Institutional Change and Ecosystem Dynamics in the Communal Areas around Mt Coke State Forest, Eastern Cape, South Africa

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Abstract

Through a combination of theoretical discussion and case study analysis from two villages in the Eastern Cape Province, South Africa, this thesis explores the relationship between institutional change and ecosystem dynamics through a multi-scale approach that combines local and scientific knowledge. Several conceptual approaches were combined in this study. These included; the Resilience perspective, the Sustainable Rural Livelihoods approach, the Millennium Assessment framework and principles, and the Environmental Entitlements approach. Various participatory research techniques were employed which combined with GIS technologies, existing data sets, and historical records.

Common pool resource areas are social spaces, where local values attached to resources are institutionally mediated, politically nuanced, economically interpreted and historically situated. Political driving forces at various scales have played a disproportionate role in local level institutional functioning in the case study area. In particular, inappropriate state-lead interventions into land use planning have weakened local level institutions, and have reduced the ability of the linked social-ecological system to cope with change and uncertainty.

People and ecosystems become more vulnerable when driving forces such as political upheaval, economic depression and drought over-lap. However, rural people are not mere spectators in the face of these driving forces; they respond both reactively and proactively to ensure resilience to change and uncertainty. Ecosystems at Mt Coke play a key role during times of crisis in rural livelihoods. These ecosystems have undergone various short-term cyclical changes largely in response to rainfall fluctuations, and some longer-term changes linked to political events and trends that have affected management practices and local institutions over time.

Orthodox ecological interpretations of ecosystem change appear to ignore four key factors identified in this study: 1) the role of institutions in shaping access to resources, 2) the demand for resources in rural livelihoods, 3) the dynamic interaction between social and natural systems, and 4) the interaction between social and natural systems across scales of analysis. The future of common pool resource management lies in the combination of local and scientific knowledge through an adaptive management approach that encourages learning and adaptation in local level institutional structures.

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Table of Contents

List of Tables

List of Figures

List of Plates

Appendices

Appendix 6: Results from a households survey at Machibi to determine the number of households with rainwater tanks, the dates when these where purchased, and the reasons for investing in a tank

Appendix 7: Metadata File of GIS work of two related villages and their respective land use

Appendix 8: Data sheets from household surveys: Machibi and Qongqota

Glossary

Amagoqo: *Plural, see Igoqo*

Capital, human: The skills, knowledge, ability to labour and good health of people that enables them to pursue different livelihood strategies (DFID, 1997).

Capital, natural: Natural resource stocks and services such as: land, forests, wild resources, water, air quality, erosion protection, waste assimilation, storm protection (DFID, 1997).

Capital, financial: The financial resources people use to achieve their objectives. These include: available financial stocks such as savings and credit/loans, regular inflows of money such as income earned, pensions, and remittances (DFID, 1997).

Capital, physical: The basic infrastructure and producer goods (tools and equipment) needed to support livelihoods (DFID, 1997).

Driver: Any natural or human-induced factor that directly or indirectly causes a change in an ecosystem (MA, 2003).

Driver, direct: A driver that unequivocally influences ecosystem processes and can therefore be identified and measured to differing degrees of accuracy (MA, 2003).

Driver, endogenous: A driver whose magnitude can be influenced by the decision maker. The endogenous or exogenous characteristic of a driver depends on the organisational scale. Some drivers are exogenous to a decision maker at one scale, but endogenous at other levels (MA, 2003).

Driver, exogenous: A driver that cannot be altered by the decision maker. See also *endogenous driver* (MA, 2003).

Igoqo (s*ingular)*: Xhosa name used to refer to a wood stock-pile collected by women and placed outside of the homestead. The stock-piles are not used solely for fuelwood purposes but have a high cultural value attached to them too, particularly for women (Cocks and Wiersum, 2003).

Institution: 'The set of rules actually used' (Oström, 1990: 19). In this sense institutions are the "humanly devised constraints that structure human interaction…made up of formal constraints (rules, laws, constitutions), informal rules and constraints (norms of behaviour, conventions, self imposed codes of conduct), and their enforcement characteristics" (North, 1994).

Knowledge system: A body of propositions actually adhered to, both formal and informal, which are routinely used to claim truth (Feyerabend, 1987).

Livelihood: The capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is defined as sustainable when it can cope with and recover from stresses and shocks and maintain or enhance it capabilities and assets both now and in the future, without undermining the resource base (Carney, 1998a; Scoones, 1998).

Livelihood strategies: This refers to the range and combination of activities and choices that people make/undertake in order to achieve their objectives (DFID, 1997).

Local knowledge: Place-based knowledge developed though experience on a trial and error basis over many generations. While local knowledge may express a different worldview to that of scientists and policy makers, it may also incorporate elements of these kinds of knowledge (Woodley et al, forthcoming).

Sustainability: A dynamic process rather than an end point. Sustainability refers to the maintenance of the capacity of ecological systems to support social and ecological systems, without compromising the needs of future generations (Berkes *et al*, 2003).

System, social: Any group that interacts in such a way that a shared set of understandings and norms exist to dictate action and resource allocation (Westley et al, 2003)

System, ecological (ecosystems): "A Dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit" (Convention on Biological Diversity, 2003: 5). An ecosystem is a functioning unit that can operate at any scale, depending upon the problem or issue being addressed (IUCN, 2000).

System, social-ecological: Interacting systems of people and nature (Berkes and Folke 1998); social-ecological systems are complex self-organizing systems dominated by cross-scale interactions, non-linearity, variability, and uncertainty (Costanza et al. 1993; Levin 1999).

Vulnerability context: The external environment within which people exist, but over which they have little control (DFID, 1997).

Chapter 1. Introduction: Background, concepts and approaches

Natural resource management that involves multiple use, common pool resources relies on robust and dynamic institutions and organisational structures at the local level (Ostrom, 1990; Berkes and Folke, 2002; Anderies et al., 2004). Multiple use ecosystems such as rangelands and woodlands are among the primary land use types in the world (Holecheck et al., 2001; Kowero, 2003), and provide several key ecosystem goods and services to rural livelihoods (Cavendish, 2000; Shackleton et al., 2000a; Rohlin and Batabyal, in press). These kinds of ecosystems have been referred to elsewhere simply as common pool resources (Ostrom, 1990; Agrawal, 2001). Common pool resources are characterised by; a) the difficulty involved in excluding outsiders from using the resource, and b) the subtractability of resources available to other users (Ostrom et al., 1999; Ostrom and Hess, 2000). In many instances, local knowledge and institutions have developed mechanisms over many generations of trial and error that enable them to cope with crisis and change in these kinds of ecosystems (Gadgil et al., 1993; Berkes, 1999; Ramakrishnan, 2001). In Southern Africa however, it is becoming increasingly clear that in many cases these institutions have been eroded since European colonization (Ainslie, 1999; Campbell et al., 2001; Twyman, 2001; Fabricius and De Wet, 2002).

Despite the evidence prevalent in the literature however, Community Based Natural Resource Management (CBNRM) programmes are going ahead in Southern Africa (Shackleton and Campbell, 2001; Johnson, 2004; Nott and Jacobsohn, 2004; Reid and Turner, 2004; Sithole, 2004), and indeed worldwide (Lele, 2000; Agrawal, 2001; Barret et al., 2001). This trend is based on three common but untested assumptions on the part of policy makers; the first is that custodianship will lead to better management, the second is that improved material benefits will benefit conservation, and the final assumption is that devolved governance is possible (Fabricius et al., 2004), in other words, that existing institutions are adequate and appropriate, and that functioning institutions and organisational structures exist at the local level capable of handling devolution in natural resource management (Anderies et al., 2004). It is therefore imperative that this assumption be tested, and that attention be paid to the

structures and processes that either foster or undermine effective institutional structures for common pool resource management in Southern Africa.

This study came about for two reasons. In the first instance, it emerged from an earlier study of mine that analysed the local factors affecting the ability of local institutional structures to manage common pool natural resources at Mt Coke in the Eastern Cape in the context of Participatory Forest Management or PFM (Cundill, 2002; DWAF, 2002a). It became clear, even in the initial stages of the PFM project, that institutional factors had a major impact on the PFM process, and on the ability of different communities to participate meaningfully in the project. It also became clear that external factors such as political and economic change, rather than local factors, had played major roles in the ability of current local institutions to manage common pool resources at Mt Coke.

The second impetus for the study was the community assessment component of the Millennium Ecosystem Assessment (MA, 2003) to which this study was linked. The MA community assessments (Fabricius et al., forthcoming) seek to understand a) societal resilience, and the role played by human (skills, education and knowledge) and social (local level institutions, community networks and organization) capital in the development of resilience; b) the impact of disturbances from varying scales on the local level, and the mechanisms used to cope with and recover from these disturbances; and c) the impact of changing socio-economic conditions over time on the demand for ecosystem goods and services. A discussion of the strengths and weaknesses of the MA framework is provided in Section 1.1.2.

The overall perspective of this study is that local level institutions are the ultimate determinants in the allocation and the use of ecosystems by people (Adger, 1999a). This use of ecosystems influences and shapes the capacity of ecosystems to generate services, and the ecosystem services available for human use influence human choices, preferences, and therefore institutions governing access to those resources. This interaction between people and ecosystems has been referred to elsewhere as a dynamic and 'adaptive dance' (Walters, 1986; Gunderson, 2003), and the term social-ecological system is used here to refer to this type of interacting system of people and nature (Berkes and Folke, 1998); social-ecological systems are complex self-

organizing systems dominated by cross-scale interactions, non-linearity, variability, and uncertainty (Costanza et al., 1993; Levin, 1999). These ideas, and specifically how they are conceptualised in this study, are taken further in Sections 1.1.1 and 1.1.2.

The term *institution* refers here to the 'set of rules actually used' (Ostrom, 1990: 19). In this sense, institutions are the 'humanly devised constraints that structure the interaction of humans both with each other, and with their surrounding environment. Institutions are made up of formal constraints (rules, laws, constitutions), informal rules and constraints (norms of behaviour, conventions, self imposed codes of conduct), and their enforcement characteristics (North, 1994).

Resilience is used throughout this thesis as an organising principle for understanding change and uncertainty in institutional and ecological processes. Resilience is a key concept when dealing with complex social-ecological systems, and refers to the capacity of a system to absorb or even benefit from perturbations and changes, and to persist following a disturbance without a qualitative change in the systems structure and function (Holling, 1973; 1986). Put another way, the resilience concept emphasises the capacity within self-organizing systems for learning and adaptation to change (Gunderson and Holling, 2002).

A resilience approach to natural resource management assumes that resource managers are part of the system in question (Walker et al., 2002), stresses that change is an inherent part of any system, and that stability is a phenomena that should be explained, rather than expected (Folke et al., 2003). In order to cope with uncertainty, variability, and surprise, as this approach advocates, management processes, and the institutions within which they are nested, need to be flexible, adaptive, and open to change (Colding et al., 2003). Thus, the challenge is not to avoid change, but to sustain a range of desirable social-ecological states in the face of complexity and uncertainty (van der Leeuw, 2000).

In sum, landscape change is linked to social change through management functions that govern access to resources (Leach et al., 1997; Berkes and Folke, 1998), and through changes taking places at broader socio-economic and political scales (Daniels

and Basset, 2002). This requires therefore that change in communally managed ecosystems be understood within its historical context of institutional change (Fairhead and Leach, 1996; Walker and Able, 2002; Beinart and McGregor, 2003). This principle applies to many multiple use ecosystems, including rangelands (Eldridge and Koen, 2003), forests (Leach and Fairhead, 2000) and aquatic systems (Hughes et al., 2003; Bellwood et al., 2004), where, despite major shifts in our theoretical understanding of ecological processes, the focus has not yet shifted sufficiently toward understanding ecosystem change in the context of broader socio-economic and institutional processes (Ho, 2001).

Objectives and key questions

This thesis aims to contribute both theoretically and empirically toward the growing literature on rural livelihoods, Environmental Entitlements, linked social-ecological systems and ideas around Resilience. The objective of this study is to examine the relationship between exogenous political, economic and biophysical trends, institutional change and ecosystem services at the local level through a multi-scale approach that combines local and scientific knowledge.

Although each of the results chapters (Chapters 3, 4 and 5) contains its own set of key questions, the over-arching questions that this study seeks to answer are:

a) What are the impacts of macro level processes and surprises on local level institutions and therefore common pool natural resource management;
b) How do local people and ecosystems respond to these processes;
c) How have these responses impacted on the ability of ecosystems to provide the desired goods and services to local people;
d) What contribution could local knowledge make to our understanding of ecosystem management at the local level?

This chapter will begin by outlining some of the key conceptual challenges faced by researchers who seek to heed calls to ‘embrace the complexity’ (Gunderson, 2003: 74) when studying these coupled systems of people and nature. Thereafter, the conceptual frameworks that aided in navigating the various challenges in this study

are elucidated. The chapter then goes on to describe the process of putting these frameworks into practice through a brief discussion of the various techniques used during fieldwork (These methods and their specific use are revisited in the respective results chapters). Thereafter, the various trade-offs involved in a participatory and transdisciplinary study are discussed. The chapter concludes with a description of the structure of this thesis.

1.1 Concepts and approaches

Understanding human-environment interactions for integrated natural resource management through local level case study analyses requires that researchers simultaneously navigate complex systems (Scheffer et al., 2001; Berkes et al., 2003) and multiple worldviews (Gadgil et al., 2003). Such complex systems are characterised by cross-scale interactions, non-linear feedbacks, variability, and uncertainty (Gunderson and Holling, 2002), and therefore any attempt to understand key processes within these systems requires an integrated and holistic approach (Adger, 1999a; Mortimore and Adams, 2001). However, there is a lack of guidance and experience in adopting integrated approaches that involve different worldviews, and few academic curricula address these challenges.

Through various innovations, and a combination of qualitative and quantitative, contemporary and historical (Fairhead and Leach, 1996), and visual and verbal methods (Motteux, 2001), integrated research can be conducted that simultaneously deals with complex systems and multiple worldviews at the local level. The conceptual and practical frameworks presented here are not offered as a panacea for systems research that involves local communities. Rather, these frameworks offer opportunities for researchers in the current theoretical landscape of complex systems research, where a distinct lack of practical guidance exists (Cundill et al., 2004).

This chapter begins by outlining some of the key theoretical challenges that confront researchers in this type of research, and then goes on to outline conceptual and practical frameworks useful in tackling these types of dilemmas. Given the current level of understanding within the scientific literature regarding human-environment interactions in complex systems (Gunderson and Holling, 2002), various trade-offs,

for example between inclusiveness and superficiality, must be made when particular frameworks are selected to answer research questions; those trade-offs relevant to this study are outlined in the final section of this chapter.

1.1.1 Background

Theories about the relationship between people and the environment influence the ways in which natural resource management is understood and applied (Janssen, 2002). Early theories relied heavily on a dichotomy between people and the environment, emphasising the inherent ecological limits to population growth (Malthus, 1798; Meadows et al., 1972). Critiques of this heavy emphasis on linearity, carrying capacity and environmental determinism (see Tiffen et al., 1994), lead later to more inclusive, integrated approaches that emphasised human adaptation to environmental and social processes (Boserup, 1965). More recently, this emphasis on adaptive capacity has paved the way for the ecosystem approach in understanding human-environment relationships (CBD, 2003), with principles and ideas that emphasise complex system dynamics (Kay et al., 1999), linked social-ecological systems (Berkes and Folke, 1998), non-linear feedback at multiple scales (Gunderson and Holling, 2002), and resilience in social and ecological systems (Holling, 1986; Scheffer et al., 2001).

Consistent with this latter trend have been growing calls for the identification of underlying causes of change in these linked systems (Adger, 1999a; Mertens et al., 2000; Lambin et al., 2001; Campbell, 2002), and the accomplishment of this through inclusive and transdisciplinary research approaches (Folke, 1996; Mortimore and Adams, 2001). However, researchers who take on the challenge of inclusivity with Quixotean zeal quickly become confused and frustrated by the many directions in which their analyses are being pulled. Three factors contribute to this confusion: scale, complexity and epistemology.

Scale

Scale refers to the spatial, temporal, quantitative, or analytical dimensions used by scientists to study objects and processes (O'Neil and King, 1998; Gibson et al., 2000).

Ecological and social systems can be viewed or depicted as strongly interacting clusters of processes operating at similar spatial or temporal scales (Allen and Holling, 2002). Consequently, an understanding of how a selected scale of analysis may influence the patterns observed, and therefore inferences made about the causes of these observed patterns, is essential in understanding interactions between human and natural systems (Gibson et al., 2000; Munda, 2000).

However, despite comprehensive reviews of scale (see for example Schulze, 2000) the disparate treatment that scale has received between the various disciplines (Table 1.1) makes 'scale' one of the most fundamental methodological challenges confronting researchers who seek to become transdisciplinary. A number of pitfalls exist when attempting to describe and interpret patterns and processes operating at different spatial and temporal scales; i) *Ostensible chaos*: patterns and processes that appear random at one level, may appear highly organised at another, and visa versa (Schulze, 2000). ii) *Misinterpreted trends*: if the duration of an observation is shorter than the characteristic temporal scale of the process, a declining trend in the process may be incorrectly inferred (Jewitt and Gorgens, 2000). ii) *Misread patterns*: if the resolution of the observation is greater than the characteristic scale of the process, spatial patterns may go undetected (Bloschl and Sivapalan, 1995; Leach and Fairhead, 2000).

Table 1.1: Approaches to scale that characterize different academic disciplines

Approach	Emphasis	Source
Ecology	Predictions are scale and level dependent	Levin, 1992; Gibson et al., 2000
Geography	Spatial scale. Understanding human behaviour requires joint spatial and temporal analysis	Meentemeyer, 1989; Wood and Lakshmi, 1993
Environmental history, historical ecology	Temporal scale. Identification of root	Worster, 1988; Balee, 1998; Berkes et al., 2003

	causes of environmental problems through analysis of historical landscapes	
Economics (including ecological economics)	Fast and slow moving emergent features. Conceptually hierarchical sets of nested sub-systems. Temporal scale is vital.	Martínez-Alier and Schlupmann, 1991; Gibson et al., 2000; Holling, Gunderson and Ludwig, 2002; Holling, Gunderson and Peterson, 2002
Sociology	Agency. Processes at smaller spatial and temporal scales react to macro level processes and may act to change them	Tilly, 1984; Coleman, 1990; Scheffer et al., 2002
Political science (including political ecologists)	Spatial and institutional scale. Actions and outcomes of aggregated units of governance at different spatial scales. Several actors, each with unique definition of knowledge, resources, and ecological relations.	Gibson et al., 2000; Williams, 1998; Murphree, 2000; Ostrom and Hess, 2000; Ostrom, 1990

Therefore, an acknowledgement of the importance of scale is essential for our understanding of human-environment interactions. But how should scale be approached? When researchers seek to become transdisciplinary, whose perspective counts? Table 1.1 demonstrates that a broad range of disciplines from both the natural and the social sciences are involved in scale and scaling issues. While systems ecologists would argue that 'scale' is an explicit consideration when assessing any system (Levin, 1992), geographers place the emphasis on spatial scale (Wood and Lakshmi, 1993), historical ecologists on temporal scale (Balee, 1998), economists on emergent features (Martinez-Alier and Schlupmann, 1991), sociologists on

interactions between scales (Coleman, 1990; Scheffer et al., 2002), and political scientists on institutional and conceptual spheres of scale (Oström and Hess, 2000). This makes for an inconsistent theoretical landscape for researchers who seek to become transdisciplinary in their endeavour to come to terms with scale in complex systems.

Complexity

Complex systems have a number of unique attributes, including; non-linear processes, uncertainty, emergence, cross-scale interactions, self-organisation, novelty, slow and fast changing variables, and a nested hierarchical structure (Walker and Abel, 2002; Berkes et al, 2003; du Toit et al., 2004). Both natural and human systems are considered to exhibit characteristics of complex systems, and linked social and ecological systems are increasingly considered to be self-organising, with a loose hierarchical structure (Gunderson and Holling, 2002), various emergent processes (Kay et al., 1999), and to be subject to relatively sudden re-configurations from one state to another (Scheffer et al., 2001). Natural resource managers and systems researchers face enormous challenges when confronting this complexity in their work (Walker et al., 2002).

Many fields of research have contributed toward the recognition of complex system dynamics in human and natural systems. However, although the approach is fairly generally accepted, a myriad of perspectives and disparate emphases exist (Table 1.2).

Table 1.2: Approaches to complexity

Approach	Emphasis	Source
General systems theory	Connectedness, context and feedback. Challenge ideas of linearity and reductionist science.	Von Bertalanffy, 1968; Berkes et al., 2003
Chaos and complexity theory (in party with non-	Natural and social systems act as open	Kay et al., 1999

equilibrium thermodynamics and catastrophe theorists)	systems exhibiting similar self-organising behaviour. Self Organising Holarchic Open (SOHO) systems.	
	Multiple stable states – coherent behaviour only within limits, focus therefore on disturbance, unstable equilibrium or catastrophe threshold.	Chase-Dunn and Hall, 1997; Ludwig et al., 1997; Scheffer et al., 2001; Janssen et al., 2004
Biological and social evolutionary theorists	Feedback. Evolutionary link between institutions, culture, resources and physical environment. Dichotomy between human and natural systems avoided through emphasis on feedback.	Berkes and Folke, 1998; Adger, 1999a; Holling Gunderson and Ludwig, 2002
Historical ecology	History. Impossible to understand complex systems without a historical analysis	Balee, 1998
Post-normal science	Uncertainty. Peer review to be extended to the community level to ensure quality and validity of conclusions.	Functowicz and Ravetz, 1990; Functowicz & Ravetz, 1992

While general systems theorists argue for an emphasis on connectedness, context and feedback (Von Bertalanffy, 1968), chaos and complexity theorists argue for the recognition of self-organising behaviours in social and ecological systems (Casti, 1994; Kay *et al*, 1999). Evolutionary theorists, on the other hand, argue for an emphasis on feedback to avoid simple dichotomies between human and natural systems (Wicken, 1987; Adger, 1999a), while historical ecologists emphasise history

(Balee, 1998). Post-normal scientists call for an emphasis on uncertainty and methods to ensure the validity of conclusions in inherently complex systems (Functowicz and Ravetz, 1990).

As a result, it has become necessary for researchers who seek to understand human-environment interactions through local level case studies to confront uncertainty by incorporating the additional complexity of peer-review by local communities (Adger, 1999a). They thus encounter various worldviews through interaction with local communities and thereby, often unknowingly, enter the equally varied theoretical landscape of epistemology while still grappling with scale and complexity.

Epistemology

Epistemology is the philosophy of knowledge, and more specifically, it is a field of research that seeks to come to terms with what we can know, and the status of knowledge about a particular reality (Jones, 2002). There are a myriad of perspectives on the topic. A few key arguments are relevant to integrated natural resource management. Most of these are from within the social constructivist school.

A core debate in the field of epistemology concerns the existence of an external reality, in other words, a reality that is not socially constructed by human beings. There is much disagreement about whether or not reality can be divorced from social experience, and therefore whether it can be objectively accessed by a particular knowledge system (Jones, 2002). For this reason, debates about knowledge are often centred on power (Healy, 2003), because logically the system of knowledge that is most widely recognized as being able to tap into the 'objective reality' holds greater sway than other, less widely recognized knowledge systems.

Debates about the value of science vis-à-vis other knowledge systems have been expounded for centuries; Bacon (1561-1626), followed by Hume (1739), and later Popper (1968), were some of the leaders in this debate. Social constructivism emerged from these early works and has, in the sense that it advocates that all reality is socially constructed (Demeritt, 1994), arguably lead the way for greater participation of local communities in natural resource management through encouraging the recognition of

alternative, and equally valid, worldviews. The various approaches and rationales both for and against the integration of (western) scientific knowledge and local or traditional knowledge in natural resource management issues are summarised in Table 1.3.

Table 1.3: Approaches to epistemology relevant to natural resource management

Approach	Emphasis	Source
Social constructivist (in the broadest sense)	Knowledge cannot be divorced from social experience, and cannot therefore objectively access an external reality. Environmental 'problems' are culturally constructed.	Macnaghten and Urry, 1998, Burningham and Cooper, 1999
Post modernist	'One truth' is as good as another, and therefore one knowledge claim cannot be privileged over another.	Symanski, 1994; Hannigan, 1995; Milton, 1996
Relativist	A common reality exists, however nobody can ever know reality exactly as it is, and therefore diverse world-views are simply different interpretations of a common reality.	Demeritt, 1994
Environmental ethics	Power. Inclusion of multiple worldviews as an antidote to Foucauldian impressions of science as all-encompassing.	Callicot, 1994; Gadgil et al., 2000
Environmental management	Ability of traditional/local knowledge to contribute toward	Gadgil et al., 1993; Alcorn, 1989; Colding,

	conservation of biodiversity, rare species, protected areas and sustainable resource use. Adaptive management has lessons learn from traditional/local knowledge	1998; Johannes, 1998; Mauro and Hardison, 2000; Berkes et al., 2000; Martello 2001; Berkes et al., 2003; Gadgil et al., 2003
Scepticism	Efforts to 'bridge' different knowledge systems will lead to the compartmentalization and distillation of the non-dominant knowledge system. Integration allows the extension of scientific frameworks and concentration of power in the hands of scientists. Local knowledge is seldom relevant outside of the local context. Integration implicitly assumes that knowledge is an intellectual product that can be isolated from its social context	Feyerabend, 1970; Latour, 1987, 1988; Forsyth, 1999; Nadasdy, 1999; Lovell et al., 2002; du Toit et al., 2004

If research is to become transdisciplinary then researchers must come to terms with these variable perspectives. While some, such as the social constructivists, argue from ontological perspectives (Milton, 1996; Macnaghten and Urry, 1998; Jones, 2002), others argue from ethical and even management standpoints (Gadgil et al., 2000; Berkes et al., 2003). Still others reject the very idea of integration and argue that

communicating between knowledge systems leads to further marginalisation of the non-dominant knowledge systems concerned (Latour, 1987; Nadasdy, 1999).

Despite these various emphases, debates from within the field of epistemology have filtered into the practice of natural resource management, and have fundamentally changed the ways in which natural resource management is conceived (see for example Lele, 2000; Fabricius et al., 2001a; Campbell et al., 2001). The most obvious trend has been a move away from draconian conservation measures, and toward the acknowledgement of the potential role to be played by local people in. This has therefore influenced the approaches adopted by researchers, and lead to a proliferation of participatory research techniques, which have contributed to changes in natural resource management approaches.

As a result, community level projects are already underway worldwide (Barrett et al., 2001; Chakraborty, 2001; Shackleton and Campbell, 2001), and therefore knowledge systems are coming to heads regardless of the arguments behind these varied perspectives. What is alarming therefore is the lack of debate amongst these groups concerning just how to integrate knowledge systems in a practicable way, and in a way that would avoid the concerns raised by the sceptics (see for example Nadasdy, 1999; du Toit et al., 2004).

1.1.2 Conceptual Frameworks to study and depict people-ecosystem relations

Given the various of perspectives and approaches to these key issues, clear conceptual frameworks become essential navigational tools for researchers who seek to become transdisciplinary in their endeavours to understand human-environment interactions. However, the selection of particular conceptual and practical frameworks can lead to various trade-offs (discussed in the final section), and it is essential for these trade-offs to be understood and made explicit at the outset of any research process, this is followed up in Section 1.2. Some of the key frameworks that researchers have adopted in order to deal with the issues outlined above include; the Sustainable Rural Livelihoods framework (Carney, 1998a; Ellis, 1998; Scoones, 1998), the Environmental Entitlements Framework (Leach et al., 1999), the Adaptive Renewal

Model (Holling 1986; Berkes and Folke, 1998; Gunderson and Holling, 2002), and more recently the Millennium Assessment framework (MA, 2003).

The Millennium Assessment Framework

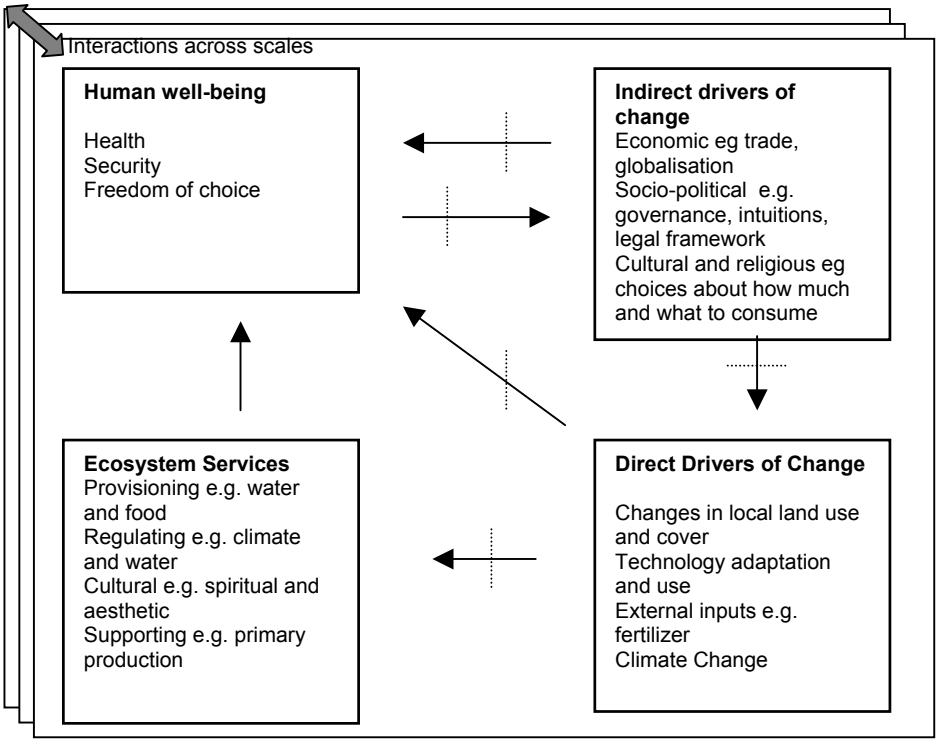
The MA framework (Figure 1.1) assumes a dynamic relationship between people and ecosystems. Human and ecological systems are considered to be interconnected, with ecosystem change affecting human well-being and vice versa (MA, 2003). Human well-being is defined within this framework as having multiple constituents, including basic material for a good-life, freedom and choice, health, good social relations, and security. These constituents of well-being are recognized as being situation dependant, as experienced and perceived by people, and a reflection of local geography, culture, and ecological circumstances (MA, 2003). An ecosystem is defined a dynamic complex of plant, animal, and micro-organism communities and the nonliving environment interacting as a functional unit. Humans are considered an integral part of ecosystems (MA, 2003).

The framework assumes that the relationship between ecosystems and human well-being cannot be understood without a consideration of multiple spatial and temporal scales, and also recognises interactions across scales of analysis. The mismatch between the scale of ecosystem processes and the scale of decision-making is considered to be a key reason for many environmental problems. The model also acknowledges that different knowledge systems (refer to Glossary) may be more important when dealing with different scales of analysis than others (MA, 2003).

Of key interest for this study, is the MA concept of ‘drivers of change’ (refer to Glossary). A driver here refers to any factor, whether human induced or otherwise, that causes change in an ecosystem. A direct driver refers to a factor that indisputably influences ecosystem processes and can therefore be identified and measured to differing degrees of accuracy. An endogenous driver is a factor whose magnitude can be influenced by the decision maker, while an exogenous driver cannot be altered by the decision maker. The endogenous or exogenous characteristic of a driver to a decision maker depends on spatial and temporal scale; some drivers (for example land use and de facto access to resources) can be directly influenced by local institutional

structures, where as others drivers (for example market prices and formal property rights) are outside of the local sphere of influence. (MA, 2003: 15 & 210).

The MA framework therefore provides a conceptual tool that allows for the analysis of linked social-ecological systems, and for the simultaneous consideration of factors operating at multiple spatial and temporal scales, and their influence on local social and ecological systems. The model also does well to consider local resource managers (referred to as decision-makers) as part of the system in question, something that has been lacking in traditional approaches to natural resource management (Walker et al., 2002). However, the model alone does not do justice to the dynamism of the interaction between human and natural systems at the local level. In particular, the model does not allow for a consideration of the process of institutional learning, adaptation and resilience within these systems.



