6**	
Not much incentive to invest in land management	**7**	**5**				**5**
Get food from Chinese shops	**7**	**5**	**5**			
Reduction in field size	**7**	**5**		**5**		
Felt by many people	**6**	**4**		**4**		
Monoculture	**4**	**3**				**3**
Rural–urban migration	**4**	**3**			**3**	
Preference for livestock farming	**3**	**2**				**2**
Food insecurity	**3**	**2**			**2**	
Negative income from land	**1**	**1**			**1**	
Total	100	67				

[a]Causes = Effects of land-use change. Rel_w = Relative weight of each criteria and each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

The responses (Table 4.9) show that the main effects of land-use change are: an increase in land degradation (15%), shift to off-farm employment (13%) and increase in soil erosion (9%), together with *unable to produce food* (9%) and selling agricultural land for settlements (9%).

In Ha Paki, the inability to produce food was ranked highest, followed by '*get food from Chinese shops'*, illustrating the village's delicate food-sufficiency situation on the peri-urban fringes of Maseru. In the more rural Ha Maphohloane the importance of agriculture was implicit in respondents' perceptions whereby *increase in soil erosion*, *reduction in field size* and *felt by many* were given as effects of land-use change. Government respondents perceived *selling agricultural land for use as settlements, shift to off-farm employment* and *increasing land degradation* as the main effects of land-use change, while for non-government respondents, *increase in land degradation, not much incentive to invest in land management* and *shift to off-farm employment* were identified as the main effects of land-use change. In explaining the effects of land-use change, one government respondent pointed out that *"land degradation is the main problem in Mohale's Hoek* "; while another stressed that *"one income strategy in Maseru district is to sell land for money, or shift its use to other non-agriculture uses, but other people even stick with land and get negative returns!." "The consequence is a loss of arable land,"* said another government respondent.

One non-government respondent offered further insight into the encroachment of settlements into agricultural lands. Referring to 'ugly politics', he explained:

"more houses are now located on previously crop lands because if government wants to develop the land, then people hurry to put their houses there so that they can get compensation for re-location. Degradation is the result of this uncontrolled encroachment caused by 'ugly politics'! This is a breakdown of law and order!"

These results speak of a general situation of decreasing agriculture and food production self-sufficiency, acting with or parallel to an increase in settlements' encroachment into agricultural land, an increasing shift to a wage-earning economy and land degradation. A decrease in food production has been confirmed and discussed, as have the other factors (Sects. 4.2.1.1.1–4.2.1.1.3).

Given the established causes and consequences of land-use change, the next section identifies where responsibility for land-use is and who, according to the respondents, should be held accountable for ensuring good/sustainable land-use practice in future.

4.2.2.3 Who Is, and Who Should Be Responsible to Ensure Sustainable Land-Use?

The responses (Table 4.10) ranked Ministry of Agriculture (56%) highest, followed by the Departments of Land-use Planning (rural lands)/Lands Surveys and Physical Planning (urban lands) (9%) and Local government/local Councils (9%) respectively. In Ha Maphohloane, government and non-government respondents gave similar answers. However, in Ha Paki, most informants did not answer this question, while those who did said that they did not know who was responsible for sustainable land-use. Surprisingly, no respondents took responsibility themselves. Yet, when asked who should be responsible for sustainable land-use they acknowledged the role of individuals (Table 4.11).

In this case, the Ministry of Agriculture scored highest (67%), followed by chiefs (24%) and finally individuals (16%) whereby farmer/land-user is perceived as the only one responsible (Table 4.11).

Table 4.10 Who is responsible for sustainable land-use?

Who is?[a]	Rel_w[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Ministry of Agriculture	**56**	**9**		**3**	**3**	**3**
No response and don't know	**31**	**5**	**3**			**2**
Departments of Land-use Planning (rural lands)/ Lands Surveys and Physical Planning (urban lands)	**6**	**1**			**1**	
Local government/local Councils	**6**	**1**			**1**	
Total	100	16				

[a]Who is ? = Who is responsible for land management and good (sustainable) agriculture/land-use? Rel _w = Relative weight of each indicator, in comparison to all others under the dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.11 Who should be responsible for sustainable land-use?

Who should?[a]	Rel_w[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Ministry of Agriculture	**40**	**10**		**4**	**4**	**2**
Chiefs	**24**	**6**			**3**	**3**
Farmer/land-user	**16**	**4**				**4**
Government	**16**	**4**	**4**			
Ministry of Justice	**4**	**1**				**1**
Total	100	25				

[a]Who should? = Who is responsible for land management and good (sustainable) agriculture/land-use? Relative _w = Relative weight of each indicator, in comparison to all others under the dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

The role of the Ministry of Agriculture is best illustrated by a government respondent*: "according to the Land Act of 1979, responsibility for land-use is under the Ministry of Local government, but the 1973 Land Husbandry Act states that it is under the responsibility of Ministry of Agriculture. The Land Act removed powers from chiefs, so now chiefs should not allocate lands. But there is bad administration and no enforcement.*" This statement possibly reflects reasons for the stated lack of implementation of policies and legislation for sustainable land-use and land management. Whether this will change with the introduction of the new Land Bill that replaces the 1979 Land Act, remains to be seen. As discussed earlier (Chap. 3), doubts and constraints already plague the new Bill.

A deeper analysis of these results shows curious differences between the respondents' perceptions.

In Ha Maphohloane respondents believed that the Ministry of Agriculture should be responsible for sustainable land-use, while the uncertainty of the people in Ha Paki was reflected in their response (Table 4.11). In Ha Maphohloane, many land-users had experience with Ministry of Agriculture officials or with their extension service officers in the village, while this was perhaps not the case in Ha Paki. The villagers in Ha Paki felt that the *Government* in general should hold sole responsibility for sustainable land-use. In marked contrast, non-government respondents rated responsibility in the following order: farmer/land-user, chiefs, and Ministry of Agriculture. Viewed in light of their previous response on current responsibility, this could signal acknowledgement of the Ministry of Agriculture's failure to sustainably manage land-use or it could indicate their acknowledgement of the important role of the farmer and chief as both land-users and managers.

Surprisingly, government informants also alluded to the role of chiefs, giving it second prominence after Ministry of Agriculture. Even more intriguing is that government officials failed to recognize the important role of the farmer/individual land-user in land-use management, believing instead that farmers needed other (outside) people to show them how to manage their land sustainably. An explanation was given by one non-government respondent: *"farmers do not do anything to protect their land because they are waiting for government to do something to 'help' them. They have*

been confused by the numerous messages coming from 'above' telling them how they should manage their land, so that now they are unsure of what exactly should be done, and in the absence of 'messages from above' they do not trust their own knowledge on land so they leave the land to degrade until government intervenes. Also, because they do not own the land, they use it until it's degraded." The role of government is viewed here as re-enforcing a culture of dependence. This was echoed by another non-government respondent: *"now, with the current food shortages, people are waiting for government to give them food. Instead, they should commit themselves to grow food!"*

As the research findings above have shown, several land-use changes have been experienced in the Lowland villages during a 20-year period. These have resulted in various impacts, as identified by respondents in the current study. The section below analyzes respondents' suggestions to address identified land-use changes and consequences.

4.2.2.4 So What? Possible (Policy) Strategies

The following factors were perceived as possible strategies for sustainable land-use (Table 4.12):

- First rank (weight of 10%) were projects/partnerships with outsiders; improve agriculture through partnerships with outsiders; agriculture credit schemes/rent of agriculture implements; (better) implementation of existing policies
- Second rank (weight of 9%) was: security of tenure; and change in attitude to land-use/management
- Third rank (weight of 7%) was: information and awareness raising/education of youth; and re-focus modern education and educate youths on sustainable land-use/management. Again in this case clustering of content has led to these discrepancies

There was a marked difference between replies from village respondents in the two villages and those of government and non-government respondents. The two villages perceived project partnerships with outsiders to be the best strategy for sustainable land-use, to alleviate the negative effects of land-use change and facilitate sustainable development in the villages.

However, government respondents perceived that better implementation of existing policies/laws, changes in attitude to land-use/management, reforming youth education land-use, and that *rural land-users should speak out and say what they want* as the possible strategies to reduce the negative effects of land-use and ensure sustainable development of the rural areas. Some government officials expressed frustration that there was a lack of uptake and support to land management measures in some villages. This was partly because there was a poor understanding by government officials of what was needed, relevant on the ground and what the farmers perceived as relevant or needed.

These responses may demonstrate acceptance of the government's failure to administer and enforce sustainable land-use and management. One government official said: *"the issue is not the land tenure system, but rather lack of enforcement*

Table 4.12 Possible (policy) strategies

So what?[a]	Rel_w[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Projects/partnerships with outsiders	**10**	**7**	**7**			
Improve agriculture through partnerships with outsiders	**10**	**7**		**7**		
Agriculture credit schemes/rent of agriculture implements etc.	**10**	**7**				**7**
(better) Implementation of existing laws/policies	**10**	**7**			**7**	
Security of tenure	**9**	**6**				**6**
Change in attitude to land-use/ management	**9**	**6**			**6**	
Information and awareness raising/education of youth	**7**	**5**				**5**
Re-focus modern education and educate youth on sustainable land-use/agriculture	**7**	**5**			**5**	
Respect authority of local informal (chiefs) land institutions	**6**	**4**				**4**
Rural land-users should speak out and say what they want of their government (rural should voice their concerns to government)	**6**	**4**			**4**	
Collateralize livestock	**4**	**3**				**3**
Visionary leadership	**4**	**3**			**3**	
Dams and irrigation schemes	**3**	**2**			**2**	
Changes in land tenure for female land ownership	**2**	**1**			**1**	
Total	100	67				

[a] So what? = Possible solutions for land management and/or sustainable agriculture/land-use. Relative _w = Relative weight of each indicator, in comparison to all others under the dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

to ensure that all land is under Lease hold. There are rules and penalties against violators, but there is no enforcement."

Another government official felt the problem was the existence of 'two citizens' – government and rural land-users – with none aware of the others' needs, perceptions and ideas. This was the main problem associated with the lack of implementation and enforcement of existing laws/policies. The same official had this to say: *"speak to Basotho people, not ministry officials or those who have been 'indoctrinated' or who practise 'good land husbandry' by employing measures that they have been told are the solutions to their perceived problems."* In the light of this response, most village people could be considered to be 'indoctrinated' since they had previously followed advice from government or other outsiders, often at the expense of their own local knowledge.

In this sense, the villagers' response could be a reflection of 'dependency syndrome' or a simple expression of their lack of confidence in their own knowledge, perhaps borne out of historical and later interventions and advice by outsiders on sustainable use and management of their land. Youth education is seen as a means to turn away from 'dependency syndrome' and give confidence back to the rural land-users/managers. Yet, seen in the light of the 'indoctrination theory' this can also be considered a type of formalized indoctrination. Other government officials see political will as the only way forward. "*We need visionary leadership to forge ahead and to achieve goals,"* said one respondent. She said that without political will, land-use could not be prioritized, leaving the current land-use situation to continue unresolved.

So which Basotho people should one speak to? Non-government respondents, being themselves Basotho, but with a more sceptical view of government and villagers, ranked their perceptions in the following order: *agriculture credits/rent of agriculture implements, security of tenure, information and awareness rising, respect authorities of land and local land institutions (chiefs).* As can be seen, these responses are in stark contradiction to those from government and village respondents. A possible explanation could be that the non-government respondents were less 'indoctrinated', so they had a more independent view of land-use and its management, particularly relating to agriculture – cropping and livestock. These responses also suggested a preference for commercializing agriculture and land-use, perhaps perceived as a better means towards sustainable land-use and to increase agricultural output and food self-sufficiency. According to a non-government informant, farmers and particularly rural dwellers have difficulty getting credit, as they do not have collateral. The Lesotho Agriculture Bank which was set up for this purpose *"went bust some ten years ago, because someone ate the money."*

A government official explained: *"the Bank collapsed because people took loans but did not repay. The government is also to blame. Ministry of Agriculture ordered tractors and distributed to everyone who asked. They should have chosen to prioritize the distribution and give only to those people already working on the land, not everyone."* It was suggested at different times by two non-government respondents to use livestock as collateral for credit to assist rural development. *"Livestock is a resource that is badly managed in Lesotho; it is unaccounted for in the formal economic sector so it cannot be used as collateral. There is no ownership on land, so the only way to have collateral for rural people would be through livestock, if that was formalized in the economic sector, that way livestock can be used as collateral,"* was their shared sentiment. In this context, however, people with no livestock may be disadvantaged further, and the traditional system of lending cattle for draught, may be eroded, with possible negative consequences, unless counter measures are put in place.

Reforming the land tenure system as proposed by non-government informants, can be seen here as a way of facilitating land ownership, which is supposed to give people greater incentives to take better care of their land and invest in sustainable land-use practices. The role of chiefs as land administrators may be hard to determine if the land tenure system is reformed, given that chiefs generally represent and guard traditional and cultural values and systems, even though legally they are not to deal with land allocation.

4.3 Conclusion

Some important conclusions can be drawn from the findings in this chapter. The study found that land-use change in the two study villages, and by implication the Lowland region, is a multi-factor phenomenon (Table 4.13). Contrary to popular narratives on land degradation in Lesotho, this was seen as a consequence rather than a cause of land-use change in the study areas. The main drivers of land degradation were identified as drought, poverty and ignorance. In terms of land-use change the findings point to drought, lack of water, mismanagement, HIV/AIDS and dependency syndrome. There was a noted decrease in crop production, attributed to drought, agriculture being too expensive, and expansion of settlements onto agricultural land. The perceived decrease in livestock production was attributed to stock theft, drought and frost. Thus, drought stands out as the main cause of land-use change, land degradation, decreasing crop production, and is also implicated in falling livestock numbers. This highlights the precarious nature of rain-fed agriculture. The impacts of frequent droughts on land-use are evident in the two villages and generally in the Lowland region of Lesotho. However, drought does not act alone, rather together with the other identified factors.

The population was said to have increased in the villages and the region, mainly due to migration and increasing births. An increase in internal migration may indicate the socio-economic ramifications of actions of the drivers of land-use change and their consequences. People prefer to abandon agriculture or sell land for settlement use; move to towns or villages in peri-urban fringes or close to main roads.

Ha Paki exhibits the effects of rural–urban migration, while Ha Maphohloane is a rural, dry, agricultural area situated off the main road south, with no paved roads

Table 4.13 Summary of causes and consequences of land-use change in the lowland region

Major land-use change	Cause of major land-use change[a]
General land-use change	Drought, lack of water land mismanagement HIV/AIDS dependency syndrome soil erosion hail storms
Land degradation	Drought Poverty ignorance
Decreasing crop production	Drought agriculture too expensive expansion of settlements
Decreasing livestock	Stock theft, Drought frost
Increasing human numbers	Internal migration increasing births retrenchments

[a]The results are given in order of their importance as determined by their weights using our MCA

Table 4.14 Summary of responsibility for sustainable land-use and management[a]

Who is responsible?	Who should be responsible?
Ministry of Agriculture	Ministry of Agriculture
No response	Chief
Department of land-use planning	Farmer/individual
Local government	Government

[a] These are given in order of their importance as determined by our MCA

and just narrow dirt tracks. Although migration can have some positive effects in both sending and receiving areas, in this case the unplanned settlements seen particularly in Ha Paki, pose difficulties with land administration, lack of basic services and poor sanitation.

The main consequences of the land-use change identified are presented below, in rank order:

- Increasing land degradation
- Shift to off-farm employment
- Increasing soil erosion
- Inability to produce food
- Selling agricultural land (conversion to settlements) and a reduction in agricultural land

This combination of biophysical-socio-economic factors reflects a possible erosion of rural societies and a pending social crisis. Our study has found that rural people are finding it very difficult to grow food, and agriculture is becoming more expensive. Coupled with this are the actions of climate and other biophysical and socio-economic factors (increasing soil erosion, land degradation, dependence syndrome, HIV/AIDS, for example) which are partly driving the loss of agricultural land to settlements. What are the alternative options for rural people, other than the expected, like the reported migration, increasing stock theft, and others (often anti-social behaviour resulting from poverty, lack of alternatives and misery)?

Understanding the actors involved in land governance might offer an explanation. The following actors have been identified as being responsible for sustainable land-use and its management: The Ministry of Agriculture, Departments of Land-use planning (urban lands) and Land Surveys and Physical Planning departments (rural land) and local government. As can be seen from the findings (Table 4.14), chiefs and individuals were not mentioned. Yet, asked who should be responsible for land-use, Ministry of Agriculture, chiefs and individuals were identified as the principal actors. This implies acknowledgement of the traditional land structures – chiefs – and their importance in ensuring sustainable land-use and management. It also shows that some individuals are willing to take responsibility for sustainable land-use, but as the findings observed, the role of the Ministry of Agriculture is pivotal, perhaps as a facilitator or initiator of sustainable land-use and management practices. Interestingly, government respondents ranked chief second after the Ministry of Agriculture. Non-government informants ranked chief first followed by farmer/individual. Government informants did not consider that responsibility for

sustainable land-use/management should lie with the farmer/individual. In Ha Paki respondents perceived that responsibility should be with government, and in Ha Maphohloane, the Ministry of Agriculture. Since adopting the Local Government Act of 1997, chiefs have no legal power of land allocation or management. This is the responsibility of local village and district government officials – community councils and district councils, respectively. Thus, identifying chiefs as those who *should be responsible for sustainable land-use/management* might essentially contradict this government law and could pose potential challenges to the new Land Bill, despite the perceived role of the Ministry of Agriculture. This indicates a potential discord between land-use and related laws and how they are perceived on the ground, emphasising the concept of *'two citizens – government and people'* as highlighted by one key government informant. These responses perhaps also question the perceived legitimacy of land institutions, including local councils vis-à-vis traditional land-use structures.

It is evident from the current study that government intervention is required to provide alternatives for rural Lowland people. In this case, the study has identified several options for rural land-users and managers in the Lowland villages, particularly in Ha Paki and Ha Maphohloane.

A first set of solutions proposed by respondents consists of: partnerships with outsiders through organized projects in the villages, agriculture and credit schemes so farmers can access necessary agricultural implements, credit to enable farmers to invest more in land-use and management, better implementation of existing land-use and related policies and laws. It has also been suggested to use livestock as collateral to acquire credit. However, all potential positive and negative socio-economic and environmental impacts need to be identified and addressed beforehand.

A second set of solutions proposed was: security of tenure and change of attitude to land management; while the third set involves: information/awareness-raising and educating youth on sustainable land-use and management practices.

These results raise important issues. Curiously, projects with outsiders scored higher than agriculture. Yet, looking at the rest of the responses it becomes clear that agriculture is still seen as an important activity by respondents. Responses ranked second and third generally pointed to a drive to improve agriculture. Yet given current changes in rainfall, increasing drought and the prevailing HIV/AIDS situation and related morbidity and mortality; and the resulting changes in the social structure, is agriculture the best land-use option in the Lowland region? As this study has shown, agriculture in the Lowland region was said to be increasingly expensive and constrained by various factors, including climate, socio-economic and health factors as well as by expansion of settlements onto agricultural land.

In Chap. 3 we saw that agriculture in Lesotho is a necessity. A majority of the local population still depend on agriculture for sustenance even though they may be engaged in wage-earning activity. The challenge for the Lowland region and indeed Lesotho is to learn to adapt to the on-going biophysical, societal and socio-economic changes, in an environmentally sustainable and socially inclusive way. This study will offer some policy and research suggestions on how to meet this challenge (Chap. 7).

The perceived solutions identified by the study might form an integral part of the response to the above questions about options for rural people and the role of agriculture.

But it is worth remembering the philosopher quoted above: *"Change alone is unchanging. The same road goes both up and down (…). And yet everything comes in season."* (Heractus of Epheus, sixth century BC).

Appendix 1

Table 4.15 Composition of key informants/interviewees[a]

Village level	District/National level	
Chief (2)	**Government officials**	**Non-government officials**
Local community council (2 in Ha Maphohloane; 1 in Ha Paki)	Ministry of Natural Resources (2 senior officials)	Lecturer, National University of Lesotho; Faculty of Science (3 lecturers, one senior)
Farmer – household heads in general (village resident; 17 in Ha Maphohloane; 30 in Ha Paki)	Ministry of Environment (1 senior official)	Former Minister of Agriculture, and chief of a village in the Northern districts (1 person)
	Ministry of Forestry and Land Reclamation (1 senior official in Land reclamation)	Owner: flour milling company, Maseru (1 person)
	Ministry of Agriculture and Food Security (1 senior official in crop production)	Young commercial farmer, Maseru district: wheat and livestock (cows) (2 people)
	Ministry of Local government (1 official)	Local owner of several businesses, Maseru (1 person)
	Land Surveys, Physical Division and Planning (2, one senior official)	Consultant – livestock and farming specialist (1 person)
		Mohale's Hoek town (2 people)
		Member of national Parliament representing village in Mohale's Mohale's Hoek (1 person)
		General public, through radio interview
		(Taxi) driver (1 person)
		Waiter (1 person)
Total 52	**Total 8**	**Total 14**

[a] This table shows the different types of informants who were interviewed and with whom discussions were held at the village and national levels. The key informants were very co-operative in nature and the discussion and interviews were often held at a place and time suggested by them. In most cases, this was either in the village, respective offices of government officials and at 'neutral' venues like in a restaurant, for the non-government key informants. A majority of the interviewees, particularly in government and private sectors, but also at the village level, preferred to stay anonymous. In order to protect their identities and to increase the robustness of the field survey research findings, the identity of all interviewees is kept anonymous

Appendix 2 : Multi-criteria Analysis of the Lowland Region of Lesotho

This section gives a step-wise description of the MCA method used in this study. Table 4.16 shows a list of the dimensions, and Table 4.17 lists the general criteria and indicators used in the study.

i. ***Step one identified the various dimensions of land-use change***, also known as scenarios or principles (referred to hereafter as dimensions). These were identified as: causes of land-use change, consequences or impacts of land-use change, responsibility for land management and possible solutions to address impacts of land-use change. It was necessarily, for clarity, to sub-divide the dimensions as shown on Table 4.16.

ii. Step two involved defining the criteria and sub-criteria for each dimension

The underlying driving forces are: climatic, demographic, political or institutional, economic, technological, and cultural or socio-political. These were further divided into their respective sub-divisions (for more details see Geist and Lambin 2004: 819). A recent study using a political ecology approach to study root causes of land-use change in semi-arid regions of Kenya alludes to several possible land-use change root causes (Olson et al. 2004:16). These are the changing rural economy, demographic trends, infrastructure development, policies and programs on land-use, political situation, social factors, climatic/hydrological factors and biological factors. **Based on these two examples from literature, discussions with key informants, the review of the multitude of literature and content analysis of the field data, the current research proposes ten criteria and 86 indicators to use to analyze causes and consequences of land-use change in Lesotho's semi-arid Lowland region.** The criteria are suggested as the possible root causes of land-use change in Lesotho's Lowland region.

Table 4.16 Dimensions of land-use change for Lesotho[a]

Dimensions	
I. Causes of major changes	Causes of land-use change/general causes of agricultural problems
	Causes of land degradation
	Changes in human population
	Changes in livestock population
	Changes in crop production
	How do you recognize land degradation?
II. Consequences/impacts of land-use change	General effects of land-use changes
III. Responsibility for land management	Who is responsible for land management?
	Who should be responsible?
IV. So what? (Possible solutions)	Possible solutions to address impacts of land-use change

[a] From this table four broad dimensions of land-use change have been identified; these have been sub-divided further in order to capture the desired information

These criteria are demographic factors, economic factors, social political/societal/institutional factors, cultural/historic factors, climatic/hydrological/biophysical factors, biological factors, vegetative factors, formal institutional/policy structures, informal institutional/policy structures, international organizations/NGOs. The criteria and indicators are illustrated in Table 4.17.