Changes in factors that indirectly affect ecosystems, such as population, technology, and lifestyle (upper right corner of figure), can lead to changes in factors directly affecting ecosystems, such as the catch of fisheries or the application of fertilizers to increase food production (lower right corner). The resulting changes in the ecosystem (lower left corner) cause the ecosystem services to change and thereby affect human well-being. These interactions can take place at more than one scale and can cross scales. For example, a global market can lead to a regional loss of forest cover, which increases flood magnitude along a stretch of a river. Similarly, the interactions can take place across different time scales. Actions can be taken either to respond to negative changes or to enhance positive changes at almost all points in this framework (black cross bars). (Source: MA, 2003: 37)

Figure 1.1: Millennium Ecosystem Assessment (MA) Conceptual Framework

The Adaptive Renewal Model

To overcome this challenge, the Adaptive Renewal Model was included (Holling 1986; Berkes and Folke, 1998; Gunderson and Holling, 2002) as a conceptual guide to simultaneously deal with scale and complexity, and to address the short-comings of the MA model for local level purposes. Gunderson and Holling's (2002) heuristic model of cross-scale interactions in linked social-ecological systems integrates the ideas of fast and slow moving emergent features of complex systems (borrowed from ecological economics), temporal scale (borrowed from geography and environmental history), vertical scale (borrowed from the political sciences) as well as the idea that

micro level phenomena affect macro level processes to an equal extent as the macro affects the local (borrowed from sociology) (Table 1.1). Coleman's (1990) argument that micro-level processes can affect and even shape those at the macro level comes across clearly in this model (refer to Section 1.1.1).

The model is premised on the idea that both natural and human systems undergo cycles of organisation, collapse and renewal, and consist of a number of phases, including the phases of 'exploitation' (r), 'conservation' (K), rapid 'release' (creative destruction (Ω) and 'reorganisation' (α). The exploitation and conservation phases form an S-shaped curve, likened to a ecological succession sequence (Holling and Gunderson, 2002), starting from *r*-strategies in the exploitation phase, and reaching a mature and complex community adopting *k*-strategies in the conservation phase. The release phase consists of a sequence of rapid transformation, and is triggered by disturbance (Walker et al., 2002).

Institutions can however act as buffering agents, enabling social-ecological systems to recover from periods of disturbance by "putting the brakes on release" and therefore building resilience (Berkes and Folke, 2002: 132). Resilience refers to the ability of a system to cope with, and recover from disturbance and crises (Holling, 1973; Holling, 1986; Walker et al*.,* 2002). The ability to achieve this is developed through experience and is stored in the 'institutional memory' of the social group, and developed over many generations through experience of dealing with similar crises (Berkes and Folke, 2002). Finally, the reorganisation phase is characterised by a number of practices, such as ecosystem monitoring, which contribute toward renewal and facilitate recovery following a disturbance (Berkes and Folke, 1998).

The adaptive renewal cycle emerged from earlier discussions around multiple stable states (Holling, 1973), and incorporates key processes underpinning resilience (Walker *et al,* 2002), institutional memory (Berkes and Folke, 2002), disturbance (Gunderson, 1999), adaptation, and novelty (Berkes et al., 2003). Thus, the model provides a useful tool for conceptualising and assessing the self-organising characteristics of complex adaptive systems (Kay et al., 1999), historical processes (Balee, 1998), context and feedback (von Bertalanffy, 1968), as well as the evolutionary link between institutions, culture, resources and the physical

environment (Adger, 1999a). The model also acknowledges the adaptive capabilities of local communities and ecosystems, an aspect significantly lacking in the MA framework.

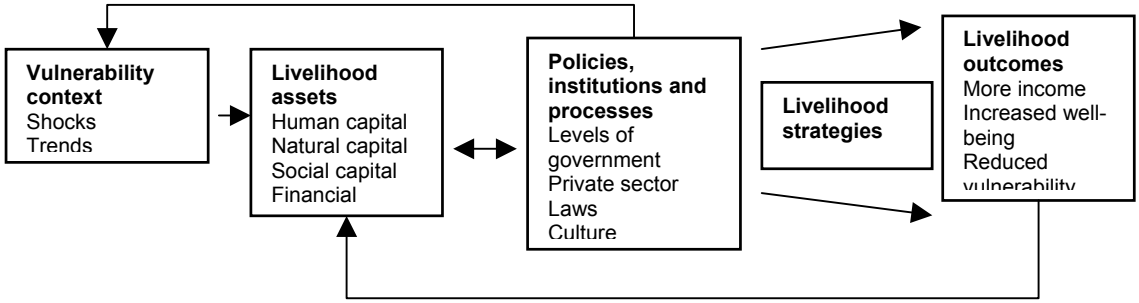
While the combination of these two models, the MA model and the Adaptive Renewal Model, proved extremely useful in identifying long term coping strategies for dealing with drivers of change at various scales, they did not allow for a deeper understanding of the day-to-day strategies that local people employ as part of the adaptive process. These day-to-day activities form the link between social and ecological systems in rural communities, and are therefore vital in understanding social-ecological interactions at the local level.

The Sustainable Rural Livelihoods Framework

In order to avert this, the Sustainable Rural Livelihoods framework and approach (Carney, 1998a; Ellis, 1998; Scoones, 1998) was incorporated into the analysis (Figure 1.2). According to Ellis (2000: 10), "a livelihood comprises the assets (natural physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household." A livelihood is defined as sustainable when it can cope with and recover from stresses and shocks and maintain or enhance it capabilities and assets both now and in the future, without undermining the resource base (Carney, 1998a; Scoones, 1998). In this sense, the resilience concept outlined previously fits easily with this framework because both approaches seek to understand responses to external perturbations. In particular, this approach allows the tracking over time of a household's productive activities in relation to its vulnerability context, and the institutions, organizations and policies that mediate its external economic and social relationships (Hulme and Shepard, 2003)

The vulnerability context is defined as the external environment within which people exist, but over which they have little control (Department for International Development, 1997). This definition therefore fits well with the idea of exogenous drivers put forward in the MA framework, and the idea of cross-scale interactions across both space and time pursued by the both the MA and Adaptive Renewal

Model. In turn, the latter framework adds the concept of local level phenomena affecting macro level processes, thereby recognising human agency to a far greater extent than is currently so in the Livelihoods Framework.



The arrows within the framework are used as shorthand to denote a variety of different types of relationships, all of which are highly dynamic. None of the arrows imply direct causality, though all imply a certain level of influence. Source: DFID, 2000

Figure 1.2: The Sustainable Rural Livelihoods Framework

The framework assumes that rural people construct their livelihoods by actively seeking to avert the risks associated with depending too heavily on any one particular type of livelihood asset by alternating between various combinations of these assets (Scoones, 1998). Livelihood assets comprise; financial capital, natural capital, social capital, human capital, and physical capital (Chambers and Conway, 1992; Carney, 1998b), and definitions of each are provided in the Glossary. Applications of this framework however often focus on describing these assets, and fall short of emphasising the adaptive nature of livelihoods, or social memory (sensu Berkes and Folke, 1998) that is built through practice, and used to cope with perturbations, or in this case 'shocks' and 'surprises'. Herein lies the strength of combining this framework with the resilience approach embodied in the adaptive renewal model just described.

The framework also places particular emphasis on the physical, socio-political, economic, institutional and historical context within which livelihoods take place

through its emphasis on the vulnerability context (Ellis, 1998; Timmermans, 2004). However, despite its recognition of a vulnerability context outside of the control of local decision makers, this framework has been criticized for ignoring issues of power and broader social relationships (Moser et al., 2001; Conway et al., 2002).

The Environmental Entitlements Framework

The Environmental Entitlements Framework (Figure 1.3) addresses these shortcomings to some extent. The framework addresses issues of power by entering the environment-development debate from the perspective of the politics of access and control over resources among different social actors (Leach et al., 1999; Sen, 1999). In this sense, environmental change follows directly from negotiation and contestation between social actors who have different priorities and interests in resource management, 'communities' are therefore considered to be heterogeneous entities made up of individuals, groups and clusters who have different interests in, and reasons for, managing resources.

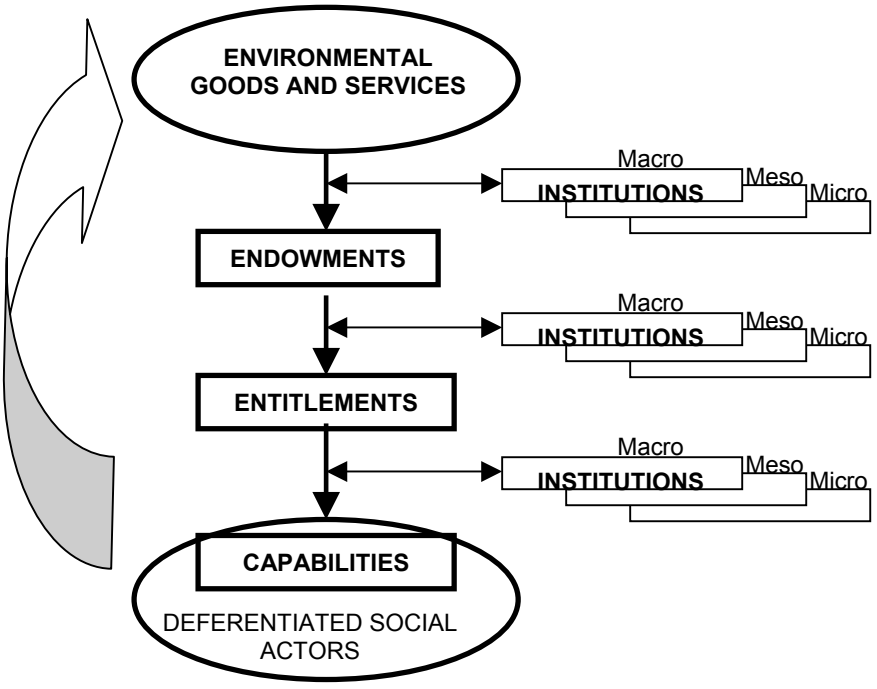


Figure 1.3: The Environmental Entitlements framework

The framework therefore allows for the explicit recognition of communities as socially differentiated, diverse and dynamic entities. Rather than shared beliefs and

interests, the framework anticipates diverse and often conflicting values and resource priorities that are constantly renegotiated (Mearns et al., 1998). According to the framework, endowments refer to the rights and resources that people have, for example land, labour, skills and so on. In this sense endowments are similar to capital assets under the Sustainable Livelihoods Framework. Environmental entitlements refer to alternative sets of benefits derived from environmental goods and services over which people have legitimate control, including direct (for example food and fuel) and indirect (for example pollution sinks) uses. These entitlements in turn enhance capabilities, which are what people can do with their entitlements (Mearns et al., 1998).

A focus on institutions is vital when considering this framework; the process by which endowments become entitlements, and are eventually converted into capabilities, is governed or shaped by multiple formal and informal institutions operating at various scales (Leach et al., 1999). Most importantly, the approach argues that institutions at various scales interact to shape the claims to resources and management practices of different social actors (Mearns et al., 1998). In this sense, again, institutions become the ultimate determinant in the allocation and access to resources (Adger, 1999a).

Integrating conceptual frameworks

To date, no conceptual guide exists that brings these four key approaches to human-ecosystem interactions together, although recently some analysts have attempted to combine various aspects of the Resilience approach with the Livelihoods (Berkes et al., forthcoming) and the Entitlements (Fraser, 2003) approaches. Figure 1.4 presents a graphic representation of how these issues are conceptualised in this study. The figure must of course be considered as a work in progress, since the ideas expressed herein are new and evolving. In this framework, the linked social-ecological system is represented through arrows that connect aspects of the system at various spatial and temporal scales. The linear representation of the Livelihoods framework has been avoided to illustrate the dynamism of interactions between the various components of the system.

The historical, political, economic and biophysical context and trends represent the 'drivers of change' or the 'vulnerability context', within which local livelihoods and land use practices are nested, and with which livelihoods and land use practices interact through both long-term trends, and short-term disturbances (shocks and surprises). The interaction is not a one-way exchange from the macro to the micro level, as indicated by the two-way arrows connecting this external context to local livelihoods and land use. Local people employ a range of coping and adaptive responses, which manifest through livelihood strategies and land use practices, in order to cope with these changes. While acknowledging the issue of power in the connection between these two scales, human agency at the local level is equally acknowledged as a transforming function of the system.

While ecosystem function is necessarily a product of the given biophysical context, ecosystem change is nested within the broader context of political, economic and biophysical trends of the linked social-ecological system. The connection between these different components of the system takes place through local livelihood practices, land use and resource use patterns. Institutions at various scales, in turn, mediate the allocation and use of ecosystems by people. Specifically, formal and informal institutions determine; a) the ways in which the external context and trends influence local livelihoods and therefore patterns of resource use, and b) the ways in which this use affects ecosystem change. This process is dynamic, particularly at the local level; institutions strengthen and weaken through interactions with factors outside of the local context, and are constantly negotiated and readjusted through a process of social learning and adaptation in response to changes in the local environment, and through interactions with the wider social-ecological environment.

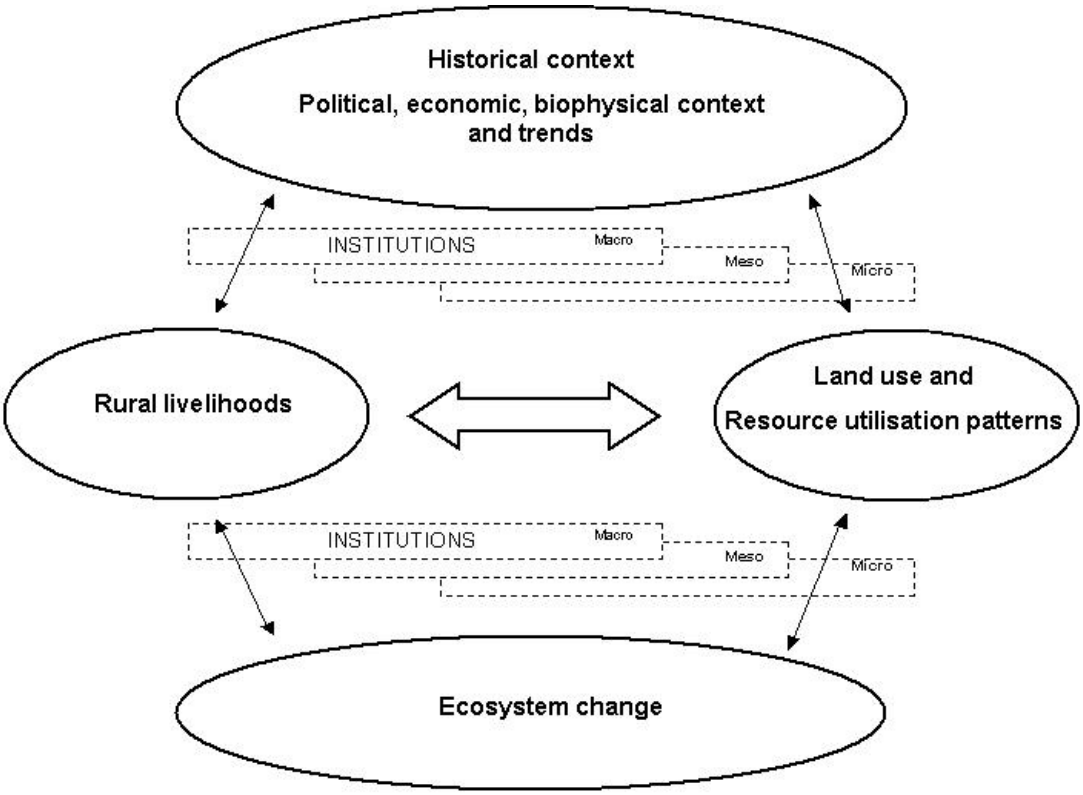


Figure 1.4 Conceptual framework of human-ecosystem interactions at the local level

Land use and resource utilisation patterns are directly related rural livelihood needs, which are in turn related to the historical processes of change operating at various scales. The use of ecosystems by people directly influences and shapes ecosystem change, this use is however mediated by local level institutional structures, which are in turn influenced by ecosystem change and local livelihood needs. The system is therefore highly adaptive.

Spatially the focus of this thesis is on the local level; at the level of the village, and those individuals within that village that are directly involved in resource use. This unit of analysis is referred to as the 'community' (refer to Glossary). Ecologically, the unit of analysis is the landscape level, and specifically the resource patches utilised by people within the 'community' to meet their livelihood needs. However, because rural livelihoods form part of a much larger system, the scale of analysis is necessarily broad, both spatially and temporally. The temporal scale of analysis is approximately

fifty years, this scale was selected in consultation with local resource users, who felt that this was as far back as living memory could contribute to the study. Spatially, cross-scale social and ecological interactions are considered from the village level to the national level. The political, economic and biophysical context and trends refer to this wide range of drivers, and the cross scale connections are illustrated in the framework through arrows that directly or indirectly affect livelihoods and resource use practices.

1.1.3 Putting Frameworks into practice

While conceptual models and frameworks help researchers to navigate transdisciplinary research, on the ground, researchers need to use innovative methods and techniques if they hope to communicate between knowledge systems (refer to Glossary) and worldviews. The problem does not only involve researchers communicating with and understanding local knowledge (refer to Glossary), it involves the additional difficulty of communicating the information thus received back to other scientists in a way that makes sense, and in a way that does not further marginalize the less powerful knowledge system concerned (Nadasdy, 1999). What follows is a broad overview of the types of practical approaches adopted in this study, each results chapter revisits these issues for the particular questions asked in that chapter, and discusses the methods used to answer the questions of relevance to that part of the research.

In this study, learning and memory is considered to occur and to be stored at the level of the group (a social constructivist approach, Table 3.3), and therefore the techniques and methods used to communicate between knowledge systems were consensus based. This means that workshops became the primary source of information, and the information thus received was tested through household surveys to ensure that no one individuals' knowledge and interpretation was able to dominate the findings of this research. Realizing that the methods used during an investigation also have ethical implications (Munda, 1999), a combination of various participatory research techniques was used, incorporating a range of visual, verbal and interactive techniques (Motteux, 2001). These included forum theatre (Burt and Coptoros, 2004), focus group workshops and interviews (Borrini-Feyerabend et al., 1997), semi-

structured interviews with key informants (Pretty et al., 1995), as well as a range of Participatory Learning and Action (PLA) techniques (Chambers, 1994; Kapoor, 2002).

These techniques aided considerably in communicating between knowledge systems at the village level, but were less helpful in communicating findings back to other scientists. For this reason, and also to improve confidence in the data, qualitative findings were validated through household surveys, vegetation surveys, water quality testing, and histiography. Participatory mapping exercises were also conducted through the use of geo-referenced orthographic photographs as well as free hand mapping. The maps were then digitised and land-use maps developed based on local knowledge that could be presented in a scientifically acceptable way.

Participatory Learning and Action (PLA)

PLA was the dominant strategy adopted in this study, and therefore deserves additional attention. PLA is a term used to refer to a wide range of similar approaches, including Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) (Chambers, 1994). The common theme is the participation of people in the processes of identifying their needs and opportunities, and in the action required to address them (IIED, 2003). A wide range of techniques were used, and many techniques were used several times for different aspects of this thesis. Therefore, in the interests of clarity, each of the techniques is briefly described below, Appendix 1 contains detailed but generic descriptions on how these exercises were conducted, and each chapter contains additional details on the specific questions each technique was aimed at in that chapter.

Time series freehand mapping (see Plate 1.2) is based on a series of participatory mapping exercises aimed at portraying changes in a particular settlement or resource pattern over time (Borrini-Feyerabend, 1997). Historical mapping provides visual evidence of changes that have occurred over time, and in this way helps to identify causes of current environmental change (Borrini-Feyerabend, 1997). Historical mapping is a powerful visual tool that can be used to convey a great deal of

information quickly and effectively from local level actors to politicians and others outside of the local context (Alcorn, 2000).

Interactive Role Playing (see Plate 1.11) involves the portrayal of particular experiences or relationships between people, and allows for the diverse participation of both the actors and the audience who can interject to change the role-play at any time (Sithole, 2002). When used as an introductory exercise, role playing can prove very useful in illustrating to all involved that their ideas about one another are often very different from the reality.

Pie charts are diagrammatic representations of local perceptions regarding various attributes assigned to given variables. For example, pie charts are useful in identifying the relative importance assigned to different sources of food, different ecosystems or different land uses from which natural resources are extracted (see Plate 1.13).

Ranking (see Plate 1.12) involves placing issues or objects in order of significance (Theis and Grady, 1991). Ranking can be used to determine the relative importance attached to various species, activities, environmental attributes, and stakeholders (see for example Richards et al., 1999; DFID, 2000). The actual rank is not as important as the comments and the debates that are generated by the exercise (Sithole, 2002). An example is wealth ranking, a type of socio-economic community profile, and is important because socio-economic inequalities influence people's behaviours, coping strategies, and views (Theis and Grady, 1991). Wealth ranking allows investigators to identify perceptions of wealth differences in a community, and to identify local indicators and criteria for wealth and well-being (Department for International Development, 2000).

Trend–lines (see Plate 1.3) are sets of key dates in chronological order with a score representing relative changes in key variables over time. Trend-lines can be used to discuss issues varying from ecological histories, changes in land use, customs and practices, population, fuels used, migration etc (Chambers, 1992). This exercise is especially useful in highlighting those events that are considered important to the participants themselves (Borrini-Feyerabend, 1997).

Matrices are either simple checklists or complex tables with rows and columns containing information regarding, for example, peoples preferences and reasons for these preferences (Sithole, 2002; Thies and Grady, 1991). Matrices are very useful tools that can be used to summarise a great deal of information regarding a range of issues, from species preferences to seasonal variability in harvesting levels. (Nori *et al,* 1999).

Ranked matrices are simply matrices in which the reasons for local preferences, for example reasons for keeping livestock or reasons for cultivating certain species, are ranked relative to one another (Theis and Grady, 1991; Rowley, 1999).

Seasonal calendars are a series of different diagrams showing the main activities, problems, and opportunities throughout the annual cycle, and are most useful in identifying the months or periods of greatest vulnerability or difficulty (Theis and Grady, 1991). Calendars can be based either on seasons or on months of the year, and are useful in identifying the temporal distribution of rainfall, water requirements, crops, labour, fuel, migration, income etc (Chambers, 1992). In this case, seasonal calendars were constructed both in PLA workshops to identify changes in water quality and quantity, and also during school projects (see Plate 1.7) where the crops grown in home gardens were placed in seasonal calendars to demonstrate the diversity of species grown.

Timelines are chronologies of events, and represent the major remembered events in a community with approximate dates (Chambers, 1992). Ideally, timelines should be developed as other exercises take place. When issues or events are raised, they are added to the timeline.

Group discussions (see Plate 1.8) are unstructured discussions around a key theme. These discussions are conducted in a relaxed setting, and are usually used to follow up on sensitive issues raised during other exercises (Chambers, 1992; Sithole, 2002). Group discussions are especially useful to introduce new topics, and to get participants involved in thinking critically about key issues.

Focus group interviews (see Plates 1.10) are semi-structured discussions with a group of people who share a common feature (Borrini-Feyerabend, 1997). Although developed initially in market-oriented research, since the 1980's focus group interviews have been used increasingly in participatory research, particularly in research seeking to identify and describe group perceptions and attitudes (Borrini-Feyerabend, 1997).

Key informant interviews (see Plate 1.9) are either structured or semi-structured interviews with individuals who are knowledgeable about a particular issue (Borrini-Feyerabend, 1997). Key informant interviews are aimed at key people that hold specialised information that others don't have (Theis and Grady, 1991).

Venn diagrams are diagrammatic representations of key organisational interactions, such as the key individuals and institutions and their interaction for decision making. This is a particularly powerful tool used to highlight relations between social groups, as well as the institutional environment in a given setting (Department for International Development, 2000; Foss and Aune, 2000).

Participatory analysis of aerial and orthographic photographs (see Plate 1.1) is the use of geo-referenced maps onto which participants directly illustrate different and changing land uses. This is a useful tool for identifying soil types, past and present land uses, degradation, and varying tenural arrangements (Chambers, 1992). The use of hi-Tec materials such as orthographic photographs can prove extremely empowering for those involved, as the fear of scientists and their tools is decreased (Alcorn, 2000; McMaster, 2002).

Community-run household surveys - community participants conduct the research, for example; interviews, transects, and observations (Chambers, 1992). This technique is useful in getting local schools involved. School pupils benefit by developing their translation and survey skills, while the research team gains through a random and often larger sample size that is less time consuming. In this case, a group of actors spent a day in the schools providing innovative training in how to conduct survey, and how to translate between English and Xhosa (see Plate 1.4). The trade-off is that the final results are often less certain. Household surveys, when conducted on a random

basis, are a well-known technique that enables researchers to make inferences regarding the population in question (Christiaensen et al., 2001).

Historical profiling – Provides a summary overview of the key historical events in a community and their importance for the current situation (Theis and Grady, 1991). Information is collected from secondary sources (books, archives, reports) and from interviews with key informants (elderly people, leaders) (see Appendix 1).

Local Level Scenario Planning

An important aspect of the study involved the dissemination of the combined local and scientific knowledge back to the communities involved. This was achieved through scenarios (van der Heijden, 1996; Peterson et al., 2003), or storylines, representing a range of plausible futures. Scenarios are plausible explorations of the future used as a means of acknowledging uncertainty and of confronting stakeholders with possible surprises (Walker et al., 2002).

Scenarios are more useful than single message stories because they directly tackle the forward-looking capacity of people. People make decisions about natural resource use today based on the mental maps they hold about the future (van der Heijden, 1996). However, when there is a great deal of uncertainty about the future, people may act today so long as it furthers their direct need in the present (Walker et al., 2002). However, confronting uncertainty can challenge those mental maps and allow for meaningful and long-term environmental management (van der Heijden, 1996).

In this case, scenarios were based on an interpretation of information already gathered at the local level, which was combined with national level data on political and economic changes. The scenarios were presented using forum theatre, Theatre for Transformation (Burt and Coptoros, 2004), and digitally enhanced posters that summarised the key changes in the relationship between local communities and ecosystems. In this way advanced technology was used to represent local knowledge in a format that both scientists and local people could understand and relate to.

The use of scenarios in this study provides a useful example of how knowledge and information can be transferred across scales of analysis in local level studies. Scenarios developed at broader regional levels (Scholes and Biggs, 2004; Bohensky et al., 2004) were interpreted first by the researcher for the communities in question. These interpretations were based on the researcher's understanding of local level processes in each community. A development acting group, who spoke the same language as the communities, then turned these interpretations into simple storylines and later into dramas. These dramas were performed for the community, and then amended through feedback from participants to better fit local realities, and thereby demonstrate to other local people how broader level economic, political and climatic changes might play out at the village level. Through a video documentary and written reports (Burt and Copteros, 2004), this information was then presented to other scientists. Scenarios therefore provide just one example of how information generated at broader scales can be translated to local level actors in a way that makes sense to them, and how local responses can be translated back to scientists working at coarser scales.

The above practical approaches and techniques allowed for an inclusive and participatory process in this study, and, perhaps most importantly, these techniques opened up spaces for context-specific challenges and opportunities to come to the fore. However, the selection of conceptual and practical frameworks in any research process necessarily brings with it trade-offs that must be carefully weighed by researchers. It is essential to acknowledge these trade-offs at the outset of any research process, this provides an opportunity to both off-set anticipated biases, and to state upfront the biases present throughout the study (Munda, 2000).

1.2 Methodological Trade-offs

The inadequacy of literature dealing with research processes in complex systems research (Campbell, 2002) means that researchers enter uncharted waters and are forced to make trade-offs throughout the research process. The trade-offs identified in this study related to: a) the convenience of pre-designed frameworks, vs. the loss of alternative perspectives on human-environment relationships; b) the inclusiveness of a transdisciplinary approach, vs. superficial research outcomes; and c) the confrontation

of uncertainty through the incorporation of more integrated and broad-based information that is more difficult to disaggregate and test statistically, vs simple data that is easy to quantify and analyse. Each of these trade-offs is discussed in turn below.

Pre-designed frameworks, vs. alternative perspectives

This study incorporated local knowledge predominantly from a natural resource management perspective, as opposed to an ethical or ontological approach outlined above (Table 1.3). This approach proved very useful in the identification of the underlying causes of change, adaptive processes at the local level, as well as non-linear relationships between different spatial and temporal scales. The use of these frameworks also improved the legitimacy and validity of the local assessments in the eyes of scientists and most policy makers.

However, these models and relationships represent particular worldviews, developed outside of the local context to identify processes deemed important by scientists. Therefore, the researcher had to compromise between utilising local cosmologies to understand changing human-environment relationships, and the *a priori* identification of processes relevant to the scientific arena, in the form of pre-determined models and conceptual frameworks. The negative trade-off was that the process was less participatory than that advocated by the proponents of CBNRM, and possibly less legitimate than a true 'bottom-up' assessment in the eyes of local people.

Inclusiveness vs. superficiality

Working across disciplines is indispensable when dealing with complex systems. Local management systems and resource use patterns know no disciplinary boundaries, and the drivers of social-ecological systems are ecological, biophysical, geographical, climatological, historical, political and economic. Therefore, a transdisciplinary and inclusive approach allowed the researcher to appreciate and record the multitude of factors that influence such systems. The negative trade-off, however, is superficiality, because a more detailed understanding of key processes was sacrificed.

In this case, participatory research, ethnography, biological surveys and historical analysis were conducted simultaneously. While this allowed for a broad and inclusive analysis of key processes and linkages between them, it was impossible to attain an in-depth understanding of the respective processes. Some of these processes, such as the relationship between diversity and productivity in natural and anthropogenic landscapes (see for example Salmon, 2000), are critical to complex system research but remain poorly understood.

Confronting uncertainty, vs. simplification

This research sought to confront uncertainty, and to acknowledge uncertainty as an inherent property of both complex systems, and of research that incorporates local knowledge. However, results obtained in this way are often difficult to validate through traditional scientific methods. Thus, a significant trade-off was made between simple data that lends itself to validation, and more integrated and broad-based information that is more difficult to disaggregate and test statistically, but which provides a more realistic reflection of the relationships between drivers of change at broader spatial and temporal scales, and realities on the ground.

In order to deal with the ambiguity that this approach generated, the researcher sought to validate information through the validation of results by both the communities involved, and through quantitative research techniques such as household and biological surveys. Local knowledge was treated as an equally powerful source of knowledge, and was therefore subjected to scientific cross validation through quantitative surveys and relevant literature. Although scientific rigour is a significant trade-off in participatory local level studies, various methods can be combined to deal with the uncertainty thus created (Section 1.1.3). This process of validation also has the positive effect of encouraging deliberative and reflexive learning as local participants are forced to debate responses and opinions.

Therefore, all of these trade-offs were acknowledged at the outset of the research process. Overall, pre-designed frameworks became an indispensable tool in dealing with the complexity that a social-ecological system approach presented. For this reason, alternative perspectives on human-environment relationships, for example

those based on local cosmologies have not been included, although mention is made throughout this thesis when these perspectives offer something particularly relevant to the study. Finally, while quantitative techniques and tools and have been incorporated into the study, confronting uncertainty was considered a key challenge. Therefore, on the whole, the study has relied predominantly on integrated and broad-based information about the processes taking place.

1.3 Thesis structure

The objective of this study is to determine the relationship between institutional change and ecosystem dynamics through the combination of local and scientific knowledge. In order to accomplish this, this thesis begins by describing the study area in terms of its historical, political, economic and biophysical context, including a general description of the study area based on original research conducted in previously in the area. Of particular focus in Chapter 2 are the livelihood options available and pursued by local people, the types of resources used to pursue these livelihoods, and the current effectiveness of institutions governing access to these resources. Chapter 3 then goes on to describe the trends in the political, economic and biophysical context. In particular, this chapter describes the "drivers", or "vulnerability context", driving changes in land use and resource utilisation patterns at the village level, taking into account multiple spatial and temporal scales.

Chapter 4 then describes local livelihood and institutional adaptive and coping responses to these exogenous driving forces, and the novelty in management arrangements that have emerged as a result. Resource utilisation patterns are directly related to livelihood strategies (Figure 1.4), and are therefore also considered in this chapter. Chapter 5 is concerned with ecosystem dynamics taking place in response to both the exogenous (cf. Chapter 3) and endogenous (cf. Chapter 4) drivers of the system. One of the major objectives of this chapter is to evaluate the potential role of local knowledge of ecosystem dynamics in rangeland management. Local responses are revisited in this chapter, with a particular focus on response to ecosystem change, rather than drivers of change at broader spatial and temporal scales. The concluding chapter brings this study full circle by discussing the major insights gained from this study, the potential contribution of local knowledge to our understanding of the ways

in which people and ecosystems interact, and finally some of the key challenges faced in this research. This final chapter then seeks to make management recommendations based on this detailed understanding of a) the drivers of change, b) local social and ecological responses, and c) local knowledge and management practices.