Table 4.17 General criteria and several indicators[a]

Criteria	Indicators
I. Demographic factors	Population pressure
	Rural–urban migration
	Increasing births
	Internal migration
	Death
II. Economic factors	No access to credit
	No jobs
	Shift to off-farm employment
	Selling agricultural lands for use as settlements
	Negative income from land
	Lack of credit
	Poverty
	High agricultural inputs
	Retrenchments
	Agriculture too expensive
	Selling livestock
	Projects and partnerships with outsiders
	Agriculture credit schemes/rent of agriculture utilities
	Collateralize livestock
III. Social political/societal/institutional factors	Land mismanagement
	Ignorance
	Lack of implementation
	Stock theft
	No crop rotation
	Lack of ownership
	Land tenure
	Conflict of responsibility
	Overgrazing
	Unable to produce food
	Get food from (Chinese) shops
	Reduction in filed size
	Breakdown in local land administration
	Monoculture
	Preference for livestock farming
	Poor agricultural practices
	No proper Structural Plan

(continued)

Table 4.17 (continued)

Criteria	Indicators
	Changes in land tenure
	Implementation of existing land legislation
	Re-focus modern education and education towards sustainable agriculture education of the youth
	Visionary leadership
	Dams and irrigation schemes
	Security of tenure
	Information and awareness raising, focus on youth
	Reduction in field sizes
	Food shortages
	Expansion of settlements into agricultural lands
	Industrial expansion
	WFP/food aid
	Reduction in field size
IV. Cultural/historic factors	Change in attitude to land-use dependence syndrome
	Colonial past
	Modern education
	Fires/burning grass
	Fragmentation (specifically pointing to traditional land allocation practices)
	People's feelings to land degradation
	Silence of rural land-users
	Respect of local traditional land authority – Chiefs, and land institutions
V. Climatic/hydrological/(bio) physical factors	Soil erosion
	Lack of water
	Hailstorms
	Frost
	Poor soil fertility
	Fertility decline
	Drought
	Rocky terrain
	Intense short rains/*sefako*
	Lack of water
	Increase in soil erosions
	Increase in land degradation
	Inferior grazing
	Climate change
	Donga formation
VI. Biological factors	HIV/AIDS
	Livestock diseases

(continued)

Table 4.17 (continued)

Criteria	Indicators
VII. Vegetative factors	Visibility of plant roots Drop in crop yields Scarce surface vegetation cover
VIII. Formal institutional/policy structures	Ministries, government departments and local government e.g. Ministry of Agriculture, Ministry of Justice, Department of Soil Conservation, Local government representatives, Agricultural Extension services, etc.
IX. Informal institutional/policy structures	Chiefs Head of household Other
X. International organizations/NGOs	WFP UNDP UNEP EU Foreign governments representatives in Lesotho

[a]Source: own table, criteria used were partly adapted from those identified in Geist and Lambin (2004) together with own criteria. This table has identified ten criteria with corresponding indicators. As can be seen, there may be some overlaps in a few of the indicators covered by criteria II, III and IV. For example, stock theft, which is now under criteria III could as well fit into criteria II
The study decided to use two slightly different approaches in the MCA analysis. One involved using these determined criteria to rank and weight the field data using Eqs. 4.1 and 4.2. These criteria are also referred to here as 'clusters' of content. The other involved performing content analysis to identify the different indicators, then each indicator was ranked and weighted in relation to the other indictors (Eq. 4.3). The two-tier approach was performed in order to test the validity of the content analysis

iii. The third step involved ranking and weighting all criteria within each dimension

Two types of ranking methods are identified – ordinal and regular. Regular ranking involves assigning a rank, for example – on a scale of one to nine, in increasing order of importance, to each criterion relative to the dimension within which it is grouped. In ordinal ranking, criteria are placed in a hierarchy of importance; thereby different criteria cannot be given the same ranking, eliminating the need to use a scale (Mendoza et al., 1999). Regular ranking was used in this research because it allows for more than one criterion to have the same order of importance, and also because it allows the possibility of assigning a grade of importance to all criteria, as opposed to ordinal ranking which does not allow for 'ties' or grading of criteria. In our research, responses from semi-structured interviews and discussions were broken down into relevant indicators and grouped into respective criteria. The grading scale of measurement used as a guide is adopted from Mendoza et al. (1999). Departing from the approach used by Mendoza et al. (1999), this research expressed a level of flexibility in the choice of scale (Table 4.18). The main reasons for this are: during field research responses from key informants were given in order of importance,

Table 4.18 A description of the 9 scale point used for ranking criteria (Source: Based on table by Mendoza et al. (1999), with own additions in bold)

1	2	3	4	5	6	7	8	9
Weakly important	**Weak to less important**	Less important	**Less to moderately important**	Moderately important	**Moderate to more important**	More important	**More to extremely important**	Extremely important

from most important to least – sometimes over nine elements were identified. The ranking from any key informants was checked against the other's responses, providing a further check on the ranking of the results obtained. The nine-point scale was simply used as a guide and reference when ranking the data. Allowance was made for extending the scale, to accommodate all the identified indicators and prevent unnecessary loss of information which might lead to a compromise in the outcome of the analysis. Therefore, the indicators were not delineated rigidly to fit into the nine-point grading system. For such cases, the importance of each rank was expressed by considering its relative ranking position, so for example, 13 would be of a higher ranking position than nine or one. The table given here was thus used only as a guide to the ranking of indicators.

Weighting is a general calculation of the relative importance of each element. **In this research, we developed weights according to the equations below. Three types of weighting were carried out.** This was done to refine the results of root causes and consequences of land-use change.

To calculate the relative weight of each criteria under each respective dimension;

$$W_x = \left(S_x / S_d\right)100 \tag{4.1}$$

Where:
W_x is the weight of criteria x under dimension d
S_x is the sum of all rankings r for criteria x under dimension $d = r_1 + r_2 + r_3 + \ldots r_{nth} \ldots$
S_d is the sum of all rankings for ALL criteria under dimension $d = S_x + \ldots S_{nth}$

To calculate the relative weight of each indicator under the respective criteria:

$$W_i = \left(S_{ix} / S_x\right)100 \tag{4.2}$$

Where:
W_i is the weight of indicator i under criteria x in dimension d
S_{ix} is the sum of the rankings for indicator i under criteria x in dimension d

To calculate the relative weight of each indicator i, in dimension d relative to the total weight of all criteria under d (the overall weight if indicator i relative to all other indicators):

$$W_{id} = \left(S_{ix} / S_d\right)100 \tag{4.3}$$

Where:
W_{id} is the weight of indicator i relative to dimension d

iv. The fourth step is a descriptive analysis of the filed data using results from the MCA analysis to identify major causes, consequences and possible solutions to land-use change in the study areas. The purpose of this step is to identify causative pathways of land-use change for Lesotho, their interactions, consequences of the change and viable solutions, as part of the fulfilment of the objectives set out by this study.

Appendix 3: MCA Results – Clustered Approach

Tables 4.19–4.28 represent the results of the MCA using the clustered approach. This was the result of using Eqs. 4.1 and 4.2. These were the control results to test the MCA method.

Table 4.19 Causes of land degradation (clustered weights)

Causes[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Government (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Demographic factors	2	4				
Population pressure	**100**	**4**			**4**	
Economic factors	20	30				
Lack of credit	**23**	**7**				**7**
Poverty	**67**	**20**	**8**	**7**		**5**
High agricultural inputs	**10**	**3**				**3**
Sociopolitical/societal/institutional factors	36	54				
Ignorance	**33**	**18**		**9**	**9**	
Lack of implementation	**12**	**7**			**7**	
Lack of ownership	**11**	**6**				**6**
Overgrazing	**8**	**4**				**4**
Monoculture	**2**	**1**				**1**
Breakdown local land administration	**4**	**2**				**2**
Poor agriculture practices	**30**	**16**			**8**	**8**
Cultural/historic factors	11	17				
Dependency syndrome	**82**	**14**			**5**	**9**
Fires/burning grass	**18**	**3**			**3**	
Climatic/hydrological/biophysical factors	29	43				
Heavy rains/*sefako*	**20**	**9**	**9**			
Drought	**70**	**30**	**7**	**8**	**6**	
Rocky terrain	**9**	**4**			**4**	
Total	100	148				

[a]Causes = Causes of land degradation. Rel-weight = Relative weight of each criteria under relevant dimension and overall relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.20 How do you recognize land degradation? (clustered)

Signs[a]	Rel-weight[a] (%)	All_ rank[a]	Ha_Paki (n=32)		Ha_Map (n=20)		Government (n=8) and Non-Govt (n=14)
Weighting		Ranking	C[b]	G[c]	C	G	Not asked
Vegetative factors	45	10					
Visibility of plant roots	**9**	**2**			**2**		
Drop in crop yields	**14**	**3**	**2**		**1**		
Scarce vegetation	**27**	**5**		**2**		**3**	
(Bio)Physical factors	55	12					
Donga formation	**50**	**11**	**3**	**3**	**3**	**2**	
Soil erosion	**5**	**1**	**1**				
Total	100	22					

[a]Signs = How do you recognize land degradation? Rel-weight = Relative weight of each criteria under relevant dimension and overall relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)
[b]C – On Crop/cultivated lands
[c]G – On Grazing/Pasteur lands

Table 4.21 Major causes of land-use change (clustered)

Causes[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n=32)	Ha_Map (n=20)	Govt (n=8)	Non-Govt (n=14)
Weighting		Ranking				
Demographic factors	1	4				
Population pressure	**100**	**4**			**4**	
Economic factors	7	22				
No access to credit	**45**	**10**	**10**			
No jobs	**54**	**12**	**12**			
Sociopolitical/societal/ institutional factors	33	100				
Mismanagement	**25**	**25**			**13**	**12**
Lack of knowledge	**10**	**10**		**10**		
Lack of implementation	**12**	**12**			**12**	
Theft	**14**	**14**	**7**	**7**		
No crop rotation	**7**	**7**				**7**
Lack of ownership	**10**	**10**				**10**
Land tenure	**11**	**11**			**11**	
Conflict of responsibilities	**9**	**9**			**9**	
No proper Structural Plans	**2**	**2**			**2**	
Cultural/historic factors	18	53				
Dependence syndrome	**36**	**19**			**6**	**13**
Colonial past	**17**	**9**				**9**
Modern education	**15**	**8**				**8**
Don't know	**11**	**6**	**6**			
Fires	**11**	**6**				**6**
Fragmentation	**9**	**5**			**5**	

(continued)

Table 4.21 (continued)

Causes[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Climatic/hydrological biophysical factors	34	101				
Soil erosion	**18**	**18**		**11**	**7**	
Lack of water	**25**	**25**	**13**	**12**		
Hail storms	**18**	**18**	**9**	**9**		
Frost	**16**	**16**	**8**	**8**		
Poor soil fertility	**6**	**6**		**6**		
Fertility decline	**3**	**3**			**3**	
Drought	**34**	**34**		**13**	**10**	**11**
Rocky terrain	**1**	**1**			**1**	
Biological factors	6	19				
HIV/AIDS	**100**	**19**	**11**		**8**	
Total	**100**	299				

[a]Causes = Causes of land-use change. Rel-weight = Relative weight of each criteria under relevant dimension and overall relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.22 Causes of changes in crop production (clustered)

Causes[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Economic factors	18	18				
Agriculture too expensive	**67**	**12**			**8**	**4**
Lack of credit	**33**	**6**				**6**
Sociopolitical/societal/ institutional factors	31	32				
Land mismanagement	**3**	**8**				**8**
Reduction in field sizes	**22**	**7**				**7**
Expansion of settlements into agricultural lands	**31**	**10**			**7**	**3**
Industrial expansion	**3**	**1**			**1**	
WFP/food aid	**6**	**2**				**2**
Reduction in field size	**1**	**4**			**4**	
Climatic/hydrological/ biophysical factors	43	44				
Soil erosion	**9**	**4**			**3**	**1**
Drought	**43**	**19**		**8**	**6**	**5**
Lack of rainfall	**11**	**5**			**5**	
Strange weather/*sefako*	**16**	**7**	**7**			
Reduced soil fertility	**4**	**2**			**2**	
Land degradation	**16**	**7**		**7**		
Biological factors	8	8				
HIV/AIDS	**100**	**8**	**8**			
Total	100	102				

[a]Causes = Causes of changes in crop production. Rel-weight = Relative weight of each criteria under relevant dimension and overall relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.23 Causative factors of changes in livestock population (clustered)

Causes[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n=32)	Ha_Map (n=20)	Govt (n=8)	Non-Govt (n=14)
Weighting		Ranking				
Demographic factors	3	2				
Death	**100**	**2**				**2**
Economic factors	2	1				
Selling	**100**	**1**				**1**
Sociopolitical/societal/ institutional factors	42	27				
Stock theft	**89**	**24**	**6**	**6**	**6**	**6**
Food shortages	**11**	**3**			**3**	
Climatic/hydrological/ biophysical factors	49	32				
Drought	**31**	**10**	**5**	**5**		
Strange weather	**13**	**4**		**4**		
Frost	**28**	**9**			**4**	**5**
Inferior grazing	**13**	**4**				**4**
Climate change	**16**	**5**			**5**	
Biological factors	5	3				
Livestock disease	**100**	**3**				**3**
Total	100	65				

[a] Causes = Causes for changes in livestock population. Rel-weight = Relative weight of each criteria under relevant dimension and overall relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.24 Causes of population increase (clustered)

Causes[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n=32)	Ha_Map (n=20)	Govt (n=8)	Non-Govt (n=14)
Weighting		Ranking				
Demographic factors	**90**	**19**				
Increasing births	**47**	**9**	**2**	**3**	**1**	**3**
Migration (internal)	**53**	**10**	**3**	**2**	**3**	**2**
Economic factors	**10**	**2**				
Retrenchments	**100**	**2**			**2**	
Total	**100**	**21**				

[a] Causes = Causes of population increase. Rel-weight = Relative weight of each criteria under relevant dimension and overall relative weight of each indicator, in comparison to all others under dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.25 Effects of land-use change (clustered)

Effects[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Demographic factors	4	3				
Rural–urban migration	**4**	**3**			**3**	
Economic factors	24	16				
Shift to off-farm employment	**13**	**9**			**5**	**4**
Selling agricultural lands for use as settlements	**9**	**6**			**6**	
Negative income from land	**1**	**1**			**1**	
Sociopolitical/societal/ institutional factors	42	28				
Unable to produce food	**9**	**6**	**6**			
Get food from Chinese shops	**7**	**5**	**5**			
Reduction in field size	**7**	**5**		**5**		
Food insecurity	**3**	**2**			**2**	
Not much incentive to invest in land management	**7**	**5**				**5**
Monoculture	**11**	**3**				**3**
Preference for livestock farming	**7**	**2**				**2**
Cultural/historic factors	**6**	4				
Felt by many people	**100**	**4**		**4**		
Climatic/hydrological/ biophysical factors	**24**	16				
Increase in soil erosion	**38**	**6**		**6**		
Increase land degradation	**63**	**10**			**4**	**6**
Total	**100**	67				

[a]Causes = Effects of land-use change. Rel-weight = Relative weight of each criteria under the dimension and overall relative weight of each indicator, in comparison to all others under the dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.26 Who is responsible for sustainable land-use? (clustered)

Who is?[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Formal policy/institutions	**69**	11				
Ministry of Agriculture	**56**	**9**		**3**	**3**	**3**
Department of Soil Conservation						
Departments of Land-use Planning (rural lands)/ Lands Surveys and Physical Planning (urban lands)	**6**	**1**			**1**	
Local government/local Councils	**6**	**1**			**1**	
Ministry of Justice						
Informal institutions/policy						
International/national Organizations/NGOs/						
Individual						
Other	**31**	5				
No response and don't know	**31**	**5**	**3**			**2**
Total	**100**	**16**				

[a] Who is ? = Who is responsible for land management and good (sustainable) agriculture/land-use? Rel-weight = Relative weight of each criteria under the dimension and overall relative weight of each indicator, in comparison to all others under the dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.27 Who should be responsible for sustainable land-use? (clustered)

Who should?[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Formal policy/institutions	**60**	15				
Ministry of Agriculture	**40**	**10**		**4**	**4**	**2**
Ministry of Justice	**4**	**1**				**1**
Government	**16**	**4**	**4**			
Informal institutions/policy	24	6				
Chiefs	**24**	**6**			**3**	**3**
International/national Organizations/NGOs/						
Individual	**16**	4				
Farmer/land-user	**16**	**4**				**4**
Total	**100**	**25**				

[a] Who should? = Who is responsible for land management and good (sustainable) agriculture/land-use? Rel-weight = Relative weight of each criteria under the dimension and overall relative weight of each indicator, in comparison to all others under the dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

Table 4.28 Possible (policy) strategies (clustered)

So what?[a]	Rel-weight[a] (%)	All_rank[a]	Ha_Paki (n = 32)	Ha_Map (n = 20)	Govt (n = 8)	Non-Govt (n = 14)
Weighting		Ranking				
Sociopolitical/policy/ Institutional	**43**	29				
Changes in land tenure for female land ownership	**1**	**1**			**1**	
(better) Implementation of existing laws/ policies	**10**	**7**			**7**	
Re-focus modern education and educate youth on sustainable land-use/agriculture	**7**	**5**			**5**	
Visionary leadership	**4**	**3**			**3**	
Dams and irrigation schemes	**3**	**2**			**2**	
Security of tenure	**9**	**6**				**6**
Information and awareness raising/ education of youth	**7**	**5**				**5**
Cultural/traditional/ beliefs	**31**	21				
Change in attitude to land-use/management	**9**	**6**			**6**	
Rural land-users should speak out and say what they want of their government (rural should voice their concerns to government)	**6**	**4**			**4**	
Respect authority of local informal (chiefs) land institutions	**6**	**4**				**4**
Improve agriculture through partnerships with outsiders	**10**	**7**		**7**		
Economic factors	**25**	17				
Projects/partnerships with outsiders	**10**	**7**	**7**			
Agriculture credit schemes/rent of agriculture etc.	**10**	**7**				**7**
Collateralize livestock	**4**	**3**				**3**
Total	**100**	67				

[a] So what? = Possible solutions for land management and/or sustainable agriculture/land-use. Rel-weight = Relative weight of each criteria under the dimension and overall relative weight of each indicator, in comparison to all others under the dimension. All_rank = Sum of all rankings from all responses. All responses (n = 74)

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Chapter 5
Village Patterns of Land-Use Change

Abstract Remote sensing analysis is commonly used to assess landscape changes. The study used a combination of bi-temporal aerial photographs and satellite images as sources of geographical data. Different types of change-detection techniques exist for analyzing geographical images. These range from visual interpretation to the more quantitative change-detection techniques like manual on-line digitization, multi-date visual composite image change detection, image differentiation and post-classification comparison, each with its merits and difficulties. The study used post-classification comparison techniques to analyze land-use change on the bi-temporal satellite images. Visual land-use change analysis was carried out on the bi-temporal aerial photographs. This chapter presents the findings of these analyses. It establishes the general patterns of land-use change in the Lowland study villages, also revealing the type, direction, magnitude and location of the changes. A land-use classification scheme for the Lowland region is also proposed.

Keywords Remote sensing • Change detection • Land-use classification • Mazenod • Mohale's Hoek • Ha Paki • Ha Maphohloane

The power to question is the basis of all human progress

(Indira Ghandi; Indian's 4th and only female Prime Minister to date; 1917–1984).

5.1 Introduction

This chapter aims to determine and quantify land-use change for the period 1960s-2000s using remote-sensing techniques and methods. In line with the quotation above, the following questions are used to guide this analysis: What is changing? Where? How much is changing and in what direction is the change occurring? In this context, the study carried out visual image analysis on

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multi-temporal aerial photos and post-classification change-detection analysis on multi-temporal satellite images. The relevance of using remote-sensing data in this study is in its ability to provide multi-temporal spatial information that is representative of actual land-use/cover systems. This information commonly gives insight into the location, nature and quantity of land-use/cover changes. This study aims to use the results obtained from remote-sensing analysis to complement qualitative social data on human behaviour and perceptions on land-use change (Chap. 4), which is necessary to understand the human-environment interrelationships of land-use/cover change in the Lowland region.

5.2 Geographical Data Sources

To analyze land-use change in the study villages, data comprising two bi-temporal remote sensing data sets: aerial photographs between the period 1960s–1980s and high-resolution Quickbird imagery consisting of satellite images for the years 2002–2004 (Ha Paki) and 2002–2006 (Ha Maphohloane), and topographic maps, were used in this study (Tables 5.1, 5.2 and 5.3). Aerial photography is generally a practical, economic, versatile source of spatial information, and a primary means of producing topographic maps (Campbell 2002); while high-resolution satellite imagery is able to provide accurate, detailed spatial images. Aerial photographs of the study sites did not exist for the 1990s, while satellite imagery for the two study sites prior to the year 2000 was unavailable. Other sources of remote sensing data used include a 1979, 1:50,000 topographic map of Mazenod and a 1981, 1:50,000 topographic map of Mohale's Hoek. A detailed discussion of the research methodology used to acquire and analyze remote sensing data is presented below (Sects. 5.2.1, 5.2.2, 5.3 and 5.4).

Before undergoing change detection, each individual bi-temporal image for the two sites was pre-processed, classified and assessed for accuracy.

Table 5.1 Topographic map and aerial photography data for STUDY AREA 1: village of Ha Paki in Mazenod (Maseru district)

Ha Paki (Mazenod)						
Image	Year	Place	Strip no.	Contract	Scale	Flight date on image
1	1961	International Airport/ Mazenod	B S2 (110)	57	1:30,000	18 Apr 1961
2	1985	As above	7571	–	1:11,000	12 Jan 1985
3	1983	As above	42	–	1:20,000	17 Feb 1983
4	1979	As above	LE 13 (081)	179	1:24,000	10 Sept 1979

Source: Aerial photos from the department of Lands Surveys and Physical Planning (*LSPP*), Maseru, Lesotho. Own Table made from information on aerial photos

Table 5.2 Topographic map and aerial photography data for STUDY AREA 2: village of Ha Maphohloane (Mohale's Hoek district)

Ha Maphohloane (Mohale's Hoek)						
Image	Year	Place	Strip no.	contract	Scale	Flight date on image
5	1976	Mohale's Hoek	LE 5 (038)	159	1:60,000	9 Oct 1976
6	1980	As above	LE 35 (043)	179	1:24,000	24 Apr 1980
7	1980	As above	LE 35 (042)	179	1:24,000	24 Apr 1980
8	1983	As above	(42)	–	1:20,000	17 Feb 1983

Source: Aerial photos from the department of Lands Surveys and Physical Planning (*LSPP*), Maseru, Lesotho. Own Table made from information on aerial photos

Table 5.3 Quickbird images used for the two study areas

Study Areas	Ha Paki, Mazenod	Ha Maphohloane, Mohale's Hoek
Co-ordinate centres	Latitude: – 29.412622	Latitude: –30.106078
	Longitude: 27.555036	Longitude: 27.441042
Projection system	UTM, ZONE 35, WGS 84	UTM, ZONE 35, WGS 84
Date and Year	02 May 2002, 06 Oct 2006	02 Nov 2002, 04 May 2004

Source: Includes QuickBird Products © DigitalGobeTM, distributed by e-GEOS

5.2.1 Pre-processing Aerial Photographs

Aerial photographs were pre-processed using ERDAS/IMAGINE (2003) software. Pre-processing involved geo-referencing all images to the local Transverse Mercator Clark 1880 projection system using a second-order polynomial transformation, and various Ground Control Points (GCP); resampling the images using the nearest neighbour method and calculating the Root Mean Square (RMS) errors for reach image transformation.

A Transverse Mercator Clark 1880 projection system has been chosen here because it is the commonly used coordinate system for Lesotho – so the wider scientific community can refer to the results obtained here (replicability).

To validate the accuracy of the resulting images, each individual image was first visually compared to the reference image (which is the 1:50,000 rectified topographic map for each area) and the resulting overlaid image was also compared to the reference image for each area and visually analyzed in ERDAS (2003) for consistency with the reference image. To achieve this, various selected features like main roads and rivers were used as reference points. Bi-temporal images for each site with the best positional match were chosen for use in visual change detection analysis.

5.2.2 Pre-processing Satellite Images

ERDAS (2003) software was used to pre-process satellite images. The resulting 2002 images for Ha Paki and Ha Maphohloane were projected to respective reference

maps using selected GCPs to the Transverse Mercator Clarke 1880 projection system. Geometric correction was achieved under ERDAS (2003) using Quickbird RPC geometric model, refined with a two-order polynomial equation, and resample using the nearest neighbour method. Accuracy assessment was performed on all the transformed images. Very high spatial (VHS) resolution images are a potentially rich source of geographic information. However, *"they are also associated with a high degree of variability and geometric errors that are difficult to constrain or correct"* (Glenn et al. 2005: 405). After adjustments of GCPs to yield transformations which correspond better with each other and further accuracy assessments, the resulting images were accepted for use in change-detection for the purposes of this study.

5.3 Image Classification

Classification can be seen as a process that assigns land-use classes to image pixels based on predetermined thematic properties. For classifying satellite images, seven land-use classes were identified based on relevance to the study area. The classes selected were: **water bodies, cultivated land, low vegetation/fynbos,**[1] **settlement/built-up/urban, main/tarred road, secondary/tertiary road and degraded/barren land** (Table 5.4). For the purpose of reliability and replicability, the interpretation of these classes was based on an adaptation of the *National Land cover Database project* classification system developed for South Africa (Thomson 1997). The suitability of these land-cover classes was further checked on the field visit in February 2007, via personal observation and discussions with key district officials in the respective District Councils, and discussions with residents of the two study areas. Field visits were undertaken in the two study areas, in February/March 2007, to carry-out a ground-truth survey of the two study areas. Ground-truth was used to verify the accuracy of classified satellite imagery. For the purposes of this study, ground-truth was performed to locate and check the different land-use classes. Some of the ground-truth points representing land-use classes are accompanied by digital photographs of the respective land classes (Figs. 5.1, 5.2, 5.3 and 5.4). The areas chosen for gathering ground-truth points were determined by their geographical distribution within the study area and surroundings, proximity to accessible roads and their ability to clearly represent respective land-use classes in the study areas. The ground-truth surveys and accompanying digital photographs, with other data, were partly used to assess the classification scheme and results of satellite image classification. Results of image classification are presented in Sect. 5.3.2.

[1] A fynbos is a type of scrubland, typically found in South Africa's Cape region, including short bushes with hard leaves; usually consisting of different type of plan forms such as *proteoids, ericoids and restoids.*

Table 5.4 Selected land-use classes and their definitions as used in this study

Land-use class	Class representative colour	Definition
Cultivated land/ field	Light green	Land that is ploughed or prepared for growing cops (excluding timber production). The category includes areas currently under crops, fallow land and areas being prepared fro crops. Class may include cover types like hedges, grass strips, small wind-breaks (Thomson 1997)
Tress/shrubs and other low vegetation	Dark green	class includes areas dominated by self-supporting woody man-managed or natural plants, like tree plantations or woodlots, both indigenous and exotic species; communities dominated by low woody self-supporting, multi-stemmed plants of less than 2 m (e.g. low Fynbos, Karroo and Lesotho alpine species) or non-woody self-supporting grass-like plants
Settlements/ built-up area	Purple	Man-made structures like houses and other buildings; excludes tarred roads and other transport-related infrastructure like bridges
Main/tarred road	Black	Transport route with a tarred surface; includes transport related infrastructures like bridges; may also include power stations or non-constructed areas within power stations; excludes secondary dirt-tracks
Secondary/tertiary road	Grey	transport route serving local communities leading to or away from main roads or within a villages; consists of dirt-tracks, foot-paths and other smaller transport routes without a concrete/tarred surface and no vegetation cover, typically found within villages
Degraded/barren land/field	Yellow	Non-vegetated areas or areas with very little vegetation cover compared to surroundings, where the substrate or rock exposure is clearly apparent; includes man-made and natural areas of very low vegetation or major soil erosion scars like sheet and gully erosion (donga), rock-features, sandy non-vegetated surfaces. Characterised on satellite imagery by significantly higher overall reflectance levels or whiter appearance (Thomson 1997)
Water-bodies/ wetlands	Blue	Surface water, natural and man-made, static or flowing, and fresh or salty; includes features like rivers, dams or reservoirs, lakes, streams
Shadows	Pink	Areas covered by shadows, created as a result of sensor angle and sun's reflection on image; includes shadows created by tress, shrubs, buildings, dongas, etc.

Adapted and modified from Thomson 1997 with permission

Pond/water-body. Notice the algal bloom growing on the pond.

Part of chief's compound/settlement

Mazenod Conference Centre/building

Pond/water-body

Fig. 5.1 Ha Paki, Mazenod. Zoom of original XS image (ground-truth survey February/March, 2007) showing marked areas. (**a–e**) Photos of marked areas are given. Black arrows show the direction of view (Source: Includes QuickBird Products © DigitalGobeTM, distributed by e-GEOS. With permission)

Photos[17] of Land-use in Mazenod, Maseru	Description
a 	**Picture showing sorghum field/cultivated land in the fore-ground and in the background is a modern settlement/house. Picture taken 4 Km from Moshoeshoe I International airport (February 2007).**
b 	**Picture showing typical secondary/tertiary road in the foreground, and in the background are new settlements/houses surrounded by cultivated fields/lands and shrubs/ low vegetation. The picture shows an example of settlement encroachment on agricultural lands. Notice river valley of the Phuthiatsana-ea-Thaba-Bosiu to the north of the houses. Picture taken on the road from Roma (February 2007).**
c 	**Trees/high vegetation - picture shows a woodlot with eucalyptus trees. The woodlot is found to the east of the tarred road towards Roma, past bridge crossing the Phuthiatsana-ea-Thaba-Bosiu. Tarred road in the foreground (February 2007).**
[17]Photos taken by Pendo Maro	
d 	**Cows grazing alongside M1 road south. Herd boy returning from Qeme plateau in the background which contains official communal grazing areas for Maseru district. Picture taken along M1 South road, south of the airport (October 2005)**

Fig. 5.2 Mazenod, Maseru. Photos showing different land uses in the area

Cultivated field–maize, off M1 road south, opposite Ha Paki village (March, 2007)

Fig. 5.2 (continued)

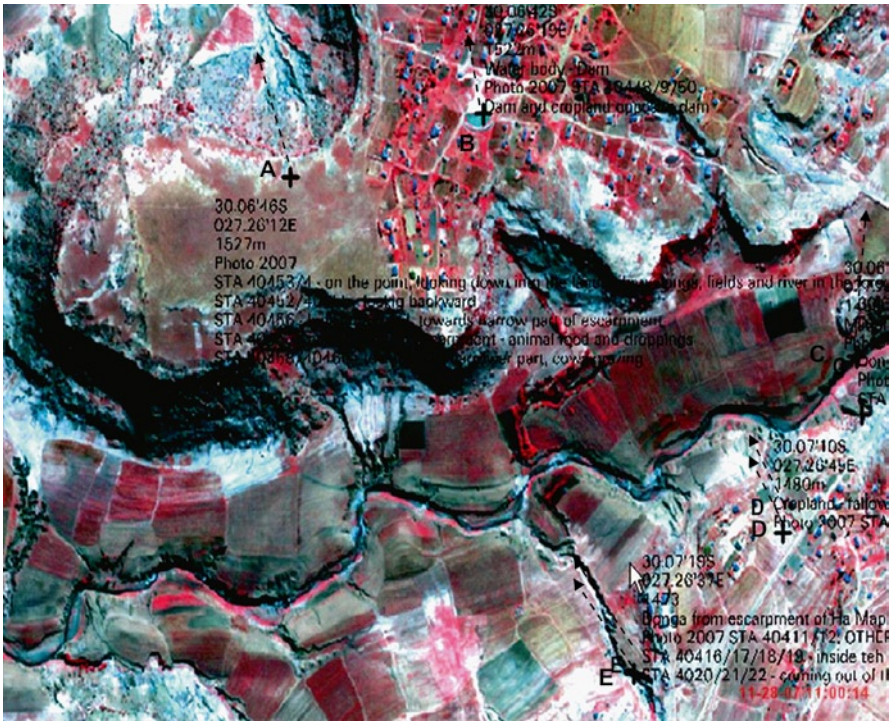

Fig. 5.3 Ha Maphohloane, Mohale's Hoek. Zoom of original XS image (ground-truth survey February/March, 2007) showing marked areas. (**a–e**) Photos of marked areas are given. Black arrows show the direction of view (Source: Includes QuickBird Products © DigitalGobeTM, distributed by e-GEOS. With permission)

Fig. 5.3 (continued)

To visually interpret land-use change on aerial photographs, three categories of land-use change for visual analysis: rural-to-urban, urban-to- rural and rural-to-rural (Table 5.13), were developed and used for this study. The focus of this study is on rural land-use change; therefore, urban-to-urban changes were not included here.

5.3.1 Accuracy Assessment

Accurate classifications are necessary to ensure accurate change detection results. This study used different methods to assess accuracy. First, digital photographs and corresponding ground-truth points were used to visually assess the accuracy of the classification, in some cases resulting in a need to re-classify the image. Second,

Photos[18] of Land-use in Ha Maphohloane Mohale's Hoek	Description
a 	**Secondary/tertiary road running through maize fields/cultivated lands at edge of Ha Maphohloane village (March,2007)**
b 	**Animals grazing on poor-cover fallow fields located to the south-west of previous picture (March, 2007)**
c 	**Severe soil erosion, in the form of a donga, on cultivated land/ field. This field has been rendered unusable for agriculture. Notice extension of the donga into fields/cultivated lands in the background (October, 2005)**

[18] Photos taken by Pendo Maro

Fig. 5.4 Ha Maphohloane, Mohale's Hoek. Photos showing different land use types in the area

accuracy assessment was performed under ERDAS (2003) using equal numbers of randomly selected reference points for each land-use class. A total of 30 reference points for each class were randomly selected and used for accuracy assessment. An error matrix and accuracy report was produced for each classified image and used to assess the classification accuracy.

Residential houses/settlements. Notice the satellite dish on the big house with the pink roof (March, 2007)

House/settlement showing an example of conservation farming–the rock structures are mini-vegetable-gardens used to trap and conserve moisture (March,2007)

Settlement/house and an example of re-using car bodies-in this case used to create a kraal for livestock. Cultivated lands/fields and scattered trees are seen in the background (October, 2005)

Fig. 5.4 (continued)

Results of accuracy assessments of land-use classifications for the two study areas yielded overall accuracies of 60.42% for Maphohloane 2002 image, 71.67% for Ha Paki 2002 image and 59.17% and 67.08% for Maphohoane 2004 and Ha Paki 2006 images, respectively. Two observations were made following a further visual assessment of the classified images and scrutiny of the accuracy matrix and accuracy report (Tables 5.5–5.12). First, it became clear that many pixels belonging to the 'secondary/tertiary road' land-use class were misclassified as 'degraded land/field'. Second, images 2002 Ha Paki and 2004 Ha Maphohloane contained shadows,

Table 5.5 Ha Paki, Mazenod 2002. Land-use classes: error matrix and accuracy assessment – before merging classes

	Cultivated land/fields	trees and shrubs	Settlement/ Built-up	Main road	Secondary road	Degraded land	Shadows	Water	Sum of rows	User's accuracy (%)
Cultivated land	**22**	**0**	**0**	**0**	**1**	**3**	**4**	**0**	30	**73**
Trees/shrub	**1**	**23**	**0**	**0**	**0**	**3**	**3**	**0**	30	**77**
Settlements/ Built-up	**1**	**0**	**26**	**0**	**0**	**1**	**2**	**0**	30	**87**
Main road	**1**	**0**	**1**	**19**	**1**	**3**	**0**	**5**	30	**63**
Secondary road	**2**	**0**	**0**	**0**	**6**	**22**	**0**	**0**	30	**20**
Degraded land	**1**	**0**	**0**	**0**	**2**	**27**	**0**	**0**	30	**90**
Shadows	**2**	**2**	**0**	**0**	**0**	**2**	**24**	**0**	30	**80**
Water-body	**0**	**0**	**0**	**0**	**0**	**3**	**2**	**25**	30	**83**
Sum of columns	30	25	27	19	10	64	35	30	240	
Producer's accuracy (%)	**73**	**92**	**96**	**100**	**60**	**42**	**69**	**83**		

Overall Classification Accuracy 71.67%

Table 5.6 Ha Paki, Mazenod 2002. Land-use classes: error matrix and accuracy assessment – AFTER merging classes

	Cultivated land/ fields	trees and shrubs	Settlement/ built-up	Main/tar road	Degraded land	Shadows	Water	Sum of rows	User's accuracy (%)
Cultivated land	22	**0**	**0**	**0**	**4**	**4**	**0**	30	**73.3**
Trees/shrub	**1**	23	**0**	**0**	**3**	**3**	**0**	30	**76.7**
Settlements/built-up area	**1**	**0**	26	**0**	**1**	**2**	**0**	30	**86.7**
Main/tarred road	**1**	**0**	**1**	19	**4**	**0**	**5**	30	**63.3**
Degraded land	**3**	**0**	**0**	**0**	57	**0**	**0**	60	**95.0**
Shadows	**2**	**2**	**0**	**0**	**2**	24	**0**	30	**80.0**
Water body	**0**	**0**	**0**	**0**	**3**	**2**	25	30	**83.3**
Sum of Columns	30	25	27	19	74	35	30	240	
Producer's accuracy (%)	**73.3**	**92.0**	**96.3**	**100.0**	**77.0**	**68.6**	**83.3**	73.3	
Overall Classification Accuracy 81.67%									

Table 5.7 Ha Paki, Mazenod 2006. Land-use classes: error matrix and accuracy assessment – before merging classes

	Secondary road	Settlement/ building	Degraded/ barren land	Field/ Cultivated land	Water-body	Trees/ shrubs	Main/tarred road	Shadows	Sum of Rows	User's accuracy
Secondary road	**6**	**0**	**19**	**3**	**1**	**1**	**0**	**0**	30	**20%**
Settlements/built-up	**0**	**15**	**6**	**5**	**2**	**0**	**1**	**1**	30	**50%**
Degraded	**4**	**0**	**21**	**5**	**0**	**0**	**0**	**0**	30	**70%**
Field/cultivate	**0**	**0**	**2**	**26**	**0**	**2**	**0**	**0**	30	**87%**
Water-body	**0**	**0**	**3**	**0**	**26**	**0**	**0**	**1**	30	**87%**
Trees/shrubs	**0**	**1**	**0**	**0**	**0**	**27**	**0**	**2**	30	**90%**
Main/tarred road	**0**	**1**	**0**	**0**	**1**	**0**	**28**	**0**	30	**93%**
Shadows	**0**	**0**	**5**	**4**	**1**	**8**	**0**	**12**	30	**40%**
Sum of Columns	10	17	56	43	31	38	29	16	240	
Producer's accuracy (%)	**60**	**88**	**38**	**60**	**84**	**71**	**97**	**75**		
Overall Classification Accuracy 67.08%										

Table 5.8 Ha Paki, Mazenod 2006. Land-use classes: error matrix and accuracy assessment – AFTER merging classes

	Settlement/ building	Degraded/	Field/ Cultivated	Water-body	Trees/shrubs	Main/tarred road	Shadows	Sum of Rows	User's accuracy (%)
Settlements/Built-up	15	**6**	**5**	**2**	**0**	**1**	**1**	30	**50.0**
Degraded	**0**	50	**8**	**1**	**1**	**0**	**0**	60	**83.3**
Field/cultivate	**0**	**2**	26	**0**	**2**	**0**	**0**	30	**86.7**
Water-body	**0**	**3**	**0**	26	**0**	**0**	**1**	30	**86.7**
Trees/shrubs	**1**	**0**	**0**	**0**	27	**0**	**2**	30	**90.0**
Main/tarred road	**1**	**0**	**0**	**1**	**0**	28	**0**	30	**93.3**
Settlements	**0**	**5**	**4**	**1**	**8**	**0**	12	30	**40.0**
Sum of Columns	17	66	43	31	38	29	16	240	
Producer's accuracy (%)	**88.2**	**75.8**	**60.4**	**83.9**	**71.1**	**96.55**	**75.0**		
Overall Classification Accuracy 76.67%									

Table 5.9 Ha Maphohloane, Mohale's Hoek, 2002. Land-use classes: error matrix and accuracy assessment – before merging classes

	Degraded/	Trees/ shrubs	Water-bodies	Secondary road	Field/ cultivated land	Settlements	Main/tarred road	Shadow	Sum of rows	User's accuracy (%)
Degraded/	**27**	**0**	**0**	**1**	**2**	**0**	**0**	**0**	30	**90**
Trees/shrubs	**2**	**24**	**0**	**1**	**1**	**0**	**0**	**2**	30	**80**
Water-bodies	**1**	**0**	**26**	**0**	**1**	**0**	**0**	**2**	30	**87**
Secondary road	**27**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	30	**10**
Field/cultivated	**5**	**1**	**0**	**3**	**21**	**0**	**0**	**0**	30	**70**
Settlements/Built-up	**8**	**0**	**2**	**0**	**5**	**14**	**0**	**1**	30	**47**
Main/tarred road	**1**	**0**	**8**	**0**	**0**	**2**	**19**	**0**	30	**63**
Shadow	**12**	**4**	**0**	**1**	**2**	**0**	**0**	**11**	30	**37**
Sum of columns	83	29	36	9	32	16	19	16	240	
Producer's accuracy (%)	**33**	**83**	**72**	**33**	**66**	**88**	**100**	**69**		
Overall Classification Accuracy 60.42%										

Table 5.10 Ha Maphohloane, Mohale's Hoek, 2002. Land-use classes: error matrix and accuracy assessment – AFTER merging classes

	Degraded	Trees/ shrubs	Water-bodies	Field/ cultivated land	Settlements/ built-up	Main/tarred road	Shadow	Sum of rows	User's accuracy (%)
Degraded	58	**0**	**0**	**2**	**0**	**0**	**0**	60	**96.7**
Trees/shrubs	**3**	24	**0**	**1**	**0**	**0**	**2**	30	**80.0**
Water-bodies	**1**	**0**	26	**1**	**0**	**0**	**2**	30	**86.67**
Field/cultivated	**8**	**1**	**0**	21	**0**	**0**	**0**	30	**70.0**
Settlements/built-up	**8**	**0**	**2**	**5**	14	**0**	**1**	30	**46.7**
Main/tarred road	**1**	**0**	**8**	**0**	**2**	19	**0**	30	**63.3**
Shadow	**13**	**4**	**0**	**2**	**0**	**0**	11	30	**36.7**
Sum of columns	**92**	**29**	**36**	**32**	**16**	**19**	**16**	240	
Producer's accuracy (%)	63.0	82.8	72.2	65.6	87.5	100.0	68.8		
Overall Classification Accuracy 72.08%									

Table 5.11 Ha Maphohloane, Mohale's Hoek, 2004. Land-use classes: error matrix and accuracy assessment – before merging classes

	Degraded	Trees	Settlement	Shadows	Secondary road	Water	Cultivated	Main road	Sum of rows	User's accuracy (%)
Degraded	**26**	**1**	**1**	**0**	**1**	**0**	**1**	**0**	30	**87**
Trees/shrubs	**2**	**25**	**0**	**1**	**0**	**0**	**2**	**0**	30	**83**
Settlements/Built-up	**16**	**0**	**10**	**1**	**0**	**1**	**2**	**0**	30	**33**
Shadows	**1**	**0**	**0**	**29**	**0**	**0**	**0**	**0**	30	**97**
Secondary road	**26**	**0**	**0**	**0**	**2**	**0**	**2**	**0**	30	**7**
Water	**5**	**0**	**0**	**2**	**0**	**23**	**0**	**0**	30	**77**
Cultivated land	**8**	**2**	**0**	**0**	**0**	**0**	**20**	**0**	30	**67**
Main road	**10**	**0**	**0**	**7**	**2**	**3**	**1**	**7**	30	**23**
Sum of columns	94	28	11	40	5	27	28	7	240	94
Producer's accuracy (%)	**28**	**89**	**91**	**73**	**40**	**85**	**71**	**100**	28	
Overall Classification Accuracy 59.17%										

Table 5.12 Ha Maphohloane, Mohale's Hoek, 2004.Land-use classes: error matrix and accuracy assessment – AFTER merging classes

	Degraded	Trees and	Settlement	Shadows	Water	Cultivated	Main road	Sum of Rows	User's accuracy (%)
Degraded	55	**1**	**1**	**0**	**0**	**3**	**0**	60	**91.7**
Trees	**2**	25	**0**	**1**	**0**	**2**	**0**	30	**83.3**
Settlements/Built-up	**16**	**0**	10	**1**	**1**	**2**	**0**	30	**33.3**
Shadows	**1**	**0**	**0**	29	**0**	**0**	**0**	30	**96.7**
Water	**5**	**0**	**0**	**2**	23	**0**	**0**	30	**76.7**
Cultivated land	**8**	**2**	**0**	**0**	**0**	20	**0**	30	**66.7**
Main road	**12**	**0**	**0**	**7**	**3**	**1**	7	30	**23.3**
Sum	99	28	11	40	27	28	7	240	
Producer's accuracy (%)	**55.6**	**89.3**	**90.9**	**72.5**	**85.2**	**71.3**	**100.0**		
Overall Classification Accuracy 70.42%									

Table 5.13 Categories for visual Land-use change analysis[a]

Category	Observed change	Explanation
1	Rural to urban	Serves as signal to indicate: • urbanization or economic development • could also signal in-migration or an increase in population • could signal an increase in settlements • could signal a decrease in agriculture and grazing land • may indicate (increasing) land degradation
2	Urban to rural	Serves as a signal to indicate: • a shift towards agriculture land-use in an otherwise developed area • increase in agricultural/grazing lands and decrease in settlements - abandonment of a settlement area/village • could also signal out-migration from an area; de-population
3	Rural to rural	Serves as a signal to indicate: • changes within agricultural land-uses e.g. could signal changes in cropping patterns, types of crops grown • changes between agricultural uses like between grazing and cultivation or vice-versa • changes from fallow land to agriculture and vice-versa, etc.

[a] The categories for visual land-use change detection were developed after visual investigation of land-use change during the two field visits in 2005 and 2007 respectively. The study areas are rural villages; no 'urban' changes were observed

mainly on trees, houses and dongas, that formed a class of its own in the Ha Paki image, which were not obvious in the classified images for 2006 Ha Paki and 2002 Ha Maphohloana respectively. An assessment was made of the user's accuracy, defined as the percentage of pixels classified on the map which actually represent that category on the ground (Glenn et al. 2005) and the producer's accuracy or percentage of reference pixels correctly classified. The two classes 'secondary/tertiary road' and 'degraded land/field' had the lowest producer's accuracies of all the classes (Tables 5.5, 5.7, 5.9, 5.11).

Given the above land-use classification discrepancies, the classification was improved through various means. A new class called 'shadows' was created on the two images with the most shadows (2002 Ha Paki and 2004 Ha Maphohloane) and later it was accounted for in their respective corresponding images through the use of 'recode' function under ERDAS (2003). The land-use class 'secondary/tertiary roads' was merged with the 'degraded land/field class to form one class bearing the latter's name. Accounting for the shadows and merging the two classes improved the classification, potentially reducing 'false alarms.' 'False alarms', particularly common in VHR images, are caused by the classifier's difficulty in distinguishing between two classes because of spectral heterogeneity and spatial variance in the image (Frauman and Wolff 2006). After improving the classification, the overall accuracies of the classification greatly improved, averaging an accuracy assessment of 75.21% for all images. No standard currently exist for assessing land-use classification accuracy of change-detection studies using VHR images (Frauman and Wolff 2006), however, for

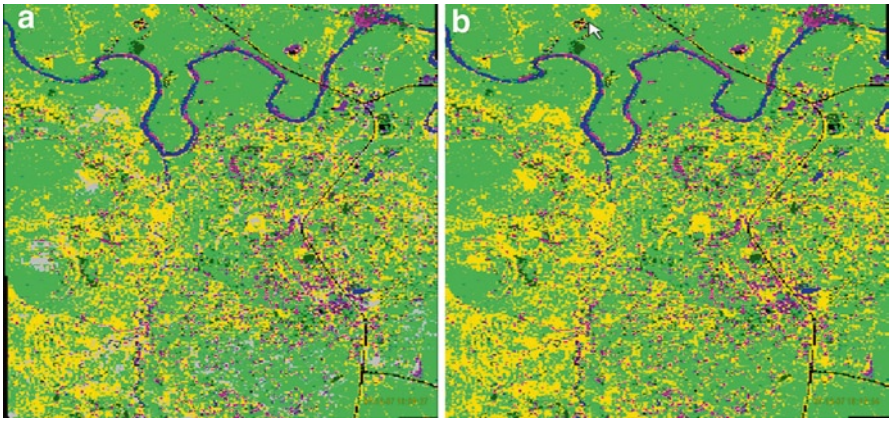

Fig. 5.5 (**a**) and (**b**) Ha Paki, Mazenod 2002: (**a**) classified image, showing the different land-use classes; (**b**) the same image after correcting for the two classes (Source: Includes QuickBird Products © DigitalGobeTM, distributed by e-GEOS. With permission)

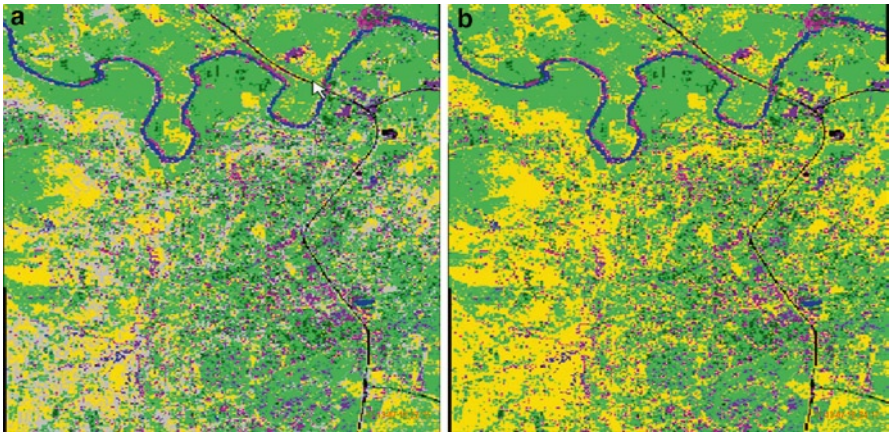

Fig.5.6 (**a**) and (**b**) Ha Paki, Mazenod 2006: (**a**) classified image, showing the different land-use classes; (**b**) the same image after correcting for the two classes (Source: Includes QuickBird Products © DigitalGobeTM, distributed by e-GEOS. With permission)

the purposes of this study, the accuracy assessment obtained after correcting the classification is considered very good, given the many data challenges.

5.3.2 Results

The classification scheme is presented below (Table 5.4). Classified images for each of the four multi-temporal images are presented below with their 'corrected' classifications which show an improvement in the classification results after

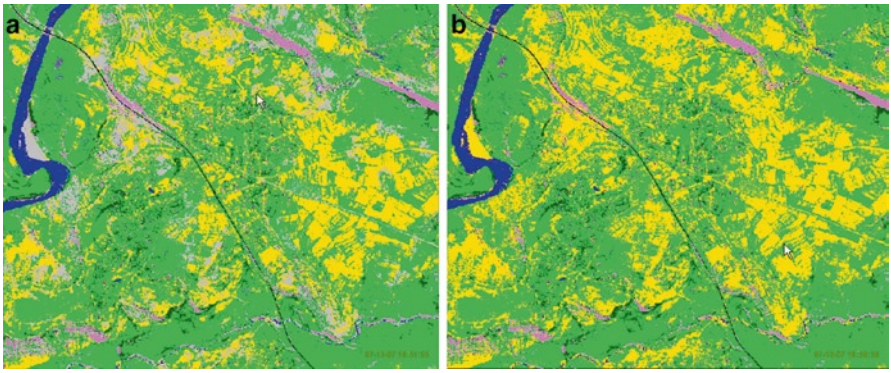

Fig.5.7 (**a**) and (**b**) Ha Maphohloane, Mohale's Hoek 2002: (**a**) classified image, showing the different land-use classes; (**b**) the same image after correcting for the two classes (Source: Includes QuickBird Products © DigitalGobeTM, distributed by e-GEOS. With permission)

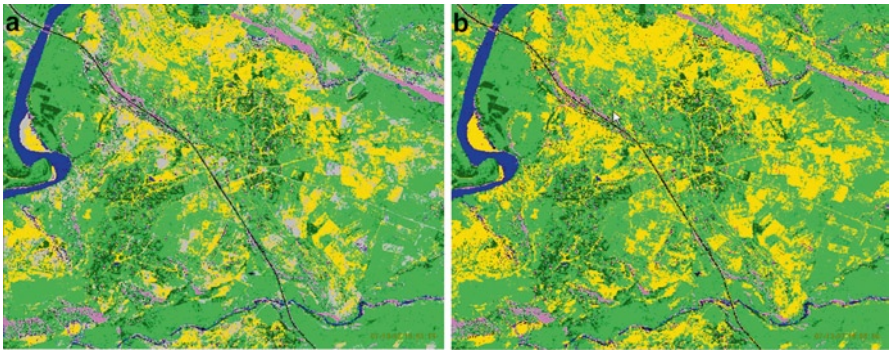

Fig. 5.8 (**a**) and (**b**) Ha Maphohloane, Mohale's Hoek 2004: (**a**) classified image, showing the different land-use classes; (**b**) the same image after correcting for the two classes (Source: Includes QuickBird Products © DigitalGobeTM, distributed by e-GEOS. With permission)

creating a shadow class and merging the 'secondary/tertiary road' and 'degraded land/field' classes (Figs. 5.3b, 5.4a, c, 5.5–5.8). The error matrices for before and after improving image classifications are given (Tables 5.5, 5.7, 5.9 and 5.11).