Plates

Plate 1.1: Participatory mapping using Geo-referenced orthographic photographs

Plate 1.2: Free hand land use mapping

Plate 1.3: Participatory trendline exercise

Plate 1.4: Local schools involved in household surveys - developing confidence in survey, mathematical, and translation skills

Plate 1.5: Water quality testing and local capacity development

Plate 1.6: Capacity development through the use of high-tech GIS maps

Plate 1.7: Four out of 63 school projects to develop seasonal calendars for home gardens

Plate 1.8: Group discussion with male user group

Plate 1.9: Key informant interview

Plate 1.10: Focus group interviews

Plate 1.11: Interactive role-playing

Plate 1.12: Ranking of wealth categories in Qongqota

Plate 1.13: Pie chart exercise in Machibi illustrating the relative importance of different ecosystem services from the community woodlands

Chapter 2. Study area

2.1. Introduction

This chapter aims to bridge the gap between the first chapter – the introduction and conceptual framework – and the more detailed empirical chapters (Chapters 3 – 5) that form the core of the thesis. It presents a detailed description of the study area on which the empirical chapters are based, and where necessary, additional information is provided within each of the empirical chapters. In particular, this chapter provides the historical, political, economic and biophysical context for this study (refer to Figure 1.4).

The case study area (27° 28' E, 33° 00' S), referred to as Mt Coke, is situated in the Eastern Cape province of South Africa, on the R53 between King Williams Town and Buffalo City (Figure 2.1). Approximately ten kilometres from King Williams Town, the area formerly formed part of the Ciskei Bantustan under the Apartheid system. Under the new dispensation, Mt Coke falls within the Amatola District Council. A District council has municipal executive and legislative authority over a large area, with its primary responsibility being district-wide planning. Within a district council's area are individual local councils that share their municipal authority with the district council under which they fall.

Although the villages of Machibi and Qongqota, which form the focus of this thesis, are geographically adjacent to one another, they fall within different local councils. Machibi falls under the Ngushwa municipality while Qongqota falls under Buffalo City. Socio-economic data for Ngqushwa municipality provides the most accurate reflection of the two villages, as the data for Buffalo City municipality (within which Qongqota falls) is skewed toward a largely urban population due to the inclusion of Buffalo City within its administrative boundaries. For this reason, data from Ngqushwa municipality is referred to predominantly throughout this chapter.

'Mt Coke' itself is not an administrative unit, rather this is the name used to refer to an area of land comprising a mix of communally and state owned land. In particular,

this study focuses on the villages of Machibi and Qongqota, which border the state owned forest named Mt Coke. The villages of Machibi and Qongqota were selected for this study based on their previous involvement in Participatory Forest Management (PFM) research undertaken by DWAF and Rhodes University between 2000 and 2003 (Rhodes et al., 2002). The villages were also selected based on their proximity to the main road between King Williams Town and Buffalo City, as well as the willingness of their inhabitants and leaders to be involved in this research.

The information presented in this preliminary chapter represents a combination of government statistics and original research conducted at Mt Coke between 2000 and 2003 as part of the PFM initiative underway in the area. The methodology of the broader PFM project at Mt Coke embraced the principles of a participatory approach, and therefore the information presented here represent a combination of focus group interviews (Borrini-Feyerabend, 1997), semi-structured interviews with key informants (Pretty et al., 1995), as well as a range of Participatory Rural Appraisal (PRA) techniques (Chambers, 1994). Full descriptions of these methods are located in the various reports produced during that study (DWAF, 2000a; DWAF, 2001; DWAF, 2002b; Fatman, 2002; Cundill, 2002).

This chapter begins by presenting a brief history of the former Ciskei homeland, as well as a general description of the biophysical and socio-economic context of what is now referred to as the Eastern Cape province. That discussion is followed by a general description of livelihoods and the role played by agriculture, natural resources, and local institutions in these livelihoods.

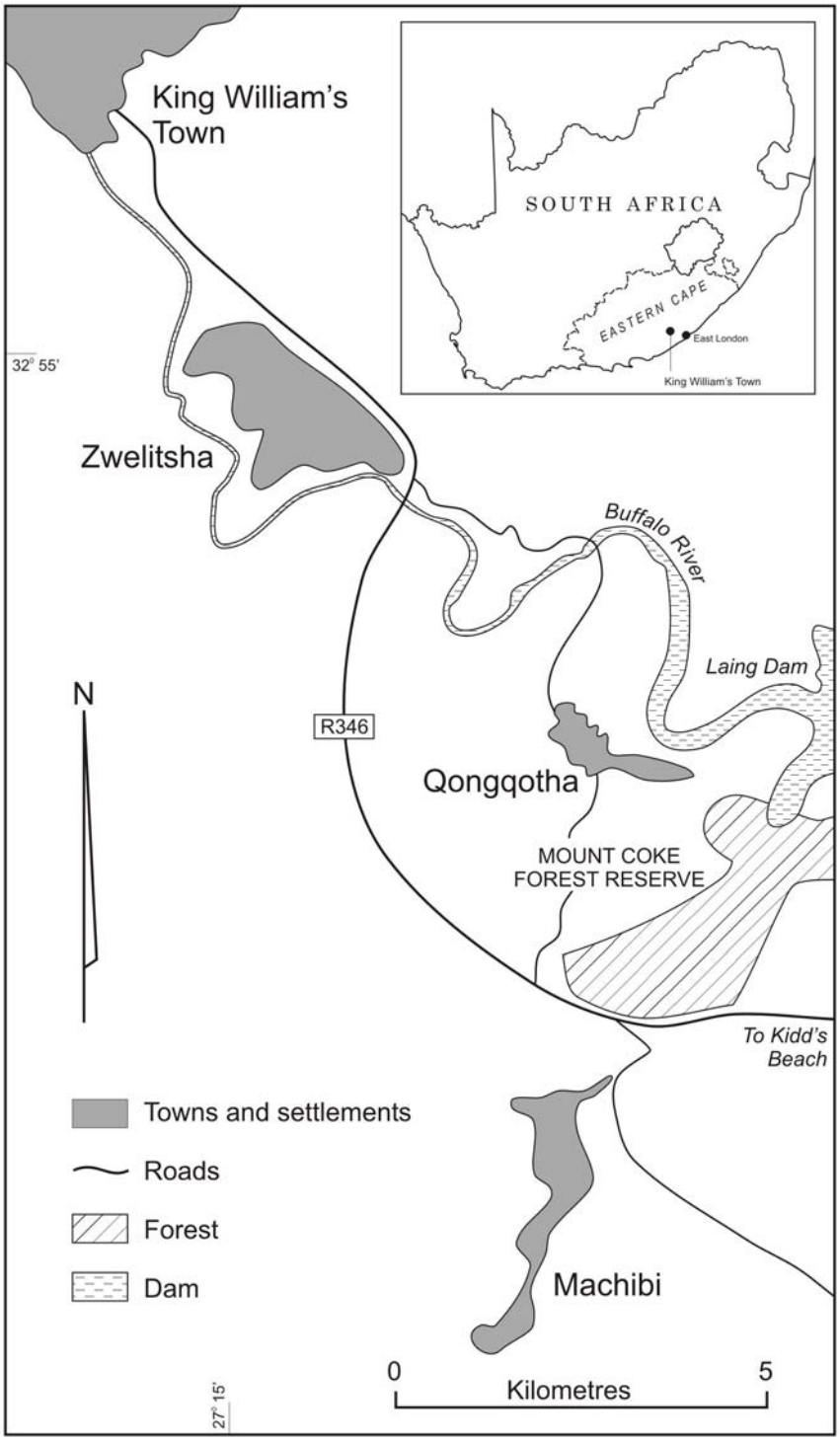


Figure 2.1: Location map of the study area

2.2 Historical Background

Understanding the history of colonial domination, and the different types of administration employed during the early period, is essential in understanding the more recent history of the former homeland areas in South Africa (Ainslie, 1998; Timmermans, 2004), and the former Ciskei homeland is no exception (Charton, 1980). A range of social, economic and political factors contributed toward and shaped the institutions of both the British colonists and the Xhosa-speaking people living in the area between the Great Fish River and the Kei River, now part of the Eastern Cape province, but formerly referred to as the Ciskei.

During the sixteenth and the seventeenth centuries, Cape Nguni peoples began to migrate southward from central Africa toward the eastern parts of Southern Africa in search of pasturage for their livestock. Although several tribes formed part of this migration (including the Pondo, Xhosa, Tembu and Tambookie), it was the Xhosa that encountered European frontier farmers in the eighteenth century in the vicinity of the Great Fish River (Houghton and Walton, 1952). At the time, both groups were in search of the rich pasturage available around the Great Fish River, the Xhosa moving southward, and the Europeans moving northward from the Cape of Good Hope. From the outset, this encounter was a hostile one (Charton, 1980); the settlers were interested in the commercial value of livestock, while the Xhosa populations had, in addition to this commercial interest, a cultural attachment to livestock (Houghton and Walton, 1952). The maintenance of the semi-nomadic tradition required by Xhosa people to sustain their livestock required large tracts of land, and an abundance of grazing; cultivation was afforded secondary importance. In 1779 the Great Fish River was declared the boundary between the indigenous Xhosa people and the European settlers. The demand for land by both the Xhosa and the European settlers was heightened by the arrival of the 1820 settlers from England, and conflict in the area escalated.

This conflict continued until 1866, when the area was annexed into the Cape Colony by the British government. The nineteenth century witnessed growing concern within the administration of South Africa to create territorially discrete administrative units in the native reserves for the purposes of administration and taxation (De Wet, 1995). The period also witnessed growing concern to 'educate' the black population with European ideals, culture and religion (Charton, 1980). Missionaries became increasingly active in the Ciskei at this time, with (mainly British) missionaries bringing European culture to the Xhosa population. One of the mission stations established by these missionaries was at Mt Coke, and continues to play an important role in health care for the rural population in the area.

Despite this early history, the political and constitutional origins of the former Ciskei as we know it today can be traced back to the Native Land Act (No. 27 of 1913) (Haysom, 1983). This Act formalised the Native Reserve system in the Union of South Africa, allocating little over 13 % of the land area of the country for exclusive occupation by black people. This was followed by the Native Trust and Land Act (No. 18 of 1936), which sought to consolidate the native reserve areas by establishing the South African Native Trust, with the responsibility of a) consolidating the reserves by purchasing additional land, specifically from white farmers whose land fell within the reserves prior to the Native Land Act in 1913, and b) of 'rehabilitating' the existing reserves which were regarded at the time as severely degraded (De Wet, 1995). The Report of the Native Economic Commission of 1930 to 1932 stated that the situation was worst in the Ciskei (UG22/1932:3-48, cited in De Wet, 1995), and that remedial measures were required. This lead later Betterment Planning, which is dealt with in the next section.

The intention of the South African government in establishing these reserves, or homelands, was ostensibly to enable separate development of 'blacks' and 'whites' that benefited both groups. In pursuance of this, The Black Authorities Act (1951) and the Promotion of Black Self Government Act (1959) were passed, which gave renewed power to refashioned traditional political structures such as chieftain rule and village headmen. As part of this process, legislative and executive powers were granted to homeland political structures such as 'Tribal Authorities'. These 'Tribal Authorities' were associated with the original chiefdoms that had once existed in the

former Ciskei. The intention was to affect a form of chiefly rule and rule through the elders by reviving traditional male leadership (Manona, 1995).

In 1982, the Ciskei became a politically independent but economically co-dependent homeland (Manona, 1995). During the period 1982-1990 however, growing discontent emerged with the then president-for-life, Lennox Sebe due to increasing concern at the local level with salaried chiefs through the Tribal Authorities, corruption and draconian leadership. This situation reached its peak in March 1990, when a military coup was orchestrated by Brigadier Oupa Goza against President Sebe. At the village level, residents at Mt Coke, and around the Ciskei, demonstrated their anger at the Tribal Authority system by burning the homes of chiefs and headmen associated with the previous Ciskei government. In one instance, this even led to the death of a headman in one of the villages at Mt Coke.

Three weeks after the coup, the Tribal Authority system collapsed, and the traditional leadership had lost legitimacy with local people due to its collaboration with the former government (Manona, 1995). During this period, the residence associations aligned themselves with the South African National Civic Organisation (Sanco) in anticipation for re-incorporation into the New South Africa, and began to agitate for control over the allocation of resources. Sanco emerged as the organisation for resolving village conflicts at Mt Coke, and indeed throughout the former Ciskei. However, because Sanco was not recognised officially by the Ciskei government at the time, it was not recognised within the villages as having the power to allocate land and regulate resource use. Thus, in the early 1990's, rural people in the Ciskei found themselves without either traditional or democratically elected leadership capabale of controlling access to common pool natural resources. This situation has not changed dramatically to date, although Sanco is becoming recognised by the present South African government as a democratically elected political body. Locally, residents at Mt Coke are not prepared to contemplate a return to traditional leadership based on their experiences with the Tribal Authority system.

Thus, this history of empowerment and disempowerment of community leaders, and the subsequent failure to replace them with new structures of leadership, can be identified as a fundamental factor contributing towards a distinct lack of institutions

governing access to common pool natural resources from the woodland and grazing areas surrounding the villages today (Ainslie, 1998, Manona, 1995). In many of the villages, Sanco has nominally taken over the role of managing village matters, however the organisation does not have statutory authority and is therefore largely ineffectual in terms of natural resource management. Institutional contestation is a major feature in one of the villages, and is currently emerging over the election of a new Sanco chairperson. This is problematic for the management of natural resources because community members identified Sanco as the organisation most likely to be capable of assisting with the management of common pool resources.

2.2.1 Betterment Planning and State intervention into Natural Resource Management

State intervention into rural land use (Table 2.1) in the former Ciskei homeland pre-1994 can only be understood within the broader context of the political and ideological aspirations of the South African government of the time (De Wet, 1995). While The Native Land Act (No. 27 of 1913) and Native Trust and Land Act (No. 18 of 1936) set aside and consolidated land for the reserve system, and identified erosion and degradation as serious issues in the homeland areas thus created, it was the Tomlinson Commission (1954) that identified the major environmental problem in the reserves as not only over population and congestion, but as "the Bantu himself" (UG 61/1955:74-77). Over stocking and erosion was identified as a direct result of the sociological, psychological and cultural condition of the "Bantu". This belief was even held by the Ciskei Government, who stated in 1975 that; " The development of the Ciskei is as much a human or social problem as it is an economic and technological one" (Ciskein Government Service, 1975).

The solution therefore was seen to lie is changing 'the Bantu'. This entailed the reduction of livestock numbers and establishment of viable agriculture, despite its lack of significance in Xhosa culture, by providing substantial inputs into the development of agriculture based on scientific methods, and by removing surplus people from the land and into rural villages. Those moved into villages would then form the basis of migrant labour required by the burgeoning mining and industrial sector in neighbouring South Africa.

Table 2.1: State interventions into the management of natural resources (Ainslie, 1998; Bundy, 1979)

Policy change	Intervention
Native Land Act No. 27 of 1913	Legally reinforced the reserve system. Set aside land exclusively for occupation by Africans
Native Trust and Land Act No. 18 of 1936	Additional land set aside for African occupation. The South African Native Trust would henceforth administer the scheduled areas set aside by the Land Act of 1913 and the 1936 act. In practice, the headmen continued to control access to resources, and remained answerable to the magistrate. The Act explicitly called for remedial action to be taken in reserve areas affected by erosion and degradation
The Native Economic Commission of 1930-32	Described environmental 'crisis' in African reserve areas. State responded with rehabilitation schemes where land was divided into arable, grazing and residential areas and people and livestock were relocated. Programme also included livestock culling, fencing, contour ploughing and soil and water conservation measures
Tomlinson Commission 1955	National Party wanted to maximise the number of people in the reserves. Recommended that reserve populations be divided into farmers and rural-based wage earners. To contain the ecological implications of such an intervention, the policy of Betterment Planning was adopted
Betterment Planning 1958 - 1990	Imposed fines for breaking contours, impounded cattle found outside allocated grazing areas, devolved responsibility for policing rehabilitation to headmen in line with the Black Authorities Act. Allowed the state to exert control over chiefs, lead to a challenging of the legitimacy of traditional leaders who accepted Betterment schemes in

	their villages
1994 - Democratic elections	Ciskei incorporated into South Africa, Ciskei government dissolved. Ciskei now fell under the administrative system of South Africa

It is useful here to use the village of Machibi as an example to illustrate the impacts that Betterment Planning had on rural communities in the former Ciskei. Through Betterment, the scattered settlements of Thafeni and Barrackson were moved 'over the river' to create 'Machibi' between 1958 and 1960 (DWAF, 2000a). No consultation was pursued, and residents had little say in where they would move to. A grid road system was imposed, and household plots allocated.

Grazing areas and arable fields were designated and allocated by state agricultural extension officers. The number of cattle, goats, sheep and pigs allowed per household was decided upon based on a combination of carrying capacity assessments of the communal areas surrounding the village, and the number of stock originally held by each family. Surplus stock was sold at auction in nearby towns, often to white farmers who were able to obtain the stock for very low prices. Grazing land was fenced, and a rotational grazing system was established, lead by the state extension officer, and policed by a 'ranger' employed by the state.

The ranger system, in existence from the 1960's until the early 1990's, effectively removed local control over both grazing patterns and resource harvesting. When an individual or household required fuelwood or building materials, a permit was acquired from the state employed village headman, described in the previous section, and presented to the ranger for inspection. Those who did not obtain a permit were sent before the local magistrate in the nearby administrative centre of King Williamstown.

Betterment Planning also encouraged agricultural pursuits through subsidies and strong extension support. Tractors were provided either free of charge, or at a nominal cost, and fertilisers and pesticides were provided by the state. A truck was provided to transport produce to the local centres for sale.

The 'Betterment package' thus consisted of strong state support for agriculture, heavy controls over stock numbers, and policing of resource harvesting by a salaried headman and ranger, and continued at Mt Coke, in one form or another, from the 1960's until early 1990 when the military coup by Oupa Goza, described earlier, brought an abrupt end to state extension services and the role of headmen and rangers.

2.3 Overview of Mt Coke

2.3.1 Biophysical profile

The Eastern Cape is recognised as a region of major climatic, topographical and geological transition, and as a result a great complexity and mixing of floral elements characterise the area (Manning, 2001). Six different biomes converge in the Eastern Cape, and Mount Coke lies at the interface between the Thicket and the Forest biome (Low and Rebelo, 1996). The Thicket biome, which falls within the communal areas at Mt Coke and is therefore of concern in this thesis, is described as having variable proportions of trees, shrubs, succulents and herbaceous species, and is thought to be a product both of the variables identified above, and of present and past land-uses (La Cock et al., 1990; Evans et al., 1997).

A large proportion of Mt Coke is vegetated by Valley Bushveld vegetation (Acocks, 1953), also known as Valley Thicket (Low and Rebelo, 1996). When undisturbed, this vegetation type consists of extremely dense, semi-succulent thorny scrub forest interspersed with grassland areas (Palmer, 1988). This kind of vegetation has a very slow recovery rate after disturbance (Midgley and Cowling, 1993; Fabricius, 1997), and in many instances has retreated to river valleys due to intensive pastoral agriculture, and Eastern Thornveld is now more common on the upper slopes (Low and Rebelo, 1996).

With an altitude of 488m, Mt Coke has an annual average rainfall of approximately 500 mm per annum (S.E +/- 50mm; AGIS, 2004). The annual average minimum temperatures at Mt Coke range between 12 – 13º C in winter, while the average maximum temperatures range between 24 – 25º C in summer (Reath, 2001). Most

slope angles are within the range of 0-4% which means that they are arable. There are also slopes in the range of 4-12%, these slopes are considered only potentially arable (Reath, 2001). Soil depth at Mt Coke ranges between 0 – 150mm and 151 - 400mm in the low-lying areas, which translates into very shallow soils on rock, and a general lack of soils. The prevalence of very shallow and rocky soils presents mechanical limitations on agriculture in the area (Reath, 2001), with the result that fairly high input agriculture, in terms of machinery such as tractors, is required.

2.3.2 Socio-economic profile

The Eastern Cape province has a population of just fewer than seven million people, 67 % of whom live in rural areas. This exceeds the national average by more than twenty percent (Lehohla, 2001). Further, roughly 75 % of the poor, a predominantly Xhosa-speaking population, live in these rural areas (Statistics South Africa, 2001), and with an unemployment rate of just below 49 %, the Eastern Cape has the highest unemployment rate in the entire country (Statistics South Africa, 2001).

Civil service salaries provide the majority of formal employment, and rural areas are characterised by sub-subsistence agriculture, migrancy, landlessness and high population densities (Ainslie et al., 1997). Sub-subsistence agriculture refers to a situation where farmers are unable to produce enough food to sustain their households. The main sources of income have for many years been in the form of pensions and social grants, with civil service salaries, migrant remittances, local agriculture and self-employment in the informal sector making a relatively small contribution (De Wet et al., 1992; Cocks and Weirsum, 2003).

Over the past thirty years population growth rates have remained relatively stable in the former-Ciskei, fluctuating between 2.16 % between 1970 and 1989 (Statistics South Africa, 1989), 2.31 % between 1985 and 1991 (Statistics South Africa, 1993), and 2.2 % between 1996 and 2001 (Statistics South Africa, 2001). Migration rates, however, have declined substantially since 1970, and people have become more sedentary (Figure 2.2). The rapid decline in migration in the 1980's coincided with a peak in inflation of 18.5 % in 1986 (Statistics South Africa, 1993), which spelled a very difficult period economically for local people. Indeed, by the 1990's a

combination of declining economic conditions, political upheaval and drought lead to a socio-economic situation at Mt Coke that is described in the chapter that follows.

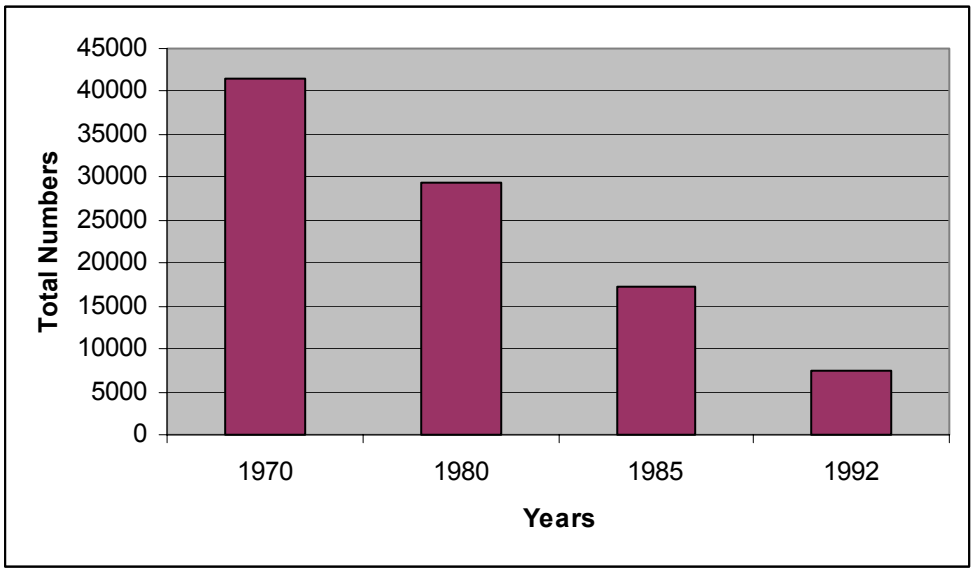


Figure 2.2: Migration numbers from the Ciskei (Statistics South Africa, 1993)

Machibi has a population of 1 584 people, and Qongqota has a population of 1 532 (Statistics South Africa, 2001). Of this population, only five and eight percent respectively are formally employed (Statistics South Africa, 2001). Employment statistics reflecting the occupation of people living within the Ngqushwa municipality are summarised in Figure 2.3. Pensions are as important a livelihood strategy as formal employment. In addition, the monthly income of those who are formally employed are in the low income categories, falling between R1 - R400 and R801 – R1600 per month (Figure 2.4).

On average, between 10 and 30 % of the residents at Mt Coke have no schooling at all, while the vast majority have completed up until grade ten (Figure 2.5). A very small percentage of the population (approximately two percent) has received any form of tertiary education (Statistics South Africa, 2001).

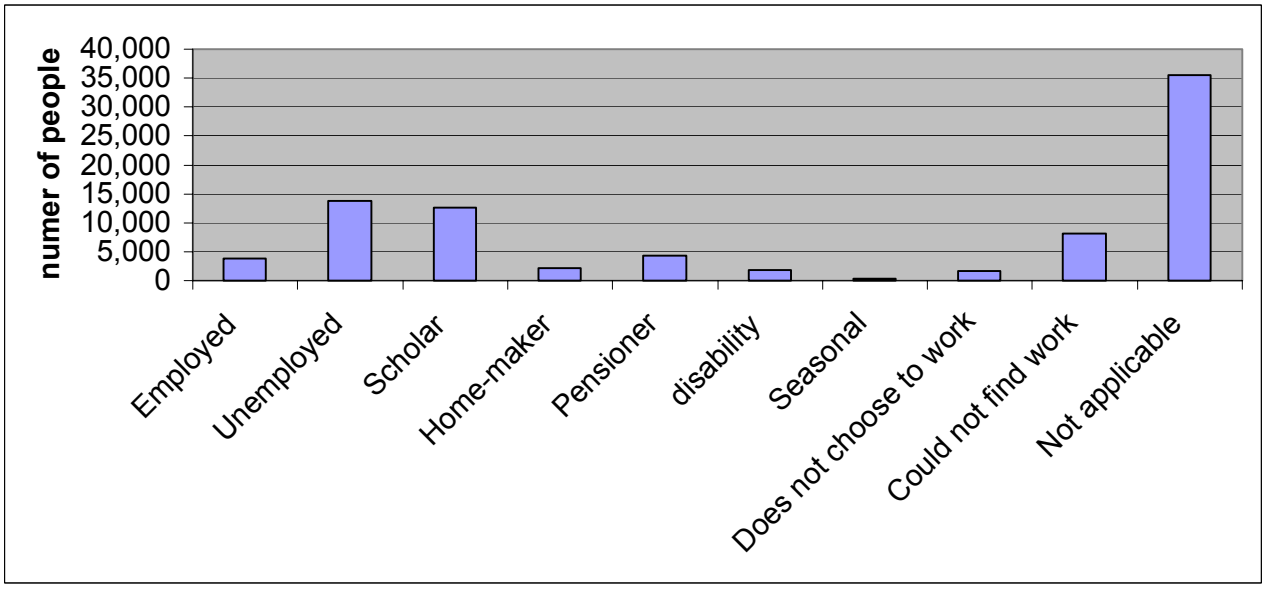


Figure 2.3: Employment status per weighted person in Ngqushwa Municipality (Statistics South Africa, 2001)

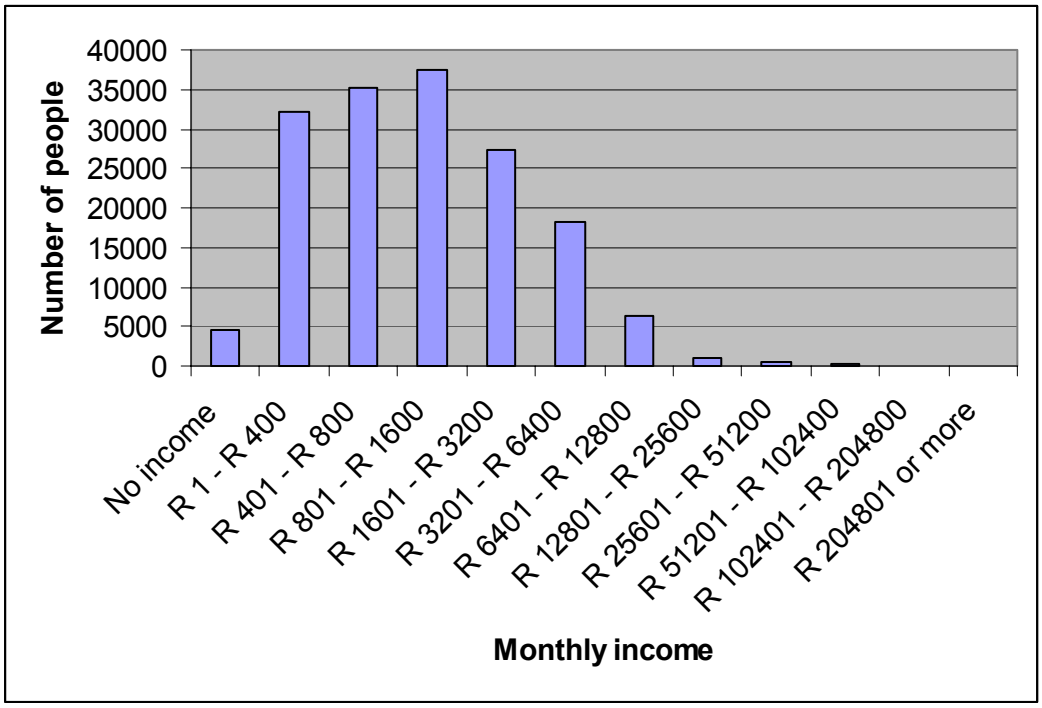


Figure 2.4: Monthly income among black Africans in the Amatole District Council (Statistics South Africa, 2001)

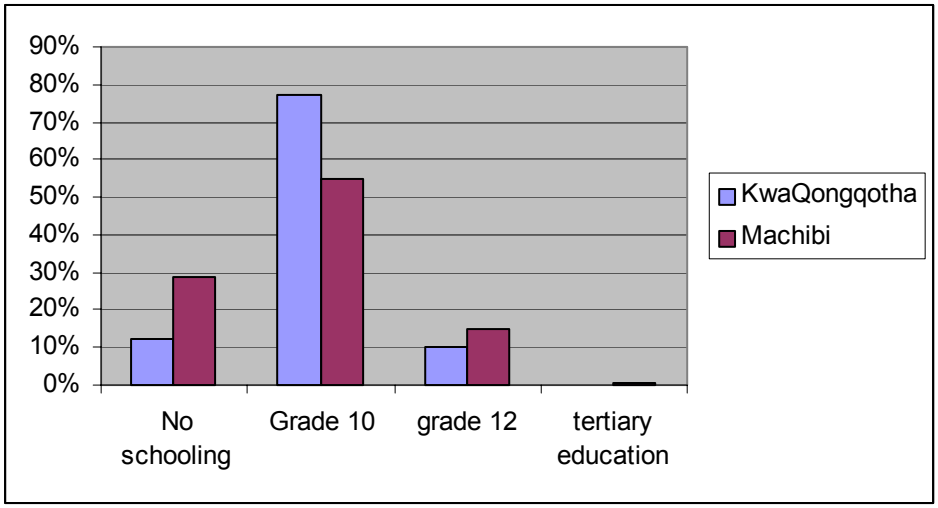


Figure 2.5: Highest level of education Mt Coke (Statistics South Africa, 2001)

2.3.3 Access to water and energy

Energy consumption nationwide in South Africa grew at a rate of 5 % per annum between 1970 and 1998 (Statistics South Africa, 2001). The national census of 1996 (Statistics South Africa, 1998) indicated a great disparity in access to energy for cooking according to race for the whole of South Africa. For example, while 98 % of whites had access to electricity for cooking, only 42 % of Africans used electricity as their main fuel for cooking. In response, the national electricity utility company stepped up its service delivery, and provided as many as 450 000 dwellings with electricity per year between 1996 and 2000 (Thomas et al., 2002).

Over half of the population in Ngushwa municipality rely on wood as their primary source of energy for cooking (Figure 2.6). While electricity is available in both villages, most residents cannot afford it, making use instead of paraffin and wood (Table 2.2). Electricity is the most common source of lighting.