5.4 Change-Detection

Change-detection was carried out in this study using visual change-detection analysis and a modified post-classification analysis. In visual analysis, the criteria described on Table 5.13 were used to analyze land-use change on the bi-temporal aerial photos for the two sites.

Quantified land-use change was effectuated on the post-classified satellite images. Quantification of land-use change was performed by subtracting the number of pixels under each class, for the two-time period. This yielded quantifications of land-use change for each set of bi-temporal images. The results represent the quantity of land-use change between the 2 years, under each class, for each study period, which can be used to compare with results obtained in the visual change-detection and perception analysis.

5.4.1 Visual Analysis of Land-Use Change: 1960–1980s

Aerial photos for 1961 and 1985 were used to analyze land-use change in Mazenod during the period 1960–1980s. The resulting overlapping image was visually analyzed for land-use changes on the basis of criteria given on Table 5.13. For Ha Maphohloane, two images for 1980 and 1983 were used for visual change detection. The results of this assessment are presented in Sects. 5.4.1.1 and 5.4.1.2 (Figs. 5.9a–c, 5.10a–c).

5.4.1.1 Visual Land-Use Changes: Ha Paki, Mazenod 1961–1985

Rural-to-urban changes

- New tarred (main) road on 1985 image, not there on 1961 image. Two new bridges, one on the new road going north-south and the other on the road going east
- New/increased settlements near road and other areas surrounding the road and bridges – settlements built on previously agricultural areas and others on areas degraded in 1961 (settlement expansion into agricultural and degraded lands)
- unidentified feature – shiny feature on the 1985 image which was not there in 1961 – feature could be located where there was a dam, close to the tributary of the Phuthiatsana-Ea-Thaba Bosiu River going south (later it is called the Koro-Koro River). It is included under this category because it is assumed that if it is located on what was once a dam, it might indicate that the land is being prepared for future development

Urban to rural changes

- Tertiary (dirt track) road that was in 1961 is now lost, but replaced by tarred road close-by.

Rural to rural changes

- land fragmentation and new fields/ subdivision of old ones. Some fields and land assumed to have been pastoral/grasslands in 1961, appears as subdivided into cropping fields and settlements and degraded lands – particularly along or near primary and secondary roads - some of these areas are located near main

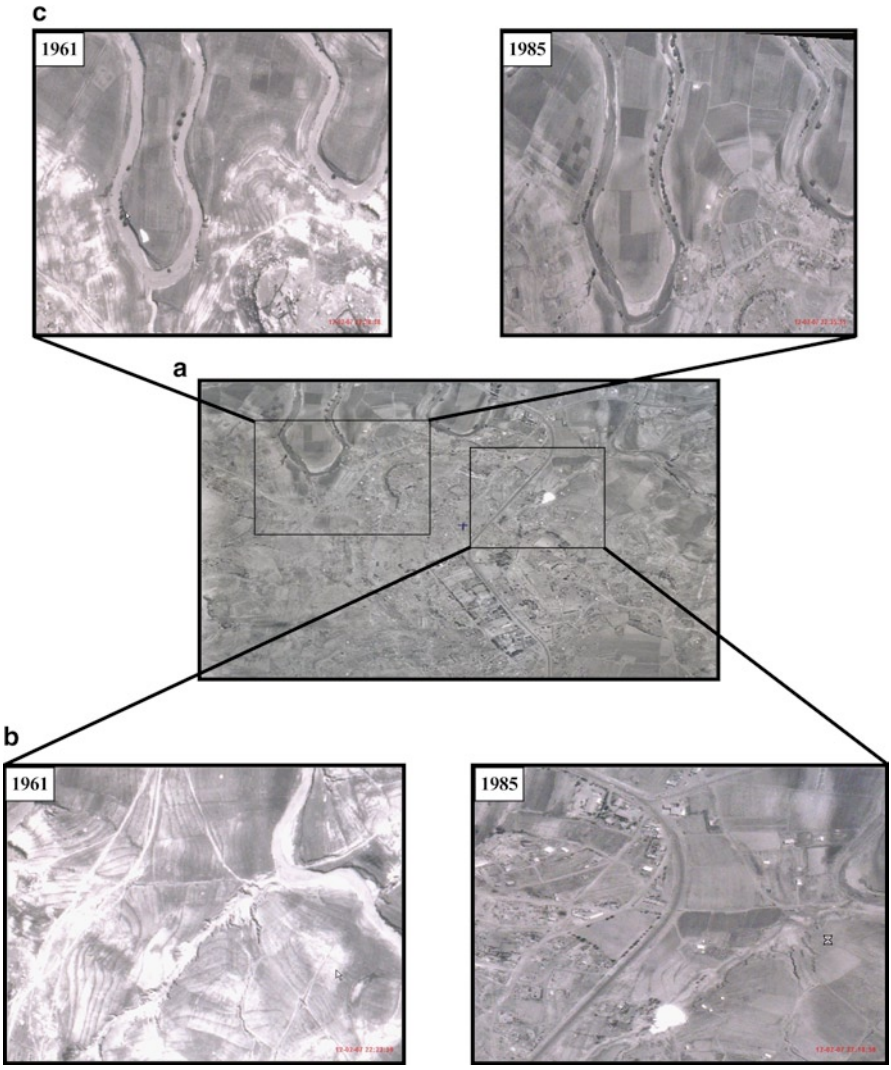

Fig. 5.9 (**a**) Mazenod land-use changes for category 1 changes. A close-up of the area enclosed by the box is given for the years 1961 and 1985 (Source: department of Lands Surveys and Physical Planning (LSPP), Maseru, Lesotho. With permission). (**b**) Land-use change in Mazenod 1961–1985: Notice the new tarred road, increased settlements and unidentified feature in the 1985 image (Source: Aerial photos from department of Lands Surveys and Physical Planning (LSPP), Maseru, Lesotho. With permission). (**c**) Land-use change in Mazenod 1961–1985. Notice land fragmentation, changes in part of the shape of the river Phuthiatsana, increased shrubs/tress along the river, some changes in cropping style, land that was degraded in 1961 appears as settlements in 1985. Notice presence of the unidentified feature on part of the 1961 aerial photo and not on that of 1985 (Source: department of Lands Surveys and Physical Planning (LSPP), Maseru, Lesotho. With permission)

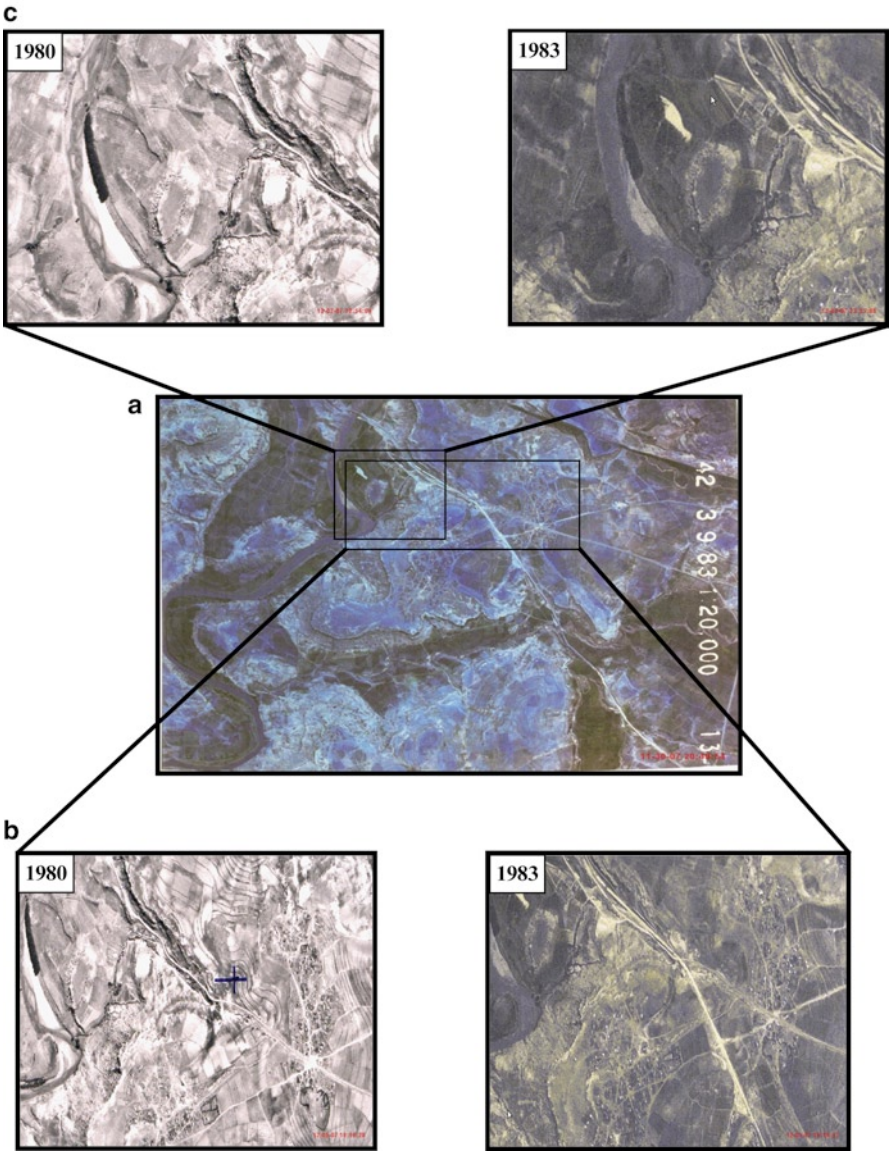

Fig. 5.10 (**a**) Ha Maphohloane, Mohale's Hoek land-use changes for category 1 change. A close-up of the area enclosed by the box is given for the years 1980 and 1983. (Source: department of Lands Surveys and Physical Planning (LSPP), Maseru, Lesotho. With permission). (**b**) Land-use change Ha Maphohloane, Mohale's Hoek 1980–1983. Notice the new road running south-east of Ha Maphohloane, some increases in settlements in 1983 and an 'unidentified' feature in the shape of a bird (it is assumed that this could be a dam/water reservoir) (Source: Aerial photos from department of Lands Surveys and Physical Planning (LSPP), Maseru, Lesotho. With permission). (**c**) Land-use change in Ha Maphohloane, Mohale's Hoek 1981–1983. Notice the dam in 1980 which on the 1980 aerial photo appears drier (the outline is visible), and the change in river appearance which appears drier in 1980 (Source: department of Lands Surveys and Physical Planning (LSPP), Maseru, Lesotho. With permission)

(tarred) and secondary roads, indicating fragmentation due to road construction/presence (economic development encroaching into agriculture lands)
- changes in the shape of the River Phuthiatsana –Ea- Thaba Bosiu are noted in 1985: signs of soil sedimentation observed in 1985 (on the portion of the river visible on the overlapping area)
- increased shrubs/trees along part of river that is on the image; other areas had some trees/shrubs in 1961 but in 1985 these have been replaced by settlements and fields
- some change in cropping style –away from what is seen as contour planting in 1961
- area that was degraded in 1961 appears as settlements (with/and) fields – especially around primary and secondary roads

5.4.1.2 Visual Land-Use Changes: Ha Maphohloane, Mohales's Hoek 1980–1983

Rural to urban changes

- new road construction
- increase in/new settlements
- 'Unidentified' object in the shape of a bird – water-body

Urban to rural changes

- None observed

Rural to rural changes

- dam that was there in 1980 seems to have dried up/disappeared in 1983
- changes in the river's appearance – in 1983 the portion of the River Makhaleng that is visible on the overlaid image appears to have more water than the same portion of the river in 1980 (it looks much drier, with less volume and more silt deposits)

5.4.2 Visual Analysis of Land-Use Change: 1980–2000s

The 1985 pre-processed aerial photo of Ha Paki was overlaid onto the 2002 pre-processed satellite image of the same area and visually analyzed for land-use change. A similar procedure was applied to produce an overlaid image of Ha Maphohloane for the years 1980 (pre-processed aerial photo) and 2002 (pre-processed satellite image) respectively. Owing to the unsatisfactory result of the overlap, the bi-temporal images for the two study sites were analysed for land-use changes individually on-screen and off, with the help of digital photographs and other secondary data . The resutls are presented below (Sects. 5.4.2.1 and 5.4.2.2).

5.4.2.1 Observed Land-Use Changes: Ha Paki, Mazenod 1985–2002

Urban to rural changes

- Increase in settlements – extending northwards along roads towards the river, westwards and towards the south
- Land degradation and footpaths – changes observed but difficult to determine visually whether the changes are real increases or decrease

Rural to urban changes

- Increase in land fragmentation – land parcels/fields seen to be subdivided particularly where settlements have increased

5.4.2.2 Observed Land-Use Changes: Ha Maphohloane, Mohale's Hoek 1980–2002

Urban to rural changes

- Increase in settlements – extending north-easterly direction towards dyke and westerly direction along the plateau; settlements have also increase in a south-easterly direction along new road. Settlements are seen to be encroaching into agricultural fields/cultivated land – assumption is that there will be a reduction in cultivated land/fields
- News tarred road – dividing Ha Maphohloane village in two, settlements have increased along this road
- Land degradation and footpaths – changes observed but difficult to determine visually whether the changes are real increases or decrease

Rural to urban changes

- Increase in land fragmentation – land parcels/fields seen to be sub-dived particularly where settlements have increased

5.4.3 Quantifying Land-Use Change: 2002–2004/2006

Results of changes in land-use within the different classes for the years 2002 and 2006 for Ha Paki and 2002 and 2004 for Ha Maphohloane are in this section. During that period, the main land-use changes in Ha Paki were: an increase in land degradation, trees/shrubs, and a decrease in cultivated land and settlements. A decrease in settlements contradicts the findings presented in Sects. 5.4.1 and 5.4.2, but the other changes are similar. In Ha Maphohloane, for the period 2002–2004, there was an increase in trees/shrubs, settlements and main/tarred roads, and a decrease in cultivated land and degraded land. The decrease in degraded land con-

Table 5.14 Quantified land-use change in Ha Paki, Mazenod 2002–2006

	2006 Ha Paki (pixels)	2002 Ha Paki (pixels)	Differences (pixels)	Differences (km^2)
Settlements	483,934	706,199	−222,265	−0.08
Vegetation/low trees	1,170,041	789,572	380,469	0.14
Main/tarred road	180,820	280,159	−99,339	−0.04
Water/water bodies	315,653	408,124	−92,471	−0.03
Degraded lands/fields	9,263,509	7,982,662	1,280,847	0.48
Cultivated land/field	9,212,665	11,456,429	−2,243,764	−0.84
Shadows	748,093	748,093	0	0
Unclassified	465,410	464,932	478	0.00

Table 5.15 Quantified land-use change in Ha Maphohloane, Hohale's Hoek 2002–2004

	2004 Ha Maphohloane (pixels)	2002 Ha Maphohloane (pixels)	Differences (pixels)	Differences (km^2)
Settlements	429,079	228,328	200,751	0.08
Vegetation/low trees	2,454,877	788,954	1,665,923	0.63
Main/tarred road	298,111	90,989	207,122	0.08
Water/water bodies	581,607	529,075	52,532	0.02
Degraded lands/fields	10,107,672	10,335,329	−227,657	−0.09
Cultivated land/field	12,093,839	14,429,852	−2,336,013	−0.89
Shadows	998,911	1,005,679	−6,768	−0.00
Unclassified	0	53,872	−53,872	−0.02

tradicts the findings for previous years of the same area, while the increase in settlements and a decrease in cultivated lands are on a par with those findings (Sects. 5.4.1 and 5.4.2).

5.4.3.1 Results

Tables 5.14 and 5.15

5.5 Analysis of Land-Use Changes

An analysis of land-use change results offers a better understanding of the nature of changes in the two study areas, during the study periods. This section seeks to comparatively assess the change-detection results over the different periods, for the two study areas.

5.5.1 *Towards Urbanization and Economic Development?*

The study areas in Mazenod (1961–1985 and 1985–2002) and Mohale's Hoek (1980–1983 and 1980–2002) show evidence of urbanization and economic development. These are marked by a new road construction, an increase in settlements, and by implication, a population increase. A closer inspection of the villages of Ha Paki and Ha Maphohloane indicate similar trends occurring to date (personal observation, 2005 and 2007). In Ha Maphohloane (2002–2004) the findings show an increase in settlements, equivalent to 8 ha. However, in Ha Paki, findings of land-use change for the period 2002–2006 show a decrease in settlements, equivalent to 8 ha. The decrease in settlements shown in the latter findings may be attributed to the accuracy of the classification. Accuracy assessment for Mazenod 2006 (Table 5.8) shows a User's Accuracy of 50% for the 'settlements' class, meaning that only 50% of the pixels classified on the map (Fig. 5.6a, b) actually represent that category on the ground. The reason is perhaps best illustrated by the error matrix which shows that some of the pixels belonging to the 'settlements' class were classified as 'fields/cultivated lands' and 'degraded lands' (Table 5.8). The 'settlements' class classified under 'field/cultivated land' had pixels of spectral qualities similar to 'field/cultivated land' class – in this case, these generally belonged to greenish-grey roof-tops similar in colour to the 'field/cultivated land' class. Similarly, 'settlements' classified as 'degraded lands' had pixels identical to the latter class. These belonged mostly to roof-tops that had a higher reflection rate (e.g. corrugated iron roofing sheets), which resulted in the roof-tops' whiter spectral appearance similar to 'degraded lands'. So the figures on 'settlements' class for Ha Paki will be discarded.

In Mazenod, the new road going north-south and towards Roma, was built in 1979 (Danziger, 2005, personal communication), as part of construction of Moshoeshoe I International Airport. In Mohale's Hoek the new road construction began after 1980. Encroachment of settlements onto prime agricultural land in Lesotho has led to a decrease in arable land which in turn leads to a decrease in crop production (Land Policy Review Commission 2000: 66). The Land Policy Review Commission (2000) identified areas around Maseru and Maputsoe as examples of areas where settlements are being established on prime agricultural land, concurring with the results obtained by this study.

An increase in settlements can reflect increasing population, like that resulting from in-migration. High out-migration areas are the eastern Highlands, mostly towards the north and western districts of the country. About 55% of Lesotho's population lives in the Lowland region, with a majority living in Maseru (Lesotho Statistical Yearbook 2008). Migration is dependent on age, education and skill level, and gender. In Lesotho, the majority of internal migrants are in the age group 15–29, mostly women with some educational qualifications (Bureau of Statistics 1996 and UNFPA: 97).

Road building in predominantly rural areas improves accessibility and mobility to and from the area. Accessibility and improved mobility potentially affect land-use

patterns, land-use preferences and decisions on land-use. Studies elsewhere have found a direct geographical relationship between road networks, distribution of natural resources and land-use systems (e.g. Castella et al. 2005). The Lesotho Highlands Development Project (LHDP), for example, has resulted in improved access and improved infrastructure e.g. roads, schools and healthcare services, to remote mountainous villages in the Lesotho Highlands region. However, to date there are still contentious issues surrounding compensation of displaced people (as a result of dam construction and related developments) and negative environmental impacts of some parts of the project (Hildyard 2000; Pottinger 1996).

Opening up transport routes is often implicated in urbanization and economic development. In this study, the term 'urbanization' is used to denote 'urbanization-type' change in predominantly rural areas, and not to the classical meaning of urbanization.[2] The difference is that, urbanization as defined here is said to occur in predominantly rural areas and not in cities, as in the classical definition of urbanization. Bid rent theory is often used to explain the effects of urbanization on land-use change. According to this theory "*… patterns of land use are determined by land values that are, in turn, related to transportation costs.*" Thus, the more accessible an area is, the higher its land-value. Such a notion would eventually encourage the development of a land market – formally or informally. The development of a land market, coupled with increasing demand for settlements, would act as an economic incentive to sell land for settlements rather than use it for agricultural purposes – particularly where the earning potential is higher for selling land than for agricultural activities. This could partially explain the increase in settlements in the two study areas.

Given that Mazenod is about 15 km south of Maseru, the presence of a tarred (new) road potentially acts as a pull factor, proving accessible and available alternative residence and business options for people who want to have a home or (retail) business near, but not in the city. Rural-urban migrants are one group who might find this a favourable residential option, given its proximity to Maseru, accessibility, and low house/land rents compared with Maseru. In the case of Mazenod, the most favourable, sought-after land would be nearest to the (new) road – as is indicated in the images for Mazenod. Recent field visits to the area (personal observation, 2000, 2001, 2005, 2007) confirm an increase in settlements (Fig. 5.11a, b) along the (new) main south road. A similar observation was made in Mohale's Hoek (Fig. 5.11c). Newly-built homes were also observed in the villages of Ha Paki and Ha Maphohloane (personal observation, 2005 and 2007).

An increase in settlements and road development is happening at the expense of agriculture. This is shown in Mazenod and Mohale's Hoek (1960–2000s) as encroachment into fields/crop lands; and in a few cases, encroachment into degraded lands. In Ha Paki (2002–2006) the study findings show a decrease in fields/cultivated lands equivalent to – 84 ha, while in Ha Maphohlonae (2002–2004) the decrease was recorded as – 89 ha. A decrease or loss of fields/cultivated lands may be translated into landlessness and low agricultural productivity. It could also be an

[2] The shift of a society from rural to urban areas and increasing economic activity.

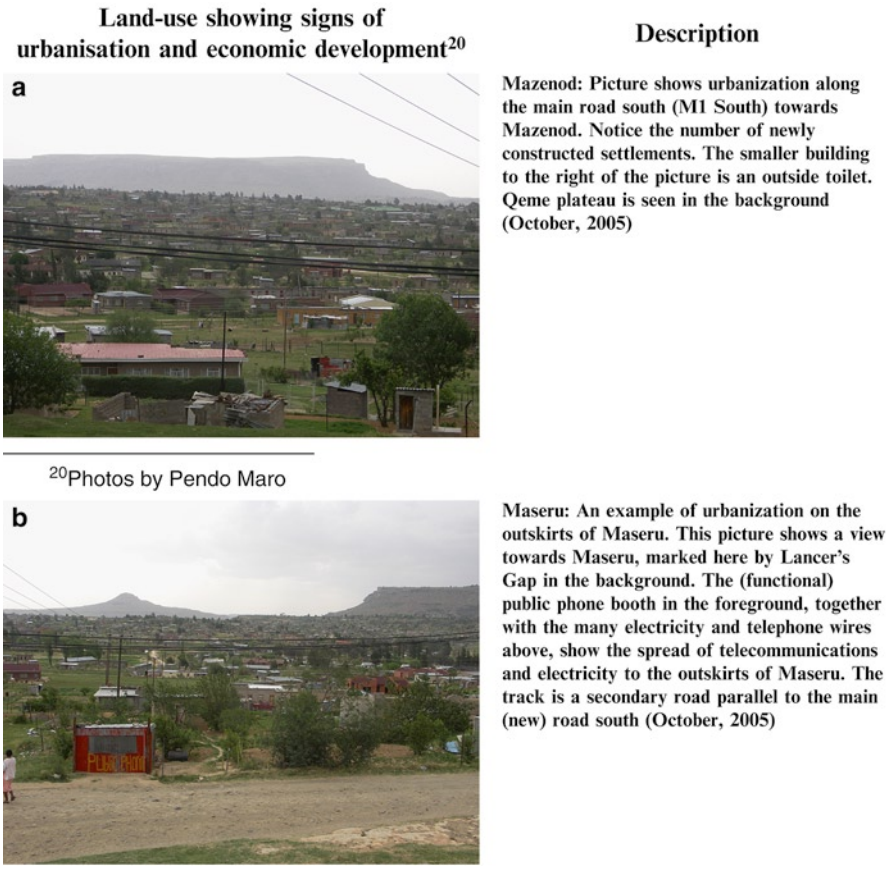

Fig. 5.11 Land-use showing signs of urbanisation and economic development (photos taken by Pendo Maro)

indicator of other underlying drivers of land-use change, for example, changes in rainfall patterns or drought.

Agricultural censuses of 1970, 1980 and 1990, for example, indicate a general increase in landlessness in Lesotho. In Maseru, the percentage of rural households without land for 1970, 1980 and 1990 is given as 14.19%, 22.30% and 60.52% respectively; while for Mohale's Hoek district a similar general increase in landlessness is also noted: 9.29%, 20.20% and 60.47% for the same years respectively (Bureau of Statistics 1994: 4). A decline in agriculture between 1979 and 1989 is documented (Monaheng 2003). The agricultural period 1999/2000 – 2004/2005 (FAO 2005), shows a steady national decline in cereal production (FAO 2004, 2005). The agricultural year 2006/2007 was a drought year, resulting in severe crop failures. Between 1990 and 1999 the agricultural sector accounted for 20% of the gross domestic product (GDP) in Lesotho; a 31% decrease from 1979 (Monaheng 2003: 1).

Mohale's Hoek commercial centre. Picture shows urbanization and the spread of businesses along the (new) road. (October, 2005)

Mazenod: Picture shows a portion of Mazenod. The water feature in the middle, southern half of the picture is the 'unidentified object' identified here as a dam. The River Phuthiatsana-Ea-Thaba Bosiu is seen in the background. Notice where the (new) road to Roma crosses the river. Crossing the picture horizontally (east-west), is the (new) main road south – Moshoeshoe I International airport is to the west of the picture. To the north of the road, between the road and the river is the village of Ha Paki (October, 2005)

Fig. 5.11 (continued)

The secondary sector (manufacturing and construction) accounted for 38%, over the same period – an increase of 23% from 1979; while the tertiary sector accounted for 42% of the GDP (Monaheng 2003:1). Since 1999, the output of agriculture as a share of total GDP has remained between 16.5% and 18.5% (of GDP at producer's prices in 2005) (Bureau of Statistics 2005). A decline in the productivity of the agricultural sector in Lesotho is noted between 1999 and 2004 (Lesotho Statistics Yearbook 2008). As explained in Chap. 3 (Sect. 3.1.3), the mining sector, together with the manufacturing and telecommunications sectors are expected to be the largest contributors to economic growth in 2010, projected at 3.6.% growth compared to 2.1% in 2008 (Minister of Finance and Development Planning Budget Speech to Parliament 2010).

A detailed analysis of the 'unidentified' object found on the 1985 image of Mazenod (Sect. 5.4.1.1) concludes that the shiny feature is a dam. This was confirmed by examining recent photographs taken from a flight between Johannesburg and Maseru (Maro, October 2005: Fig. 5.11d). The dam's appearance as a shiny feature – possibly due to the sun's reflection during the original flight - led to its interpretation as a 'development' site. Given this confirmation, this observation is

now discarded. The 'birdlike' feature found on the 1983 image (Sect. 5.4.1.2) of Mohale's Hoek (and not the 1980 image) occurs at the exact place where there was a dam in 1980. Yearly rainfall figures for Lesotho, for the years 1979/80 and 1980/ 81 indicate the following amount of rainfall in mm: 684.8 and 796.8 mm respectively (an average of 690.80 mm for 1980); compared to 538.6 and 668.8 mm (average of 550.36 mm for 1983) in 1982/83 and 1983/84 respectively (Bureau of Statistics 1994: 5). 1983 is known as a drought year (ACC/SCN 1988). Therefore, the 'disappearance' of the dam can be explained in light of the reduced rainfall of 1983.

5.5.2 Land Degradation and Changes in Vegetation Cover

The research findings show the prevalence of land degradation, notably in Ha Maphhloane and Mohale's Hoek in general. It was not possible to quantify changes in degraded land by using visual change-detection (1980–2000s). National land-cover change analysis points to an 11.9% increase in degraded land and a 27.1% increase in forest plantation, between 1989 and 1994 (Sevenhuysen, 1999 in Land Review Commission 2000: 61). Our findings for Ha Paki show an increase in degraded land during the period 2002–2006, equivalent to 48 ha. In Ha Maphohloane (2002–2004), however, there was a decrease in degraded land, equivalent to – 9 ha. This decrease is not thought of as a real decrease on the ground, but can be explained with reference to the Producer's Accuracy. The Producer's Accuracy for Ha Maphohloane 2004 show that only 55.56% of reference pixels for the class 'degraded land' were correctly classified (Table 5.12), meaning that about 44% of 'degraded land' that appears on the ground was not represented on the classified map (Fig. 5.8a, b) resulting in the lower quantity of 'degraded land' for this year compared to 2002. Seasonality differences between the two images and differences in positioning of the sun reflection may be the main causes.

A previous study on Lesotho concluded that most degraded areas were found around settlements (Rydgren 1988). In our study degraded lands were mostly visible on various fields as well as around settlements/houses. An increase in degraded land can be implicated in reduced size and/or quantity of household field(s) and in reduced agricultural productivity and soil fertility. *"Crop yields are in general very low in Lesotho because most of the cultivated soils have low levels of fertility and poor moisture retention capacities (…). Crop production is heading towards a serious crisis and could cease altogether if steps are not taken to reverse the decline in soil fertility"* (FAO 2001).

The presence of increasing trees/shrubs in some sites in the study areas was observed in Ha Paki (1961–1985). Most families in Lesotho plant trees mainly for shade or fruit (Lesotho National Report on Climate Change 2000). An increase in 'Trees/shrubs' in Ha Paki (2002–2006) and Ha Maphohlonae (2002–2004), equivalent to 14 and 63 ha, respectively, was also noted. According to other studies on Lesotho, in 1979/80 *"2599 ha of trees had been planted in 148 separate woodlots ranging in size from less than ten hectares to more than one hundred*

(Report of Review Mission 1980), and by the beginning of 1989, 9000 ha of trees were reported to have been planted" (Showers 2006). The trees were planted on land which was considered unsuitable for agriculture and grazing, and also in dongas. People's desire to plant trees during this period was partly driven by a government food-for-work programme that 'employed' villagers (mostly women) to plant and maintain woodlots (Showers 2006). This increase in trees is expected to continue to reach the target for planting 1.5 million trees annually, with a goal of increasing national tree cover from less than 1% to 5% by the year 2020, as set by the Ministry of Forestry and Land Reclamation – which was created in 2003 (Showers 2006). In parallel to this, of the 6,131 ha of woodlot established between 1973 and 1992, 4,231 ha required re-planting in 2004 (Kingdom of Lesotho 2004, in Showers 2006:27).

5.5.3 *Land Fragmentation and Changes in Agricultural Patterns*

Subdivisions of agricultural land generally lead to land fragmentation. Fragmentation "*of a farm, (is) the division of land of a FARM into separate, isolated parts. If the farm remains a single holding it may become difficult to work as a single unit if the land is divided (e.g. if the construction of a MOTORWAY cuts through the farm). If the fragmentation is the result of the law of equal inheritance the land being parcelled out to family members, a number of small farm units of doubtful economic viability may be created.*" (Clark 1985: 228).

Visual land-use change noted an increase in land fragmentation in Ha Paki (1960–2002) and Ha Maphohloane (1980–2002). This was mostly apparent on fields/cultivated lands near (new) road and rivers and also around settlements. Land fragmentation leads to reductions in land holdings, potentially in land ownership, a loss of soil fertility and reduced yields (Berry et al. 2003), with negative effects on rural livelihoods. As was stated in the previous section, an increase in landlessness between the years 1970, 1980 and 1990 is noted in Lesotho. The loss of farmland to urban development has negative effects on wildlife habitats and the quality and quantity of water resources (McInnes 2010). Another study concluded that land fragmentation can have a positive impact on farm biodiversity and crop profitability (Di Falco et al. N.D.). This has implications for policy aimed at increasing land consolidation. Thus, even if policies were designed to promote land consolidation, they may fail and farmers may prefer to keep the number (and spread) of fields in the fragmented state.

Land fragmentation is caused by various factors. The traditional Sesotho holding consists of various small fields (wedged in between those cultivated by other people) scattered throughout a village area (Morojele 1963; Part 3: 33); often falling under the jurisdiction of a village chief or headman. Traditionally, each adult has the right to three fields. Theoretically, these are used for maize, sorghum and wheat (Report

of Land Policy Review Commission. 2000). The distance of the fields from the household and from each other may make it difficult for farmers to manage their fields efficiently; it is also more expensive to operate scattered plots of lands (Report of Land Policy Review Commission. 2000), the distance often acting as a disincentive to invest in land management techniques. In this study, field sub-divisions were found to occur mostly near the new road – indicating that population pressure due to urbanization, may be the underlying cause of land fragmentation in the study area. Land fragmentation is partially implicated in changes in land management techniques, like a shift away from contour cultivation (Fig. 5.9c). Contour cultivation is a characteristic of Lesotho agriculture. The practice involves growing crops along contour lines to conserve moisture and decrease soil erosion. Remnants of earlier contour planting are evident throughout Lesotho – particularly visible on the mountain slopes in the Highlands.

5.5.4 Changes in River Flow

Changes in the flow of Phuthiatsana-Ea-Thaba Bosiu and Makhaleng rivers were observed for the period 1961–1985 and 1980–1983 respectively. The portion of the Phuthiatsana-Ea-Thaba Bosiu observable on the Mazenod image (1985) shows signs of increased sediment deposition along the river banks and meanders. Several explanations are possible. This could indicate that the river has reached a developmental stage termed 'old age' – marked by broad valley, an increase in sediment and deposition and a sluggish flow of water (Clark 1985). Another most possible explanation is seasonality. This is determined by the date on the aerial photograph. In this case, the 1961 image is dated April 18, while the 1985 image is dated January 12. January and February are the hottest months in Lesotho, the middle of the summer, with temperatures of about 30°C in the Lowlands, and a mean summer temperature of about 25°C (Lesotho Statistics Yearbook 2008). The rainy season extends from October to April, with most rain falling during January–March and October–December (Fig. 5.12, long-term mean monthly 1961–1990). The observations above most probably reflect this seasonal trend. The river would have more water during the rainy season and thus an increase in sediment load that can be deposited along its banks.

The Makhaleng River forms part of the three main river systems in Lesotho (together with the Senqu/Orange and Mohokare/Caledon), with a catchment area of 2,911 km^2. It originates in the vicinity of Mount Machache and leaves the country near Mohales Hoek (Lenka 2007: 2). The portion of the Makhaleng River visible on the Mohales' Hoek image (1983) shows an increase in river volume. As stated above, 1983 was a drier year compared to 1980. Therefore, what the visual land-use change analysis detects as an increase in river volume in 1983 is refuted here as possibly a result of errors in co-registration of this portion of the image or a not-so-perfect overlap between the images 1980 and 1983 for Mohale's Hoek, rather than a real increase in the volume of the river in 1983.

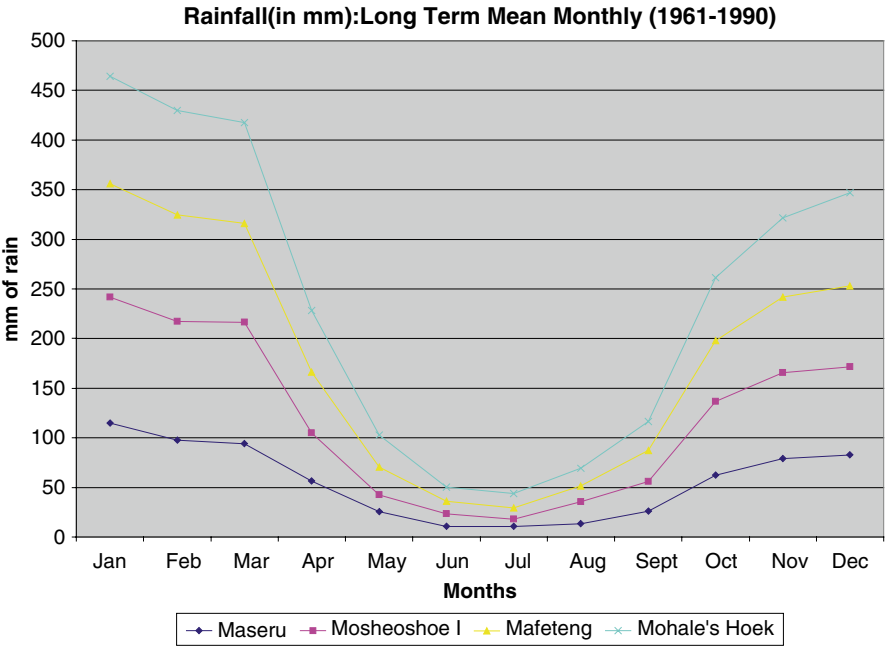

Fig. 5.12 Long-term mean monthly rainfall for Lesotho (1961–1990). The rainy season is marked here as October–March. The winter months are the driest (Source: own graph, made from data from Bureau of Statistics)

5.6 Summary

Many changes in land-use were recorded for the two study areas. This chapter has responded to the questions posed on Sect. 5.1. From the findings, it can be concluded that the major changes during the study periods occurred within the rural-urban and rural-rural land-use categories. These are marked by biophysical and socio-economic implications. These changes can be broadly presented as:

- Increase in urbanization and economic development
- increase in settlements and population increase
- encroachment of settlements into agricultural lands and land fragmentation
- increase in land degradation and changes in vegetation cover
- changing climatic conditions and changes in river flows

Major land-use changes identified through remote-sensing analysis are given below (Table 5.16). An increase in settlements and land degradation and a decrease in crop lands were confirmed by these results. Another major change identified was an increase in woodlots.

Consequently, it is suggested here that improved accessibility and a changing climate have a major function in driving land-use changes in Ha Paki and Ha Maphohloane. Interestingly, both these areas were marked by similar land-use

Table 5.16 Summary of the major land-use changes in the two study villages

Major land-use change	Ha Paki	Ha Maphohloane
Settlements – increase	Visual remote sensing analysis showed increase settlements (1960–2002)	8 ha (0.4%) (2002–2004)
Crop land – decrease	−84 ha (14.3%) (2002–2006)	−89 ha (4.6%) (2002–2004)
Woodlots/plantations - increase	14 ha (2.4%) (2002 – 2006)	63 ha (3.3%) (2002–2004)
Land degradation - increase	48 ha (8.1%) (2002–2006)	Visual remote sensing showed an increase in land degradation (1983–2002)

changes, despite the minor discrepancies expressed by the 'settlements' class in Ha Paki (2002–2006) and 'degraded land' class in Ha Maphohloane (2002–2004). An important element of the findings is that they can be extended to reflect the general prevailing conditions in the Lowland region, and possibly in Lesotho, as has been shown by other studies and secondary literature.

The next step in this study is to compare land-use change results obtained from applying remote sensing techniques and those from perception analysis using Multi-Criteria Analysis techniques in order to understand and test commonly held views on land-use change in the study areas in the Lowland region, and by implication, in Lesotho.

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Chapter 6
Discussing Causes and Consequences of Land-Use Change in the Lowland Region

Abstract Land-use change is expected to affect, among other things, agricultural production and livelihood options. An understanding of the causes and consequences of land-use change is important to inform policy and measures aimed at promoting sustainable land-use and successful adaptation strategies for the agricultural sector, particularly in the face of prevailing internal and external pressures on rural populations. Several commonly held views about causes and consequences of land-use change persist in Lesotho. Based on the study findings expounded in Chaps. 4 and 5, and the theories proposed in Chap. 2, this chapter questions the commonly-held view about labour migration and land-use change in the Lowland region. Similarly, it scrutinizes the possible links between farmers' perceptions of land quality and their decisions on land-use. The possible impacts of policy and institutional factors on land-use decisions are also assessed. The chapter gives an in-depth critique of these assumptions. It concludes by shedding light on the interactions between the different elements and the inter-linkages with land-use change and its consequences. The chapter ends with a revised conceptual framework for land-use change in the Lowland region.

Keywords Climate • Conceptual framework • Credit • Farmer perceptions • HIV/AIDS • Labour migration • Land degradation • Land-use decisions • Policy and institutions • Population

"Khotso, Pula, Nala" (*peace, rain, prosperity*)

(Lesotho motto)

6.1 Introduction

Previous chapters have identified the major land-use changes, their causes, consequences and perceived solutions. The study's general findings underline a decrease in crop production, and livestock numbers; and an increase in human population,

P. Maro, *Environmental Change in Lesotho: An Analysis of the Causes and Consequences of Land-Use Change in the Lowland Region*, DOI 10.1007/978-94-007-1881-4_6,

settlements and land degradation. An increase in trees/shrubs and land fragmentation was also noted. The study's remote sensing analysis of land-use change (Chap. 5, Sect. 5.4.3.1) has found a decrease in fields/cropland to the magnitude of – 84 ha in Ha Paki (2002–2006) and – 89 ha in Ha Maphohloane (2002–2004). The remote sensing analysis also showed a large increase in low vegetation/trees amounting to 14 ha increase in Ha Paki and 63 ha increase in Ha Maphohloane, during the same periods. Land-use change in this study is defined on the basis of observations made between two defined periods in time, so does not necessarily account for any transitions in land-use, which might have occurred over the specified periods (e.g. Stehman 2005).

The findings reveal important perceived causes of land-use change. It is clear that land-use changes were caused by the interaction between many factors and actors. Essentially, land-use change as manifested through the perceived decrease in crop production and land degradation were largely viewed as climate-driven. Land degradation was seen more as the consequence of land-use change than a cause *per se*. This was largely linked to drought, poverty and ignorance, as the main proximate drivers of land degradation. Perception analysis in the study was taken to represent a 20-year period respectively. Local people in the study areas and nationally were able to identify land degradation and were aware that it was a problem, sighting its many negative socio-economic, food self-sufficiency and biophysical impacts. However their role was to a large extent that of passive observers, with the exception of a few 'progressive farmers'. The causal association between identified drivers of land-use change and decisions of land-users and managers was thus not as straightforward and obscured by other factors.

This chapter will discuss the causes and consequences of land-use change as captured in Chaps. 4 and 5, within the context of the study's hypotheses. The aim is to test the hypotheses proposed in Chap. 1 (Sect. 1.4). Theories that were tentatively put forward in Chap. 2 will also be questioned. Doing this would help dispel or affirm commonly-held views on land-use change in Lesotho and thus offer evidence-based, comprehensive, plausible explanations of land-use change cause and consequence in the Lowland villages and by inference, Lesotho. This could form a foundation for guiding future land-use policies and further studies on the topic.

6.2 Labour Migration and Observed Land-Use Changes, Is There a Link?

According to the first hypothesis of this study, $\mathbf{H_1}$: *Labour migration from Lesotho to South African mines reduced the number of available men to work on agriculture and soil and land management. This led to a preference for livestock keeping and off-farm activities and resulted in decreased crop cultivation, increasing land degradation and a move towards food purchasing.* Based on the study results, there is a need to re-think this hypothesis.

Table 6.1 Comparative population figures for Maseru and Mohale's Hoek districts

	Number of people (*de jure* population)				
District	1966	1976	1986	1996	2006
Maseru	201,832	257,809	311,829	393,154	429,823
Mohale's Hoek	109,927	136,311	174,998	185,459	174,924
Total Lesotho	969,634	1,216,815	1,605,177	1,862,275	1,880,661

Source: Own table made with data from Lesotho Statistical Yearbook, 2008

i. **Population dynamics and land-use change**

Perception analysis demonstrated an increase in the number of people over a 20-year period in the Lowland study villages. This was attributed to internal migration, increasing births and the return of miners from South Africa (hereafter referred to as retrenchments) (Chap. 4, Sect. 4.2.2.1.5). National population and migration figures offer a glimpse of the overall situation. The latest population census of 2006 estimate the *de jure* population of Lesotho as 1,880,661 people, compared to 1,605,177 in 1986 and less than a million in 1966 (Lesotho Statistical Yearbook 2008). District figures mirror this trend (Table 6.1).

According to some official statistics, between 1976 and 1986 Lesotho's population growth rate was estimated at 2.8%, decreasing to 0.1% in 1996–2006 (Lesotho Statistical Yearbook 2008). Such a national decrease in the population growth rate does not necessarily indicate a decrease in the number of people at district or village level, but signal possible long-term population stagnation or eventual decrease if the rate continues to drop. The number of Basotho working in South African mines continues to decline, from 80,000 in 1998 to 53,000 in 2007 (Lesotho Statistical Yearbook 2008). This might indicate an increase in immigration to Lesotho and a potential increase in the labour force.

Figure 6.1 shows a general decrease in external migration during 1976–1996 out of Lesotho. The 1999 Lesotho Labour Force Survey (Ministry of Labour and Employment Bureau and Bureau of Statistics, 2001) states that there were 103,499 migrant workers in 1999 compared to 108,808 in 1997. The report also shows that 68.8% of the currently employed population was engaged in subsistence farming, of whom 81.1% males and 75.1% females lived in rural areas. The number of Basotho workers working in South Africa has decreased steadily in 1991–2001 (Table 6.2). This would support the supposition that the number of immigrants from South Africa to Lesotho has perhaps been increasing since early the 1990s. Malthusian theories suggest that an increase in population would ultimately lead to land degradation (see Malthus 1798). Conversely, the optimistic view holds that an increase in population provides surplus labour which can be absorbed into land-rehabilitation techniques, improved farming technologies and sustainable soil and land-management techniques (Boserup 1965). These two theories were discussed in Chap. 2 as tentative explanations of land-use change in Lesotho. This study's findings support neither of these theories with reference to the Lowland region and Lesotho. Another explanation for labour shortages in Lesotho is presented in later sections.

Table 6.2 Number of basotho working in South African mines (1991–2001)

Year	Number of workers	Year on year change (%)
1991	122,188	
1992	119,596	−2.1
1993	116,129	−2.9
1994	112,722	−2.9
1995	103,744	−8.0
1996	101,262	−2.4
1997	95,913	−5.3
1998	80,445	−16.1
1999	68,604	−14.7
2000	64,907	−5.4
2001	59,900	−7.7

Source: IMF Country Report 2002 (in FAO 2002). With permission

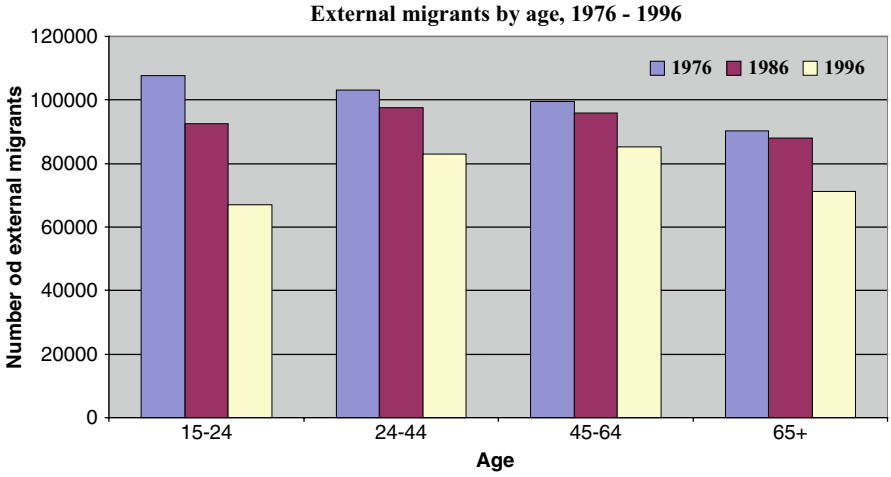

Fig. 6.1 Lesotho external migration by age – 1976–1996 (Source: Maro 2001. With permission)

ii. Economic development and HIV/AIDS on land-use change

Visual analysis results (Chap. 5, Sects. 5.4.1 and 5.4.2) show evidence of urbanization and economic development in Mazenod (1961–1985 and 1985–2002) and in Mohale's Hoek (1980–1983 and 1980–2002). This was marked by a (new) road and increasing settlements (mostly houses) in the two areas. This research's remote-sensing analysis established that there was an 8-ha increase in settlements in Ha Maphohloane (Table 5.15). The opening of transport routes is often linked with urbanization and economic development. The Lesotho Highlands

Development Project (LHDP) for example, built roads into remote mountain villages which resulted in improved access and other infrastructure like health-care services and connecting roads and bridges to and between remote mountain villages. As discussed earlier (Chap. 5, Sect. 5.5.1) accessibility potentially increases the land-value of an area, thus favouring the development of a formal or informal land market. In cases where this is coupled with a demand for settlements (houses or land for development) and particularly where the earning potential is higher for selling land than for agriculture, this would act as an incentive to sell land for non-farming activities.

Ha Paki, which is situated on the peri-urban outskirts of Maseru, is the best example of a village that has largely shifted towards non-farming economic activities at the expense of agricultural production. A combination of water shortages, due to irregular or scarce rainfall, 'no jobs' and the impetus of HIV/AIDS, were the main negative factors affecting crop production. According to key informants in Ha Paki, who were predominantly female villagers, the *'men were gone'*. When asked why, HIV/AIDS-related deaths and illness were cited. Thus a decrease in the male labour force in this case can be attributed to HIV/AIDS-related deaths and not necessarily to labour out-migration. These results are echoed by other studies on Lesotho. Studies in the mountainous Ha Poli village in the Katse Catchment and the northern Lowland village of Matsatsaneng in Butha Buthe district in Lesotho found that HIV/AIDS-related labour shortages and the length of mourning had substantially damaged agricultural yields; in some cases leading to the postponement or abandonment of agricultural activities (Drimie 2002). Recent reports on Lesotho, for example UNICEF (2007), have documented the prevalence and intensity of HIV/AIDS*: "With an HIV prevalence rate of 23 per cent among adults aged 15–49 (DHS 04/05), Lesotho has the third highest prevalence rate in the world. According to the latest local estimates from UNAIDS 29,000 new infections are expected in 2007 (80/day) bringing the number of people living with HIV to total of over 270,000, of which over 16,000 are children (0–14). 57 per cent of those infected are women."*

The study's findings confirmed a shift towards non-farm activities, particularly selling land for settlements (Chap. 4, Sect. 4.2.2.2). These factors can be viewed in the context of the perceived hardships associated with agriculture, including lack of credit, lack of agricultural input, lack of water/irregular rainfall and HIV/AIDS-related illnesses and its associated economic implications. Additionally, the proximity of Ha Paki to Maseru and demand for settlements might have pushed people towards selling their land instead of getting *negative returns*, leading to more urbanization as previously explained (Chap. 4, Sect. 4.2.2.2). Similar findings of increasing (illegal) land sales and land-use conversions in mountain villages in Lesotho, borne out of economic pressures and exaggerated by HIV/AIDS, are reported by Drimie (2002). A study on the Kagera Region, in north-western Tanzania, found that in most cases it was the men (widows were also implicated in very few cases of selling land leaving their children landless), who learning they were HIV-positive, would sell their land without consulting their spouses or other family (Aliber and Walker 2006). In contrast,

studies in Kenya and KwaZulu-Natal found that such a practice was uncommon (Aliber and Walker 2006). The dissimilar findings in Kenya were attributed to *"the positive role played by Kenya's Land Control Boards in deterring land sales that are not approved by spouses and other affected parties"* (Aliber and Walker 2006: 706), and the study concludes that "(the results*) are comforting in the sense that it does not appear that, together with all of its other ills, the HIV/AIDS epidemic is responsible for an epidemic of landlessness in Kenya*" (Aliber and Walker 2006: 275). Rather, HIV/AIDS was regarded as an additional pressure which embraces others, including population pressure, poverty, and unequal gender relations between men and women. Lesotho's new Land Bill (Chap. 3, Sect. 3.6.1) introduces a Land Market Board which would, *inter alia*, protect disadvantaged groups for example orphans from unscrupulous land sales, and govern land transactions: sub-leasing agricultural land and sharecropping, to ensure the protection of contracting parties (Selebalo, N.D.).