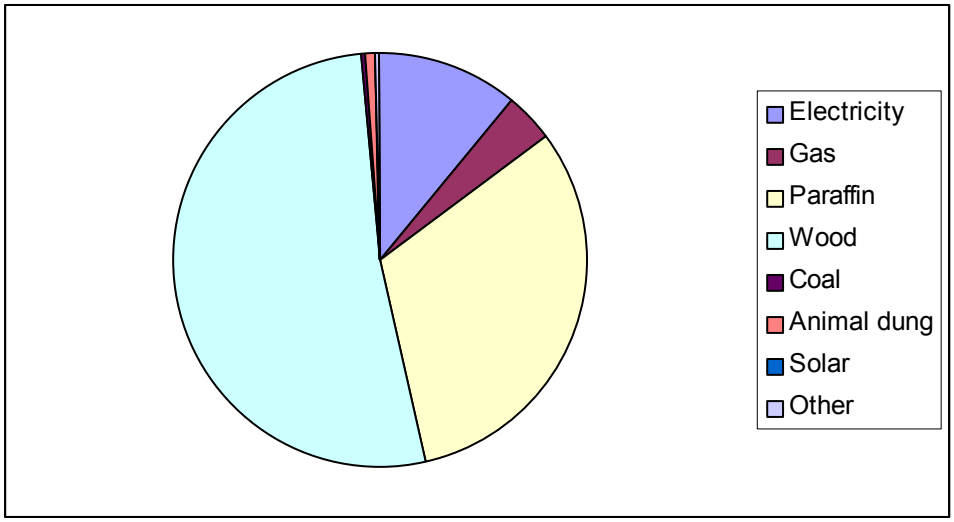


Figure 2.6: Sources of energy for cooking among black Africans in Ngushwa Municipality (Statistics South Africa, 2001)

Table 2.2: List of fuels and their uses in the household in Machibi obtained during group discussions

Fuel	Use
Electricity	Lighting, ironing, radio, kettle, fridge, T.V.
Fuelwood	Cooking, heating, boiling water
Paraffin	Cooking, lighting
Cattle dung	Cooking

In terms of water supply, prior to 1994 responsibility for basic service provision at Mt Coke fell under the jurisdiction of the Ciskeian government. Under this government, the policy was to provide bulk water supply to rural villages (Pers comm. Mr Mitchell, DWAF King Williams Town). Machibi and Qongqota received bulk water supply from a reservoir situated in Qongqota location. This reservoir was constructed in 1970, and due to its central location in the village of Qongqota, supplied the local residents with running water from 1970. However it was not until the 1980's that bulk water was available in Machibi, this was available from a reservoir in the village,

however the reservoir was over two kilometres away from many of the dwellings, and as a result most residents continued to use natural streams, springs and man made dams.

This changed in 1994, with the new dispensation and national drive toward basic service provision. In 1994, the National Constitution stated that "everyone is guaranteed access to sufficient water", the Water Services Act (108 of 1997) followed to enable the Department of Water Affairs and Forestry to fulfil its constitutional obligations. According to national standards stipulated by the Water Services Act and the Reconstruction and Development Programme (RDP), the basic level of water provision is 25 litres of potable water per person per day within 200 meters from each dwelling. The Khambashe Water Supply Scheme was thus established to provide reticulated water, in accordance with the RDP standards, to several villages at Mt Coke, the reservoir within Qongqota being the central storage facility. The process was slow, however in 2000 Machibi received reticulated water, with a tap within 200m of every household. For Qongqota, little changed during this period as the village had had access to reticulated water for well over thirty years by 2000.

Villages at Mt Coke generally have access in varying degrees to reticulated water, electricity, schools, crèches, churches, and shops. Provincial statistics indicate that access to municipal water in the Eastern Cape is generally good, with over 60 % of the population with access to piped (reticulated) water. However, when examined by racial group and at a finer resolution that considers the types of access available (Figure 2.7) it becomes clear that in fact many are without sufficient access to municipal water. In particular, only one percent of the population in Ngushwa municipality has reticulated water within their homesteads, in comparison to the 16 % at the provincial level. More importantly, just under half of the population in Ngushwa is without piped water that meets with the water quality guidelines according to the national Water Services Act (Act 108 of 1997).

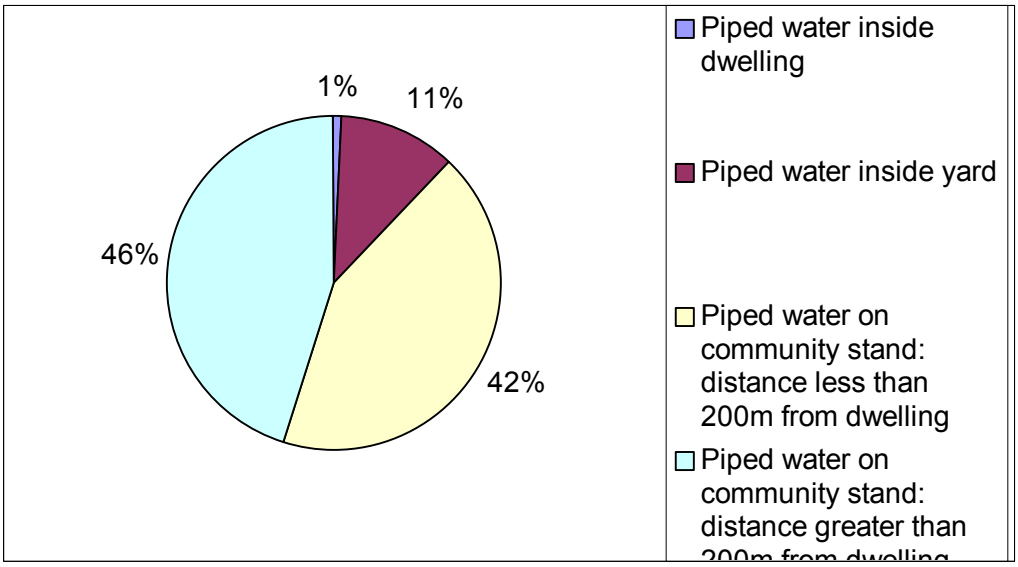


Figure 2.7: Access to reticulated water amongst black Africans in Ngushwa municipality (Statistics South Africa, 2001)

These statistics do not, however, reflect how people cope with a lack of access to water at the local level. For example, while access to reticulated was at the provincial and municipal level appears good, in reality these the system is prone to breaking down on a regular basis at Mt Coke, and people are forced to employ a range of coping strategies in order to ensure adequate water in the household (see Chapter 4). One of these strategies is the purchase of rainwater tanks, of various sizes (Section 4.3.2, Chapter 4). In a survey of 40 households in Machibi for example, one hundred percent of households owned a rainwater tank (Ibid). Unfortunately this type of coping strategy is not reflected in government census statistics.

2.4 Livelihoods at Mt Coke

This section provides a description of the various aspects of rural livelihoods at Mt Coke, including the role of agriculture and livestock production, natural resources and local institutions in the construction of these livelihoods. The analysis is not intended to be extensive; rather, this section provides a summary of the information that already exists for the specific area of Mt Coke, and therefore represents the background and the context within which the chapters that follow are situated.

Communities at Mt Coke construct their livelihoods in a variety of ways. The different sources of income provide some preliminary insight into the options available to these communities. Sources of monetary income in villages at Mt Coke are listed in Table 2.3, and are arranged in order of importance, or ranked, as a source of income for households. Pensions and disability grants have been identified as the biggest contributor to household income. Small businesses were ranked second most important. Only two of these small businesses relate directly to forest utilisation; basket and mat weaving.

Table 2.3: Ranked list of sources of household income in Machibi (DWAF, 2001).

Ranking	Source of income
1.	Pensions and disability grants
2.	Small business
3.	Community services
4.	Sale of medicinal plant
5.	Sale of food crops
6.	Salaries
7.	Remittances from migrant labour
8.	Sale of livestock
9.	Sale of meat and skins from wild animals

Services to the community were ranked third most important, and included the collection of forest products on behalf of others (see Plate 2.1), fence-building, circumcision doctors, and animal doctors. The sale of medicinal plants was ranked fourth ahead of the sale of food crops which was ranked fifth. Salaries were ranked sixth as not many people were earning a monthly income (see also Figure 2.3). Remittances from migrant labour were ranked seventh as they were irregular and did not amount to much. The sale of livestock was ranked eighth, this is thought to be as a result of the apparent absence of marketing outlets such as sales and auction yards. Finally, the sale of meat and skins from wild animals was ranked ninth (DWAF, 2001).

The above list indicates a diversity of livelihood options available, and therefore suggests that human adaptability is potentially strong. However, although residents earn financial capital in a variety of ways, money is generally considered to be scarce, as Tables 2.4 and 2.5 illustrate. In both cases, the largest wealth category is considered to consist of households where there is no income earner, and where family survival depends on the use of natural resources and the generosity of others.

Table 2.4: Wealth categories identified during a wealth ranking exercise at Machibi (DWAF, 2000a)

Category	% of village	Description
Abangathathi ntweni (very poor)	17	Households with no source of income, and depend on others for food. They have no furniture, and cannot afford to buy electricity cards. They cook outside, and have no livestock. They depend on natural resources such as fuelwood, building materials, and medicinal plants
Abasokolayo (poor)	44	Households that depend on others for children's school fees. Nobody earning an income, someone may receive a disability grant. They may have up to two cows, and two rondavels, but very little furniture, and cannot afford electricity. They depend on natural resources such as firewood and building materials
Abaphakathi (better-off)	30	Households that receive a pension and have one member of the household working. They use electricity and can afford the transport to send their children to school. Homes are built with bricks, they have furniture and have more than three cows
Abangcono (well-off)	8	Includes shop-owners, and households where more than two family members are working. Homes are large and made of bricks. May have up to forty cows, large fields, tractors, cars, and are able to send their

	children to tertiary institutions

Table 2.5: Wealth categories identified during a wealth ranking exercise at Qongqota (DWAF, 2002b)

Category	% of village	Description
Poor	70	Households that have no money and depend on the generosity of others. Households that rely on pensions for basic requirements
Better off	23	Households with two members who receive pensions, or households in which one member earns a salary
Well off	7	Households with two or more family members earning a salary. These families can afford comforts such as cars.

In terms of expenditure, food was considered the largest household expense, which suggests that households are not producing at a subsistence level in agriculture. This was followed by the cost associated with burial societies and education. Rates and taxes were ranked fourth, followed by transport, medication, building expenses, clothing, livestock, entertainment and bridewealth (DWAF, 2001).

2.4.1 The role of agriculture and livestock production

Both villages have arable fields and a livestock dipping facility. While Machibi has fences around its fields, Qongqota does not, and while Machibi residents have access to two privately owned tractors, Qongqota residents are still dependent on animal traction. Agricultural production has been imbued with varying degrees of significance in the livelihoods of rural people living at Mt Coke over the past four or more decades. This changing importance has been linked to a large degree to state support in the agricultural sector, political changes at the local level, and the economic security of the residents.

Relative to other land uses, agriculture is important in Qongqota (Figure 3.5, Chapter 3). Agriculture provides both food for the household, and an income to buy non-perishables from the local shops. However, although a high level of importance is attached to arable fields, this does not mean that arable fields are cultivated every year. In fact, there has been a systematic abandonment of fields over the past decade in both Machibi and Qongqota. The reasons behind this include the costs involved in hiring tractors, people no longer sharing their oxen due to distrust, and finally the threat of theft of produce by people outside of the villages. For example, the area used for agricultural production in Qongqota has declined by almost 168 ha since the 1980's (see section 3.3.3, Chapter 3).

The proportions of land reserved for grazing, agriculture and residential purposes have, according to local knowledge, changed substantially since 1958 (Figure 2.8). Most significantly, the area allocated as grazing land according to local practice has increased during this period, while the amount of land used for cultivation has declined. The reasons behind this shift in land use are explored in Chapter 3.

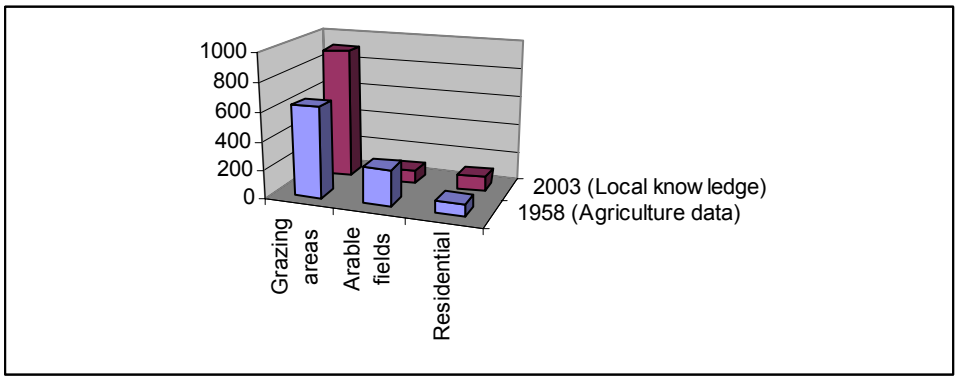


Figure 2.8. Hectares per land use type in Qongqota location

Although the 1958 land use areas per hectare are not available for Machibi, there has been a substantial change in the total land use area. The total official boundary assigned to the village in 1958 enclosed 1976 ha, however, according to local knowledge this area has increased to 3918 ha today. In both villages, a strong trend of arable field abandonment has been identified, with this land use being converted to grazing.

This trend of field abandonment can be assigned to two key factors: 1) The number of people cultivating land has declined since the 1990 coup d'etat on the Ciskei government (see Section 2.3), at which time all government assistance, which had previously been substantial, was withdrawn. 2) Although livestock has always been considered the 'Xhosa bank', this trend has become increasingly important to people who have adopted risk avoiding behaviour by investing in livestock in order to protect themselves from the risks of poverty. Crops are in many instances seen as a high-risk investment due to crop failure (see Chapter 3).

A range of crops are cultivated in both villages, despite the declining importance of this land use, these are listed in Table 2.6.

Table 2.6: Natural resources from arable fields in Qongqota, and reasons for their cultivation

Key: ✔ crop is grown for this purpose
-- Crop is not grown for this purpose
✔ ✔ This is the most important reason for cultivation

Crops	**Household use**	**For sale**		
			Town	Locally
Maize	✔	✔ ✔	✔	✔ ✔
Potatoes	✔	✔ ✔	✔ ✔	✔
Pumpkin	✔	✔ ✔	✔ ✔	✔
Iimbotyi (beans??)	✔	✔ ✔	✔ ✔	✔
Green beans	✔ ✔	✔	--	✔ ✔
Melon	✔ ✔	✔	--	✔ ✔
Wheat	✔	✔ ✔	--	✔ ✔
Amazimba	✔	✔ ✔	--	✔ ✔
Wild spinach	✔	✔ ✔	✔	✔ ✔

On a national scale, vegetable production increased by 16 % and animal products by 14% between 1970 and 1996 (Statistics South Africa, 2001). The use of these national level statistics tends to mask the high level of complexity that exists at the local level; nevertheless, they are useful in framing broader scale trends, against which one is able to compare the local changes.

At the local level, the 1980's witnessed an increase in horticultural cultivation due to strong government support with capacity development and funding (Mr Mazamisa, Department of Agriculture, King Williams Town, pers. comm.). However, between 1990 and 2000 this cultivation declined dramatically due to the withdrawal of state support and an insecure political environment (see Section 2.2), both of which prevented the sharing of oxen and labour among community members due to distrust and conflict. However, in the last three years cultivation of horticultural products has once again begun to increase (Pers. Comm. Mr Mazamisa, Department of Agriculture, King Williams Town).

Livestock play several important roles in the livelihoods of rural people. Just some of these roles include; a store of wealth, a source of protein, and a link to the ancestors. Table 2.7 illustrates the various reasons for keeping different kinds of livestock in Machibi, and is representative of both villages. It is worthwhile to note that by the term "bank" the participants stated that "Xhosa people don't like to use the banks in town". An additional reason for keeping livestock was suggested to be "security", meaning security for when times are tough, much like an insurance policy. This was grouped under the term "bank" because it was claimed that "cattle in the kraal is money in the bank".

Table 2.7: Results of a matrix exercise where workshop participants were asked to indicate the reasons for keeping each type of livestock in Machibi. A dash indicates that livestock are not kept for that purpose, a tick indicates that livestock were kept for that purpose, a second tick denotes the most important reason for keeping each type of livestock.

Livestock	Bank	Food	Medicine	Animal traction
Cattle	✔	✔	✔	✔ ✔
Goats	✔ ✔	✔	✔	--
Sheep	✔ ✔	✔	✔	--
Pigs	✔	✔ ✔	✔	--
Chickens	✔	✔ ✔	✔	--
Geese	✔	✔ ✔	✔	--
Ducks	✔ ✔	✔	--	--
Dogs	✔ *	--	✔	--
Cats	✔ *	--	--	--
Horses	✔	--	✔	✔ *

The keeping of livestock has gone through various stages of decline and growth at the local level. During the period 1960 to 1990 tight state controls on numbers of livestock allowed per household lead to a decline in the number of livestock (Mr

Mazamisa, Department of Agriculture, King Williams Town, pers. Comm.). However, with the dissolution of state controls over the types and number of livestock that could be kept after the coup in 1990 came an increase and diversification of the types of livestock kept in the households according to local people. This was in response not only to a loosening of state control, but also in response to growing uncertainty regarding livelihood security (see Chapter 4). In this case people invested in cattle and other livestock as an "insurance policy" in against growing financial insecurity (see Section 4.3.2b, Chapter 4).

2.4.2 The role of natural resources

Natural resources make a significant contribution to livelihoods at Mt Coke. Land uses and land use trends are discussed in detail in the chapter that follows, however here it is important to note that natural capital at Mt Coke consists of land (used for grazing, agriculture and settlement), water resources (in the form of natural springs, streams, and dams), and communal and state owned woodland and forest resources. In particular, several indigenous woodland areas exist and are utilised within each villages' boundaries (see Plate 2.3). These vary in size and composition and have historically provided most of the communities' forestry requirements. Each patch has its own history, spiritual value and use value.

In Qongqota for example, people use a range of natural resources from woodland areas. These woodlands consist a variety of scattered indigenous trees, as well as the occasional exotic such as *Eucalyptus c. f. grandis* and *Acacia mearnsii*, and are used as grazing areas for cattle and other livestock (DWAF, 2002b). These woodlands were designated as 'camps' during Betterment Planning, and were initially intended as grazing areas, and were therefore fenced by the state, and were also subject to government lead projects to remove alien species.

Table 2.8 below lists the livelihood products that are derived from woodlands in the village of Machibi, this is typical of the villages at Mt Coke. In Machibi, land is identified as the most important resource, because livestock need forage and space (DWAF, 2001). Poles, firewood and medicinal plants are considered the most important woodland resources (see Plates 2.2 and 2.4). The most common use of

resources from these woodlands is for construction, biomass fuel, and consumption. However, woodlands are not the only source of ecosystem goods and services, arable fields and forested areas also provide essential livelihood products for rural communities, as Tables 2.8 and 2.9 indicate. Chapter 4 examines more closely the reasons behind the cultivation of these crops.

Table 2.8: A list of products obtained from woodlands at Machibi (DWAF, 2000a)

Product	Use
Building poles	House construction
Fire wood	Cooking
Medicinal plants	Curing ailments
Brushwood	Ritual fires
Kraalwood	Kraal construction
Wild fruits	Consumption
Honey	Consumption
Meat	Consumption
Bush willow	Seclusion house construction
Reeds	Mats
Palm	Brooms
Grass	Grazing
Thatching grass	Thatching of roofs
Soil/land	Construction
Sand	Construction
Stones	Construction
Skins	Thongs
Water	Drinking, cooking, washing, livestock watering
Mushrooms	Consumption
Forests and rivers	Ancestral veneration

Table 2.9: Ranked list of natural resources from arable fields at Qongqota (DWAF, 2002b)

Xhosa name	English name
Umbona	Maize
Itapile	Potatoes
Ithanga	Pumpkin
Intyabontyi and Ertjies	Melon and green beans
Ingqolowa	Wheat
Imifino	Wild spinach
Ingca	Thatching grass

People also attach indirect use values to these ecosystem goods. For example, women construct *amaqogo* outside their homes for cultural reasons, and do not usually use that wood for fuel purposes (Cocks and Wiersum, 2003). *Amagoqo* refers to the wood stockpiles collected by women, these woodpiles have a high cultural value, and are used by females within a household to demonstrate womanhood. For example, a large *igogo* (refer to Glossary) outside a homestead demonstrates to other community members that the female head of the household is a hardworking and devoted wife.

People are more dependent on natural resources at certain times of the year than at others (See Plate 1.7, Chapter 1). Winter (May to August) is the busiest time for forest related activities as there is an increase in firewood and building wood collection for both heating and cooking. The period between September and December is also busy, as these are the best months to collect medicinal plants, wild fruits and honey. Few forest related activities take place between January and April as people invest time in their gardens and fields, during this period forest products such as wild fruits and honey are not abundant and fuelwood requirements are low.

A number of ecosystem trends have been identified at Mount Coke. There is, for example, a growing scarcity of indigenous trees used for building poles and rituals, in particular Sneezewood (*Ptaeroxylon obliquum*) and Wild Olive (*Olea eurpaea Subsp. africana*). The woodland areas surrounding Machibi are also less dense than they were two or three decades previously, in particular, their general health is perceived locally to have declined sharply after 1990 (DWAF, 2000a). Unpalatable shrubs such as Bluebush (*Pteronia incana*) have started to colonise these open spaces, and Sweet thorn (*Acacia karroo*) is invading the grazing lands and abandoned fields. Reeds and medicinal plants are also becoming scarcer. However, woodland areas that were abandoned five years ago because of the growing scarcity of forest products are now recovering (DWAF, 2000a).

2.4.3 Tenure and the role of institutions

As stated in Chapter 1, institutions here refer to the "rules that individuals use to order specific relationships with one another…an institution is simply the set of rules actually used" (Ostrom, 1990: 19). The role of natural resources from commonage areas surrounding the villages at Mt Coke has been outlined above, what is of interest now are the institutional arrangements governing access to these resources. Woodland and grazing areas are currently held under a lassaiz faire communal tenure system. This means that management is not entirely open access, as residents from adjacent villages are not allowed to graze their cattle on the land of another village. An open access system exists where members of a group do not have the legal right to exclude anyone from using a resource (Ostrom and Hess, 2000). "Outsiders" from other villages are kept out through negotiation between village elders when a transgression takes place. However, while institutions governing the exclusion of outsiders are still nominally functional, management controls within each village governing where and when people are allowed to harvest resources and graze their livestock have all but disappeared since the coup d'etat in early 1990.

Prior to 1990, headmen managed the forests with the assistance of a community appointed forest ranger. The headman, who was appointed by the state, would apply forestry regulations as stipulated by the government, and would ensure that anyone

who transgressed the regulations be brought before the Tribal Authority, and if necessary be charged at the magistrates office (Fatman, 2002). The Tribal Authority and the headman lost their authority to manage the woodlands following the transition to a democratic government between 1990 and 1994 (see following chapter). This was a period of significant political upheaval, marked by the burning of all structures that related to the political administration under the former Ciskein president, Lennox Sebe (Fatman, 2001). Since this period, nobody has been tasked with authority to manage the woodlands (see also Manona, 1995), and the collection of forest products has gone unchecked, except for the nominal existence of a forest committee established through DWAF's PFM initiative in 2000. Indeed, some products that were traditionally used only for ritual purposes, such as *Olea eurpaea Subsp. africana* are now used for fencing (DWAF, 2000a).

Effective institutional arrangements are a core feature of strong social capital (Section 1.1.2, Chapter 1). At present, the potential social capital at Mt Coke is regarded as high, with several community-based organisations in existence in each village. The South African National Civic Organisation (Sanco) has been highlighted as the main structure representing the community. Other structures identified include other political parties, church committees, farmer's associations, burial societies, sports clubs, youth gospel groups, adult choirs, stokvels, NGO's and a brick-making company that adjoins one of the villages. However, these structures have not taken charge of resource management to date, and therefore natural resources, a key component of livelihoods in the areas, are to date unmanaged (Cundill, 2002).

3.5 Conclusion

This brief description of the current situation at Mt Coke, and the historical context within which this is situated, has serious implications for research in the area. It is clear that historical political processes, interventions and institutional structures have played a major role in shaping access to resources and incentives for particular land uses in the former Ciskei (Section 2.2). This process of political intervention and concomitant institutional change has had implications for local level resource management too (Section 2.4.3), which makes a consideration of macro level divers

such a national political policies and aspirations imperative to understanding human-environment interactions at the local level in the former Ciskei.

In addition, Section 2.5.2 indicates a high level of reliance on local ecosystems to support rural livelihoods, and therefore any analysis of this system requires an understanding of how these systems interact, and specifically a deeper understanding of the trends of ecosystem use. In particular, the Xhosa people have had a long history of reliance on ecosystems for survival, both economically and culturally, which begs the question of how this relationship was maintained for such a long period of time, and what role outside interventions, such as the creation of homeland territories, played in the degradation and erosion of ecosystems described by the Tomlinson Commission in 1954. Perhaps most interesting is the fact that despite the severe erosion and degradation described in the 1950's, ecosystems continue to play a vital role in rural livelihoods today. This points to some form of adaptation on the part of local people or ecosystems, or both, in order to cope with and respond to changes in ecosystems and demand for resources.

In sum, this chapter has highlighted the need to consider, simultaneously, drivers of change, interventions into local management practices, local rural livelihoods and vulnerability, and the adaptive relationship between ecosystems and local people. This requires therefore that not only traditional disciplinary lines be transcended, but that different conceptual frameworks be combined, as to date no one conceptual guide exists that allows for the simultaneous consideration of all of these issues (see Chapter 1). Figure 1.4 (Chapter 1) goes some way toward conceptualising the complex interactions between social and ecological systems on this area, by incorporating rural livelihoods, land use, ecosystem change, and the broader context within which they are nested. The trends in this context, and the impacts of these trends on land use practices is the subject of the next chapter.

Plates

Plate 2.1: Men offering a service to the community by collecting fuel wood and construction materials for others

Plate 2.2: Women collecting fuel wood for home use

Plate 2.3: An example of the woodland patches that surround the villages at Mt Coke

Plate 2.4: Collection of fuel wood for the traditional *amaqogo*

Chapter 3. Land use change

3.1 Introduction

Land use refers to the human exploitation of environmental attributes (Mertens et al., 2000), and affects global biodiversity, regional and global climate change, soil degradation, and therefore the ability of biological systems to support human needs (Vitousek et al., 1997; Chase et al., 1999; Houghton et al., 1999; Sala et al., 2000). Large-scale land use change affecting the global ecosystem originates from small-scale modifications that are significant through their cumulative effects (Wilbanks and Kates, 1999). Therefore, the appropriate scale at which to analyse land use change is the local level (Reid et al., 2000). At the same time however, in order to make meaningful predictions about the future of land use change, an understanding of the driving forces, or underlying causes of change, at various scales is required (Mortimore, 1998; Lambin et al., 2001; Rao and Pant, 2001; Campbell et al., 2002b; MA, 2003).

A driver of change is defined in this study as any natural or human-induced factor that directly or indirectly causes a change in an ecosystem (MA, 2003). In accordance with the Millennium Assessment framework (Section 1.1.2, Chapter 1), a direct driver refers to a factor that unequivocally influences ecosystem processes, while an indirect driver is generally linked in a non-linear way to ecosystem change. Drivers of change can also be differentiated in terms of their relationship to the social system in question. An endogenous driver refers to a factor whose magnitude can be influenced by the decision maker, while an exogenous driver cannot. The endogenous or exogenous characteristic of a driver depends on the organisational scale of analysis; some drivers are exogenous to a decision maker at one scale, but endogenous to decision makers at coarser scales (MA, 2003).

Identifying the drivers of land use change at the local level requires the consideration of a wide range of socio-economic, political and biophysical factors operating at a variety of spatial and temporal scales (Musters et al., 1998; Wilbanks and Kates, 1999; Lambin et al., 2001; Rao and Pant, 2001). However, the methodological

difficulties involved in linking social and ecological data of this nature has been identified as a major challenge in achieving this objective (VeldKamp and Lambin, 2001). The trend in land use and land cover change literature has therefore been to focus rather on easily identifiable causes of change, such as changes in endogenous management practices, despite the fact that this narrow focus often prohibits the identification of causal linkages (Veldkamp and Lambin, 2001), and therefore prohibits predictive understanding necessary for policy development.

Land use change research in Southern Africa typically focuses on the impacts on biodiversity of commercial agriculture, alien invasive species and urbanisation (see for example Rouget et al., 2003), while very few studies have assessed temporal changes in rural land use (although some have highlighted the need to do so: Cousins, 1999; Shackleton et al., 2001). This is significant since communally managed resources such as rangelands cover 14 % of the countries land surface (Scholes, 2004). Land use practices in the Thicket biome are of particular concern due to the fragility and low resilience of the vegetation type (see Section 2.3.1, Chapter 2), as well as the fact that a large percentage of the biome exists outside of protected areas (Fabricius, 1997). Specifically, concerns abound regarding the suitability of subsistence land use practices and livestock farming for this vegetation type (Kerley et al., 1995). Thus, rural land use in the communal areas of the Eastern Cape, and specifically the driving forces behind these changes, should be a major concern for policy makers and conservationists alike.

More generally, rural studies in southern Africa have been criticised for failing to consider politics and economics, and for ignoring the role of history in explaining environmental change (Campbell et al., 2002a and b). This is alarming since research in the former homeland areas has demonstrated the role played by national level policies in influencing local level common pool resource management (Manona, 1998; Ainslie, 1999; Adams et al., 2000; Kepe, 2002), and the role of history and context in shaping current land use practices (Sansom, 1974; Beinart, 1992; Duvel and Afful, 1996).

Finally, what has been lacking in the South African literature, as elsewhere in the world, is a meaningful analysis of the consequences of the interplay between multiple

factors operating at the same time, and the interpretation of these interactions through case study analysis (Adger, 1999a). Specifically in the case of land use change, the complexity of land-use systems requires multidisciplinary analyses (Clayton and Radcliffe, 1996; Zimmerer, 2000). Moreover, since the drivers of change are often outside the local context, both spatially and temporally, understanding these driving forces requires the combination of a systems and a narrative approach (Lambin et al., 1999, cited in Veldkamp and Lambin, 2001).

This chapter builds on the historical, political, economic and biophysical context provided in Chapter 2 by describing the trends that have occurred, and are occurring, in these various factors. In particular, this chapter explores the impacts that these trends have had local level land use in the communal land utilised by the villages of Machibi and Qongqota at Mt Coke (Figure 2.1, Chapter 2) through a systems perspective and multidisciplinary approach.

The plurality of perspectives required to identify the political, economic and biophysical drivers of change simultaneously is achieved through a combination of the various frameworks discussed in Chapter 1, and summarised in Figure 1.4. While the MA framework allows for the identification of driving forces at various spatial and temporal scales, as well as the interactions between those driving forces, the Entitlements framework enables a consideration of how institutions at those scales affect local peoples' ability to access resources. This perspective becomes considerably important in identifying land use change in response to either the weakening or strengthening of local institutions for the management of common pool resources. The Resilience perspective, on the other hand, allows for reflection on the adaptive nature of the interaction between drivers at broader spatial and temporal scales, and local level land use choices. The connection between these and local livelihoods and ecosystems dynamics is discussed in Chapters 4 and 5 respectively.

Objective and key questions

The objectives of this chapter are to identify a) local level land use practices and trends on communal land at Mt Coke; and b) the key driving forces behind these changes. In order to achieve this following key questions are asked;

1. How has land use changed over the past fifty or more years?
2. What are the immediate causes of land use change?
3. What are the ultimate causes of land use change?
4. Can this understanding be used as a predictive tool in understanding future land use changes at Mt Coke?

3.2 Methods

The underlying causes of land use change are elusive and multiple. The identification of these underlying causes, or 'driving forces', therefore requires innovative combinations of conceptual and practical approaches and techniques (see Chapter 1 and Appendix 1). Therefore, a broad combination of Participatory Learning and Action (PLA), Geographic Information Systems (GIS), historical and archival records, key informant interviews, and household surveys were employed to identify the drivers of land use change at Mt Coke. The range of methods as well as the questions they were intended to answer are summarised in Table 3.1, and discussed below.

Historical records are well known to provide detailed accounts of government resource management strategies, and how they influenced local land use and resource management strategies (Rao and Pant, 2001). The combination of remote sensing data and household survey and participatory research methods have been used world wide to understand land use change (Fairhead and Leach, 1996; Cousins, 1999; Leach and Fairhead, 2000; Mertens et al., 2000). PLA, and its predecessors, Rapid Rural

Appraisal and Participatory Rural Appraisal, have all played significant roles in understanding human-environment interactions (www.iied.org). For a detailed analysis and critique of these participatory methods refer to Chapter 1.

In terms of the PLA portion of the fieldwork, four user groups were identified; two in Machibi and two in Qongqota. Prior to the identification of these user groups, the idea of 'drivers' and 'indicators' was explained to a combined group composed of political leaders and forestry committee members in each village. Indicators were explained through the example of a car, something which the villagers are familiar with because they regularly use taxis. It was for example explained by facilitators that; "*When a car is about to turn a corner, the indicator is turned on. This indicator does not turn the car; it simply tells those around the car in which direction the car is about to turn. Indicators are vital in order to avoid accidents on the road. The driver turns the car, but we cannot guess what the driver is thinking. The indicator provides the link between the driver and those around the vehicle, enabling us to understand where the driver is heading. The village can be regarded as the car itself, with various people representing various parts of the car".* The elders likened themselves and their knowledge to the engine of the car, because even when the car is old and rusted, the engine is always there. The youth were compared to the wheels, because they keep the village moving forward all the time.