In the more rural Ha Maphohloane village, our findings showed land-use changes that were marked as encroachment of settlements (mostly houses) into field/croplands, and in a few cases into degraded lands (discussed in Chap. 5, Sect. 5.5.1), a decrease in crop production (Chap. 4, Sect. 4.2.2.1.3), increase in land fragmentation (1980–2002; Chap. 5, Sect. 5.4.2) and land degradation and a decrease in livestock numbers (Chap. 4, Sect. 4.2.2.1.4). These changes were attributed to; *drought, lack of water, soil erosion and lack of knowledge.* In essence, similar factors were acting here as in Ha Paki, with different outcomes. As this study has discovered, there was no perceived migration-driven shortage of labour in either village. In Ha Maphohloane, there was even a well-organised system of labour-sharing (*letsema*) during labour-intensive periods.

iii. **Variable climate and land-use change**

Unlike in hypothesis **H1** above, the study findings confirmed a relationship between changes in local climatic conditions and reduced crop production. Drought was implicated in land degradation (Chap. 4, Sect. 4.2.2.1.1) and decreasing crop production (Chap. 4, Sect. 4.2.2.1.3). Remote-sensing analysis confirmed the decrease in croplands in Ha Paki and Ha Maphohloane, equivalent to −84 ha in Ha Paki (2002–2006) and −89 ha in Ha Maphohloane (2002–2004) (Chap. 5, Table 5.14, 5.15 and Sect. 5.4.3). Remote-sensing analysis also established an increase in land degradation, for example in Ha Paki, where there was an increase in degraded lands equivalent to 48 ha between 2002 and 2006 (Chap. 5, Table 5.5 and Sect. 5.4.3). Additionally, visual analysis of land-use change for Ha Paki (1961–1985) and Ha Maphohloane (1980–2002), showed encroachment of settlements and road infrastructure into fields/croplands (Chap. 5, Sects. 5.4.1 and 5.4.2). In accord with the current study, Kessler and Stroosnijder (2006) found that farmers were aware of decreasing crop productivity, which they attributed to changes in rainfall regime ('crazy rains') and less available cropland due to increasing settlements and land degradation. According to some estimates on Lesotho (SADC Trade, Industry and Investment Review 2006): "*the quality of arable land has declined from around 13 percent of total land in the 1960s to less*

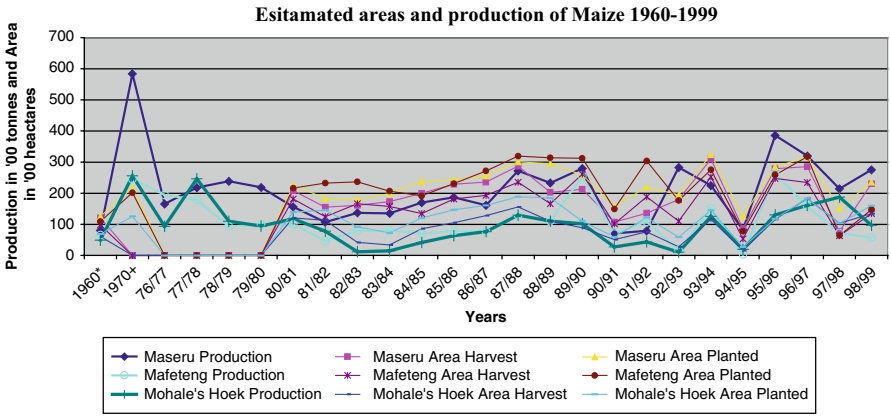

Fig. 6.2 Comparative production of maize for the Lowland districts of Maseru, Mafeteng and Mohale's Hoek. The three districts exhibit a similar production pattern. The 1960 data is the average of yellow and white maize, for 1970 there were no data for winter maize. There were no data available for the 'Planted' and 'Harvested' areas for 1970 – 1979/80 for the three districts (Source: own graph, made from data from Bureau of Statistics 1960, 1970, 1980 and 2000)

than 10 percent today." National crop production figures showed a steady decline in crop production from 1999/00 – 2004/05 (Chap. 3, Fig. 3.3 and Chap. 5). A similar trend is echoed by district crop production figures (Figs. 6.2–6.4). In these figures, declines in crop production mirror years of severe drought.

Recently recorded long droughts were between 1991 and 1995 (Chakela 1999; Sechaba Consultants 1996); and during the following agricultural years: 2001/2002, 2002/2003 and 2006/2007 (FAO 2003; Lesotho Statistical Yearbook 2008). District crop production figures (1970–1999) for the major cereal crops maize, wheat and sorghum showed a general pattern of decreasing production, irrespective of the area planted (Figs. 6.2–6.4). According to these figures, low crop production years correspond to the drought years of 1991 and 1995. This partly confirms observations made by key respondents, who saw drought as an overall principal driver of reduced crop production and land-use change in the Lowlands. As stated earlier in this study (Chap. 3, Sect. 3.3), drought-induced crop failures have become more common in the Lowlands of Lesotho. Mohale's Hoek district was declared the hardest hit by the 2001/02 drought period, requiring emergency food assistance to cope (FAO 2002). The district was also declared as one of three southern districts most vulnerable to climatic shocks (FAO 2002). Emergency food aid amounting to 2,200 tonnes was set to be distributed to 36,000 poor people in Lesotho owing to the 2001/02 drought-induced crop failure (SADC Food Security update 2002). El Niño phenomenon, in combination with the Southern Oscillation, form ENSO – is implicated in rainfall abnormalities and drought (e.g. severe droughts of 1982/83, 1991/92, 1997/98, 2001/02, 2003/04 and 2006/2007) in southern Africa (e.g. Chimhete 1997; SADC Food Security Update 2004; Glantz et al., N.D.; Rook 1997).

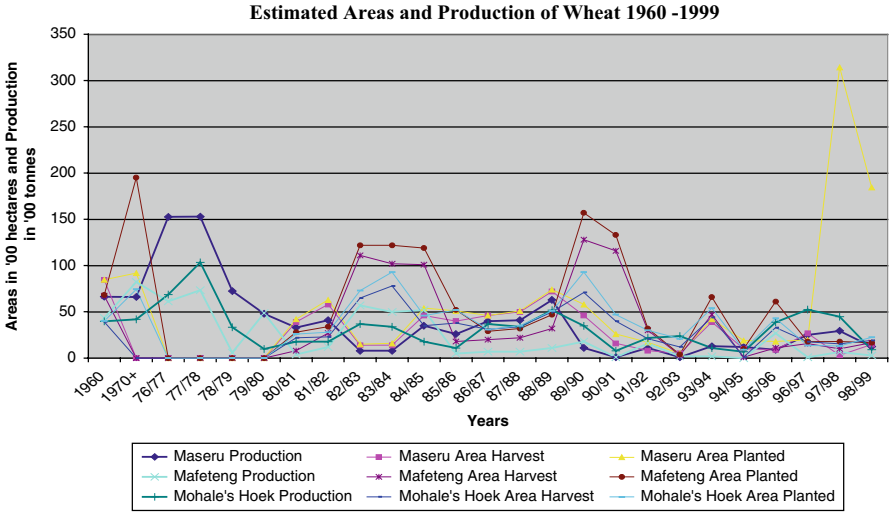

Fig. 6.3 Comparative production of wheat for the Lowland districts of Maseru, Mafeteng and Mohale's Hoek. The three districts exhibit a similar production pattern. The 1960 and 1970 data are the average of summer and winter wheat. There were no data available for the 'Planted' and 'Harvested' areas for 1970 – 1979/80 for the three districts (Source: own graph, made from data from Bureau of Statistics 1960, 1970, 1980 and 2000)

Erratic rainfall and drought are cited in national statistics reports as the main causes of recorded decreases in crop production (Bureau of Statistics 2002; 2005; 2006). For example during the 2005/06 agricultural year: "*early frosts and erratic hailstorms both contributed to a weather pattern which affected not only the land area planted but also adversely affected harvests. (…) Standing water in fields was a common sight during 2005/06 crop year, given heavy rainfalls, which resulted in reduced crop yields"* (FAO 2006). This accords with our respondents' perceptions linking *sefako*/strange weather, drought and declining rainfall to reduced crop production (Chap. 4, Sect. 4.2.2.1.3). A recent study in Swaziland suggests that land-users often recognize and remember the nature of rainfall inputs from previous years, often relating this to the agricultural production (Stringer 2009). For example, respondents in Ha Paki rated *sefako* as the second highest-ranking cause of reduced crop production (after HIV/AIDS) and in Ha Maphohloane they blamed the long drought for hindering agricultural production during the (drought) years 2001–2004. Hydén and Sekoli (2000) concur with these observations: "*The inter-annual rainfall variability is great, resulting in low food security, since the growing of crops is almost exclusively rain-fed.*" Literature also suggests that, *"Poor countries, which rely heavily on agricultural production, are expected to be most vulnerable to climate change and climate variability"* (Bryan et al. 2009:413).

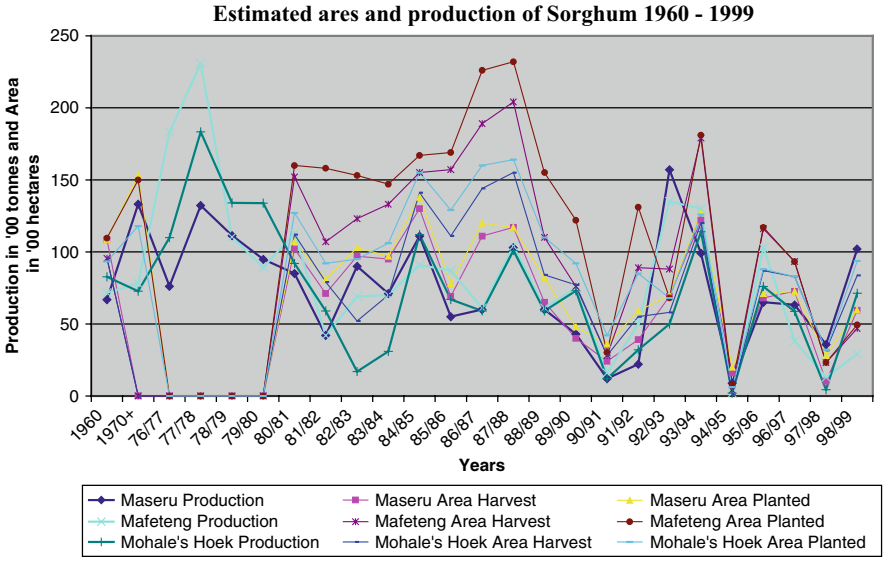

Fig. 6.4 Comparative production of sorghum for the Lowland districts of Maseru, Mafeteng and Mohale's Hoek; the three districts exhibit a similar production pattern. For 1970, there are no winter figures available. There were no data for 'Planted' and 'Harvested' areas for 1970 – 1979/80 for the three districts (Source: own graph, made from data from Bureau of Statistics 1960, 1970, 1980 and 2000)

The combined annual cumulative rainfall for Butha-Buthe, Leribe and Maseru (Phuthi River catchment area), for the period 2000–2007 is shown below (Fig. 6.5). This graph illustrates that the cumulative rainfall for the years 2001, 2003, 2004, was below the calculated average for the period, with January – April 2007 being drier than the rest of the years during the period 2000–2007. This has possible negative implications for food production as evidenced above.

iv. **Livestock decrease and stock theft**

Historical analysis of livestock in Lesotho showed a general decrease in livestock numbers starting in the 1970s (Swallow and Brokken 1987). More recent figures also point to a decrease in livestock numbers in the Lowland region (Figs. 6.6–6.8). This contradicts $\mathbf{H}_1$ which hypothesizes that the increase in livestock numbers is a consequence of labour out-migration. Furthermore*:* "*while Lesotho has historically been a net importer of cattle, there have been four periods since 1900 when significant net exports have been reported. 1916–1920, 1930–1937, 1952–1955, and 1966–1974. Even in those years when net imports have been reported, exports have often been significant. Between 1933 and 1973, the average number of cattle exported each year was 10,516. Since 1973 exports have been at their lowest since the turn of the century"* (Swallow and Brokken 1987:2). Perception analysis established a decrease in livestock numbers over a

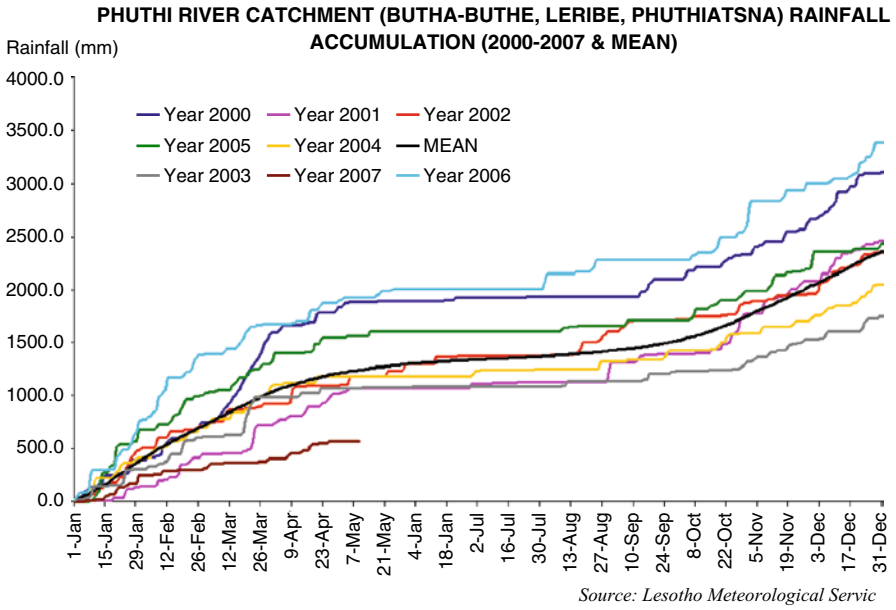

Fig. 6.5 Comparison of the combined accumulated rainfall for the years 2000 – 2007 and the mean (Source: Lesotho Meteorological Services, Maseru, Lesotho. With permission)

20-year period, caused mainly by stock theft, drought and frost (Chap. 4, Sect. 4.2.2.1.4). These findings are confirmed by literature. *"The primary reason for the decline of livestock was given as stock theft. This has also adversely affected the wool yields from 2.9 kg to 2.4 kg per sheep as stockowners disinvest in the livestock sector. According to the National Livestock Development Study Phase 1 report of March 1999, stock theft has reached epidemic proportions throughout Lesotho*" (Dzimba and Matooane 2005). According to other official reports (FAO 2002: 8): "(stock) *theft has become a major problem in the country. Thefts occur in and between villages, between districts, and across borders. The situation is getting worse and becoming increasingly dangerous, and is having a serious negative impact on household food security. Livestock are a vital source of cash to purchase food when agricultural production is low (…) and supply draught power for cultivation.*"

6.2.1 *So Is There a Link Between Labour Migration and Observed Land-Use Changes?*

Labour migration was not perceived to be either a cause or consequence of land-use change in this study. To answer the above question, new information from the study

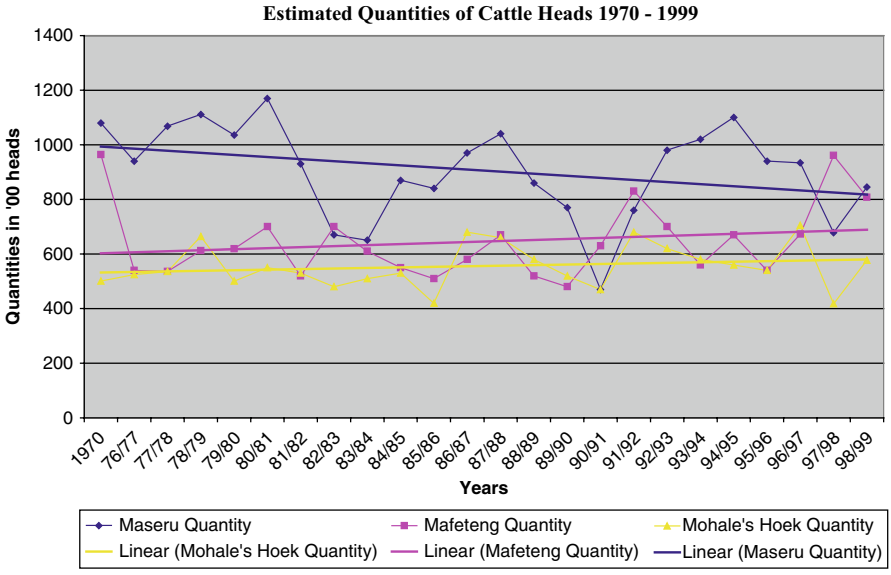

Fig. 6.6 Comparative livestock quantity– cattle, for the Lowland districts of Maseru, Mafeteng and Mohale's Hoek. Maseru had the highest numbers of cattle compared to Mohale's Hoek, but the three districts exhibit a similar trend of decreasing (Source: own graph, made from data from Bureau of Statistics 1960, 1970, 1980 and 2000)

on the Lowland villages found neither a direct link nor correlation between labour migration and migration-induced labour shortages, nor decreasing crop land, increasing livestock numbers or land degradation. Common sense insists that out-migration has produced a reduced labour force to work in agriculture in Lesotho, resulting in reduced crop production, land degradation, and increased livestock numbers. In essence, although out-migration may have had an effect on the quantity of the labour-force, the current magnitude of HIV/AIDS and related diseases, estimated at 80 infections per day in 2007 (UNICEF 2007), is the most important factor affecting the quality and quantity of the labour force in the Lowlands and Lesotho. National migration figures (Fig. 6.1 and Table 6.2) showed that there was a decline in labour out-migration, possibly meaning an increase in the available labour force for agriculture. The study findings echoed this and established that there was a population increase in the study villages attributed mostly to increasing births and immigration. An increase in the village population could mean an increase in available labour-force, but the quality and quantity of this potential labour-force was found to be limited by HIV/AIDS and related illnesses and not by out-migration *per se*. HIV/AIDS and related illnesses also place additional economic burdens on households. Our findings also demonstrated that agriculture production was constrained by increasing economic demands of agriculture and HIV/AIDS, biophysical and climatic factors. This mainly contributed to land-use changes from crop production to settlements and a decrease in crop lands.

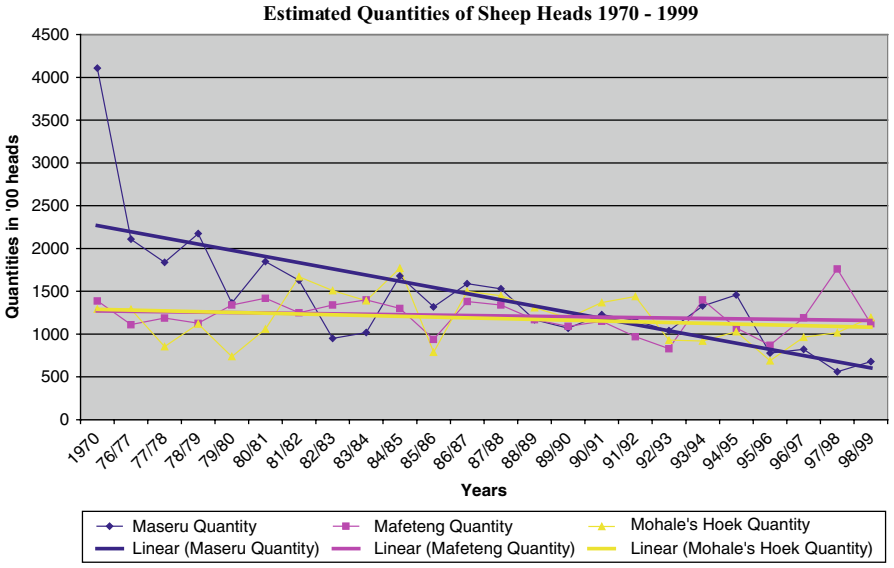

Fig. 6.7 Comparative livestock quantity – sheep- for the Lowland districts of Maseru, Mafeteng and Mohale's Hoek. Maseru had the highest numbers of cattle compared to Mohale's Hoek, but the three districts exhibit a similar trend of decreasing (Source: own graph, made from data from Bureau of Statistics 1960, 1970, 1980 and 2000)

This study found a general decrease in livestock numbers in the Lowland villages and Lesotho in general over the last 20 years. As discussed previously, this was supported by historical and more recent secondary literature and data. A major cause of this decline was stock-theft. Therefore, hypothesis H_1 on increasing livestock numbers can be refuted.

This study identified a broad increase in land degradation over a 20-year period, which was attributed to drought, poverty and ignorance and not labour-shortages. Land degradation was found to be an effect of land-use change. This may be an additional support to indicate that land degradation was not driven by migration-induced shortages in the labour-force *per se*.

In conclusion, a shift to non-agricultural activities and selling land for settlements were seen as one of the main mechanisms used to cope with food-insecurity and livelihood sustenance. Consequently, the common view that labour migration has led to land degradation, decreasing crop productivity, a shift to off-farm employment and increasing livestock (which is blamed for increasing degradation), is thus dismissed as a myth by this study's findings. As one government key informant put it, such a statement *'is an oversimplification of the situation and not necessarily true'*.

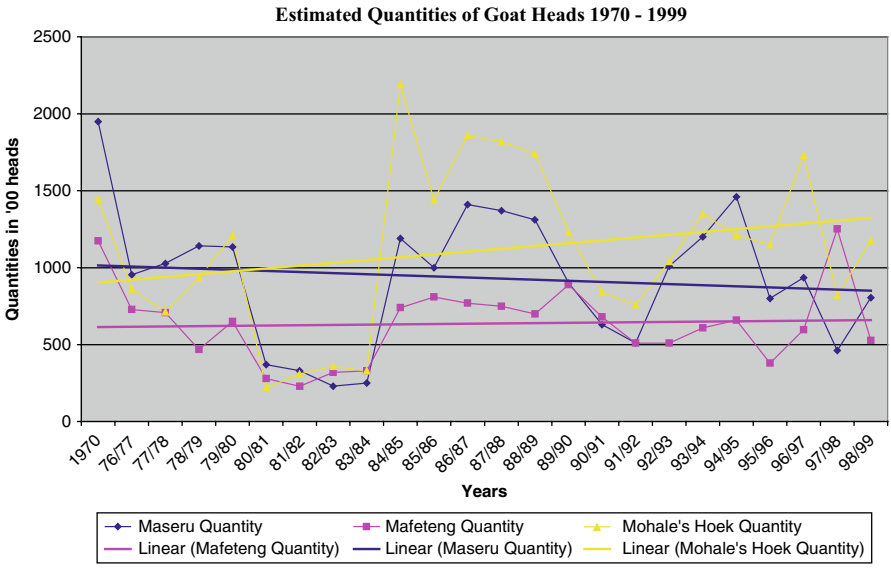

Fig. 6.8 Comparative livestock quantity – goats – for the Lowland districts of Maseru, Mafeteng and Mohale's Hoek. The three districts exhibit a similar trend of decreasing goat (Source: own graph, made from data from Bureau of Statistics 1960, 1970, 1980 and 2000)

6.3 Do Perceptions on Land Quality and Climate Determine Land-Use Decisions?

The second hypothesis of this study, hypothesis $\mathbf{H}_{2,}$ states that: *Perceptions on biophysical characteristics like quality of land and drought (climate change) determine people's land-use decisions.* Land quality and climatic conditions are often linked to land-use/cover changes in Lesotho (chaps. 2 and 3). Sometimes what is perceived may not necessarily reflect 'reality'. Hence actions or decisions made on the premise of such perceptions would not be based on 'reality' so they may differ substantially from action taken in response to 'real' situations. However, in the findings of our perception analysis, 'perceptions' of the quality of land and climatic conditions were established to be a reflection of reality. A recent study in semi-arid areas of central Tanzania concluded that farmers' perception of an increased drought risk was related to agricultural droughts (Slegers 2008). Additionally, *"Farmers recognized differences in drought vulnerability between soil types, location and state of land, land management practices and farmer types"* (Slegers 2008:2106). In our study drought was singled out as the most important driver of land-use change (Chap. 4, Sect. 4.2.2.1.2) and as the highest-ranking driver of decreasing crop production (Chaps. 4, Sect. 4.2.2.1.3). Together with frost, drought was one of the secondary factors seen to be causing a decrease in livestock numbers (Chap. 4, Sect. 4.2.2.1.4).

As shown earlier in this chapter, secondary data and literature support these findings (Sect. 6.1). The findings also confirmed an increase in land degradation, quantified as 48 ha in Ha Paki (2002–2006; Chap. 5, Sect. 5.4.3). Studies elsewhere in sub-Saharan Africa have found a correlation between people's perceptions on land quality and land-use decisions (e.g. Aprioku 2004; Amsalu et al. 2007; Solomon et al. 2007; Maconachie and Binns 2006). For example, the study looking at territorial conflict and urbanization in Nigeria found that the quality of the physical environment influenced people's perceptions and preferences on land and their land-use decisions (Aprioku 2004). The current study obtained similar findings. These are discussed in forthcoming sections.

i. **Climatic factors and land-use decisions**

In general, the Lowland region and Lesotho, are dependent on rain-fed agriculture. However, in our study key informants perceived drought and water scarcity to be the highest-ranking major constraints to agriculture, which drive land-use change. Drought was also seen as the overall driver of increasing land degradation and the main driver of land-use change in our study. The influence of drought, reduced rainfall and 'crazy' rains on crop production as shown in our study was discussed in detail earlier. As stated, a long drought period was recorded during the years 1991 and 1995, and also during the agricultural years 2001/2002, 2002/2003, 2006/2007 (Chakela 1999; Sechaba Consultants 1996; FAO 2003; Lesotho Statistical Yearbook 2008). Drought was indicated as a major reason for crop failures in 1992 and 2000 (ODI, N.D.). Economically, agriculture's contribution to GDP has been falling, from about 30% in the 1980s (SADC Trade, Industry and Investment Review 2006) to about 14% in 2007 (FAO 2007). The severe droughts in 1991 and 1992 are believed to have largely contributed to the fall in agriculture's contribution to GDP. In 2001/02 famine was declared in Lesotho following low grain production; while during the second half of the 2003/04 cropping period, the country suffered its worst drought on record (Bureau of Statistics 2005). The effect of this and previous droughts was widespread abandonment of cropland/fields with an increasing reduction in agricultural production, and physically manifested via soil compaction and soil erosion, as shown in Ha Maphohloane (Figs. 5.3 and 5.4c). In this research, the increasing frequency of erratic and 'strange rains' was also implicated in influencing land-use preferences. In February 2006, heavy rains in Lesotho destroyed crops caused destructive floods that washed away roads and bridges, and caused human deaths. As explained in the media (IRIN 2006): "*Lesotho's heaviest rainfall in nearly two decades has destroyed more than a third of the crops in the ground ahead of the April harvest (…). Years of drought has hardened the soil in Lesotho's southern districts to such an extent that the rains have cracked the ground, resulting in the formation of gullies in farmers' fields, and washing away top soil …"* These issues were also echoed by respondents in our study.