Fuelwood collection, water quality, dependence on natural streams, arable field cultivation and changing levels of co-operation between farmers were all identified at the outset by local participants as potential indicators of land use change. These indicators were identified in the preliminary workshops held in each village. Thereafter, the original combined group was asked to identify additional members of the community who held in-depth knowledge of these various indicators. Both villages decided to break up into two user groups based on gender. The female user groups held knowledge about water quality, fuelwood and woodland condition, while the male user groups held knowledge regarding arable field cultivation and rangelands.

PLA methods proved very useful in identifying changes in these indicators, described in detail in Chapter 1. The range of PLA techniques, as well as other field methods,

are summarised below, and Appendix 1 contains step by step descriptions of how each of these methods was conducted.

Time series free-hand land use mapping - historical mapping provides visual evidence of changes that have occurred over time, and in this way helps to identify causes of current environmental change (Borrini-Feyerabend, 1997). In the initial combined workshop in Qongqota, participants drew three maps to highlight a) the current land uses in the village, and b) spatial changes in these land uses between 1947 and, for example, 1960 after Betterment Planning. The three 'epochs' selected were; 1947, 1960, and 2003. 1947 was selected because this was the year that Laing Dam was constructed and some homesteads were moved to a more central location, 1960 was selected because this was the period when people were moved from their scattered settlements into a central location, and grazing areas and arable fields were designated and allocated (see Section 2.2.1, Chapter 2). 2003 was selected to show current land use patterns.

Participatory analysis of aerial and orthographic photographs involved the use of geo-referenced maps onto which participants directly illustrated different and changing land uses. This was a useful tool for identifying past and present land uses, degradation, and varying tenural arrangements (Chambers, 1992). The use of materials such as orthographic photographs can prove extremely empowering for those involved, as the scepticism toward of scientists and their tools is decreased by people becoming familiar with the technology used (Alcorn, 2000; McMaster, 2002). In this case, participants in each user group, for each village, used the orthographic photographs to identify more accurately the precise location of the different land uses identified in the previous free hand mapping exercise. These were then drawn directly onto laminated photographs using different coloured pens and a map key (refer to Appendix 1 for a detailed description of this process).

Geographic Information Systems (GIS) - Polygons were then extracted from the maps drawn directly onto the orthographic photographs during participatory analysis workshops and captured using Arc View 3.2 at a scale of 1:2500. The orthophotos were projected in Transverse Mercator with WGS84 Datum. The official boundaries were extracted from scanned images obtained from the department of Agriculture and

in Bisho. These where projected in Transverse Mercator with Clarke 1880 Datum, and over laid on the boundaries assigned by local people.

Pie charts are useful diagrammatic representations that can be used to identify the relative importance assigned to different sources of food, different ecosystems or different land uses from which natural resources are extracted. Pie charts were used to illustrate the relative importance, as well as changes in the relative importance over time of different land uses for the periods 1947, 1960 and 2003. In addition, the female user groups constructed pie charts to illustrate the changing daily division of time amongst women in response to interventions such as the provision of basic services.

Ranking can be used to determine the relative importance attached to various species, activities, environmental attributes, and stakeholders (see for example Richards et al., 1999; Department for International Development, 2000). The actual rank is not as important as the comments and the debates that are generated by the exercise (Sithole, 2002). Ranking was used an accompaniment to the pie chart exercises in the initial joint workshop Qongqota to discuss the changing importance of different land uses relative to one another, and in the female user groups in both villages to discuss changes in the daily division of time.

Trendlines can be used to discuss issues varying from ecological histories, changes in land use, customs and practices, population, fuels used, and migration (Chambers, 1992). In this case, trendlines were constructed to demonstrate changes in the number of fields cultivated, changes in the level of co-operation between farmers, and changes in the relationship between community leaders and organisations and the forestry department.

Matrices are useful tools that can be used to summarise a great deal of information regarding a range of issues, from species preferences to seasonal variability in harvesting levels. (Nori et al., 1999). In this case, matrices were developed to demonstrate the innovations that had occurred in agriculture over the years, including who had introduced these innovations, and to illustrate what livestock were kept in the villages, including the range of reasons for keeping each type of livestock.

Timelines are chronologies of events, and represent the major remembered events in a community with approximate dates (Chambers, 1992). This was a continuous exercise throughout the workshops, when issues or events were raised, they are added to the timeline. At the end of a set of workshops, the time line was used to identify and discuss drivers of change.

Group discussions were used to follow up on issues raised during other exercises (Chambers, 1992; Sithole, 2002). Group discussions were combined with the timeline and matrix exercises. On the final day of a set of workshops for all user groups in both villages, the timeline that had been developing over the course of the week was returned to. Participants were asked to consider the timeline, and then to discuss what they felt was causing change in the village. The idea of drivers and of indicators was returned to.

Community-run household surveys – when conducted on a random basis, surveys are a well-known technique that enables researchers to make inferences regarding the population in question (Christiaensen et al., 2001). In this case, surveys were used to test the information that came out of the PLA workshops, and to further test the validity of the indicators identified previously. Local school pupils were recruited for this purpose, for a detailed description of this process see Appendix 1. Where key or important statements were made, these were tested through household surveys. A total of 70 households were sampled using random sample techniques (see Chapter 1), 36 in Machibi and 34 in Qongqota . Key questions relevant to this chapter included (see Appendix 8 to view the full set of data sheets):

- How many households have home gardens?
- What is being cultivated?
- How many households had fuelwood piles or *amagoqo*?
- What is the average number of species in these piles?
- Has there been a change in the size of the woodpile over the past twenty or more years? Why?

Table 3.1: Summary of the key Questions and the Methods used to answer these (For a detailed description of the methods, see Chapter 1 and Appendix 1)

Key questions	Combination of methods
a) How has land use changed over the past fifty or more years?	Free hand mapping (time series) Ranking GIS and participatory mapping Pie charts Trendlines Historical records, maps and archives Household surveys Key informant interviews
b) What are the immediate causes of land use change?	Trendlines Government agricultural records Group discussions Matrices Pie charts ranking Household surveys Key informant interviews
c) What are the ultimate causes of land use change?	Pie charts Trend lines Timelines Group discussions Key informant interviews Historical records and archives Key in formant interviews
d) Can this understanding be used as a predictive tool in understanding natural resource management in these villages?	Group discussions Case study comparisons

While PLA and household survey techniques were useful in identifying *how* land use has changed over the years, or the indicators of change, these techniques proved less useful in identifying *why* these changes had occurred, or the drivers/underlying/ultimate causes of change. In order to move from questions of 'how' to questions of 'why', a wide range of historical records and key informant interviews were employed. When key dates or key individuals were identified during workshop or interview settings, these were followed up through snow-ball sampling (Olsson, 2003) to identify key macro level economic, political and biophysical processes taking place during those times, and key individuals, particularly in government, provided the linkages for understanding policy-local interactions (see Table 3.2 for a detailed list).

Table 3.2: Key informant interviews and key questions

Information	**Key informants**
Past and present land use maps	Mr Lyndon Hall, Department of Agriculture, Stutterheim; Promrose and Pat, Department of Agriculture, Bisho Village headmen Current extension officers
Basic service provision	Mr Derek Mitchell, Department of Water Affairs and Forestry
Agricultural census data	Ms Matho, Department of Agriculture Bisho, Mr Nico Meyer, Development Bank SA, Pretoria
Municipal demarcations	Ms Mama, Local Government, Bisho
Economic changes at the village level: purchasing power, and changing preferences	Local shop owners, anonymous.

Historical records containing or referring to census data, local land use descriptions, national and regional agricultural conditions, former Ciskei agricultural data, and governmental policy information were employed in a snow-ball fashion to either validate, dispute, or extend the information gathered during PLA workshops. These records were obtained from the Cory Library in Grahamstown, Statistics South Africa in Bisho, the Department of Agriculture in Bisho, Department of Local Government in Bisho, the Department of Agriculture in King Williamstown, the Mt Coke Hospital, and from the former Headmen and Chairmen of the villages involved.

3.3 Results

The presentation of results in this section is arranged to ensure clarity for the reader. Although intuitively one expects to find the evidence of change (ie spatial land use change data), and thereafter a discussion of the driving forces behind that change, this section presents the findings in a different way. The section begins by sketching the broader context of change by identifying the ultimate causes of change, or the exogenous drivers, affecting land use practices at Mt Coke. Thereafter, the immediate causes of change, or the endogenous drivers, are presented. The final section presents evidence to demonstrate the ways in which these various drivers manifest 'on the ground'.

3.3.1 The ultimate causes of land use change (exogenous drivers)

The ultimate causes of land use change are related to direct and indirect state intervention into rural agriculture in the former Ciskei over many decades, as well as to various economic and climatic changes taking place at the same time at the local, provincial and national level. While this analysis could go back as far the eighteenth century (see Section 2.2, Chapter 2), the results presented in this chapter are based on the living memory of local participants, and therefore the analysis is limited to land use change over the past fifty years.

a) Direct state intervention

Betterment Planning, described in Section 2.2.1 (Chapter 2), and the Ciskei Co-operatives programme, described below, provide two examples of direct intervention by the state into rural land use practices in the former Ciskei homeland. Although Betterment Planning had been underway in various guises since the Native Trust and Land Act (No. 18 of 1936, see Table 2.1, Chapter 2), it arrived at Mt Coke in the early 1960's. Specifically, the associated resettlement of scattered homesteads into central 'locations' under Betterment Planning occurred in Qongqota in 1961, and in Machibi in 1964. This intervention is regarded locally as the most significant direct manipulation by the state of local land use practices.

During this period, according to local respondents, agricultural extension officers became increasingly active in the villages and encouraged people to adopt scientific farming practices, preaching the inefficiencies of traditional methods (see also Manona, 1998). Advice was offered on new agricultural techniques, and access to fertilisers, chemical pesticides and GMO's was provided. Markets for produce were opened up in the surrounding cities, and the state provided tractors for ploughing, and even transport for the agricultural produce to the local markets. Grazing areas and arable land were demarcated by the Department of Agriculture in Zwelitsha, the administrative centre approximately eight kilometres from Mt Coke on the King Williams Town road (refer to Figure 2.1, Chapter 2).

As part of this process, the Department of Agriculture imposed fines on farmers who broke contours, and limits were imposed on the number and type of livestock that could be kept. Cattle found outside allocated grazing areas, or small stock found outside of homesteads, were impounded and fines imposed. Responsibility for policing these restrictions was devolved to local headmen and rangers (refer to Section 2.2.1, Chapter 2). These people came to be seen locally as pawns of the white South African government, which lead to a loss of legitimacy for traditional leaders

who accepted Betterment schemes in their villages in the early 1960's (see Table 3.3), and a concomitant decline in traditional forms of agriculture and belief systems.

Table 3.3: The results of a trend-line exercise in Qongqota where participants were asked to indicate changes in the relationship with the traditional authority system by identifying key dates when the relationship changed, and placing stones next to each date to indicate the state of the relationship. Many stones indicate a good relationship, while fewer stones indicate a bad relationship. Explanations are provided for each.

Years	Number of stones	Explanation
1950	20	"The headman helped to create jobs for the villagers. For example, people were employed in a project aimed at removing prickly pear and other invasive species."
1965	11	"The headman began to demand larger gifts from the villages, in addition to their salaries from the government, they were working for the government instead of developing the village."
1976	Not included but also an important date	"The assassination of Steve Biko [a prominent anti-Apartheid activist], the political climate became very volatile. The youth in the village were protesting."
1990	9	"Roads became bad, fences were stolen from the grazing areas. The headman stopped looking after the people, and only cared about himself. The last straw was when he demanded that the community pay lobola [bride wealth] for his wife."
2003	----	"Today there is no more traditional leadership, Sanco has taken over, but has changed nothing."

Table 3.3 illustrates the connection between the broader scale political changes occurring in South Africa between 1950 and today described in Chapter 2, and local realities at Mt Coke. In particular, it points toward the loss of legitimacy of traditional leaders, and the lack of any effective structures for natural resource management after the coup in 1990 (Section 2.2, Chapter 2). For example, people refer to the stealing of fences from grazing land, and the lack of authority held by the South African Civic organisation (Sanco) since that time.

The Ciskeian Co-operative farmers programme was another direct manipulation of rural land use by the state, this time by the 'independent' Ciskeian government, under the then president-for-life Lennox Sebe, in the 1980's. By 1982 the Ciskei had gained the status of a self-governing homeland. By this time however, the commercial agricultural sector was deemed to be unviable, and the subsistence sector had all but collapsed (Ainslie, 1998). In response, the Ciskei Farmers Co-operative was registered on the 21 July 1987, and commenced operation on 1 April 1988 (DBSA, 1988). Although the Ciskei government began to encourage local farming and the creation of a viable Ciskeian agricultural sector in the mid 1970's, it was only in the 1980's that support and equipment was provided. Two of the key objectives of this initiative included: The application of scientific and 'proper' management principles and objectives to rural agriculture, and to assist in the marketing of and/or secondary manufacturing of members' products (DBSA, 1988).

The co-operative programme came partly in response to the findings of the Swart Commission in the early 1980's. The commission was intended to investigate economic development options in the former Ciskei (Black Farmer, 1984), and concluded that an inefficient extension service was responsible for the slow adoption of modern farming methods. In response, the agricultural extension service was stepped up once again and small co-operative vegetable production projects were initiated. The co-operative projects were intended "to enable every rural family to have a fresh vegetable meal as well as the development of rural infrastructure of resettled people" (DBSA, 1988: 1). In both Machibi and Qongqota, infrastructure in the form of an irrigation pump, pesticides and seeds were also provided by the state for these projects. This direct intervention into rural land use should be regarded

therefore as one of the ultimate causes of the strong emphasis on arable field cultivation during the 1980's, as demonstrated by Tables 3.6, 3.7, and 3.11 discussed below.

b) Indirect political intervention

Political changes at broader spatial scales, such as the military coup in 1990 (Section 2.2, Chapter 2), and basic service provision (Section 2.3.3, Chapter 2) in the past decade, have had indirect and often unintended impacts on local land use practices at Mt Coke.

The bloodless coup in 1990 is considered by local people to have had one of the most important indirect impacts on local land uses at Mt Coke. The period between mid 1980 and 1990 witnessed growing political agitation for a change in government in the former Ciskei, and in 1990 the coup spelled the end of government aid for farming initiatives (Manona, 1992). This collapse of government support for agricultural initiatives after 1990 resulted in a decline in the policing of transgressions of former rules regarding land use boundaries, access to common pool resources, and livestock numbers. These boundaries therefore became increasingly flexible, the impact that this has had on land use boundaries and characteristics is discussed in Section 3.3.3. Residents in Machibi claim historical and ancestral land rights over the areas surrounding their village from where they were resettled during Betterment Planning. Therefore, once state control was weakened, and people began again to invest in livestock, the official boundaries were ignored and people extended their territory to include this land.

Basic service provision is another intervention that has had indirect consequences for rural land use at Mt Coke since 1994. Prior to 1994, no national institution existed that was responsible for ensuring equitable and sustainable access to water supply or sanitation in South Africa. After 1994 however, the Reconstruction and Development Plan (RDP) identified the severelack of access to adequate water and sanitation as a priority for government intervention (http://www.polity.org.za). The enactment of the South African Constitution in 1996, the election of a democratic local government, along with two key policy documents (White paper on Water Supply and Sanitation in

November, 1994, and the Framework for Water Services, 1997) made it possible to provide a constitutional and legal framework within which these services could be provided and regulated (Water Services Act 108 of 1997).

The Water Services Act (108 of 1997) states that everyone has the right to basic water and basic sanitation, and lays out the conditions under which these services are to be provided. In rural areas, where communal street taps are to be installed, the standard is based on the RDP definition of basic water supply. This definition implies access to twenty five litres of potable water per person per day at a communal street tap which is within 200m of the dwelling. These taps are to have a 98 % reliability and a 10 l/min flow rate (DWAF, 2000b). As an illustration of the force behind this drive for equitable access to services, piped water was supplied to over 3.5 million dwellings between 1994 and 1999 (Thomas et al., 2002).

A similar drive has been underway since the early 1990's with regard to energy supply. The national Census of 1996 indicated a great disparity in access to energy for cooking according to race. For example, while 98 % of whites had access to electricity for cooking, only 42 % of Africans used electricity as their main fuel for cooking. In response, the national electricity utility company stepped up its service delivery, and provided as many as 450 000 dwellings with electricity per year between 1996 and 2000 (Thomas et al., 2002).

In sum, the political ideologies, aspirations and trends of national and provincial level government have had serous implications, both directly and indirectly, for the types of interventions considered important in rural agriculture in the former Ciskei. These interventions are summarised in Table 3.4. However, these political 'drivers' did not take place in the absence of other economic and climatic shifts occurring at the same time, these are discussed in the next section.

Table 3.4: Summary of direct and indirect political intervention, and consequences for land use and demarcation at Mt Coke

Intervention	Land use preferences	Land use boundaries
1960 – 1990 Betterment Planning, Tribal Authorities	Arable fields very important, grazing land declines in importance	Set by the state, inflexible
1985 – 1990 Ciskeian Farmers Co-operatives	Arable fields became source of income, importance increased	Set by the state and local people, inflexible
1990 - 2000 Political crises, incorporation into New South Africa	Arable field cultivation collapses, people invest in livestock as risk avoiding mechanism	Flexible, pastoralism favoured over cultivation (low risk)
2000 – 2003 Participation in forest management, farmers co-operatives re-established, reticulated water supply	Arable cultivation increasing, home gardens more important	Flexible

c) Climate change

The increasing unpredictability of rainfall was identified repeatedly during group discussions as an important factor that makes arable field cultivation an inherently risky activity. Participants claim that rain has become far more difficult to predict in recent years. National rainfall data indicates that rainfall throughout South Africa declined steadily between 1980 and the 1990's, while temperatures increased steadily at the same time (Hoffman and Ashwell, 2001). For example, while summer

temperature increases were measured at 0.8°C to 2.7°C between 1940 and 1989, in some areas midsummer rainfall declined in the period 1961 – 1990 by between 5% and 10% when compared to the period 1930 – 1960 (Hoffman and Ashwell, 2001).

In addition, a dry spell experienced between 1991 and 1995 is considered the driest sequence of years during the twentieth century in South Africa. Village residents identified this period as a time of extreme hardship; this is discussed in the next chapter. One of the explanations given for the decline in rainfall is the El Niño/Southern Oscillation phenomenon which changes sea surface temperatures in the Pacific, Indian and South Atlantic Oceans, causing drier than average conditions on the subcontinent. La Niña events have the opposite effect, resulting in wetter than average conditions. Over the past two decades, however, while three El Niño events have been experienced, only two La Nina events have occurred (Hoffman and Ashwell, 2001).

Climate change was, however, a far more important factor for residents at Mt Coke in the past when arable field cultivation was a key livelihood pursuit. Local shop owners noticed that men and women left the villages to find work in the cities during the droughts of the early 1980's. Today men work mostly in the surrounding towns, and women tend to home gardens that are easily manageable and can be irrigated using the municipal water supply (see Section 4.3.3, Chapter 4).

d) Economic change

Between the 1960's and early 1990's the South African economy experienced relatively low growth rates, which, between 1989 and 1993, culminated in the worst recession since the 1930's (Rwelamira and Kleynhans, 1996). During the 1980's national economic growth averaged 1.2 %, becoming negative between 1988 and 1993. Growth improved somewhat to 3 % between 1993 and 1996, and has continued until present, with a 3.3 % growth rate in 2003 (South African Government, 2004).

"The Black Farmer" (1985) reported that farmers were in the position where they "had to make the harrowing decision to either hang on to farming or abandon it all

together". Political factors associated with apartheid, poor economic policies, unusually low incomes for the poorest 80 % of the population, intensive drought, high inflation rates, high interest rates, and expensive fuel were among the factors blamed for the situation (Black Farmer, 1985; Rwelamira and Kleynhans, 1996).

Rural-urban migration had been common place at Mt Coke since 1948; men from both villages migrated for work in the mines near Johannesburg, while women often worked as domestic help in the surrounding urban centres of King Williams Town and East London. By the time that state extension services failed in the 1990's, migration was no longer as viable an option as it had been previously (Table 3.5), due in large to the general economic downturn (Rwelamira and Kleynhans, 1996). Previously, according to local respondents, income from migratory work had allowed community members to purchase pesticides and fertilisers, and to hire tractors for the high input agriculture pushed by the state at the time (see Table 4.9, Chapter 4). In the absence of this option, arable field cultivation became increasingly unattractive and a high risk activity (see Section 4.3.3a, Chapter 4 for a discussion of this).

Table 3.5: Migration numbers from the Ciskei (Statistics South Africa, 1993)

Year	Migration numbers
1970	41 523
1980	29 365
1985	17 284
1992	7 530

3.3.2 The immediate causes of land use change (endogenous drivers)

The immediate causes of land use change are related to local level management practices, all of which are nested within the broader scale changes described in the previous section. Key changes in management practices have included: a) changes in the level of cooperation between farmers; b) a shift toward home gardening rather than arable field cultivation, and c) changes in resource use patterns.

Local residents in both Machibi and Qongqota argued that the extent of arable field cultivation was closely related to ability of community members, and particularly farmers, to co-operate with one another. Those who do not own cattle for animal traction for example, or cannot afford tractors one their own, are unable to cultivate fields without assistance from others (Tables 3.6 and 3.7)

Table 3.6: Results of a trend-line exercise in Qongqota where participants were asked to indicate changes in the level of co-operation between farmers by identifying key dates when changes occurred. Stones were placed next to each date to indicate the level of cooperation. Many stones indicate a good relationship, while fewer stones indicate a bad relationship. Explanations are provided for each.

Year	Number of stones	Explanation
1985	12	During this time there was a high level of co-operation. People shared everything, for example the children would guard the livestock. Government supplied tractors, although they had to pay for the use of the tractors, it still made farming easier, and families co-operated together to hire the tractors.
1990	3	This is the year when Gqozo took power [Coup de tat]. At this time people stopped working together, and each family only looked after themselves. There was a lot of corruption, and very little co-operation. Only people in the same family worked together.
1995	3	People were still working as individuals at this time. Some stopped cultivating because they could not plough if they didn't have cattle. In the past they would have borrowed somebody else's cattle, but at this time everybody was suspicious and nobody was working together.
2003	6	Co-operation is improving now. There is a farmers co-operative

	who are working together to improve farming. People are holding meetings again to discuss their problems. The extension officers have returned.

Table 3.7: Results of a trend-line exercise in Machibi where participants were asked to indicate changes in the level of co-operation between farmers by identifying key dates when changes occurred. Stones were placed next to each date to indicate the level of cooperation. Many stones indicate a good relationship, while fewer stones indicate a bad relationship. Explanations are provided for each.

Year	Number of stones	Explanation
1963 - 83	11	Management and co-operation was strong. Government sent people to help farmers market their produce, cultivate their land "properly" and to erect fences around arable fields and grazing camps. Community members worked together to improve farming in the village through the farming co-operatives in Barrackson and Thafeni.
1991	4	This was a tumultuous time in the history of the village, and a period when co-operation was at its lowest. In 1990 the headman system collapsed and people began to steal fences. The rangers who were employed by the government disappeared, and crime in general increased. In 1991 there was a lot of political activity as people canvassed for the next government. The loss of fences lead to a process of field abandonment which has continued until the present.
2001	5	Co-operation began to improve in 2000 and 2001. The co-operatives regained some of their former organisation. During this year the two co-operatives came together to apply for fences from the DA, and were successful.

Co-operation was high during the mid 1980's due to high levels of state involvement in agricultural pursuits (3.3.1a). Directly following the Ciskei coup in early 1990 co-

operation deteriorated and people actively broke rules governing access to resources. In particular, the break down in cooperation between farmers, at the same time as the state withdrew assistance and extension services, meant that fields were abandoned (Section 3.3.3), the impact of this trend on broader land use characteristics in discussed in Section 3.3.3.

Home gardening has increased dramatically in importance in the past five or so years. Household survey evidence indicates that 94 % (N=71, see Appendix 3 for original frequency table) of households cultivate home gardens, with 33 different species identified (N=28, see Appendix 4 for original frequency table). Table 3.8 provides a summary of the daily activities of women in Qongqota. The lists are ranked, illustrating the changing division of time between 1990 and 2003, in other words, before and after the arrival of reticulated water and electricity. Fuelwood and water collection are no longer considered time consuming activities, in fact, fuelwood collection was left off the 2003 list. Gardening has now become the most important daily activity, mainly because there is more time available since tapped water and electricity has arrived. The household survey data indicating that 94 % of households cultivate home gardens corroborates this.

Table 3.8: Ranked list of daily activities in Qongqota, 1990 and 2003. Data source: participatory pie charts

1990	2003
1) Collecting fuelwood	1) Gardening
2) Collecting water	2) Cooking
3) Cooking	3) Cleaning the house
4) Cleaning the house	4) Washing clothes
5) Gardening	5) Resting
6) Washing clothes	6) Collecting water
7) Resting	

	**People no longer collect fuelwood very often **have extra activities such as working in nearby towns or for the local feeding scheme

Although fuelwood collection is no longer an important daily activity for women, household surveys (N=67, see Appendix 5 for original frequency table) revealed that 81 % of households did in fact have fuelwood piles and *amagoqo* at their homesteads. However, of those who had fuelwood piles, 98 % claimed that these fuelwood piles would have been larger in the past. The most important reasons for this included; the recent access to electricity and other alternative fuels such as paraffin and a change in cultural values, which has decreased the importance of the *igogo* for women (Figure 4.6, Chapter 4). Group discussions revealed that local entrepreneurs increasingly conduct fuelwood collection. These livelihood strategies are discussed in the next chapter.

3.3.3 Land use change at Mt Coke

The symptoms of the changes described above manifest spatially at the local level. Men and women at Mt Coke classified land use differently, but the sex-differentiated classifications for the two villages were similar. In the male user groups, land uses identified included grazing land (including the woodland areas), arable fields, and residential areas (Figures 3.1 and 3.2). In the female user groups, home gardens were added to this list of land uses. While mapping, however, home gardens fell under 'residential' land use.

These local land use classifications differed from the official classifications used by the local Department of Agriculture, which referred to; intensive irrigation, semi-intensive irrigation, major rainfed cropping, moderate rainfed cropping, limited rainfed cropping, pineapple production, grazing, and forestry (DBSA, 1988). However, in order to ensure that local knowledge about land use areas could be compared with official data, the categories of cropping assigned by official land use

estimates (ie ‘intensive irrigation’, ‘major rainfed cropping’, and so on) were combined under the title ‘arable land’ inline with local interpretations.

A key symptom of land use change has been the increasing flexibility of land use boundaries since the state’s withdrawal of extension and funding for local agricultural pursuits in the early 1990’s (see Section 2.2, Chapter 2; Section 3.3.1b). As a result, current land use boundaries are significantly different to the official boundaries assigned under Betterment Planning in 1958, as illustrated by Figures 3.3 and 3.4. The total land use area utilised by each village has more than doubled since 1958 when the original Betterment boundaries were first assigned (Table 3.9). Residents in Machibi, in particular, claim that they have an ancestral claim to much of the land surrounding the village boundaries. This land now falls within the communal areas of other villages. The claim stems from the resettlement of scattered homesteads under Betterment Planning into the central location referred to as Machibi. As a result, many resident still claim ancestral rights to the land they were moved from. Since state extension officers, headmen and rangers are no longer involved in regulating grazing and access to resources, these lands are again being utilised for these purposes.

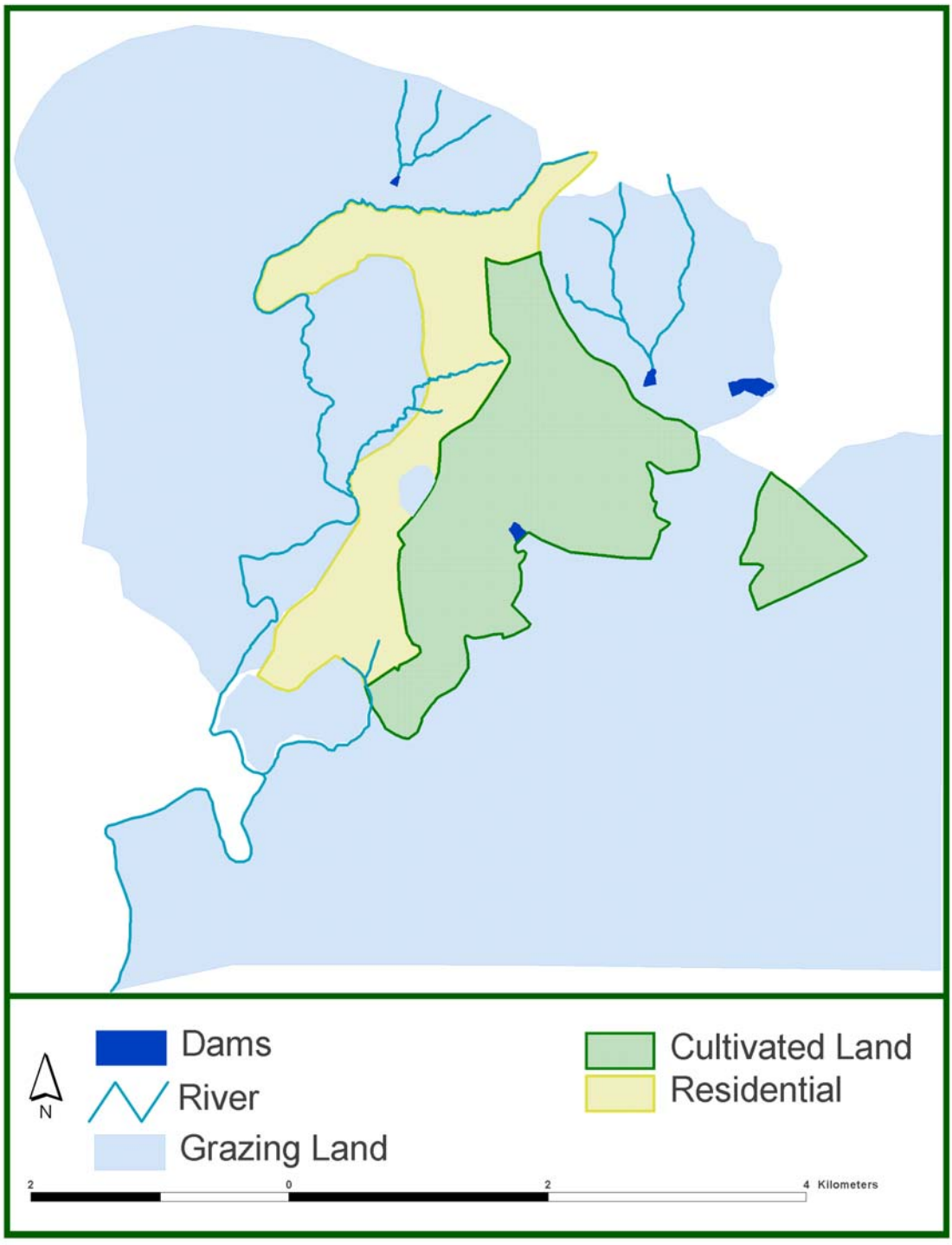


Figure 3.1: Land use map illustrating current land uses in Machibi village, Mt Coke. Data source: participatory mapping

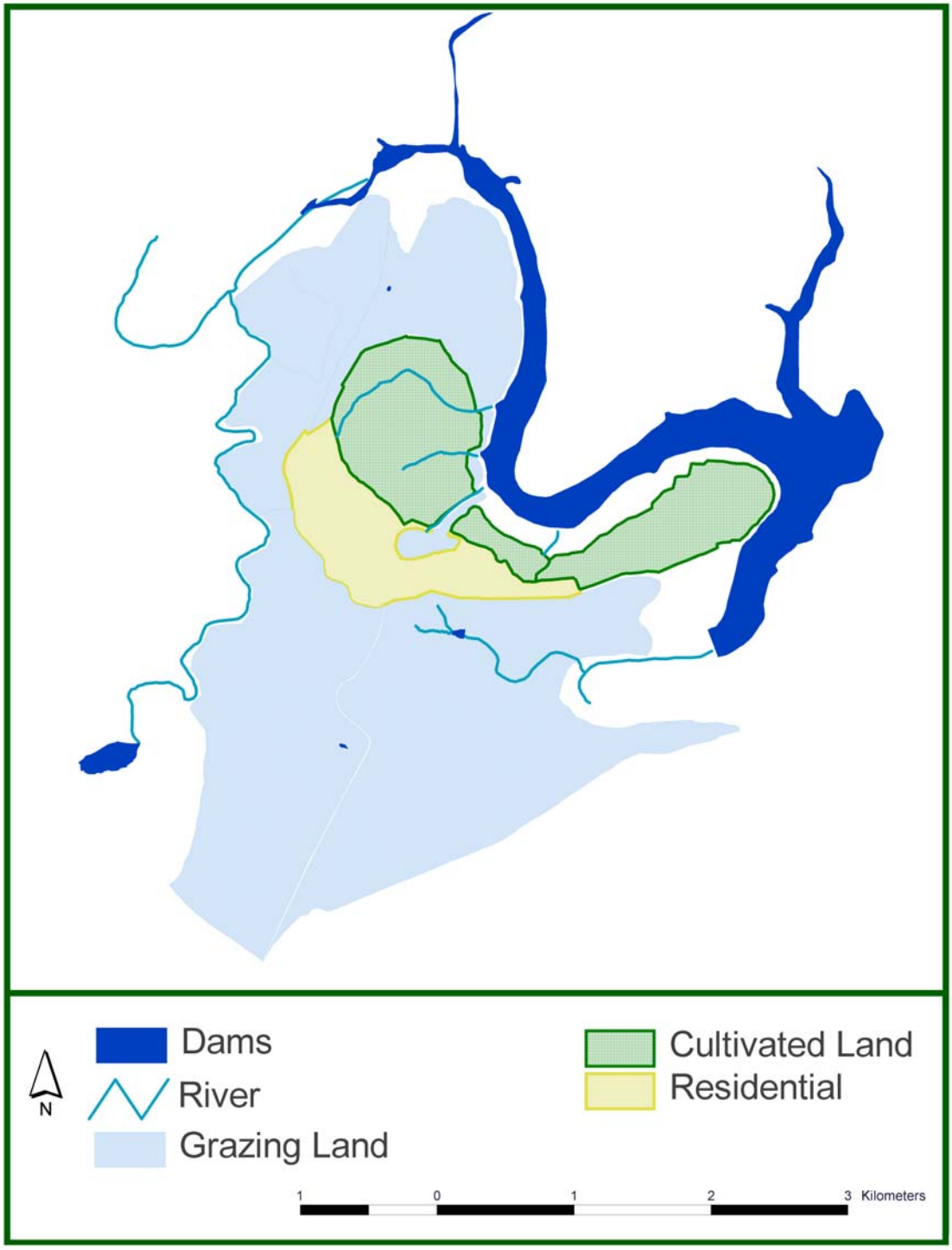


Figure 3.2: Land use map illustrating current land uses around Qongqota village, Mt Coke. Data source: participatory mapping

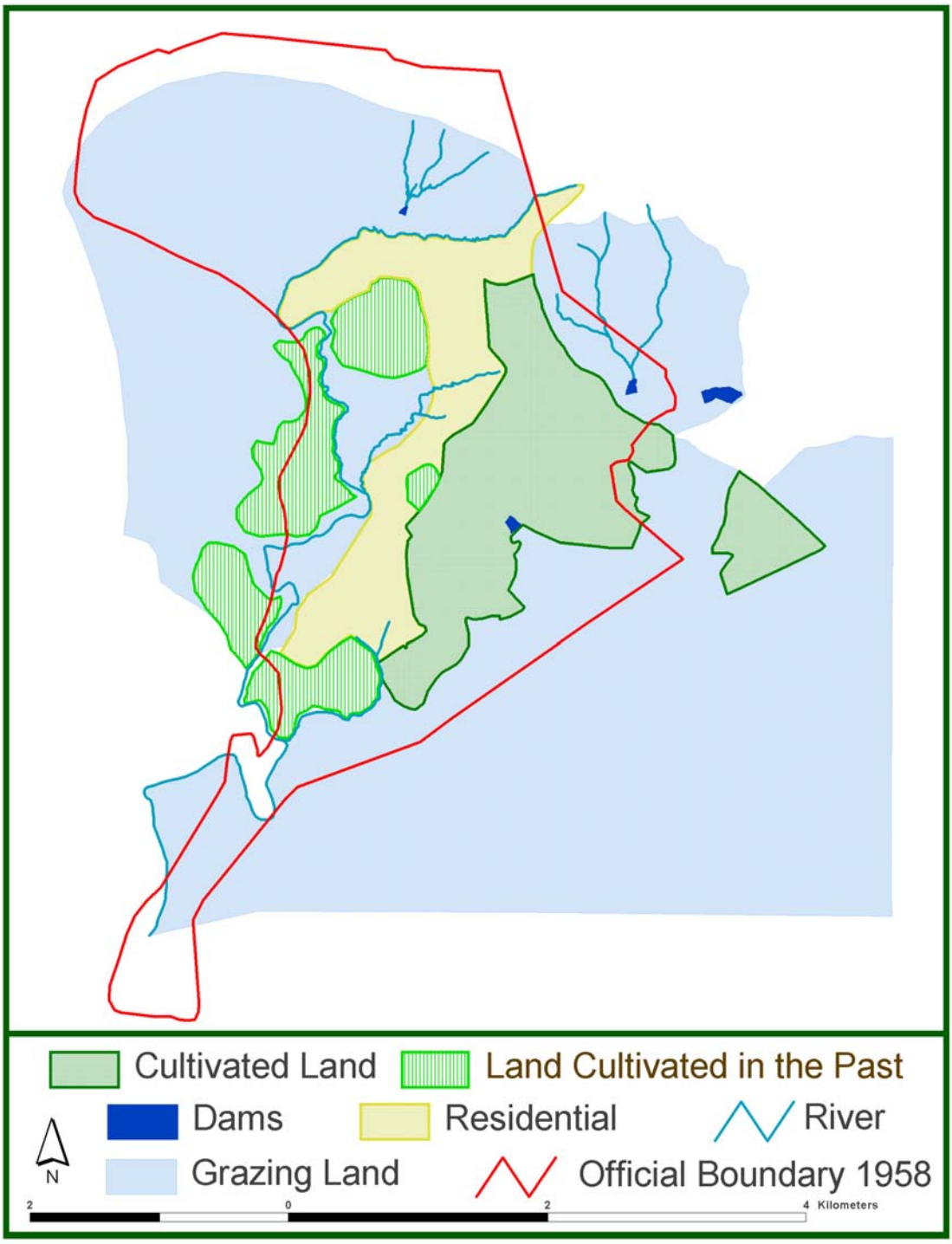


Figure 3.3: Historical land use map of Machibi showing current versus official boundaries from 1958. The Map also illustrates the process of field abandonment underway since 1990 with "land cultivated in the past". Data source: participatory mapping and official Betterment Planning maps obtained from the Department of Agriculture, Bisho.

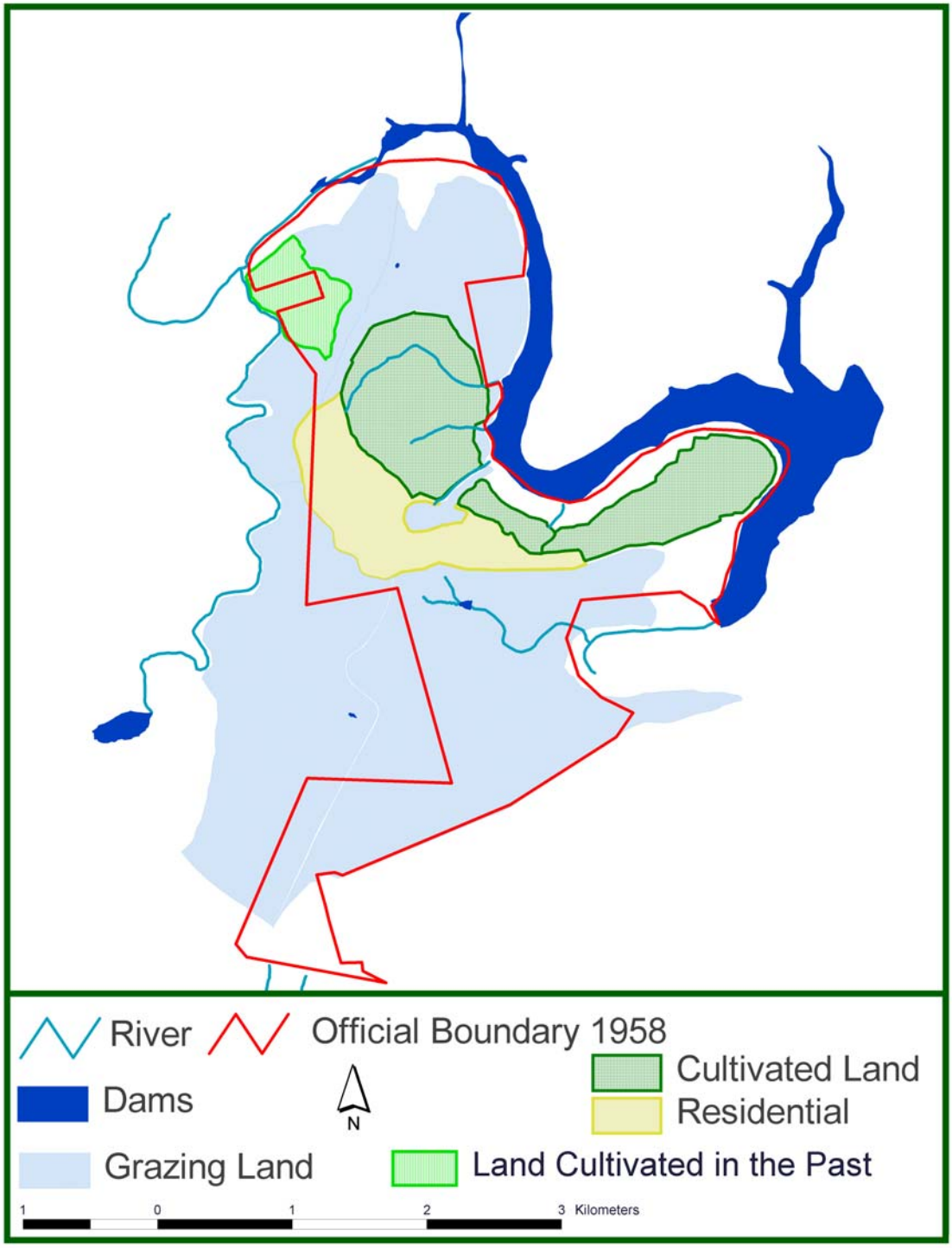


Figure 3.4: Historical land use map of Qongqota showing current versus official boundaries from 1958. The Map also illustrates the process of field abandonment underway since 1990 with "land cultivated in the past". Data source: participatory mapping and official Betterment Planning maps obtained from the Department of Agriculture, Bisho.

Table 3.9: Changes in total land use area in Machibi and Qongqota (data source: GIS participatory maps overlaid with original land use boundaries)

	Total area (ha)	
Village	**1958**	**2003**
Machibi	1977.621	4179.671
Qongqota	947.774	1135.468

Residents' access to land has therefore come, at least in part, in response to the collapse of state-regulated rotational grazing systems and access to resources in 1990.. Table 3.10 summarises the amount of land currently used by the residents of Machibi and Qongqota at Mt Coke according to local land use classifications in both absolute values and percentage of the total. Grazing land is by far the dominant land use in both villages. According to official 1988 estimates (Ciskei Census, 1988), cropping accounted for up to 80 % of the land use in Mt Coke. Today, local estimates place cropping at only 10.3 % of land use in Machibi and 7.6 % in Qongqota (Table 3.10).

Table 3.10: Current land use percentage per land use type in Machibi and Qongqota in 2003 (GIS participatory land use maps)

	Machibi		**Qongqota**	
Type of Land use	**Total available land (ha)**	**Percentage land use**	**Total available land (ha)**	**Percentage land use**
Arable fields	431	10.3	87	7.6
Abandoned fields	260	6.2	37	3.3
Grazing areas	3192	76.4	909	80

Residential	297	7.1	102	9.1

This indicates a drastic decrease in agricultural activity in both villages since Betterment first began in the early 1960's, and is corroborated by local surveys and trendline and mapping exercises. In the first instance, of the 48 % (N=33, see Appendix 2 for the original frequency table) of households in Qongqota that have access to arable fields, only 44 % have cultivated their fields in the last 12 months. Indeed, since the 1960's, 260 ha of arable land have been abandoned in Machibi alone. Table 3.11 specifically shows local perceptions of a sharp decrease in the number of cultivated fields after 1990 in Qongqota, in accordance with the official versus local knowledge figures for total area allocated for arable field cultivation identified above.

Table 3.11: The results of a trend-line exercise in Qongqota where participants were asked to indicate changes in the numbers of fields cultivated by identifying key dates when changes occurred. Stones were placed next to each date to indicate the level of cooperation. Many stones indicate that many people were involved in cultivation, while fewer stones indicate a that few were cultivating their fields. Explanations are provided for each.

Year	No. of stones	Explanation
1985	13	People got a lot of support from the government, and were working together, and therefore there were many fields cultivated at this time. The community vegetable production project was also operating at this time.
1990	3	In this year people were starving. People had no way to plough. The government provided no support and people did not trust each other.
1995	3	There was no change from 1990. People were still supporting one another with food.
2003	6	People are doing better now, there has been a little improvement. People are getting together to make progress in farming. People are still helping each other with food.

Residents claimed that 1990 was a turning point in local agriculture; aid from the state ceased, fields were abandoned, fences were stolen, and people stopped co-operating with one another (refer to Section 3.3.2). This correlation between the levels of cooperation and the numbers of fields cultivated is considered to key to local respondents, as a comparison between Tables 3.6 and 3.11 indicate. Cooperation, on the other hand, was shown in Section 3.3.2 to be closely related to broader scale political changes.

Agricultural production fell into disarray following the coup in 1990 (Tables 3.6, 3.11, and 3.12), and arable fields were abandoned (Table 3.12, and Figures 3.3 and 3.4). According to local respondents, families found it too difficult to cultivate land using the high input methods formerly encouraged by the state, particularly in the absence of extension services, funding, and management institutions (see section 2.2, Chapter 2). The decline in agriculture is explained consistently by local residents through either the lack of access to a tractor, or/and the difficulty of farming at present due to the lack of government support. This reliance on state support, and the collapse of support, is linked directly to the interventions discussed in the previous section between 1960 and 1990 in the first instance, and the collapse in local governance in 1990 in the other.

The importance attached to different land uses has also changed, although not drastically, as illustrated by Figure 3.5 below. While the total land area assigned to arable fields has declined by almost 30 % Qongqota for example (Table 3.12), and grazing land has increased by roughly 40 % since the Betterment demarcations in 1958's, arable fields remain the most important land use in both villages today (Figure 3.5). 1949 was selected as a key date because it represented land uses prior to intervention, and because it stood out in local memory as a year of good harvest following the severe drought of 1945.

Figure 3.5: Results of pie chart exercises where workshop participants were asked to illustrate the changing importance of key land uses in local livelihoods in Qongqota.

Table 3.12: Changes in hectares per land use type in Qongqota location (Department of Agriculture (1958 data); GIS analysis of participatory mapping in 2003)

Land use	Area (ha) according to DA in 1958	Area (ha) according to local knowledge in 2003
Grazing areas	630	909
Arable fields	255	87
Residential	84	102

In both Machibi and Qongqota the farmer's co-operative project initiated in the mid 1980's projects ensured that during the mid to late 1980's arable field cultivation was still widely practiced, as indicated by the trendline results for Qongqota (Table 3.11). In Addition, in light of Tables 3.6 and 3.7, which indicated a relationship between the number of arable fields cultivated and changing levels of co-operation and management functions, the significantly reduced, or even non existent, authority of traditional leadership and even Sanco at present is one of the key endogenous drivers behind the decline in agriculture (Section 3.3.2), and the exogenous political processes that lead to this situation as the ultimate causes (Section 3.3.1).

3.4 Discussion

Land use choices and trends at Mt Coke are dynamic; local choices respond to varying levels of state interference, macro and micro economic change, weather patterns, and local people seek flexibility in boundaries as a coping mechanism during times of uncertainty and crisis. Agricultural intensification occurred as the result of state lead intervention between 1960 and 1990, while arable field abandonment and increasing investment in livestock occurred in the wake of extreme drought, and political and economic unrest between 1990 and 2000, which lead to a weakening of local institutions. At present, in the period between 2000 and 2003, agricultural intensification is again rising as local organisations and institutions are regaining strength, although the emphasis has now shifted toward small scale home garden cultivation rather than high-risk agricultural pursuits. The results suggest therefore that a causal link exists between land use change, changes in management structures, and the functioning of local level institutions (see Figure 1.4). The implications of this finding for understanding ecosystem change are explored in more depth in Chapter 5.

3.4.1 Local land use and drivers at broader scales

The social and ecological impacts of state lead intervention into rural land use planning are well documented around the world (Swynnerton, 1954; Brinkerhoff, 1995; Williams, 1998; Sarch, 2001; Rao and Pant, 2001), and specifically in South Africa with Betterment Planning (Andrew, 1992; Cousins, 1996; Palmer, 1997; Ainslie, 1998; Manona, 1998). The impacts of the withdrawal of state aid following decades of intervention have, however, received less attention. This is surprising since a comprehensive review of rural livelihoods in South Africa found that the current process of field abandonment in the former Transkei and Ciskei homelands is due at least in part to the poor service delivery of government agricultural departments in recent years (Andrew et al., 2003).

a) The local level institutional implications of state withdrawal after prolonged involvement in rural agriculture

The findings presented here suggest that a causal link exists between land use change and the functioning of local level institutions that govern access to resources and maintain boundaries between different types of land uses. Indeed, evidence from Vietnam (Adger, 1999b), Nigeria (Sarch, 2001), and South Africa (Ainslie, 1999) suggests that state-lead intervention has weakened local institutions governing access to natural resources. While in Vietnam institutional weakening came in response to indirect institutional changes or social upheavals, in Nigeria the cause was primarily direct state intervention that removed decision making powers from community based institutional structures, whether formal or informal. In other areas of the former Ciskei, Ainslie (1999) found that state funded environmental rehabilitation projects had lead to apathy toward common pool resource management based on local institutional structures. At Mt Coke, institutional weakening is directly linked to several decades of indirect policies that affected local opinion of traditional leadership, and direct state involvement in land use and resource management, followed by an abrupt withdrawal following the political upheavals in the early 1990's in the former Ciskei.

Many co-operative management strategies for rangeland and woodland ecosystems dissolved in 1990 at Mt Coke. Fences were stolen and rules governing access rights purposively broken. The resultant lack of identifiable boundaries (i.e. fences) and reduced co-operative activities has been identified as a contributing factor to the decline in agricultural pursuits throughout communal areas in South Africa (Andrew et al., 2003). The conservation practices of farmers in Kenya were shown to decrease considerably during times of political uncertainty (Daniels and Bassett, 2002). Similarly, farmers in this study referred time and time again to the early 1990's as a period of institutional disarray directly following the Ciskei coup.

At first glance, Table 3.11, where the number of cultivated fields is shown to have declined, appears to contradict Figure 3.5, where the importance attached to arable field cultivation is shown to have remained the same. Evidence from Zimbabwe sheds some light on this; Campbell et al., (2002) found that, despite a decline in the number of fields actively cultivated, cultivation remained the central livelihood strategy. Similarly, while many farmers at Mt Coke considered arable field cultivation an important land use, they were constrained by the lack of extension from government agricultural agencies. In addition, arable fields are seen as a potential source of income, this potential income is considered more important than, for example, fuelwood from the woodlands because it can be used to pay school fees and other expenses.

b) The impact of political, economic and climatic uncertainty on demand for grazing land

The inherent risk associated with arable field cultivation in the absence of state assistance in the form of extension, subsidies, fences and tractors has, however, not deterred rural people from investing in livestock, thereby placing increased pressure on grazing land, as demonstrated by various case studies within South Africa (Cousins, 1999; Kepe, 2002; Ntsebeza, 2002). National level livestock records corroborate this argument, where, although national livestock numbers have declined, livestock numbers in the former homeland and communal areas have increased (Andrew et al., 2003). The evidence presented here indicates that investment in livestock has increased precisely because of the increasing risk associated with arable field cultivation, in addition to a loosing of control over livestock numbers by the state. In response to increasing uncertainty regarding weather patterns, economic security and reliance on state extension services, investment in livestock is regarded locally as a risk avoiding mechanism that has been part of the cultural institutions of the Xhosa people for many generations (see also Ainslie, 2002a).

The safety net function played by livestock during times of economic crisis and risk has been well documented in South Africa (Duvel and Afful, 1996; Cousins, 1999; Shackleton et al., 2000a). A comprehensive review of twenty case studies from South

Africa found no evidence of a decline in the importance of livestock to rural households, and in fact found an increase in importance during times of economic crisis (Andrew et al., 2003). In Zimbabwe too, cattle were found to be the most important factor in dryland production (Campbell et al., 2002b).

More generally, analysts have argued that rural communities will invest in slow growing species during times of crisis and disturbance as a form of insurance (Berkes and Folke, 1998). It is feasible to argue that the Xhosa people have dealt with regular cycles of climatic stress over many generations, and that this experience has been internalised into the collective memory of the group, and is expressed through cultural and institutional practices that place emphasis on slow growing species such as livestock, rather than cultivated crops that are less drought resistant and therefore a more high-risk investment.

c) Basic service provision, risk, and home garden cultivation

The growing importance attached to home cultivation appears to have come in response to several factors. At face value, women claim that the availability of reticulated water in recent years is a key reason behind the shift; it is now easier for them to irrigate vegetables because irrigation water is more readily available. However, research from communal areas in other areas of Southern Africa indicates that the expansion of home gardens has taken place at the same time as arable field cultivation has declined (Campbell et al., 2002b; see Andrew et al., 2003 for a review). This complicates the argument that the availability of water is a key driver, because basic water provision would also make water available for arable field cultivation. Therefore, this evidence points toward a more salient risk avoiding strategy.

In the former Transkei, Andrew (1992), and Andrew and Fox (2004), found that increased field abandonment in the 1960's and 1970's was accompanied by a dramatic increase in home garden cultivation, which the authors refer to as a 'compensating intensification strategy'. Conversely, evidence form Limpopo and Mpumalanga indicates that the expansion of agricultural pursuits is related to the decline of home gardens (Baber, 1996; Giannecchini, 2001). At Mt Coke, the impacts

of a withdrawal of assistance from the state have been identified as one of the underlying causes of field abandonment because in the absence of state extension services, subsidies and fences, agriculture became a high risk activity. Therefore, home garden cultivation arguably came in response to a) the provision of reticulated water; and b) declining arable field cultivation and the associated food insecurity. It is therefore a risk avoiding strategy whose success is tied to broader level political drivers, such as first a change in government in the former Ciskei in 1990, and a change in national government in 1994, precipitating the South African government's drive to provide basic services to the poorest of the population.

d) Macro economic change and local agriculture

Macro economic change has also played a role in this shift away from arable field cultivation, and its role has been well documented for several third world countries, including Costa Rica (Persson, 1995), Mexico (Mendoza and Dirzo, 1999) and Cameroon (Mertens et al., 2000). The nation wide economic decline in South Africa between the 1980's and mid 1990's had a dramatic effect on the former Ciskeian economy because of the associated decline in employment for migrant labourers (Andrew et al., 2003). This decline had serious impacts on local people's ability to afford the high levels of inputs required to sustain the mode of agriculture pushed by the state through Betterment Planning and the Ciskeian co-operative programme.

As a result, and in conjunction with the climatic trends at the time, arable field cultivation at Mt Coke became an expensive, and therefore inherently risky activity. At the same time respondents reported an increase in the illegal harvesting of natural resources (such as fuelwood) for household use from the natural woodlands (cf. Table 3.8) (see also Andrew et al., 2003), the level of co-operation and trust declined in 1990, leading to transgressions of the rules governing access to woodland resources. In Cameroon too, macroeconomic change was found to play a fundamental role in deforestation rates. Deforestation rates increased significantly during periods of economic crisis as migrants followed logging roads, and cleared areas of forest for plantain and non-plantain food crops (Mertens et al., 2000).

e) Climate change, political crisis and resilience at Mt Coke

People at Mt Coke have reported a declining ability to cope with climatic extremes in the management of rangeland resources in particular, and often blame the lack of fences since the political upheaval in the early 1990's. Evidence from lowland Vietnam suggests that colonialism and political change can significantly undermine societal resilience to climatic extremes such as drought (Adger, 1999b). Land use history in lowland Vietnam has been affected by various stresses and shocks over time, caused by political upheavals and climatic extremes, this is similar to the experiences of people at Mt Coke, who have had to deal with variable rainfall and various political crises. In Vietnam, the evolution of local institutions is considered to have taken place within the context of these biophysical and socio-political changes, with political changes making it increasingly difficult for local people to cope with drought (Adger, 1999b).

It is feasible therefore also to argue the converse; that climatic extremes can make it increasingly difficult to cope with political upheavals. Severe drought during the early 1990's at Mt Coke militated against local people's ability to cope with political upheavals surrounding the coup on the Ciskeian government, and resultant uncertainty and violence at the local level. The concommittant removal of state 'traditional' leadership following the coup (Section 2.2, Chapter2) resulted in weak institutional structures and wide-ranging transgressions of existing rules governing access to natural resources.

Therefore, the findings presented in this chapter suggest that drought, economic change and political upheaval all affect local resilience interactively. Weakened institutions are a direct result, which in the case in question lead to open access resource use at Mt Coke, and therefore a blurring of the boundaries between different land uses.

3.4.3 Scale and predictive understanding

Land use areas in areas such as the former Ciskei, where political, economic and climatic drivers are highly dynamic, should not be misconstrued as spatial entities

with clearly defined spatial boundaries. In fact, because 'land use' denotes human exploitation of environmental attributes (Mertens et al., 2000; Lambin et al., 2001), these areas lie at the interface between social and ecological systems, and are therefore subject to various interactions between social and ecological processes across spatial, temporal and institutional scales (see Chapter 1). In addition, because these interactions take place as part of a complex system, and as part of constitutive hierarchies, conceptual scale and the issue of emergence become important considerations too (Gibson et al., 2000).

Constitutive hierarchies give rise to various emergent features, which make prediction in complex systems inherently difficult, and scale dependent (Section 1.1.1, Chapter 1). For example, at the level of the household, an individual household deciding not to cultivate their arable field based on the collapse of state funded extension services, growing political uncertainty, or/and drought, does not lead to dramatic land use change. At the level of the community however, an entire community simultaneously deciding to pursue home garden cultivation at the expense of arable field cultivation can lead to very significant land use changes, and a concomitant change in ecosystem structure and functioning (see Chapter 5, see also Reid et al, 2000). Scientists and decision makers therefore need to consider processes and causal factors at multiple spatial and temporal scales when they interpret and predict land use choices made by communities.

Indeed, it has been argued that land use areas are 'arenas' in which various social, political, and ecological processes interact at multiple spatial and temporal scales (Daniels and Basset, 2002). That case study suggests that political strife, and in particular ethnic conflicts taking place at various spatial scales, from the national to the local level, affect the utilisation of natural resources at the household level. At Mt Coke, complex interactions between political upheavals, and economic and climatic trends interact to influence local land use practices. Similarly, in other areas of South Africa, complex interactions of market access constraints, resource constraints, and biophysical processes at various scales are blamed for field abandonment processes underway in several areas (Andrew et al., 2003).

In all three cases, the underlying cause of change has been beyond the local context, and embedded in historical and institutional processes (see also Scoones, 1997). This makes a simplistic analysis of land use change that does not consider the broader context of change essentially limited, and incapable of making meaningful predictions about the future. Therefore, natural resource management spaces must be extended beyond the local arena though a consideration of cross scale interactions between political, economic and ecological processes if predictions are to be made regarding the future of natural resource management in any setting.

3.4.4 Conclusions and future challenges for natural resource management at Mt Coke

This chapter has demonstrated, through both original research and case studies from around the world, that land use areas are politicised spaces embedded within a social and historical context (see Figure 1.4). Land use at Mt Coke is embedded within a history of state intervention, subsequent political isolation, and more recent basic service delivery. Agricultural pursuits and natural resource management strategies in the area must therefore acknowledge this history, and attempt to build strategies for resource management based on an understanding of this context.

Until recently, state officials have become frustrated by failed attempts to initiate community based natural resource management (CBNRM) strategies around Southern Africa (Fabricius et al., 2004), a case in point being the recent attempt at PFM at Mt Coke. After three years of failed attempts to establish working committees and operational management rules in the villages, officials and researchers have all but given up.

The blame for this failure has been laid variously at the feet of government extension officers, the nature of academic research, and even the committee members themselves. However, participatory forest management in the area was based on the assumption that forests, woodlands, rangelands, and rivers are spatially discrete entities, that can be mapped using participatory methods, and thereafter managed successfully by local people who take control of management functions. Very little consideration has yet been given to the history of state enforced rules for woodland

management, forced resettlement from the woodland areas during Betterment Planning, or the more recent provision of basic services that has lead to declining significance attached to natural streams and woodlands.

The challenge for natural resource management initiatives in the future will be to acknowledge this history, accept that resource areas are not only 'local', spatially definable units, but also equally politically nuanced, economically interpreted, and socially constructed by the resource users and managers. This chapter has identified the major drivers of change at Mt Coke, both endogenous and exogenous, and their impacts on local management strategies. This chapter has not explored the local adaptive responses to these drivers, or the impacts of these drivers on ecosystem functioning. Chapter 4 explores the local adaptive responses in the social system, and Chapter 5 then explores the impacts of both the drivers identified here, and the local responses, on local level ecosystem change (see Figure 1.4).

Chapter 4. Coping strategies and adaptive responses

4.1 Introduction

Individuals, households, and communities respond to the trends, surprises, and uncertainty described in the previous chapter by constantly renegotiating their relationship with their immediate environment (Scherr, 2000), and by adapting their livelihoods and institutions accordingly (Berkes and Folke, 1998; Adger 1999b; Berkes and Jolly, 2001; Lam, 2001; Snel and Staring, 2001). Institutions are the ultimate determinants in the allocation of resources (Adger, 1999a; Figure 1.4, Chapter 1), and therefore an analysis of institutions in conjunction with livelihoods is important because rural livelihoods in many parts of the world depend on common pool resources (Jodha, 2001), and this is particularly so in Southern Africa (Shackleton et al., 2000b).

Functioning institutions and organisational structures at the local level are crucial ingredients for effective common pool resource management (Shackleton and Campbell, 2001). Although common pool resources do not share any automatic association with common property resources, they do share two important characteristics: the first is that it is costly to exclude outsiders from using the resource, and the second is that the resources consumed by one individual subtract from those available to other users (Ostrom and Hess, 2000). In South Africa, much formalised common pool natural resource management involves co-management between local communities and state departments (for example PFM), due in large to a history of state involvement in the management and ownership of natural resources, particularly forest resources. However, local people also manage common pool resources, often through informal rules that regulate behaviour, such as taboos (Lingard et al., 2003). In South Africa perhaps the most widely cited example of this is that of sacred pools, which are areas of high species richness where it is taboo to harvest resources without permission from the ancestors (Bernarn, 2004).

This chapter explores the coping and adaptive strategies employed by local people at Mt Coke in order to deal with exogenous (refer to Glossary) political, economic, and biophysical drivers (refer to figure 1.4, Chapter 1) over the past fifty years. In order to

conceptualise these strategies, the livelihoods framework is used as a guide throughout. The focus throughout this analysis is on the role of local institutions in determining whether local responses are appropriate for the common pool resources on which they depend. This chapter does not deal with local responses to endogenous drivers (refer to Glossary), such as ecosystem change, as these are dealt with in Chapter 5 (Section 5.5.4).

While analyses of this nature generally ask important questions regarding appropriate and inappropriate local responses to exogenous forces, the focus has often been limited to a single driver, for example climate change (Adger, 1999a), economic change (Mertens et al., 2001), or political change (Korf, 2002; Bruck, 2003). This chapter offers a novel approach through the simultaneous analysis of local livelihood and institutional responses to a combination of these overlapping driving forces. A systems approach is employed, incorporating relevant spatial, temporal and conceptual scales simultaneously, as well as the cross scale interactions between factors at these scales.