Drought, water scarcity and 'crazy rains' can have a dual effect on land-use decisions. First, they have a direct impact on agricultural output and land quality. This may act as a disincentive to agricultural production, because of the resulting

losses of input, reduced crop production and poor land quality. As we found in this study, the resulting decision was often abandoning agriculture and *'doing nothing'* to remedy the situation, particularly given the frequency and intensity of these climatic factors. Similarly, in another study, villagers ranked recurrent and prolonged drought as the main contributing factor to rangeland degradation (Solomon et al. 2007), which led to changes in their land-use decisions and options. Second, these climatic factors may exert an indirect effect on the economic attractiveness of land and preferences for the type of use. This may favour non-farming over agricultural activities. In our study, agriculture was believed to be too expensive as a result of changing climatic conditions including intensity and frequency of drought, erratic rain, and frost. Elsewhere, perceptions that food crises were caused by recurrent droughts contributed to changes in land-use (Baijukya et al. 2004). In our study, an important push factor to shifting from cropping to settlement-use was the comparative attractiveness of converting cropland to settlements or selling it for development. Ha Paki village was a good example. Our study established that large parts of the village and previous formerly agricultural land had been converted into settlements and other infrastructure (1961–1985; Chap. 5, Sect. 5.4.1.1). In Ha Maphohloane too, a similar change was observed (1980–2002; Chap. 5, Sect. 5.4.2.2). Construction of Moshoeshoe I international airport about 5 km from Ha Paki and its proximity to Maseru, also helped fuel further development in this village for example roads, bridges and other infrastructure. Our research revealed that another important push factor determining a household's decisions on land-use was HIV/AIDS and related impacts on the quality and quantity of the labour force to work on agriculture and also its economic impact on a household. These factors acted in favour of selling land for income or shifting to other non-agriculture income sources. Some of the non-agriculture activities identified by our study were keeping chickens or pigs for money and food, and sewing to generate money – mainly in support of HIV/AIDS inflicted households and orphans. These were mainly female-based activities.

ii. **Land degradation and land-use decisions**

Other perceived factors driving land-use change in this research were land mismanagement, and 'dependency syndrome.' In Chap. 4, land mismanagement was linked by some key informants to 'the mindset of the Basotho' and 'dependency syndrome.' Conventional wisdom points to land mismanagement and overgrazing as two of the major drivers of land degradation. Similar to a study by Maconachie and Binns (2006), respondents in our study widely recognized land degradation and acknowledged its detrimental consequences on the land, on crop production and on grazing lands. (Perceptions of) Land degradation can influence land-use decisions in various ways. Two pathways identified by our study are outlined here: abandonment of agricultural activities and doing nothing, or changing from agricultural activities to non-agricultural activities. First, land (field or other) perceived as degraded was often viewed as poor quality and unproductive – therefore economically unattractive for agricultural activities.

In most cases, such agricultural land was abandoned (as seen in Ha Maphohloane) and no action taken to adopt previously-introduced land-management practices. This passivity can be ascribed to various factors. Kessler (2006: 41) explains: "*the limited adoption and spreading of SWC (*Soil and Water Conservation*) practices is not a technical problem that can be solved by research, but rather a socio-cultural and economic problem, with many constraints playing a role.*" Such constraints include farmers' unwillingness and inability to adopt land management techniques; and institutional constraints. This study found that perceptions of institutional constraints (to be discussed in the next section) played a central role in hindering such actions. Elsewhere, the most important constraints to adopting soil conservation and management techniques were identified as *"lack of capital and tools, labour shortage and construction know-how" (*Okoba and De Graaf 2005:486). The resulting decision was principally to abandon the land in question, or change to non-agricultural activities.

Second, land that was (perceived to be) degraded was often converted to non-agricultural use. Our visual findings showed that encroachment of settlements onto former fields was happening in Ha Paki (1961–1985; Chap. 5, Sect. 5.4.1.1) and in Ha Maphohloane (1980–2000s; Chap. 5, Sect. 5.4.2.2). Findings of our remote-sensing analysis also showed some increase in settlements in Ha Maphohloane (Chap. 5, Table 5.8b). The decision to convert agriculture land to settlements or non-agricultural activities can best be explained in terms of socio-economic conditions and the economic attractiveness of converting land to non-agricultural use (as discussed earlier). This was illustrated by a government key informant: "*Lowland people need jobs to survive. The land is already degraded. In the Highlands they have animals. Lowlands are semi-arid, with rainfall averages of 500 mm, for example Mohale's Hoek.*"

This statement reflects observations that perceptions of the quality of the physical environment influence space-perceptions and land-use decisions (e.g. Aprioku 2004).

The concepts of 'mindset of the Basotho' and 'dependency syndrome' were both viewed as drivers of land-use change (Chap. 4). As identified by this study the essence of the 'mindset of the Basotho' concept in influencing decisions on land degradation could be explained as a lack of responsibility and accountability, which is perhaps re-enforced by 'dependency syndrome'. The main outcomes of 'dependency syndrome' on land degradation, as identified in this research, were: unwillingness pro-actively to initiate or engage in land protection and soil and water management techniques as such, indirectly causing or increasing land degradation. Some land-use decisions as a consequence of this syndrome were identified by our study as land-use changes away from agricultural production, an increasing dependence on food aid and buying food 'from the Chinese shops' (e.g. Ha Paki). This observation is confirmed by the Bureau of Statistics (2005:7): "The *acreage of maize remains highest in the lowlands although it has been decreasing since 2001/02. In the following year 2002/03 it fell by 29% and further by 13% in 2003/04 as a result of the dependency syndrome created by*

foreign Food Aid and increasing costs of inputs." In this research, the World Food Programme, as a provider of food aid, was also perceived to have reduced crop production in the Lowland region.

This research has established the effects of land-use changes, ranked as: increasing land degradation, shift to off-farm employment and increased soil erosion and reduced ability to produce food. Land mismanagement and its associated 'dependency syndrome', thus act as proximate drivers of land degradation, which influence people's perceptions of the land and their land-use decisions. Other factors like poverty, lack of capital and tools, labour shortages and limited conservation know-how are the most probable underlying drivers of land degradation which influence farmers' land-use decisions.

HIV/AIDS and related illnesses and their impact were discussed in the previous section. It has been established by this research that HIV/AIDS a major constraint of agriculture which influenced people's decisions and possibilities on land-use (Chaps. 4 and 6).

6.3.1 So Do Perceptions on Land Quality and Climate Determine Land-Use Decisions?

In summary, the above discussion has established a link between people's perception of the quality of land and climatic conditions and their land-use decisions. It has also been shown here that these perceptions were in line with the 'real' quality of land and actual climatic conditions. In Chap. 2, land characteristics, drought and desertification were offered as possible causes of land-use change in the Lowland villages. Our findings have confirmed this. Other studies and secondary data support findings that local perceptions of these factors influence land-use decisions. Consequently, the answer to this question is yes. Hypothesis $\mathbf{H}_2$ can be accepted as true.

6.4 Do Policy and Institutions Influence Land-Use Decisions?

It is widely believed that policy and institutional factors influence decisions on land-use. This study's third hypothesis, hypothesis $\mathbf{H}_3$, states: *Policy, legislative and institutional frameworks influence people's decision-making on land-use.* Policy and institutional factors can have a positive or negative effect on land-use change. A positive effect would mean that the ensuing land-use decision results in better management of land-use and generally favours sustainable use of the land. A negative effect could mean land-use decisions result in diminishing land quality and/or quantity, like land degradation and soil erosion. In this study institutional factors were more prominently mentioned than policy factors. Most probably because rural

land-users/managers were more aware of land-use institutions than of land-use policies. Further studies are needed to establish the role of different policies on land-use decisions in the Lowland region and in Lesotho in general. Studies elsewhere have identified policies like agriculture policies (e.g. Sikor and Truong 2002), national land allocation policies (e.g. Stolle et al. 2003) and policies of decentralising natural resources management (e.g. Woodhouse 2003) as some of the main policy drivers of land-use changes. In our research (Chap. 4, Sect. 4.2.2.3), respondents regarded the Ministry of Agriculture as the main institution responsible for land-use and its management. Other institutions identified by our research as being responsible for (sustainable) land-use and management were the Department of Land use Planning (rural lands) Land Surveys and Physical Planning (urban lands), and local government/local council, in that order. However, when asked who should be responsible for sustainable land-use and land management, respondents identified the following: the Ministry of Agriculture, chiefs, *government*, the farmer/land-user, and lastly Ministry of Justice. This response highlights the importance attached to chiefs as guardians of the land and their role in ensuring sustainable use and management of the land. Because of their historical nature, it is assumed that chiefs are the carriers of important traditional knowledge and techniques on land-use and management.

i. **Land institutions influence on land-use decisions**

In theory, the Ministry of Agriculture is responsible for formulating and implementing Lesotho's agricultural production policies; providing equipment and input to farmers and co-ordinating marketing of agricultural products and exports (Mphale and Rwambali, N.D). However, a recent report on Lesotho's food security observed that*: "the Ministry of Agriculture was directly involved in production, marketing and processing activities for which it had neither comparative advantage nor a pool of expertise. The government-run agroindustries and state farm enterprises such as Lesotho Flour Mills, National Abattoir, Irrigation schemes, Poultry Farms and Sheep Stud Farms pursued non-commercial trading policies, they lacked managerial skills and they had poor financial and performance records. It is the realisation of these limitations that led to the decision by the government to privatise such enterprises. If the move succeeds, it would be a commendable step towards involving the private sector in food security decision making process"* (Mphale and Rwambali N.D.:5). Hence farmers might be justified in implicating the Ministry of Agriculture in land (mis)management and the general decline in Lesotho's agricultural situation. In this case, the Ministry of Agriculture (MOA) can be seen as having an indirect negative impact on land-use decisions through its actions, or the lack thereof, in managing land-use, agriculture productivity, marketing etc., as illustrated above.

In our study, the Ministry of Agriculture was perceived as enforcing a culture of dependence, to such an extent that people often decided not to trust their own knowledge of the land as they believed they had to await instructions from the Ministry or other 'outsiders'. Most rural dwellers were generally becoming 'crippled' by aid. A potential consequence of this is the abandonment of agriculture, greater reliance on government and donor food hand-outs and aid. This was

reflected by some respondents in Ha Paki. Indeed, the erratic climatic conditions have helped obstruct agricultural food production, but the competing roles of relief agencies also hindered progress. Respondents identified relief agencies, specifically the United Nations (UN)'s World Food Programme (WFP) as having conflicting interests over agricultural land-use, as opposed to another UN organization, the Food and Agricultural Organization (FAO). The former was seen as encouraging dependence on food hand-outs as it encouraged food distribution for free. This discouraged farmers from investing in agricultural food production, as the grain handed out was considered much cheaper than investing in own production, so they preferred to convert their agricultural land to non-agricultural use or abandon it (Chap. 4, Sect. 4.2.2.1.3). In accordance with some non-governmental respondents in this study, some grain destined for food aid was sold at below average prices, creating another competitive disadvantage for agricultural production. The second UN organization was seen more positively, as favouring increased food production and self-sufficiency.

The Ministry of Justice was considered important in terms of settling stock-theft disputes and using the police to pursue cases of stock-theft. According to one key non-government respondent, some livestock owners were willing to pay for personalised electronic identification chips in their animals to prevent stock-theft and increase recovery-rates if stolen. Cases of livestock theft with such a device would be reported to the police who were expected to carry-out a criminal investigation and seek to recover the stolen livestock. Once recovered the animals would be easily identified and returned to their owners. The Stock Theft Act of 2000, implemented under the Ministry of Agriculture, was supposed to improve livestock registration so as to increase livestock recovery, arrests, and sentencing of offenders (Dzimba and Matooane 2005). A 38% livestock recovery increase between 2000 and 2004 was reported (Dzimba and Matooane 2005). Respondents in our study area perceived that there was an increase in stock theft in the Lowland region, and Lesotho (Chap. 4, Sect. 4.2.2.1.4). Despite these recovery rates, stock theft remains a major problem affecting farmers in rural areas in the Lowland region and perhaps throughout Lesotho. It is thought that sometimes reports and official figures like the ones on recovery rates could be used to justify government intervention, whether justified or not. As one key informant said, *'Lesotho has two citizens'*, government and others, who seem to exist in parallel and oblivious to the others' realities and needs. The 'two citizens' phenomenon was seen by some key respondents as a probable cause of inappropriately designed land-use/management solutions and decisions, and also a possible additional cause for the observed passivity regarding land management.

A farmer's decision to do nothing in terms of land management or changing land-use practices could be partly explained by a household's socio-cultural characteristics and income potential. Kessler (2006) found that a farm household's progressiveness was by far the most decisive factor at household level that influenced decisions on investing in soil and water conservation techniques. This is similar to our study's findings where non-government informants – most of

whom could be considered progressive farmers- said they invested in agricultural input and 'modern' farming techniques to increase returns from the land. In most cases this group favoured and practised the commercial farming of maize and wheat. But it was not the same in the two study villages. In addition, when asked who should be responsible for land management, the non-government key informants pointed to the farmers first, followed by chiefs and the Ministry of Agriculture. Thus they see themselves as farmers who should be responsible for land management. The desire to increase the land's output drives them to invest in agricultural production instead of waiting for outside help. Such a response and actions could indicate that progressive farmers were aware of institutions' failure to manage land and agricultural production, believing that farmers should be given more opportunities or should be more proactive in doing so themselves. They also referred to chiefs as probable second-choice managers of land-use (Chap. 4), emphasizing the importance of traditional land tenure in Lesotho (Chap. 3).

The study by Kessler (2006) also established that at field level key decisive factors of land-use change were surface conditions, field location and land tenure. In the current study, similar observations have been established. The responses 'no jobs', 'no credit', 'illness' could be related to characteristics at household level, while 'drought' and 'land degradation' could be representative of field level characteristics as in the Kessler (2006) study.

ii. **The influence of policies on land-use decisions**

Land tenure and access were not given much prominence by respondents as either a driver of land-use change or a cause of land degradation in this research, although one non-government informant did relate to it as a contributing factor to land degradation. The type of land tenure, access rules and local institutions was not sufficiently investigated by this study to provide general conclusions. Further research is needed here. It is, however, important to note that in both study villages the *pitsos* where held in the presence of both the chief and local council representative. Perhaps this illustrates the continued existence of both traditional and modern tenure – contrary to legal requirements. Yet in terms of managing land-use, this it could cause confusion and frustrate enforcement. Several female respondents in Ha Paki also said they had no land. A state of landlessness and diminished access to land could be partly attributed to increasing land-use change in settlements, which in turn could have been driven by pull-factors (e.g. presence of a (illegal) land market) or push-factors (e.g. HIV/AIDS), as illustrated earlier in this chapter. Studies elsewhere in sub-Saharan Africa, for example, have shown that female and orphans' land-tenure and access rights were sometimes compromised where their husbands (or parents) decided to sell land upon realizing they were HIV/AIDS positive (Aliber and Walker 2006).

'Ugly politics' was also established as another driver of land-use change leading to settlement encroachment onto agricultural land. An example of this phenomenon in our study is where farmers discover the government's policy to develop agricultural land, then rush to build on the identified land so they can

later claim compensation for re-location. In this case it is government policy which drives people's land-use decisions, however irrational these might be.

The legal framework designed to protect and manage land-use in Lesotho reveals some weaknesses (Chaps. 2–4). The most obvious are inconsistency and non-coherence with other existing measures. In some cases, implementing these legal and policy frameworks might result in 'perverse' incentives of land-use change (e.g. Wunder 2000). But the Lesotho Land Act (1979) is partly implicated in influencing land-use decisions. It has been blamed for much of the lack of implementation and land degradation in the country (Lesotho Land Policy Review 2000). As stressed by one government key informant, *"according to the Land Act of 1979, responsibility for land-use lies under the Ministry of Local government, but the 1973 Land Husbandry Act states that it is under the Ministry of Agriculture. The Land Act removed powers from the chiefs, so now chiefs should not allocate land. But there is bad administration and no enforcement."* The spread of settlements onto previously agriculture land might be considered a failure by institutions to enforce appropriate use of land. Poverty could be the major underlying factor acting in tandem. Drimie (2002) found that in the villages of Ha Poli and Matsatseng in Lesotho, some chiefs did not observe laws on leaving land fallow. Instead, chiefs allocated a special concession to HIV/AIDS-affected households by indefinitely postponing land fallowing. Although this served somewhat to secure a livelihood for the affected households, it can be assumed to have other – perhaps more negative implications for sustainable land management. In Ha Maphohloane, cows were seen grazing on some fallow fields (Chap. 5, Fig. 5.4b).

However, public road-building has been identified as a strong factor in driving land-use change (Chap. 5). Elsewhere, public-road building policy was established as "*a more powerful factor in shaping pressures on forests than credits and land-tenure policies combined"* (Wunder 2000: 202). As in our study, Castella et al. (2005) recognized that improved village accessibility had led to changes in land-use systems and patterns, and led to differentiated development pathways. In our study, visual and remote-sensing analysis have found an expansion of settlements near (newly-built) main roads, as well as increasing disaggregation of fields, and a general increase in development resulting from improved access (Chap. 5). In the two villages there was a notable decrease in cultivated land: in Ha Paki cultivated land decreased by about 84 ha between 2002 and 2006, and in Ha Maphohloane there was a decrease of 89 ha between 2002 and 2004, respectively (Chap. 5, Sect. 5.4.3). These were among the largest observed land-use changes in the two study villages.

Studies elsewhere have identified other national policies as major drivers of land-use change. For example Stolle et al. (2003:289) reported that: "*Policy decisions on which areas are allocated to transmigration projects or for conversion to plantations or production are the main driving forces of fires (…) Fire probability thus increases in areas allocated for logging when these areas are not yet under use or are abandoned by the companies. Likely the attractiveness of these areas for conversion by large- or small-holders is high given their accessibility"*

Yet the relationship between national policy and local land-use is generally complicated by two factors (Sikor and Truong 2002): "*(1) changes in local institutions may predate national reforms, and (2) implementation of national policy and the resulting local institutions may differ from place to place"* Lesotho's 2000 Land Policy Review recommended that the state hold land in trust through the National Land Council operating through District Land Boards and Local Land Boards, instead of through chiefs. However, as was established by Drimie (2002), chiefs still played a prominent role in land management at village level in Lesotho. Our study also established that chiefs were perceived to be important local land-use managers. We observed a gravitation towards the acknowledgement of chiefs as the preferred managers of land-use particularly at village level, as shown by responses to the question "*who should be responsible for sustainable land-use?"* in Chap. 4, Sect. 4.2.2.3. As stated earlier, during village interviews it was generally the chiefs who called for the *pitsos*. A presumed outcome of these conflicting views and co-existing institutions is poor enforcement of land policies and land management measures, with the continuation of the current 'state of affairs' (e.g. increasing conversion of agricultural land to settlements, increasing land degradation, etc.).

iii. **Access to credit and land-use decisions**

Access to credit was discussed in previous chapters. In Ha Paki, the failed credit union was perceived to be the cause of much poverty in the village (in Chaps. 3 and 4). Respondents in our study said they had used it as a savings bank too. Its collapse was seen both as a loss of villagers' savings and a loss of agricultural credits. But most importantly, as stated by some respondents – they had lost a source of money to spend on HIV/AIDS-related costs and funerals. In Ha Paki there were observed and perceived conflicts and tensions relating to the collapse of the credit union between villagers and officials of the bank managing the credit union (Chap. 4). This was also implicated as a cause of land-use change in Ha Paki. In Ha Maphohloane, respondents pointed to the existence of *letsema*. As discussed earlier, this form of organized labour can ensure 'survival' of agriculture and a household's food production capacity, particularly in terms of labour shortages and/or increased poverty. A recent report on agriculture food production in Lesotho states (WFP 2006:19): "*Cooperatives are very dynamic in Mohale's Hoek and facilitate access to agricultural inputs although prices remain very high. The role of agricultural extension services is very strong, backed by NGOs such as Catholic Relief Services (CRS), World Vision International (WV), Rural Self Help Development Authority (RSHDA) and some agricultural programmes such as Sustainable Agricultural and Natural Resource Management Programme (SANReMP).*" These programmes and projects are presumed to have influenced the increase in areas planted with sorghum and maize in the Mohale's Hoek district during the 2005/2006 agricultural year. It is important to note that an increase in the area planted does not necessarily translate into increased crop production (e.g. Figs. 6.2–6.4). Other factors like drought, badly-timed rainfall, storms, can come into play. Planting a large area is a strategyto ensure maximum output.

The collapse of the Lesotho Agricultural Bank, as explained earlier (Chap. 4) is also partly responsible for the loss of access to credit for agricultural production. The loss of credits and subsidies for agricultural inputs may be seen as factors favouring decisions to change land-use away from agricultural production. Credit inaccessibility has been identified elsewhere as *"perhaps one of the most critical factors that impedes peasant agricultural production"* (Kajembe et al. 2005).

6.4.1 *So Do Policy and Institutions Influence Land-Use Decisions?*

In concluding discussions on $\mathbf{H}_{3,}$ several issues must be highlighted. This section has confirmed that policy, legislative and institutional factors were partly driving land-use change in the Lowland villages, as proposed in Chap. 2. As has been explained, these drivers do not act in isolation but in tandem or parallel with other underlying drivers like poverty, HIV/AIDS and other socio-cultural and economic factors acting both at household and regional (or landscape) level. As shown in the previous sections, the outcomes of these decisions had differing land-use change effects. At first it seems obvious that policy and institutional factors affect land-use change, prompting some to question the need to investigate such a hypothesis. But the research discussion in the sections before this has shown that such a link is neither immediately obvious nor always direct. Perhaps the most important contribution of this analysis is its identification of **how** policy and institutional factors affect land-use decisions and not on whether they affect such decisions *per se*. As a result, an answer to the question above would be: *yes, but it would be better to focus on the nature of this influence rather than on the fact that there is an influence or not*. Within this conditionality, hypothesis $\mathbf{H}_3$ is accepted by this study.

6.5 Summary

Decisions on land-use change are driven by the interaction and trade-offs between many biophysical, socio-cultural and socio-economic factors. Our study established the presence of underlying and other drivers influencing decisions on land-use. The immediate, proximate, drivers were often those that people were able to identify immediately. A closer look revealed another layer of drivers – underlying drivers, and sometimes other additional drivers, which act on the primary drivers to cause land-use change.

This study identified the following major land-use changes: an increase in settlements and population, decreased crop production, increased land degradation, decreased livestock numbers and decreased arable land. Respondents perceived the effects of these land-use changes as negative.

As previously explained, land-use changes towards increasing settlements and urbanization were identified as being mainly a response to the perceived unattractiveness of agriculture and effects of HIV/AIDS-related mobility and mortality on the quality and quantity of the available labour force and its economic impacts on a household. The existence of migration-induced labour shortages was disputed by this study. In this case, it may be assumed that the decision to sell or convert land into settlements is directly related to the perception that agriculture is not economically efficient or viable under the perceived constraints like drought, lack/irregular rainfall or illness. This creates a need for alternative income sources, often non-agricultural, in this case partly leading to land-use change to settlements and selling of livestock. This chapter has confirmed that policy and institutional factors also played a role in driving land-use change within the defined context and conditionality. These changes partly led to a decline in crop productivity. Livestock numbers also decreased because of increasing stock-theft, despite new anti-theft laws. Farmers' perceptions of the biophysical characteristics of their land and climatic conditions were found to influence decisions on land-use. These perceptions were representations of what is 'real' on the ground. It is submitted that local knowledge contributes a sound basis for assessment and monitoring initiatives on environmental change and can contribute to sustainable natural resources use (Klintenberg et al., 2007).

The nature and outcomes of decisions on land-use were also affected by a combination of underlying and other factors. For example, the decision to sell/convert agricultural land to settlements or abandonment, as observed by this study, was perceived to be driven mainly by biophysical conditions of the land and climatic factors. Yet other underlying factors may need to be in place to arrive at the desired end-point. As Honewood et al. (2001) found: "*decisions over land use are driven by tradeoffs between different economic opportunities (…) and not by population pressure. Private land tenure makes possible and market conditions encourage commercial cultivation, which leads to major land cover change*…." In relation to the current study, proximity to Maseru and the demand for more settlements and development land nearer to the capital might have triggered a prospective land market in Ha Paki which, was perceived as an economically attractive option by farmers. It was partly responsible for driving land-use away from crop production.

The study findings did not support widely-held views that population pressure led to land-use change, nor that increasing population growth would lead to improved land management (Chap. 2). Both Maltheusian and Boserupian theories have been rejected by these findings (Chaps. 4–6). The commonly held views that land degradation causes land-use change were also rejected by findings of this study. It was established here that land degradation was a result of land-use change and not the reverse as widely portrayed (Chaps. 1–4 and 6).

Widely-held views that policy and institutional factors drive land-use decisions, as tentatively put forward in Chap. 2, are confirmed by this study within the defined conditionality. Essentially, various weaknesses were identified in the legal and administrative framework designed to protect land-use in Lesotho. At national level,

fragmentation of policy and the institutional frameworks were identified, particularly relating to the role of the Ministry of Agriculture in land-use management. The lack of a qualified human resource base and a lack of financial resources were other salient features often used to explain the lack of implementation. Political will was proposed by some respondents as a way forward. Yet in the absence of clear guidelines, responsibility, enforcing existing policies and laws, and coherence in the policy and institutional frameworks, political will alone cannot be expected to make the necessary change in structure to ensure land management and its sustainable use. At most, it could lead to paying lip-service to land-use management, unless existing policy and legislative measures were adequately implemented and strengthened.

This chapter has established that in Ha Maphohloane and Mohale's Hoek district in general, there was better organization of labour and the existence of support networks as opposed to Ha Paki on the peri-urban fringes of Maseru – which was undergoing uncontrolled settlement expansion at the expense of agriculture production and food-self-sufficiency.

Contrary to theories identifying rural land-users as ignorant (as described in Chap. 2), these findings have identified rural land-users in the Lowland region as possessing an accurate understanding of their local biophysical and socio-economic conditions. Through this knowledge they carried out decisions to enable them to adapt to the changing socio-economic and biophysical conditions. Sometimes, such 'rational decisions' like converting farming land to settlements for income generation, did not necessarily conform with existing government policies on land-use. However, this study has also established that farmers felt disempowered to manage land sustainably, and instead relied heavily on outside help. This was defined as 'dependency syndrome.' Interestingly, there exists a group of progressive farmers who were willing, and in most cases able, to invest in agricultural activity. But they too said they were encountering major difficulties and some were thinking of engaging in share-cropping or selling their fields in favour of another more economically-viable activity. They perceived lack of access to credit for agriculture as a major impediment to crop production and agricultural land-use. Access to credit was seen as a means to acquire agricultural inputs, labour and as insurance against poor crop yields, particularly in the light of the current biophysical and socio-economic conditions.

This study has also established a direct relationship between land-use changes towards more urbanization and the appearance of new roads (improved accessibility). This was more obvious in the peri-urban village of Ha Paki where there were more favourable factors driving land-use changes away from agricultural land-use. Settlements were often located along main roads where an increase in settlements was generally seen.

In conclusion, Lesotho's motto quoted above, perhaps best embraces some principal 'ingredients' towards more sustainable land-use. Peace, rain, prosperity.

Following the discussion in this chapter, another conceptual framework of land-use change in the Lowland region is proposed (Fig. 6.9). This is based on a modification of the initially proposed framework in Chap. 2.

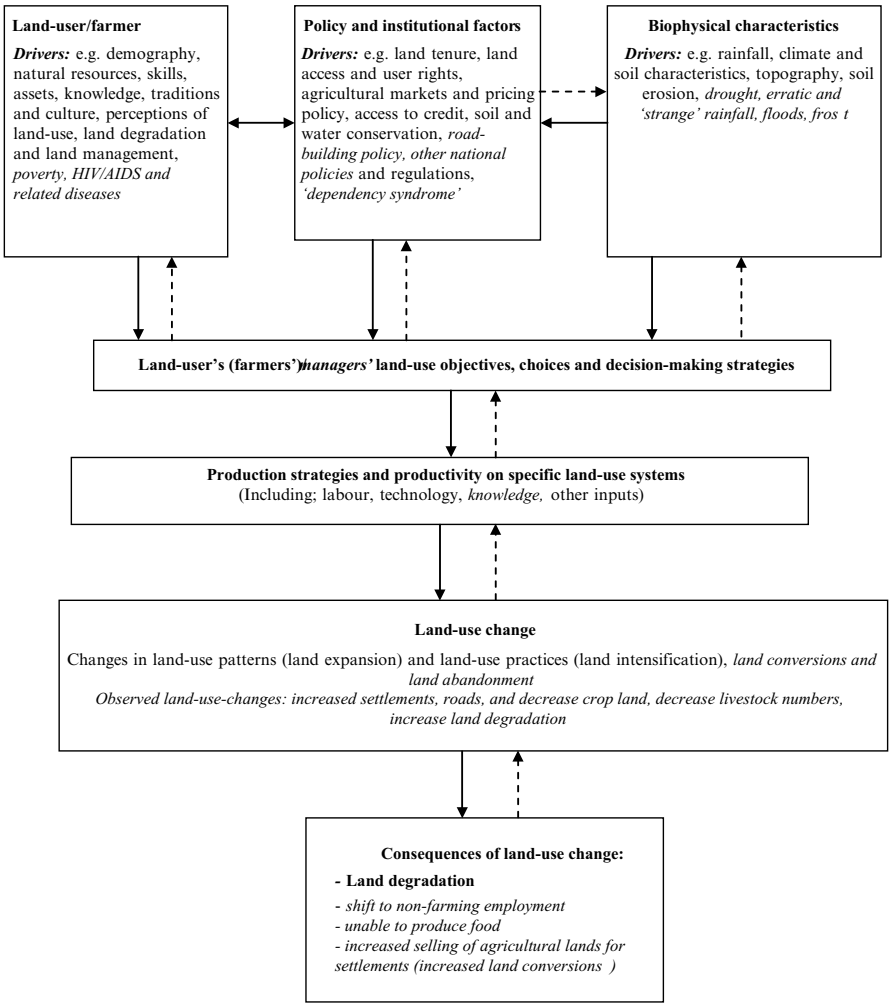

Fig. 6.9 Proposed conceptual framework for land-use change in the Lowland region

The writing in *italics* are new additions (to the previously proposed conceptual framework in Chap. 2, Fig. 2.1) based on our research findings.

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Chapter 7
Conclusions: So What?

Abstract This chapter provides a synthesis of the main study findings. It offers further considerations and recommendations for policy and research. The study used remote-sensing and perception analysis to assess causes and consequences of land-use change in the Lowland region (Chaps. 4 and 5). A theoretical framework proposed in Chap. 2, and refined in Chap. 6 set the conceptual basis for the study. Within this context, the analysis' findings were tested *vis-à-vis* the study hypothesis, challenging commonly-held views about land-use change in the Lowland region, and Lesotho in general. This chapter provides a summary of the main findings. These findings aim to contribute to improved understanding and knowledge about the causes and consequences of land-use change in the Lowland region of Lesotho in particular, and by implication, shed light on plausible explanations of similar occurrences in Lesotho and perhaps in other similar semi-arid regions in sub-Sahara Africa. Human wellbeing, health, access to food and nutrition, the environment on which we depend for our survival, institutions and our socio-economies, are critical factors, some of which cause, and/or are effected by changes in land-use.

Keywords Land-use change • Lowland region • Lesotho • Guiding principles • Sustainable land-use • Policy recommendations • Proposals for action

> You must be the change you want to see in the world.
>
> (Mahatma Gandhi; *Indian ascetic & nationalist leader*, *1869–1948*)

7.1 Introduction

This study has achieved the aim and objectives set out in Chap. 1 (Sects. 1.3 and 1.5). It has identified and analyzed the causes of land-use change and their consequences on rural livelihoods and the environment, as shown in the Lowland region of Lesotho.

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The research findings have shed light on the intricate dynamic nature of the human-environment nexus in the region and offered an understanding of how different human, socio-economic, political, institutional, biophysical and cultural factors influence decisions on land-use. The results show that land-use change is mainly driven by prevailing biophysical-climatic uncertainties and socio-economic imbalances in the rural farming 'subsistence' sector, and their interactions, coupled with constraints and opportunities offered by institutional and policy factors, in combination with a tendency towards 'dependence syndrome.' Rural farmers and land-managers responded to these changes in differentiated decisions through altered actions and choices, manifested in part, as changes in land-use patterns, and by implication, land-cover change. Through the analysis of an insider's perspective (e.g. Briggs et al. 1999; Kajembe et al. 2005; Klintenberg et al. 2007; Mapedza et al. 2003; Mortimore and Tiffen 1995; Roba and Oba 2009) this study has identified some proposals and issues which deserve further analysis and others which can be used as a basis for political recommendations on how to effectively ensure sustainable use of land resources in the Lowland region.

This final chapter provides a synthesis of the main findings of this study with some additional perspectives. The first section provides an integrated vision and explanations into the main causes and consequences of land-use change in the Lowland region of Lesotho. This is followed by a section on recommendations for policy and actions, and thereafter, a section on perspectives for further research.

7.2 Causes and Consequences of Land-Use Change in the Lowland Region of Lesotho

Drivers of land-use change can act at different levels to cause land-use change. These drivers act in combination with or parallel to other factors. This study has recognized the following most important land-use changes: increased settlements and population, decreased crop production, decreased livestock numbers and increased trees/woodlots. The effects of land-use change were perceived as negative by all respondents. Respondents recognized the major effects of land-use change as increasing land degradation, shift to off-farm employment, increasing soil erosion and inability to produce food, and having to sell agricultural lands for settlements. Based on the research findings, key proximate drivers of land-use change in the Lowland villages were established. These were drought, lack of water, land mis-management, HIV/AIDS and dependency syndrome. These were acted on by underlying and other drivers, discussed below, to bring about major changes in land-use.

Settlements increased mainly along newly–built roads and secondary pathways, as well as on former cropland. The increase in settlements was associated with changes in infrastructure and accessibility. The resulting impacts for rural land-use were manifested in part as increasing fragmentation of field/cropland, decreasing crop production, urbanization and population increase (Chaps. 4 and 5). In Ha Paki,

closer to Maseru, this phenomenon was more evident than in Ha Maphohloane. Yet the improved access to and from the capital city was not seen as a positive development by local people. Increases in settlements lead to decreasing cropland and decreasing food production. Remote sensing analysis showed that settlements increased by 8 ha (about 0.4% of the share of the total study area) in Ha Maphohloane (2002–2004), and decreased by 8 ha (about 1.4% of the share of the total study area) in Ha Paki (2002–2006). But the decrease in Ha Paki was attributed to poor data quality and not a true interpretation of the land-use changes. Perception and visual analysis confirmed an increase in settlements between 1960–2000s (Chap. 5, Sect. 5.4). Findings of remote-sensing analysis in the current research established a decrease in crop land for the periods 1960–2000s, quantified as – 84 ha (or about 14.3% of the share of the total study area) in Ha Paki (2002–2006) and – 89 ha (or about 4.6% of the share of the total study area) in Ha Maphohloane (2002–2004). As shown in Chap. 6, official figures confirm these results. Proximate drivers of declining crop production were identified as drought, economic unattractiveness of agriculture, and expansion of settlements into agricultural lands. Recent recorded drought periods (e.g. 1991/1992, 1998/1999, 2001/2002, 2002/2003, 2006/2007), reflected years of reduced agricultural crop production as stated by respondents in the study areas (Chap. 6, Sect. 6.2). The principal drivers causing an increase in settlements were HIV/AIDS-resulting economic and labour shortage pressures and the perceived 'unattractiveness' of agriculture – mainly due to drought and water shortages, in combination with non-access to credit and increasing livestock thefts. However, remote-sensing analysis revealed an increase in woodlots/tree plantations in the study villages, equivalent to 14 ha (about 2.4% of the share of the total study area) and 63 ha (about 3.3% of the share of the total study area) in Ha Paki (2002–2006) and Ha Maphohlonae (2002–2004), respectively. This is assumed to be caused by a government food-for-work programme that 'employed' villagers (mostly women) in selected parts of the country, particularly in Maseru district, to plant and maintain woodlots. The programme was initiated by the Ministry of Forestry and Land Reclamation in 2003.

This research found no causal associations between migration-induced labour shortages and a decrease in cropland/crop production and increasing settlements. On the contrary, there was a perceived increase in population in the villages. Yet HIV/AIDS-induced morbidity and mortality was negatively affecting labour availability. Although land degradation was perceived to be increasing in Lowland villages, the causes for the increase were not associated with migration-related labour shortages. The main drivers of land degradation were identified by perception analysis as drought, poverty and ignorance. The study established that local land-users/managers were able to identify land degradation, despite their passivity. They widely recognized land degradation on fields as *dongas* or gullies and on grazing land as scarcity of vegetation, thus contradicting popular myths about the knowledge of local, particularly rural, farmers (Kessler and Stroosnijder 2006; Slegers 2008). In the study areas no household was identified as involved in soil and water conservation techniques, although in Ha Maphohloane, the village chief did say that the village had used fertilizers previously. However, non-government respondents, who were

engaged in a more commercial form of agriculture, did confirm using agricultural inputs like fertilizer and to some extent, rotational cropping on their fields. This could imply that socio-economic status, which to a large extent determines the type of agriculture practiced, or a household's progressiveness, as found in a study by Kessler and Stroosnijder (2006), was by far one of the most decisive factors at household level that influenced decisions on whether to invest in soil and water conservation techniques.

Although Basotho are traditionally livestock-keeping peoples, the study did not establish any particular preference for livestock-keeping in the study areas. On the contrary, the numbers of livestock were perceived to be decreasing. The proximate drivers for this decrease were increasing stock-theft, drought and selling livestock for income-generation – mainly to cover HIV/ADS-related costs (Drimie 2002).

The study found that perceptions of land-users and managers on the biophysical environment and climatic constraints were additional central underlying factors driving land-use change. As was shown by this study, secondary data supported the respondents' views on these constraints, showing that the perceived constraints were representations of real occurrences.

Local land-users responded to perceived changes on the biophysical environments and climate changes through differentiated actions. These were generally guided by their socio-economic opportunities and livelihood options. HIV/AIDS and related impacts were a principal socio-economic factor in the study villages that led to increasing social misery, morbidity, disease, labour shortages and severe economic pressure. Therefore, decisions on changing land-uses could be considered part of a household's adaptation strategy to changes in climate and biophysical environment, within a changing socio-economic context. Consequently, local land-users were neither powerless nor as ignorant as they perceived themselves to be.

Policy and institutional factors affected land-use decisions. As explained above, public road-construction has led to changes in land-use, as has lack of access to agricultural credit and implements. Other government policies like the food-for-work- tree-planting programme resulted in an increase in woodlots. Trees were planted mainly on degraded land or land considered unsuitable for agriculture. This programme provided an alternative source of income for local women, while it resulted in changes in land-use from degraded/unsuitable lands to woodlots/trees. The non-implementation of policies and laws, fragmentation, lack of clear responsibilities and lack of policy coherence and non-complementarities with existing related policies and measures, were implicated in the unlawful encroachment of settlements onto agricultural lands, and increasing land degradation. The Ministry of Agriculture was often seen as the main institution responsible for land-use management, and blamed for increasing land degradation and soil erosion. Local land-users expressed a culture of dependence which was underlined by inertia and a loss of confidence in their own ability and knowledge of land management, preferring instead to await outside intervention – like from the Ministry of Agriculture, (and other government departments), international donor organizations and others. The World Food Programme (WFP) was found to have a negative influence on food production. Respondents pointed out that WFP emphasized a culture of dependence

by removing the emphasis on farmers to grow their own food and become self-sufficient. Some believed that increasing local dependence on food-aid served to justify the agency's existence yet increased the possibility of land conversion away from agriculture towards more settlements and land abandonment. These short-term solutions, comparable to placing a 'band-aid' on a deep wound, would in the long-term not solve the lack of food self-sufficiency nor any of the problems identified in the Lowland region. More holistic, long-term solutions, rooted in the perceptions and knowledge of local land-users and managers, while recognizing the link with national, regional and global systems (Maconachie and Binns 2006) ought to be pursued. Some of these ideas are expounded below.

Local actors have the necessary understanding of local, social, economic and biophysical situations, so they are best-placed to explain the local human-environment interactions and their effects and decide how they can deal with these impacts. In this study, local perceptions were confirmed as real, actual situations partly by remote-sensing analysis and secondary information. Thus perceptions of local land-users and managers in the Lowlands are imperative in understanding rural communities. Policy decisions must, therefore, be rooted in this understanding, using it as a framework on which to construct alternative sustainable land-use options.

7.3 Policy Recommendations and Strategic Actions

Chapter 4 (Sect. 4.2.2.4) identified several possible solutions to the identified land-use change issues. These were ranked in order of importance as:

- Projects/partnerships with outsiders; improve agriculture through partnerships with outsiders; agriculture credit schemes/rent of agriculture implements; (better) implementation of existing policies
- Security of tenure; and change in attitude to land-use/management
- Information and awareness raising/education of youth; and re-focus modern education and educate youths on sustainable land-use/management

Considering the above causes and consequences of land-use change and their interactions, and the research findings on possible solutions, pertinent recommendations are proposed below. The presentation below is divided into two sections; the first is on general principles, followed by a section on strategic actions.

7.3.1 Proposals for 'Guiding Principals for Sustainable Land-Use Policies and Actions'

- Before deciding on any policy solutions, identify and establish for each locality, the causes and consequences of land-use change on local populations at village level and their interactions with the sub-national and national land-use systems.

Remote-sensing analysis of geographical images, and secondary data should be used to complement perception analysis, whether the analysis is qualitative or quantitative. The results would be excellent indicators of the local situation and could be used as cornerstones to guide any future policy interventions, taking into account the interactions between locally perceived solutions within the context of the national, regional and global land-use systems.

- Any land-use/land management strategy should contain elaborate proposals on how to address the HIV/AIDS situation and the labour shortages and socio-economic impacts that are constraining agriculture and rural development. Widow-headed, orphan-headed or grandparent-headed households should be helped to participate in land-use decisions and land administration functions (Drimie 2002).
- The role of chiefs as guardians of the land should be investigated. Tribal land administration can be vital in ensuring sustainable land-use and management a local level, particularly in view of the study's findings. An exchange of best-practice and information on this should be initiated at village, district and inter-national level with neighboring countries. Local council officials could be trained to work with chiefs on land administration and ensure registration of rural lands and participation of vulnerable households. The new Land Bill removes discrimination against women in terms of land ownership. However, by removing powers from chiefs the Bill risks encountering resistance to its implementation at local level, particularly given peoples' positive perceptions on the role of traditional land administration. Civil society, local researchers and different government ministries could play an important role here.
- The Ministry of Agriculture should work more closely with local farmers and land-users, chiefs and other local figures to inform the people of the long-term (financial and other) benefits of sustainable land-use and land management. Increased participation by local land-users in decision-making, in conjunction with transparency, clearly defined responsibility roles between all concerned, improved monitoring and governance would potentially assist implementation of land-use and management policies and intervention. Local knowledge and institutions should be allowed to play a central role.
- Guard against the use of policies and measures that promote a culture of dependence. Any intervention policies should be based on a thorough understanding of local situations and local perceptions of the situation, coupled with the analysis of geographical and secondary socio-economic data. Alternatively, or in addition to this, all proposed policies and measures should undergo an impact assessment that analyzes their potential negative and positive impacts on the environment, local communities and the local and national economy, before decisions on their adoption is made. Local participation in such a process should be facilitated.
- Any actions and policies promoting sustainable land-use should have a holistic approach, recognizing that humans are part of nature, and promote empowerment of local people to manage their own land. They should not be based on prescriptive, top-down, or 'imported solutions' that have often exaggerated the culture of dependence and irresponsibility to land management, and resulted in loss of local confidence and valuable indigenous knowledge on land management.

7.3.2 *Proposals for Action*

- Immediate efforts should be made by the government, involving ministries such as those responsible for agriculture, local government, land-use and planning, culture, among others, together with scientists, researchers, civil society and local people, to revive relevant indigenous knowledge on land-use and incorporate this into existing (and future) land-use and management solutions.
- Agricultural credit schemes should be re-introduced and promoted in rural areas. Appropriate policies and measures should be put in place to allow farmers access to credit to facilitate higher investments in agriculture and provide a 'safety net' in view of the unpredictable agricultural situation. The cost of agricultural inputs and implements should be subsidized by government. Progressive farmers should be given preference renting agricultural implements and given the necessary skills and information to ensure the long-term survival and success of such an initiative.
- The government should investigate possibilities of using animals as collateral through consultation with village, district and national land-users/managers and any interested people. Local micro-bank lending schemes run within the village or at district level should be established to facilitate agricultural food production and allow investment in diversification of activities, given existing constrains within agriculture.
- The role of foreign agencies like WFP should be independently evaluated, reconsidered, and where necessary, limited. Local researchers, scientists, villagers, civil society and relevant government services can play an important role here.
- Local people should be encouraged to diversify their livelihood options and not only rely on agriculture, particularly in the face of drought and other constraints, and should be discouraged from converting agricultural land into settlements. Possibilities for alternative livelihood options should be sought in consultation with local land-users and managers. Donor and government funding, and the participation of local people, civil society, government extension services and local researchers can help facilitate this. The author believes that existing structures and projects like the women's self-help group that was seen engaging in creating hand-crafts should be taken into consideration first and developed further before starting new projects. Further dialogue with villagers and other local people would help identify suitable alternatives or complementary measures well-suited to local preferences and conditions in each village or locality.
- Local traditional and contemporary socio-economic sharing and networking mechanisms should be identified and examined to strengthen their role in supporting rural livelihoods (Turner 2003). The role of local people, scientists, researchers, elders, relevant government ministries and civil society is important here.
- The government and responsible ministries and departments should ensure implementation of existing policies and legislation on land-use, land management and on natural resources. Chiefs could be encouraged to support such an initiative. Local civil-society organizations should also be persuaded and facilitated to engage in monitoring policy implementation.

- Educate not indoctrinate. The Ministry of Education should lead efforts to re-focus the education system towards more ethical education, with an emphasis on integrity, acknowledging the role and responsibilities of an individual within a wider inter-linked community. Primary and secondary education should be re-focused to incorporate local knowledge on sustainable land-use and management techniques and on other diversified livelihood options. Youth-headed households should particularly be targeted with appropriate information and assistance to provide them access and enable them to continue with education and develop appropriate skills and guidance towards targeted opportunities. Campaigns and other educational and information programmes that target female-headed households and other local people should be initiated at the village (and district) levels. The inclusion of local civil-society organizations and allocation of adequate financial and human resources would be essential in this respect.
- The national (district, youth-targeting) media e.g. radio, television, local newspapers should be used to sensitize people nationwide to the constraints and opportunities of land-use and land-use changes. The media could also play a central role in providing a platform for discussion, exchange of information on how to deal with identified issues, or provide an opportunity to share best-practices between villages, districts and with neighbouring countries. Local politicians should be encouraged to play a central role and participate in such discussions with their constituencies and others.
- Resources and efforts should be placed on collecting data and information relevant for policy-making. Relevant statistical data need to be made available on the internet at a central location (such as the government Ministry of Statistics), and this should be communicated to the relevant people and the public. Statistics and (non-sensitive) socio-economic data that reflect village-level conditions should be made available at an appropriate central location in different formats – digital or print. Such data is important to decision-making at village and national level. Government and donor efforts should secure adequate financial and human resources to relevant government ministries, departments, scientific and others researchers, research organization and experts responsible for the collection, interpretation, storage and communication of such data.

7.4 Recommendations for Further Research

Based on this study's work and findings, several issues for future research have been identified:

- Improve the collection and availability of geographical and socio-economic data, particularly to cover more (remote) villages in the Lowlands e.g. Ha Maphohloane and in other parts of the country.
- Research efforts should be placed on quantifying actual changes on land-use for different places, focusing on quantifying vegetation losses, and identifying the

speed at which widely presumed desertification is occurring in the Lowland region. Availability of appropriate remotely sensed data is a major factor here.
- Investigate appropriate adaptation measures and techniques to climatic changes and changes in the biophysical quality of land in the Lowland region in particular.
- Further investigative studies on the land tenure system within continuing changes on land-use and their consequences are needed. This should help identify best options to address issues like the encroachment of settlements into agricultural lands and help prevent the abandonment of crop lands in the Lowland region.
- Research the possibilities and impacts of alternative livelihood options in rural settings within select villages, with the full consent and participation of local people.
- The role of the Ministry of Agriculture in managing land-use at village level should be investigated in view of the changing rural and agricultural circumstances. The co-existence of chiefs and local council officials at village level needs be evaluated in view of these findings and in the face of current changes in land-uses and their consequences, with a view to improving land administration and governance.
- Resources should be made available to investigate the existence of alternative technologies which are made locally and how these could be used to benefit the rural farming sector. In this respect, the use of renewable energy technologies should also be studied further. The possibility of using locally-made solar-based cookers and ovens could reduce the economic burden of buying energy for cooking in rural households. Ovens using solar energy that are large enough for commercial mass-baking – for use in local income-generation projects could be developed. Opportunities for using simple solar-based technology in village projects, for example, to dry fruit or other food-stuffs in quantities large enough to create surplus for local markets should be investigated and promoted. Different departments of the government, local academics, land-users and interested civil-society groups should be incorporated in such efforts.
- Investigate possibilities of diverting some of the water in the Highlands Project to some southern Lowland villages, to reduce water scarcity.

7.5 Final Word

This study has provided an in-depth understanding of the key causes and consequences of land-use change in Lesotho's Lowland region. Such an understanding is perhaps of the uttermost importance particularly with reference to policy and decision-making. As was seen in this research, there are some differences in how villages react to change. As such, it is vital that any actions at village level take into account local nuances and do not apply a strictly uniform solution to all Lowland villages. Taking into account local nuances, the study's conclusions can be generalized for the Lowland region and its proposals to the Lowland region and Lesotho at large. Efforts

to carry-out further research on this topic, as suggested above, should be stepped up and backed by sufficient public funding and participation. In this respect, particularly young scholars and others interested in specializing in scientific fields should be supported and encouraged to stay in Lesotho – instead of the continuous 'brain-drain' for 'better pastures' into neighbouring South Africa. Other policies, like economic, labour and health policies should take into account the identified changes and their consequences on rural people's livelihoods in the Lowland region. In the spirit of the quotation above, it is sincerely hoped that the work accomplished by this research and its proposals can be used and developed further for the benefit of the people of Lesotho, and particularly those visited in the Lowland villages.

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