Local responses differ according to the type of perturbation (sensu Berkes and Folke, 1998) to which people are exposed, i.e. whether they are long-term trends or short-term disturbances (Gunderson and Holling, 2002). Coping strategies refer here to periodic responses to stress caused by short-term disturbances that threaten livelihood systems (Berkes and Jolly, 2001). Five major coping strategies have been identified for rural people dealing with economic and climate change. These include: land use change (e.g. stocking rates or crop types), changes in resource management, changes in assets (e.g. livestock, savings), changes in labour allocation (e.g. gender division of labour, migration), and changes in market relationships (e.g. reciprocal or local exchanges) (Rubin et al., 2001).

Adaptive strategies, on the other hand, refer to the ways in which local people change their local rules and institutions to secure livelihoods in response to slower changing trends in the long term (Berkes and Jolly, 2001). Examples of these long-term adaptive strategies include: ensuring mobility and flexibility, strengthening social networks, and intercommunity trade (Berkes and Jolly, 2001). The distinction between short term coping strategies and long term adaptive strategies is vital, and is

linked to the issue of identifying the appropriate temporal scale for analysis (Adger, 1999a). An emphasis on short term coping strategies in response to crises alone may lead to the conclusion that local people are reactive rather than proactive. This approach is held partially responsible for the 'dependency' thinking so prominent throughout Africa until recent years (Mortimore and Adams, 2001). An emphasis on adaptive responses on the other hand leads to conclusions emphasising the adaptive and proactive nature of local people. However, in reality people are both proactive and reactive, they respond on a daily basis to threats and in the long term through a process of social learning where experiences are internalised and used to avert or cope with a recurrence of a threat. Therefore, a thorough analysis of local responses to the drivers identified in Chapter 4 requires an emphasis on both coping and adaptive strategies.

Mental models that refer to dependency, 'downward spirals', and crises have long governed interpretations of human-environment interactions in rural areas across Africa (Raynaut, 1977; FAO, 1982; Wiggins, 1995; Ford and Thomas-Slayter, 2001). In South Africa in particular, the notion of a "Legacy of Apartheid" has become so institutionalised that research questions are designed specifically to address this issue (Letsoalo and Rogerson, 1982; Durning, 1990; Koch et al., 1990), and responses are interpreted according to a mental model of areas devastated by deforestation, over population, and dependency on the state for agricultural pursuits and natural resource management (see for example Whyte, 1995). So salient is this discourse in South Africa, that it is often the starting point for rural studies. The time has come to move rural studies in South Africa away from a perception of local people as passive spectators, who respond only to crises, and toward an emphasis on local adaptive capacity (Scherr, 2000), livelihood diversification (Cousins, 1999), and institutions as mediating factors between external processes and local responses (Kepe 1997b; Scoones, 1998; O'Riordan and Jordan, 1999; Kepe, 2002).

These shifts are linked to new theories about change in dryland ecosystems (Behnke and Scoones, 1993; Scoones, 1995). While in the past, analyses were focussed on carrying capacity and crises, analysts are now focussing on the ability to manage 'unstable but resilient' ecosystems (Holling, 1973, 1986), and the role of local people in adapting local technology to respond to perceived changes in ecosystems (Tiffen et

al., 1994). These new emphases have further lead to a more multi-dimensional interpretation (Lambin et al., 2001) of Malthusian notions of ecological limits to growth (Meadows et al., 1972), with the emphasis on context-based interpretations of human-environment interactions (Adger, 1999a), and in particular on the importance of social and ecological history in order to understand this (Fairhead and Leach, 2000).

The local historical context of change provides the framework within which responses take place, and informs the responses considered appropriate by local people. This context is dynamic (Vásquez-León et al., 2003), as illustrated in the previous chapter. Institutions at the local level, which have co-evolved with the environment (Adger, 1999a), mediate both the short-term responses and long-term adaptive strategies (Scherr, 2000; Sarch, 2001), because they represent the social parameters within which people take action (Agrawal, 2001). For example, even during the driest drought in the past, Xhosa herders would not take their cattle to sacred pools without the permission on the ancestors, which was granted only through spiritual leaders. This was not considered an option when searching for water because it was outside of the accepted social norms (sensu. Ostrom, 1990). These 'social parameters' are however dynamic: short-term coping strategies can eventually become internalised and incorporated into local institutions, and eventually become part of long-term adaptive strategies (Berkes and Folke, 1998). For example, in the Eastern Cape today, many of the younger people no longer adhere to taboos governing access to sacred pools (See Section 4.3.3b). Institutions are, thereby, constantly renegotiated through human agency and interactions with their broader environment (O'Riordan and Jordan, 1999).

Spatial and temporal scales become vital considerations in identifying the unit of analysis when dealing with local responses. Temporal scale for example determines the type of responses that will be identified, and therefore the conclusions reached. The selected temporal scale of analysis will influence those responses considered 'coping strategies' and those considered 'adaptive strategies'. For example, if the temporal scale is approximately five years, then coping strategies will be easily identifiable, while longer term adaptive strategies will be more elusive. Spatial scale, on the other hand becomes an important consideration when identifying the

vulnerability context (Section 1.1.2, Chapter 1; refer to Glossary), because the types of driving forces identified will depend heavily on whether the analysis is considering village level, national level, regional level, or even global level changes. 'Vulnerability' itself, can be assessed at least two spatial scales, by being broken down into individual vulnerability (i.e. fine scale) and collective vulnerability (i.e. coarse scale) (Adger 1999b). Individual vulnerability, or personal risk (Korf, 2002), is influenced by an individual's access to resources and the diversity of sources of income (Adger 1999b). Collective vulnerability, on the other hand, is a function of institutional and market forces (Adger 1999b). Collective vulnerability refers therefore to vulnerability to changes outside the local context at the level of the group, such as a village.

This concept of vulnerability can be coupled with the idea of resilience in social ecological systems (Gunderson and Holling, 2002), and to notions of 'entitlements', which are the structure of rights governing an individual's access to resources (Sen, 1981; Leach et al., 1997). In the first instance, 'vulnerability' and 'resilience' are almost synonymous, because both emphasis the embility of people to cope with change and surprise outside of the local sphere of influence. Both emphasise the need to diversify in order to cope with change. In the second instance, vulnerability relates to entitlements because it is seen to be a function of access to resources. This concept is cornerstone to the entitlements approach, and the entitlement frameworks brings in the added emphasis on institutions at various scales in determining access to resources.

Objective and key questions

The objective of this chapter is to determine the ways in which local people respond to the underlying causes of change identified in Chapter 4. In order to address this issue, and to approach local responses in a multidimensional way, the following key questions were asked in this chapter:

1. What have been the major challenges to rural livelihoods at Mt Coke over the past fifty years?
2. How do local people cope with shocks and surprises in the short term?

3. What have been their long-term adaptive strategies?
4. How appropriately do local people respond to trends and surprises?
5. How have local institutions affected the efficacy of adaptive management responses?

4.2 Methods

There is very little guidance exists on how to conduct complex systems research that incorporates and considers various spatial, temporal and conceptual scales to understand people's vulnerability and coping strategies. One of the challenges of this study was therefore to develop new ways to look at and study these issues. Because of the novelty and lack of consensus and structured guidance, a participatory and interactive learning process approach was therefore adopted. This approach was informed by literature from a variety of sources and disciplines, from complex systems thinking, to rural livelihoods and coping strategies (see Chapter 1), but was unavoidably experimental.

A number of barriers had to be overcome in order to achieve this. Firstly, local responses are difficult to observe and therefore to measure directly because of the temporal dimension (Adger, 1999a), and because most of them are inter-related. For example, in many instances, institutional responses "kick in" during times of crisis (Folke and Colding, 2001). Access rights to sacred sites during times of drought are one example, reciprocal exchanges are another (Adger, 1999b). This is difficult to observe during a short-term research project.

A second challenge involved identifying appropriate methods. Although methods were employed from various case studies from around the world, in many instances, these methods were not quite appropriate due to the complexity of the questions being asked. Therefore, many of the techniques had to be adapted, and this was done within the research team in an interactive way, and often within the user group workshops in response to participants' feedback. The dominant strategy employed to deal with the lack of guidance in the literature was a learning process approach. Mistakes were treated as lessons, and lessons were harnessed to improve the research process. In this

sense, mistakes are part of the game, indeed a prerequisite, for a meaningful research process (Korten, 1980).

The methods or techniques themselves should have various characteristics in order to overcome these barriers. In Zimbabwe, it was found that quantitative data only provided a snapshot view into rural livelihoods, and that qualitative data was an essential prerequisite for understanding the dynamics of change within livelihoods (Campbell et al., 2002b). In addition, lessons from Sri Lanka (Korf, 2002), Vietnam (Adger, 1999a) and Botswana (Sporton et al., 1999) indicate that interdisciplinary and time series data collected through a wide variety of qualitative and quantitative methods are necessary to develop an understanding of social vulnerability and response to change. Data must be collected from various levels of the institutional hierarchy (eg Sporton et al., 1999) in order to validate and triangulate the analysis of power relationships (Adger, 1999b). This means collecting qualitative and quantitative information from, for example, both agricultural officials and from households, using, *inter alia*, semi structured interviews with key informants, household surveys, and secondary archive data. A qualitative data set, in particular, has proven especially useful in differentiating between short-term coping and longer-term adaptive strategies (Korf, 2002).

Particularly, in this research, I had to rely on the collective memory of community members in order to deal with the first challenge of not being able to directly observe response to crisis. Elders (50+ years old) dominated workshops, but younger members (25-50) of the community were always present to provide an understanding of contemporary changes in institutions at the same time learn from the knowledge of the elders. Memory is a difficult source of information; it becomes nuanced by time, constantly reinterpreted depending on the question, and is therefore often unreliable. This challenge was managed through several rounds of triangulation. Dividing the groups up into key sets of users, and focussing attention on key issues helped in focussing people's memories.

In Zimbabwe, a combination of PRA and household survey techniques has proven useful in understanding local livelihoods and institutional dynamics (Cousins, 1999), and an understanding of local livelihoods can be greatly improved by the ability of

researchers to return frequently to the same study sites. It has been found, for example, that two nearby sites provide a degree of contrast, while at the same time making the research easier logistically (Campbell et al., 2002b). A similar rationale informed the selection of sites for this research. Machibi was selected because of the history of relevant research in the village, while Qongqota was selected as a contrasting site with apparently greater levels of organisation and stronger institutional structures.

4.2.1 Techniques

This section provides a general rationale and explanation for each of the techniques used in this chapter. For a detailed, step-by-step description of how each technique was conducted, refer to Appendix 1. Conveying concepts from academic discourses such as 'risk', 'cope', and 'vulnerability' was a major challenge during workshops. An interactive learning process was explored, and Interactive role-playing proved the most useful technique to convey these ideas in the initial stages of the research. Role-playing (See Plate 1.11, Chapter 1) involves the portrayal of particular experiences or relationships between people, and allows for the diverse participation of both the actors and the audience who can interject to change the role-play at any time (Sithole, 2002). In this case, role-playing was used to discuss coping mechanisms during times of crisis, for example when droughts occurred in the past, and when the taps stop working at present.

This type of role-play begins with facilitators pretending to be village members, and complaining about certain issues. Workshop participants are then encouraged to interrupt and correct the facilitators, until eventually the story being told is true to their situation. One method of bringing coping strategies out is for facilitators to say; *"when the taps break in my village, people die of thirst"* (pretending to be a member of the given village). This type of extreme statement incites response, often even laughter, and people usually follow by explaining that they would never die of thirst, they simply go to the river. This is a useful way to explain a coping strategy through the use of an example that participants have provided themselves. Various other techniques were used, and are summarised below, while the questions they were

intended to answer are summarised in Table 4.1, and step-by-step description is provided in Appendix 1.

Pie charts are useful diagrammatic representations used to identify the relative importance assigned to different sources of food, different ecosystems or different land uses from which natural resources are extracted (Marindo-Rangana, 1995). Participants were, for example, asked to discuss and decide on key periods in the past when the sources of food in the household were low and high respectively. For each period, participants were asked to list all of the different sources of food during that period, and thereafter pie charts were constructed for each date identified to demonstrate the relative importance of each source relative to the others (see Plate 1.13, Chapter 1 for an illustration).

Ranking can be used to determine the relative importance attached to various species, activities, environmental attributes, and stakeholders (see for example Richards et al., 1999; Department for International Development, 2000). Ranking was used several times; during the matrices for sources of food, the different sources were ranked relative to one another in order of importance. Ranking was also used to determine the most important sources of household income (Appendix 1).

Trend lines can be used to discuss issues varying from ecological histories, changes in land use, customs and practices, population, fuels used, and migration (Chambers, 1992) (see appendix 1). In this case, trendlines were used to illustrate changes in the amount of fuelwood used in both villages. Participants were, for example, asked first to discuss and debate key years when the amount of fuelwood used by households changed. Once all were in agreement, these dates were placed on card on the floor. Participants then distributed stones among the dates to illustrate these changes; many stones indicating more fuelwood use, and visa versa (Plate 1.3, Chapter 1).

Matrices can be used to summarise a great deal of information regarding a range of issues, from species preferences to seasonal variability in harvesting levels. (Nori et al., 1999). In this case, participants, for example, constructed a matrix showing the different sources of food, and were then asked to rank the sources of food for each food group (eg meat, grain products etc). In Qongqota, this exercise was taken a step

further, and participants used symbols to illustrate how the most important sources for each food group had changed over time (Appendix 1).

Management *pyramid* this technique has not been used elsewhere, but evolved during one of the workshops. It was useful for participants to describe the various levels or hierarchies of management authority, and recent changes in this authority. The organisation or institution with the final say in natural resource management was placed at the top of the pyramid, while the people who actually use the resources on a daily basis but have little formal say in their management, were placed at the bottom.

Group discussions are unstructured discussions around a key theme, and have been used extensively to identify local coping strategies, particularly in the food security literature (Maxwell et al., 1999), but also local management arrangements in South Africa (Grundy and Cocks, 2002). These discussions are conducted in a relaxed setting, and are usually used to follow up on sensitive issues raised during other exercises (Chambers, 1992; Sithole, 2002). Group discussions were used throughout to introduce new topics, and to get participants involved in thinking critically about key issues. Group discussions were especially useful in getting people to talk about difficult memories, as many of the situations to which they were forced to adapt are remembered as difficult and painful times.

Key informant interviews are useful with individuals who are knowledgeable about a particular issue (Borrini-Feyerabend, 1997). In this case, local shop owners were interviewed to identify local responses to economic changes. For example, when pensions didn't arrive, the local shop owners are the best placed individuals to identify changes in collective behaviour in terms of the products that people usually turn to or away from.

Table 4.1: Summary of the key Questions and the Methods used to answer them (For a detailed description of the methods, see Chapter 1 and Appendix 1).

Key questions	Combination of methods
a) Challenges to rural livelihoods	See Chapter 3 for the drivers of change
b) What have been the short term responses	Time series pie charts Ranking Matrices Seasonal calendars Key informant interviews Household surveys (water tanks) School projects and surveys
c) What have been the long term strategies	Time series pie charts Role playing Trend lines Group discussions Key informant interviews Household surveys Historical archives
d) The role of local institutions	Pyramid Group discussions Role playing Key informant interviews

Household surveys – when conducted on a random basis, surveys are a well-known technique that enable researchers to make inferences regarding the population in question (Christiaensen et al., 2001). Household surveys were used to test the information that came out of the PLA workshops. Where key or important statements were made, these were tested through household surveys. A total of 70 households were sampled using random sample techniques (see Chapter 3), 36 in Machibi and 34

in Qongqota. The questions relevant to this chapter were (see appendix 8 for the full set of data sheets and accompanying questions):

- Does the household have a fuelwood pile or *amagoqo*?
- Would the fuelwood pile or *amagoqo* have been larger or smaller in the past, and if so, why?
- What are the first and second most common species in the *amagoqo*?
- Does the household have a home garden?
- Does the household have a rain water tank?
- If so, when did the household obtain the tank?

4.3 Results

4.3.1 Challenges to rural livelihoods: the drivers of change

Vulnerability to external trends and surprises appears to increase when driving forces overlap. In Figure 4.1, a red circle highlights periods when drought events overlapped with extreme economic decline. These are also periods identified repeatedly by local respondents as difficult years (see section 3.3.2, Chapter 3), although local respondents could not pin point the cause of the difficulties. Significantly, the early 1990's, most commonly cited by local respondents as a crisis period politically, was also a period of extreme drought and economic decline. These issues are outlined below. Endogenous drivers of change, and local responses to these, are discussed in Chapter 5.

a) Macro economic change in South Africa

Between the 1960's and early 1990's, the South African economy experienced relatively low growth rates, which culminated between 1989 and 1993 in the worst recession since the 1930's (Rwelamira and Kleynhans, 1996). During the 1980's national economic growth averaged only 1.2%, and in 1993 it was positive again at 1 %, for the first time since 1988 (see Figure 4.1). Growth improved somewhat to over 3 % between 1993 and 1996. This situation was reflected in the popular agricultural

literature of time, with "The Black Farmer" (1985) reporting that farmers were in the position where they "had to make the harrowing decision to either hang on to farming or abandon it all together". Figure 4.1 illustrates changes in the Gross National Income per capita, and confirms local claims that the period between 1980 and the early 1990's was a time of extreme economic hardship.

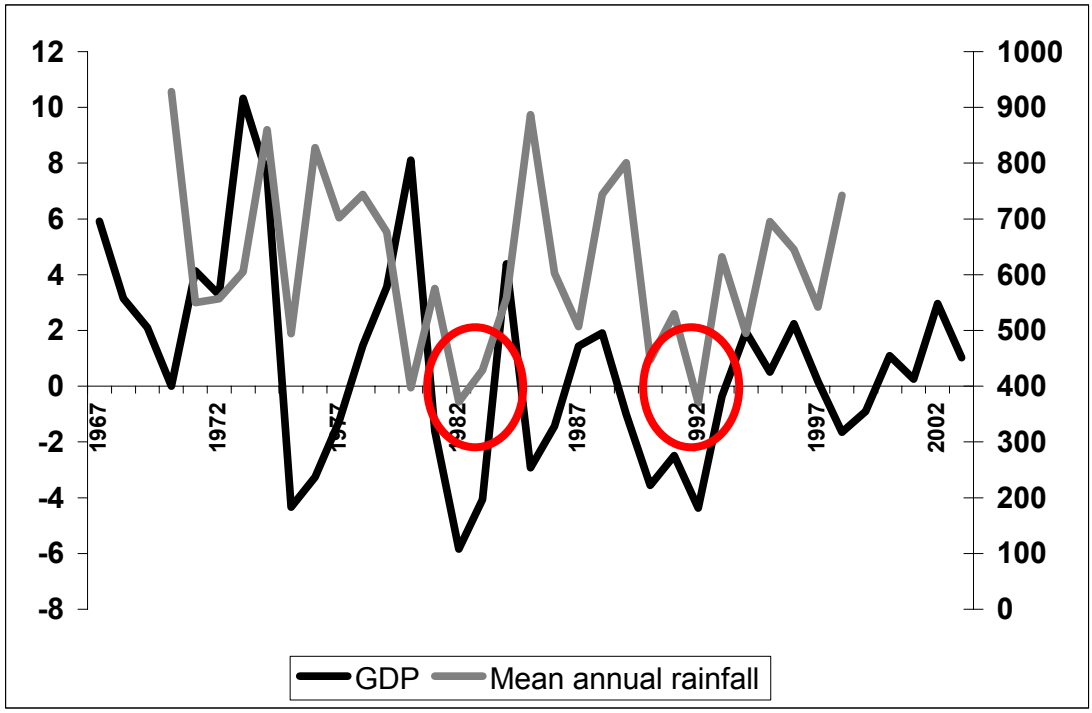


Figure 4.1: Time series graph illustrating fluctuations in rainfall at Mt Coke, and macro-economic indicators (GDP) for South Africa as a whole. Periods of increased vulnerability caused by low rainfall and negative GDP are illustrated with a red circle (Sources: AGIS, 2004; Statistics South Africa, 2001)

b) Climate fluctuations

Average annual rainfall at Mt Coke ranges between 501 – 600 and 401 – 500 mm per annum (Reath, 2001). This is however subject to large inter-annual variations, for example, between 1945 and 2001, the average ranged from as little as 265mm (in 1945), to a maximum of 928 mm (in 1970) (Statistics South Africa, 2002). During the periods reported as drought years by local residents, below average range fall was reported by the local weather station in King Williams Town (See Figure 4.1). As already stated, 1945 was a record low for the area, with an annual average rainfall of

265 mm (Statistics South Africa, 2001). Between 1980-1985, the average rainfall was recorded as 443 mm, with a low of 372 mm in 1983 (Statistics South Africa, 2002). Similarly, between 1990 and 1993, the average rainfall was recorded as 449mm, with a low of 370 mm in 1993 (Statistics South Africa, 2002). This dry spell between 1991 and 1995 is considered nationally to be the driest sequence of years during the twentieth century in South Africa (Hoffman and Ashwell, 2001). In addition to these periodic drought events, more long-term changes with regard to rainfall patterns have also been reported. National midsummer rainfall declined in the period 1961 – 1990 by between 5 % and 10 % when compared to the period 1930 – 1960 (Hoffman and Ashwell, 2001).

c) Political interference and crisis

The level of political interference, weather direct or indirect, in rural agriculture has been discussed at length in the previous chapter. Table 4.2 summarises these politically motivated interventions and events.

Table 4.2: Politically motivated interventions and events in rural land use and livelihoods at Mt Coke

Period	Interventions and events	Detailed description
1960-1990	Betterment planning, tribal authority system	Sections 2.2. and 2.2.1, Chapter 2; Section 3.3.1a, Chapter 3
1985 – 1990	Ciskeian Farmers Co-operatives	Section 3.3.1a, Chapter 3
1990 – 2000	Political crises as a result of the Ciskeian Coup, incorporation into New South Africa	Sections 2.2 and 2.3.3, Chapter 2; Section 3.3.3b, Chapter 3
2000 – 2003	Participation in forest management,	Section 2.3.3, Chapter 2;

	farmers co-operatives re-established, reticulated water supply	Section 3.3.1b, Chapter 3

4.3.2 Short term coping mechanisms

a) Coping with water scarcity

People innovate both technologically and socially in order to cope with variable rainfall and recurrent drought at Mt Coke. Technological innovations include an investment in rainwater tanks. Figure 4.2 presents the results of a household survey (N=32, see Appendix 6 for the original frequency table) intended to test workshop participants' claims that rainwater tanks were an investment that households have made in response to recurrent drought and water insecurity at Mt Coke (see Plate 4.1).

The survey found that in Machibi 100 % of households had rainwater tanks (of various sizes, see Plates 4.2 and 4.3), and the reasons most commonly stated for the investment were water scarcity and the salinity of local streams. Figure 4.2 indicates the years when rainwater tanks were purchased. When compared with Figure 4.1, there is a clear correlation between the most commonly sited dates of purchase and the droughts reported in the early 1980's and early 1990's, with an investment in tanks accruing directly after each event. Subsequent group discussions revealed that households would seldom be able to afford the tanks during the crisis, and would therefore save money during the next good year and use that to purchase the tanks. The logic behind this was that the family would then be prepared the next time there was drought. In other words, people were learning from crisis situations in order to bolster themselves against experiencing another.

Salinity was identified as one of the main water quality concerns in Machibi with regard to natural streams, and indeed in the Amatola basin in general, especially from ground water sources (Shand, 1999). Most of Machibi's natural streams originate from natural springs within the village commonage. The salinity of local streams was tested in order to validate or refute local claims. These tests indicated a mean total

water hardness of 250 (mg/l CaCo3), a figure more than double the recommended level of less than 100 (mg/l CaCo3) by the national Water Quality Guidelines (Water services Act No. 108 of 1997).

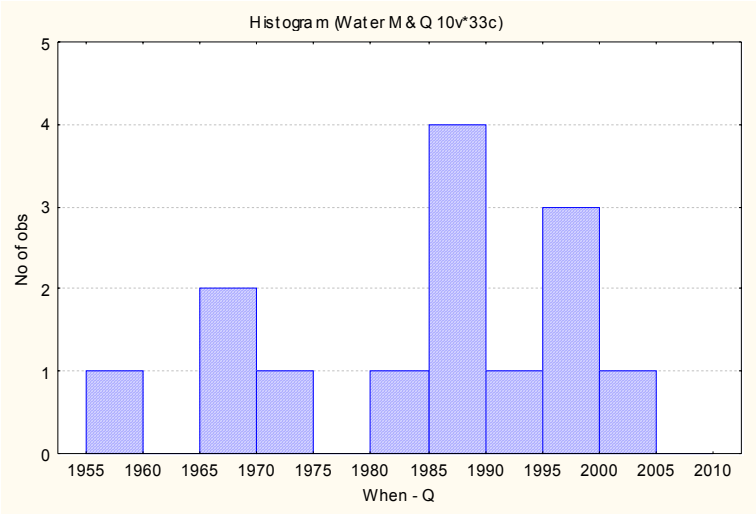


Figure 4.2: Household survey results for Machibi showing dates of purchase of rainwater tanks. The graph indicates a clustering of purchase dates just after extreme drought events in the 1980's and 1990's (refer also to Figure 4.1 for comparison and Appendix 6 for the original frequency table).

Drawing on social networks represents yet another coping strategy during times of crisis such as drought. Figures 4.4 and 4.5 represent pie charts constructed by village residents in Qongqota to demonstrate changes in local coping strategies to ensure enough food in the household during drought years. Figure 4.3 is included to illustrate household sources of food in a normal rainfall year. Figure 4.4 indicates that local shops were by far the major source of food during drought years. Workshop participants argued that this was made possible through remittances sent home by family members working away in the mines. During this period, extended family units came together to ensure that all family members were able to eat, hence the significance attached to "family".

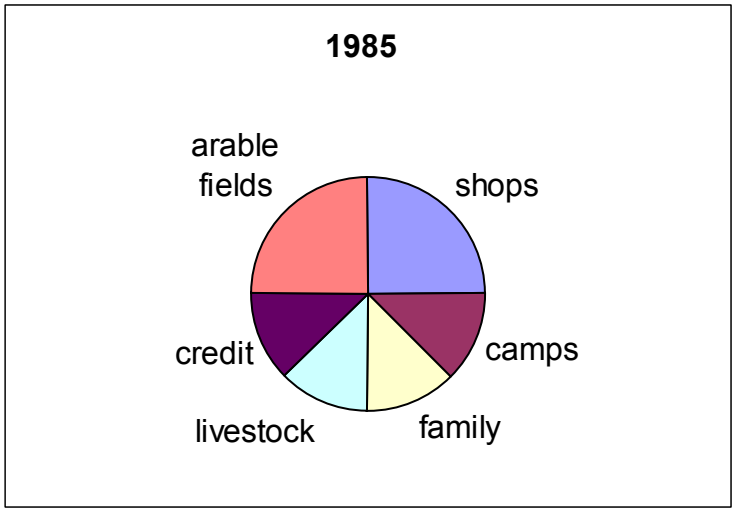


Figure 4.3: Results of a participatory pie chart exercise indicating the relative importance of different sources of food in Qongqota in a normal rainfall year. "Arable fields" refers crops used within the household for food, and to the money received from the sale of crops to buy additional food that cannot be cultivated locally. "Camps" refer to grazing land, but also include the woodland ecosystems within these areas. "Shops" refer to local stores that sell basic household products such as bread, flour, maize and so on. "Family" refers to kinship links that are drawn upon during times of difficulty, here it specifically refers to food exchanges. "Credit" refers to credit offered by local shop owners provided livestock were left with them as assurance that the money would be paid back. "Livestock" refers here to the slaughter of livestock for food.

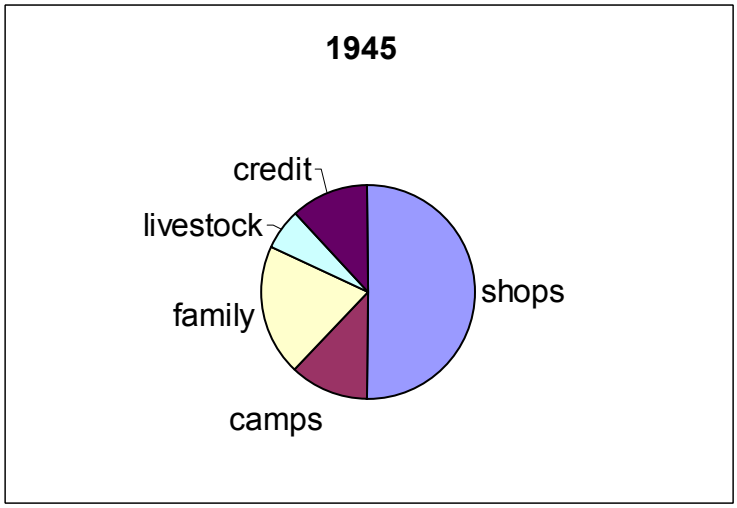


Figure 4.4: Results of a participatory pie chart exercise indicating the relative importance of different sources of food in Qongqota during a major drought year, before the economic depression. "Camps" refer to grazing land, but also include the woodland ecosystems within these areas. "Shops" refer to local stores that sell basic household products such as bread, flour, maize and so on. "Family" refers to kinship links that are drawn upon during times of difficulty, here it specifically refers to food exchanges. "Credit" refers to credit offered by local shop owners provided livestock

were left with them as assurance that the money would be paid back. “Livestock” refers here to the slaughter of livestock for food.

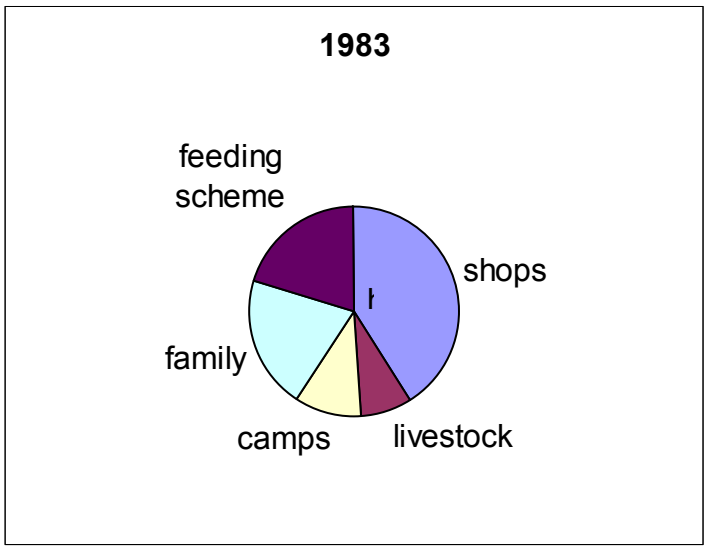


Figure 4.5: Results of a participatory pie chart exercise indicating the relative importance of different sources of food in Qongqota during a drought year, during the economic depression. “Camps” refer to grazing land, but also include the woodland ecosystems within these areas. “Shops” refer to local stores that sell basic household products such as bread, flour, maize and so on. “Family” refers to kinship links that are drawn upon during times of difficulty, here it specifically refers to food exchanges. “Livestock” refers to the slaughter of livestock for food. “Feeding Scheme” refers to a community run project that received funding from the Department of Health to provide lunches to school children.

Reciprocal sharing of food between family members was therefore an important coping strategy. In this regard kinship and reciprocity were very important, however these form part of long term adaptations and are therefore revisited in the next section. Sources of credit also became important during drought years (Figure 4.5), especially for those families who did not have family members sending remittances from either the mines or urban centres. People would take their livestock to the local shop owners and leave them there; this was a form of collateral which assured the shop owner that the person would pay back the credit provided. Shop owners would then approach adjacent white owned farms and pay a nominal fee to graze the cattle on the land. This was financially viable for the shop owners because in many instances people would never pay back the loans, and the cattle would become the property of the shop owner.

b) Coping with political intervention

Fuelwood accessibility: When Betterment planning was initiated at Mt Coke in the early 1960's (see Section 2.2.1, Chapter 2; Section 3.3.1a, Chapter 3), local residents were forced to shift livelihood practices in a number of directions. On the one hand, Betterment resulted in the movement of many people "over the river"; for many this meant moving further away from the woodland patches that they utilised every day for fuelwood and other natural resources. Women were forced therefore to walk much farther distances to collect fuelwood. The *amagoqo* described in Chapter 2, therefore became difficult to maintain. As a result, today 81 % of households (N=67) have fuelwood piles or *amagoqo*, 98 % claim that these piles would have been bigger in the past (Table 4.3, see Appendix 5 for original frequency table).

Table 4.3: Household survey results from Mt Coke indicating the number of households with fuelwood piles, and the percentage of people claiming that these would have been larger in the past

	Observed frequency (N=67)	**Expected frequency**
Households with fuelwood piles outside their homesteads	55.00	33.50
The fuelwood pile is smaller now than in the past	66.00	33.50

A significant difference was found between the observed ratio of people with and without fuelwood piles at their homesteads and the expected equal frequencies using a log-likelihood ratio test (Sokal and Rohlf, 1995) as implemented in PopTools (Hood, 2004; G = 29.68, $G_{critical}$ = 3.8, P-value <0.01). A significant difference was also found using the same test between the observed ratio of people who claimed that their fuelwood piles would have been larger in the past and the expected equal frequencies (G = 191.71, $G_{critical}$ = 3.84, P-value < 0.01).

In addition to the distance to woodland areas referred to during group discussions, the reasons given for this shift during household surveys included a change in culture, which resulted in less emphasis placed on the importance of *amagoqo*, and the presence of paraffin since the 1960's and electricity in recent years (see Figure 4.6). The proportions of the responses were significantly unequal (G = 73.26, $G_{critical}$ = 9.49, P-value <0.01). Group discussions and trendline exercises corroborated these findings, as Tables 4.4 and 4.5 illustrate. Thus, it can be concluded that the major causes of the shift have been cultural change and distance from woodlands.

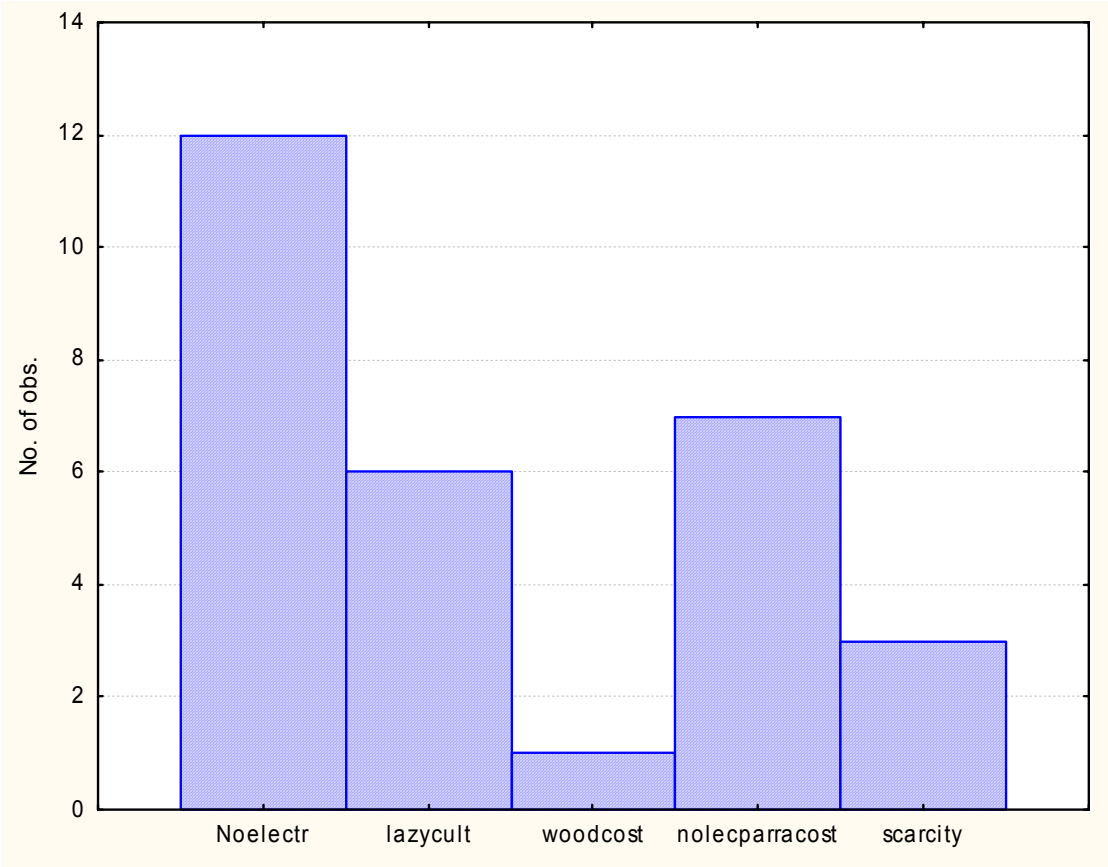


Figure 4.6: Reasons for stating that fuelwood piles are smaller now than in the past (noelectr=no electricity, lazycult=cultural change, nolecparracost=no electricity, and the cost of paraffin, see Appendix 5 for the original frequency table)

Table 4.4: Results of a trendline exercise in Machibi where participants were asked to indicate changes in the quantity of fuelwood used (including *amagoqo*) in Machibi. More stones indicate higher levels of use, while fewer stones indicate a decline in the levels of use

Years	Number of stones	Explanation
Before 1967	9	People were dependent solely on fuelwood. In these days (before 1963) people also lived closer to the woodlands and therefore collection was easier. This was changed after the trust when people were moved "over the river".
1967 – 1998	6	People started to use paraffin in 1967. While the level of use did decrease in this period, it was not an enormous change as people continued to use fuelwood.
1998 – 2003	3	Most people have electricity boxes in their houses now, however fuel wood is still used, especially for rituals, because electricity is expensive.

Table 4.5: Results of a trendline exercise in Machibi where participants were asked to indicate changes in the quantity of fuelwood used (including *amagoqo*) in Qongqota. More stones indicate higher levels of use, while fewer stones indicate a decline in the levels of use

Years	Number of stones	Explanation
1950	15	There was no electricity and people depended on fuelwood for cooking and other household uses. During this period was a lot of unemployment
1965	10	Paraffin became more affordable because this was a period when the mines offered employment to many people
1980	6	People had paraffin stoves. Fuelwood was still being used because this was a difficult time economically.
1996	4	Electricity arrived in the village, but some people could not afford it so still used some fuelwood

2003	2	People now use fuelwood only when there is a traditional ceremony or a funeral. Older people still use it for cooking outside.

Increased input costs: Betterment planning also resulted in a mode of agriculture that necessitated high levels of inputs, such as fertilizers, pesticides, hybrid seeds, and tractors for ploughing. In order to cope with this change, people migrated to urban areas in order to earn money to send back to family members to pay for this high input agriculture (see Table 4.9 later in this section). In this sense, while livelihood options shifted toward agriculture during this period, the emphasis came equally to bare on alternative sources of income. Local respondents explain this shift through the fact that livestock numbers and land holdings were reduced through the Betterment Scheme (see Chapter 3), which required alternative sources of wealth. Migration has been a coping strategy for many decades, and is used to cope with most types of crisis. During the innovation matrix exercise (Table 4.9) both Machibi and Qongqota identified migration as an "innovation" in agriculture because it made it possible to pay for the tractors, fertilisers, pesticides and hybrid seeds considered necessary by the state.

Livestock reduction: A reduction in livestock numbers was a key characteristic of the Betterment system, and people responded by drawing family ties and social networks. Quota's were given to household units by agricultural extension officers, and the excess livestock were to be sold through local auctions in King Williams Town or East London, a practice common throughout the former Ciskei (Manona, 1992). However, as the previous chapter illustrated, livestock perform several important livelihood functions, including a store of wealth and a form of financial security or insurance during times of hardship. Therefore, local residents in both villages drew on local networks to ensure that livestock numbers were maintained in the villages. Not all households owned large numbers of cattle, and therefore those with too many according to the Betterment quotas would give their excess cattle to other households through staged *ibola* ceremonies, where livestock are used a bride wealth, thereby maintaining the pool of livestock available in the village.

Yet another coping strategy came in the form of local markets for agricultural produce. According to the Betterment system, a quarter of the profits from all agricultural produce had to be given back to the state. However, these profits could only be monitored if the residents utilised the state sponsored transport for goods to the local centres. Local residents in Machibi soon responded by opening markets for their produce within the villages themselves, where the state could not monitor sales.

The coup de tat of 1990 lead to various risk taking coping strategies. Rules governing access to the community woodlands were purposefully broken, and many people simply turned a blind eye to transgressions such as cutting live wood, and using axes in the woodlands. Households also turned inward, and co-operation between households broke down during this period (Tables 3.6 and 3.7, Chapter 3).

d) Coping with macro-economic change

Figure 4.1 illustrates two periods of severe economic depression at the same time as severedrought; one in the early 1980's, and another in the early 1990's. This general economic downturn (Rwelamira and Kleynhans, 1996) lead to a reduction in the number of jobs available in the mines, and therefore a reduction in migratory labour from the former Ciskei to Gauteng (Table 4.6, Statistics South Africa, 1993).

Table 4.6: Migration numbers from the Ciskei (Statistics South Africa, 1993)

Year	Migration numbers
1970	41 523
1980	29 365
1985	17 284
1992	7 530

Local residents reported the loss of the option to migrate as a severe constraint on local capacities to cope with the droughts of 1983 and 1993. During the economic recession people were less dependent on shops as a source of food (Figure 4.5) than before the recession (Fig 4.4). This was due in part to fewer family members able to find work in the mines.

4.3.3 Long term adaptive strategies

When taken in isolation, the coping strategies described above appear to represent short-term responses to crisis. However, when considered collectively, and over a longer time period, they form part of larger strategies to diversify outcomes, and maintain flexibility in livelihood options. The key difference between the coping strategies described in the previous section, and the adaptive strategies outlined below, can be found in the impetus for the strategies themselves. Coping strategies come into play in response to crises. Adaptive strategies, on the other hand, manifest in the day to day, and year to year, social and cultural norms of the community. These adaptive strategies are intended to avert risk, rather than respond to it; in this sense, coping strategies can be described as reactive, while adaptive strategies are proactive.

a) Investing in diversity

Diversifying livelihood outcomes is probably the most important way in which people manage risk and uncertainty over the long term. Investing in diversity ranges from household income sources, sources of food, the variety of crops cultivated, to an investment in many different species of livestock.

Machibi provides a useful example of how this investment in diversity manifests itself, with nine different sources of household income identified (Table 4.7). Pensions and disability grants have been identified as the largest contributor to household income, mainly because they represent the most reliable and regular source of income in comparison to other forms of income. Small businesses such as local shops were ranked second most important. Services offered to the community were ranked third, and included the collection of forest products on behalf of others, fence-building, circumcision doctors, and animal doctors. The sale of medicinal plants was ranked fourth ahead of the sale of food crops which was ranked fifth. This was because most people grow food for their own consumption, and only the sell the surplus locally. Salaries were ranked sixth as not many people were earning a monthly income. Remittances from migrant labour were ranked seventh as they were irregular and did not amount to much. The sale of livestock was ranked eighth, this is thought

to be as a result of the apparent absence of marketing outlets such as sales and auction yards. Finally, the sale of meat and skins from wild animals was ranked ninth.

Table 4.7 : Ranked list of the most important sources of income

Ranking	Sources of income
1.	Pensions and disability grants
2.	Household businesses
3.	Services to the community
4.	Sale of medicinal plants
5.	Sale of food crops
6.	Salaries
7.	Remittances
8.	Sale of livestock
9.	Sale of meat and skins from wild animals

The diversity of sources of food corroborates this indication that diversification is a key adaptive strategy. Table 4.8 illustrates that for almost every food group there is more than one source. Significantly, the sources inevitably involve one source that relies on financial capital (shops), and another than relies on natural capital (for example home gardens and fields). This variety of options allows people to switch between different sources as they are forced to shift emphasis between different types of capital in order to cope with the types of crises discussed previously, this is revisited in the discussion.

Table 4.8: Results from a matrix exercise where participants were asked to indicate the various sources of food in the household in Machibi. Ticks indicate that food from the given food group is obtained from the given source. Dashes indicate that food from that food group is not obtained from that source.

Food group	**Food sources**			
	Gardens	Fields	Shops	Livestock
Grain products	✔	✔	✔	--
Meat	--	--	✔	✔
Fats	--	--	✔	✔
Milk and egg products	--	--	✔	✔
Vegetables and fruit	✔	✔	✔	--
Sugar, tea and coffee	--	--	✔	--

In order to achieve and maintain these diverse livelihood options, local residents at Mt Coke have had to actively take advantage of opportunities that present themselves. Innovations in agriculture provide one such example, Table 4.9 summarises three such innovations identified during PLA workshops. Although government introduced many of the innovations identified in the exercise (for example tractors, fences and pesticides), their success required that people actively took advantage of their availability. For example, tractors became available for hire through government extension and subsidies in the 1960's, however, these tractors were only of use if people migrated to the nearest centres in order to earn enough money to pay for them. For this reason, migration was identified as an innovation in agriculture that was locally introduced.

Table 4.9: Results of an innovation matrix exercise summarising key innovations in agriculture in Qongqota

Innovation	When was it introduced?	Who introduced it?	Why was it needed?	How did it affect farming
Tractors	1960-1985	Government	Traditional methods are very slow. It digs deeper, and ploughs much faster	People were able to produce more and therefore sell or exchange the crops in both the village and in King Williams Town
Manure	Always	Ancestors	To keep the soil fertile and to renew it	The crops were bigger and the soils improved. Able to cultivate every year.
Working in the mines	1960-1984/5 (people had been migrating since 1948, but it was used as an innovation in the 1960's. This ended in 1985 because the mines stopped employing people)	Community members	Government reduced land and livestock in 1960, therefore people needed money. People also needed money to purchase inputs for agriculture. The nearby factories were paying very little, and people battled to save when	Able to buy more cattle and increase farms. Able to hire tractors. Used it for labola therefore they could save their own cattle and the woman's family then had more cattle and there were more cattle in the village as a whole. Those people then had cattle and could plough, therefore more fields

	living at home. In Johannesburg they could save.

Similarly, in the face of increasing uncertainty regarding agriculture in the 1990's, caused by severe drought and the withdrawal of government assistance, discussed in the previous chapter, people jumped on the opportunity for small scale agriculture presented by reticulated water in 2000. Household surveys showed that over 94% of households (N=71, see Appendix 3) in both villages were cultivating home gardens. Group discussions revealed that these home gardens had become far more common in the last five to ten years, and were a response to increasing uncertainty regarding rainfall patterns and a lack of government assistance with larger scale agriculture. Men were therefore away in the cities working, and women used the free time created by the arrival of electricity and reticulated water (Section 2.3.3, Chapter 2; Section 3.3.1b, Chapter 3) to grow vegetables, fruits, and grains. A wide variety of crops are grown in these home gardens with 33 different crops identified through household surveys.

People also invest in a wide variety of livestock, for a wide variety of reasons, as summarised in Table 4.12. In some respects, livestock have come to represent a less risky livelihood option than arable field cultivation. As Table 3.11 in the previous chapter illustrates, the number of fields under cultivation declined considerably during the late 1980's and early 1990's, a period of considerable uncertainty caused by a combination of drought, economic depression and political unrest. Table 4.10 indicates a considerable increase in total cattle numbers between 1986 and 1987 in the Zwelitsha agricultural zone, within which both villages fell at the time. Table 4.11 corroborates this at the village level, with total numbers of cattle having increased in recent years. Table 4.12 illustrates the reasons for keeping livestock in Machibi today, the most important reason for almost all of the stock listed is "the bank", described locally as a means to save money for a time of crisis. Traction is considered the most important reason for keeping livestock, although local respondents argued that cattle are the most important "bank" species when compared to other livestock.

Table 4.10: Total cattle numbers according to the Zwelitsha agricultural census 1987/88

	1986-1987	1985-1986	1984-85
Cattle	23 234	17 164	17 822

Table 4.11: Stock numbers for Qongqota: 1999 – 2002 (Source: Department of Agriculture, Zwelitsha)

Year	Cattle	Sheep	Goats
1987	513	190	13
1992	517	168	14
1997	517	129	11
2002	540	96	9

Table 4.12: Results of a matrix exercises where workshop participants were asked to indicate the reasons for keeping livestock in Machibi village (Two ticks indicates the most important reason for keep that type of stock, and a dash indicates that stock are not kept for that purpose)

Livestock	Bank	Food	Medicine	Animal traction
Cattle	✔	✔	✔	✔ ✔
Goats	✔ ✔	✔	✔	--
Sheep	✔ ✔	✔	✔	--
Pigs	✔	✔ ✔	✔	--
Chickens	✔	✔ ✔	✔	--
Geese	✔	✔ ✔	✔	--

Ducks	✔ ✔	✔	--	--
Horses	✔	--	✔	✔ ✔

The 'medicine' category refers to traditional cultural practices such as communication with the ancestors, as well as the treatment of illness. Investing in a wide variety of small and large stock is an adaptive strategy that ensures a supply of protein and manure, and provides a level of security during times of crisis when livestock can be either sold or slaughtered.

b) Ensuring flexibility

Local people ensure flexibility in almost all aspects of their lives, from land use choices and species preferences, to cultural practices and traditional gender roles.

As Figures 3.3 and 3.4 in the previous chapter demonstrate, boundaries for different land uses have become increasing flexible since the decline in state intervention and management in the past decade. This level of flexibility provides options for people during times of crisis, for example during drought. Many of the official boundaries are aligned to natural features such as rivers and valleys, during times of drought people will often push beyond these artificial boundaries in order to reach water and pasturage. Flexible boundaries are also essential in the long term, as land use preferences change, as discussed in the previous chapter, in response to economic and political change. In the case of Mt Coke, the shift is being made toward livestock, and therefore grazing land is becoming more important and taking over some agricultural areas. Strictly enforced boundaries would not allow this to occur.

Flexibility is also demonstrated by peoples' changing preferences for particular ecosystem products, such as fuelwood. The maintenance of flexibility allows people to respond to feedback from the environment, for example when particular species become scarce, preferences shift to other species that are more available, this is revisited in the discussion. For example, in an exercise on preferences, it was

indicated that *Acacia karroo* is currently the most preferred fuelwood species, followed closely by *Scutia myrtina* and *Acacia caffra*. This is unusual in the former Ciskei, where *Ptaeroxylon obliquum* is a key species used for fuelwood, fencing, poles, kraal building and rituals (Grundy and Cocks, 2002; Cocks and Wiersum, 2003; Shackleton et al., 2004, see Section 5.5.4, Chapter 5). Household surveys (N=67) corroborated this finding however, were in both villages the most abundant species in both fuelwood piles and *amagoqo* was *Acacia karroo*, followed by *Scutia myrtina*. This shift has arguably come in response to the increased abundance of *Acacia karroo* on abandoned fields (This has come in response to shifts in management, which is an endogenous driver, and therefore discussed in Chapter 5).

Maintaining and ensuring flexibility goes beyond simple preferences and land use choices; cultural and institutional flexibility play a major role as well. The coping strategies discussed previously require a great deal of cultural flexibility, ensuring this cultural flexibility can be seen as an adaptive response. The declining importance of the *amagoqo* is just one such example of cultural flexibility. In response to a combination of a) the move associated with Betterment, b) the availability of paraffin, and c) the more recent arrival of electricity, the cultural role of the *amagoqo* has declined in importance. During group discussions, younger members of PLA workshops argued that the amagoqo is no longer an important marker of a woman's status (see Chapter 3). When they get married, these young women say that they will not feel compelled to build an *amagoqo*. Older women still consider the amagoqo important, and continue to collect wood when necessary to repair their *amagoqo*. One respondents claim encapsulates the argument:

"The youth of today are lazy. When I was growing up, every woman wanted to build the biggest igoqo to demonstrate that she was a good wife, and she wanted to carry the wood herself [on her head]. These days, young women don't care - those who still build amagoqo just pay for local wood collectors to get the wood for them. The others don't bother at all."

Cultural flexibility also involves letting go of practices no longer considered important to ensure a livelihood. The loss of local knowledge regarding the location of scared pools in the local streams, and taboo areas in the local woodlands is one

such example. A comparison of the two villages is useful to some extent in highlighting this process. Qongqota has a reservoir within the village, and a large dam bordering the village too. Since 1970, limited reticulated water has been available in the community. In Qongqota, while mapping sacred pools, it became clear that the youngsters did not even know that there were sacred areas. The elder women knew that they existed, but had to debate for a long time over the exact location. Group discussions after the mapping exercise indicated that stories were longer being handed down to youngsters regarding the sacred pools because taps had bee around for over thirty years and therefore folklore regarding natural streams was no longer useful. A story told about a mermaid during the workshop was the first the youngsters had heard of it. Conversely, in Machibi, were reticulated water arrived only in 2000, women of all ages in the workshop had some knowledge of the sacred areas. During group discussions after the mapping exercise in that village, it became clear that stories were still told to youngsters, although some were claiming that it is not that important anymore since taps arrived.

The cultural role of women is also changing, and this change is an important adaptive strategy. Traditionally, women divided their days predominantly between collecting fuelwood, collecting water, and preparing food for the household (Table 3.8, Chapter 3), while men were responsible for agricultural practices such as field cultivation and tending to livestock. In response to the declining reliance on fuelwood and the arrival of reticulated water, women now have far more free time, and use this time predominantly in their home gardens. When placed alongside the decline in arable field cultivation, the role of woman as provider has changed dramatically, and even become essential in order to cope with the decline in agriculture.

Figures 4.4 and 4.5 in the previous section illustrate how important familial ties are during times of crisis, especially to ensure food security. As already discussed, during drought, when a head of cattle dies, the household will invite all neighbours to the household to share the meat. This ensures that the family will be repaid in the future by those invited, and ensures a source of protein for all involved.

Similarly, during Betterment, kinship links were again called upon. When livestock quotas were assigned to each household, the cultural significance of livestock lead

people to innovate and create ways of maintaining cattle numbers within the villages. Toward this end, people who had too many cattle would give the excess to extended family whose herd was below the quota. In this way, the number of cattle in the villages was maintained to some extent, which ensured a safety net and pool of livestock during times of crisis.

In summary (Table 4.13), local people at Mt Coke employ a range of coping and adaptive strategies to deal with trends and surprises caused by political, climatic, and economic changes. Short-term strategies include investing in technology, employing social networks, and migration. Long-term strategies have included investing in diversity through, for example, various income sources, multiple food sources, and integrating multiple crop and livestock species. The second long-term strategy has involved maintaining flexibility in land use boundaries, resource preferences, and cultural and institutional values.

Table 4.13: Summary of long and short-term coping and adaptive strategies at Mt Coke

Challenge and / or surprise	**Date**	**Short term Coping strategy**	**Longer term Adaptation**
State Intervention	1960-1980	Social networks, familial exchange, shifting preferences	Flexibility, mobility
Drought	1983	Familial exchange, technological investments	Investing in diversity
Political upheaval	1990	Risk taking, breaking rules, common pool resources	Flexibility
Economic	1980-	Familial	Investing in

depression	1995	exchange, migration	diversity, mobility

4.4 Discussion

Local responses to external forces are difficult to quantify or even observe, and therefore understanding interactions between resource use, institutions and external forces relies on an interpretation of processes such as social learning (Adger, 1999a). The local responses identified in the previous section indicate that local responses form part of a complex system, where external events and trends over lap, not only with one another, but also with feedback from the local environment, which is embedded in a history of experiences of dealing with events and trends (See Chapter 4; Gunderson et al., 1995). This process of 'social learning' within the context of systems thinking has been referred to else where as institutional learning (Berkes and Folke, 1998), and is discussed further in Section 4.4.3.

When confronted with this multitude of factors acting on local management arrangements, a single analytical framework becomes insufficient. Local responses have been studied around the world for many years, and from a variety of perspectives; from food security (Maxwell et al., 1999; Davies, 1996; Chung et al., 1997), to climate variability (Adger, 1999b; Ruben et al., 2000; Mortimore and Adams, 2001), to war-time responses to political crises (Korf, 2003; Bruck, 2003). From a social science perspective, most of these analyses have relied strongly on the concepts of livelihood security (DFID, 2000) and entitlements (Sen 1981, Leach et al., 1997). In particular, adaptive livelihoods have been approached either from the perspective of land use change, adapting technologies, or changes in labour allocation (Ruben et al., 2000).

Comparatively less attention has been paid within this paradigm to the more recent contributions made by ecologists and economists regarding ideas around linked social and ecological systems (Berkes and Folke, 1998), and resilience to change within these systems (Gunderson and Holling, 2002). This discussion will begin with an evaluation of the usefulness of both of these approaches to the analysis of local

responses at Mt Coke, before going on to evaluate the role of institutions and the importance of scale in this type of analysis.

4.4.1 Livelihoods and vulnerability: short term coping strategies

The DFID Sustainable Livelihoods Framework (2000) provides a useful tool for conceptualising changes in livelihoods in response to external shocks and surprises (see section 1.1.2, Chapter 1). The framework recognises that livelihoods, and the institutions that influence them, are dynamic (Korf, 2002). Figure 1.2 in Chapter 1 illustrates the conceptual framework commonly used in livelihood studies to conceptualise the internal and external factors that influence household level livelihood strategies and coping mechanisms. According to this model, people have six forms of capital assets (natural, physical, human, social, political, and financial, (Refer to Glossary) with which to a) carry out livelihood strategies, and b) cope with shocks and trends.

Evidence form South Africa suggests that livelihoods are complex, highly differentiated, and institutionally mediated (Cousins, 1999). Principally, five major characteristics of livelihoods have been discerned (Cousins, 1999): a) livelihoods are dynamic, and often aimed at managing risk (see also Kepe, 1997b; May et al., 1997), b) livelihoods bridge the urban-rural divide through, for example, remittances (see also Sporton et al., 1999), c) livelihoods involve maintaining complex social and economic relationships at a variety of levels, from the local to the non-local (see also Campbell et al., 2002b), d) livelihoods are highly differentiated and therefore subject to unequal power relations (see also Carter and May, 1997), and e) livelihoods are institutionally mediated (see also Sarch, 2001; Lambin et al., 2001), these institutions are the ultimate determinants in the allocation and access to key resources (see also Kepe, 1997a and b; Leach et al., 1997; Adger, 1999a).

Evidence from other countries in Africa indicates that households have responded to crises in rainfall, food supply, livestock management and degradation in dryland ecosystems by a) managing variability, b) selectively and experimentally adapting technologies, c) allocating labour, and d) using markets to improve livelihoods and cope with crisis (Mortimore and Adams, 2001). Over time, households and

individuals develop technical and institutional innovations in managing natural resources that are aimed at reducing risk (Tiffen et al., 1994; Forsyth et al., 1998).

These observations regarding rural livelihoods, combined with the DFID framework, do go some way toward conceptualising identified livelihood strategies and coping mechanisms at Mt Coke. In response to water scarcity, Section 4.3.2a describes investment in rainwater tanks, and the importance of kinship and reciprocity networks in coping with food insecurity during drought years at a household level. These two coping strategies represent shifting emphasis intermittently between physical capital (rainwater tanks) and social capital (kinship, reciprocity) through technological and institutional adaptation. In Zimbabwe, reciprocity within familial networks was found to be an important factor in spreading wealth within communities during times of crisis (Campbell et al., 2002b). Trading livestock for credit at local shops during drought years (Section 4.3.2a) indicates the conversion of one type of capital to another in order to cope with an external shock such as drought. Again, evidence from Zimbabwe suggests that livestock sales are a key risk avoiding strategy for rural households (Campbell et al., 2002b).

Similarly, a shift in emphasis from natural to financial capital over a longer period is alluded to in Section 4.3.2b. Tables 4.4 and 4.5 indicate the declining reliance on fuelwood, and toward substitutes such as paraffin and electricity (see also Grundy and Cocks, 2002) in response to the complex interaction of political intervention which lead to resettlement farther from the woodland areas, economic changes that made possible the availability and purchase of paraffin, and more recent political changes that have ensured the provision of basic services such as electricity (See Section 2.3.3, Chapter 2).

Rural-urban migration is a well-documented coping strategy in rural livelihoods around the world (Adger, 1999b; Sporton et al., 1999; Korf, 2002; Campbell et al., 2002b). Although community members at Mt Coke have a long history of migration in search of wage based employment, migration became a key coping strategy between 1960 and 1990 (Table 4.9) in order to participate in the high input agriculture pursued by the state at the time. Similarly, in Botswana, population migration was found to be a significant coping strategy employed by communities forced to deal

with both environmental variability and externally induced land use change simultaneously (Sporton et al., 1999). Evidence from Sri Lanka (Korf, 2002) and Vietnam (Adger, 1999b) suggests that, as part of household level coping strategies in response to collective vulnerability (Korf, 2002), migration represents a complex combination of capital assets in order to ensure desired livelihood outcomes. Human capital, in the form of knowledge and skills, is drawn upon in order to increase financial capital (through migration and remittances). Social capital, in the form of family members working away at the mines who send money home, and family members who remain behind to tend the fields and livestock, is a key asset during this type of coping strategy.

a) Appropriate and inappropriate responses

The Livelihoods framework recognises that various combinations of capital assets assist people to achieve desired livelihood outcomes in the present, but may have either positive or negative impacts on peoples' livelihoods in the future, this is represented through the feedback loops. However, assessing whether a livelihood response is appropriate for the external threat or environmental change in question is considered one of the major difficulties in research into local livelihood responses. Nonetheless, evidence does suggest that coping with environmental stress may lead to further impoverishment (eg food and fuel shortages), or may further degrade the resource base (eg exploiting common pool resources), or may both improve the resource base, and decrease poverty at the same time (eg diversifying on-farm production) (Scherr, 2000).

Shifting emphasis between different types of capital in response to shocks and surprises depicts rational decision-making and therefore arguably appropriate responses, and the livelihoods framework does well to explain these rational decisions. Local responses to political crisis in 1990 however, provoked arguably irrational responses, such as breaking social networks, degrading the resource base through rule breaking, risk taking, and abandoning arable field cultivation at a time when food security was at low point. These decisions appear irrational in the absence of an understanding of processes taking place at broader scales. Figure 4.1 illustrates that this political crisis occurred at the same time as severe drought and economic

decline. The question of when people do and do not act rationally is answered in part by the combination of various and overlapping trends and surprises, however, other contributing factors such a reduction in social resilience, are discussed in Section 4.4.2.

Evidence from Sri Lanka indicates that people tend to deplete their capital assets when confronted with gradual economic decline and a sudden political crisis (Korf, 2002), a situation akin to the experiences of rural communities in the early 1990's in the former Ciskei. In this situation, cash income is more easily acquired through welfare grants and migration, and therefore cultivation collapses. As demonstrated in Chapter 4, natural resource management was severely disrupted immediately following the 1990 coup (de Bruyn, 1998); agriculture collapsed and woodland areas declined in health (See Chapter 5) due to over harvesting and changed harvesting techniques (eg cutting live wood). This was allowed to occur because local people turned a blind eye to transgressions of rules (Grundy and Cocks, 2004), which occurred within the context of weakened local institutions after many decades of government interference in natural resource management, through, for example, the ranger system described in Chapter 4, and discouragement of local participation in resource management (see also Grundy and Cocks, 2004).

Thus, the reason why analysts have largely failed to identify the key factors determining when people will act 'rationally' or respond 'appropriately' is because the questions that have been asked have been limited in scope; a) analysts have often considered responses to only one type of external factor at a time, without a holistic interpretation of the entire system and the identification of overlapping drivers and therefore periods of extreme vulnerability, and b) many analysts involved in adaptive management research are now arguing that adaptive management actually *requires* 'irrational' responses (Westley, 2002). This more nuanced understanding of local management responses is the contribution of a complex systems approach, and is pursued further in the next section and in Chapter 5.

4.4.2 Resilience and long term adaptive responses

The potential contributions of ideas surrounding resilience have not been adequately explored in literature dealing with coping strategies and adaptive livelihoods. In particular, while the livelihoods framework offers an opportunity to explore short term coping strategies, resilience offers an opportunity to explore the adaptive capabilities of local people over larger time horizons through its incorporation of multiple spatial, temporal and conceptual scales. Resilience is defined as the capacity of a system to absorb disturbance and undergo change without the system redefining its structure by changing the variables and processes that control behaviour (Walker et al., 1967; Holling 1973; Gunderson et al., 2002). Resilience provides complex systems with the ability to endure in the face of shocks and surprises (Gunderson, 2003), and therefore contains a potentially powerful contribution to understanding the elusive concept of 'sustainable livelihoods' (DFID, 2000).

Within this paradigm, adaptability and flexibility are considered key concepts (Berkes et al., 2003, see Section 1.1.2, Chapter 1). Adaptability refers here to the capacity of actors within a system to manage for resilience. 'Managing for resilience' (Walker et al., 2002) means acting proactively to ensure that people and ecosystems will be able to cope with future changes, which can be achieved in part by moving the current state of the system away from a threshold (Scheffer et al., 2002). Flexibility in natural resource management is considered vital to maintain resilience (Westley, 2002). Attempting to stabilize social-ecological systems in a perceived optimal state, through for example the inflexible command-and-control approach to management, a) reduces resilience and b) often results in the system being close to a critical threshold.

The importance of institutional learning

This perspective sheds further light on the institutional collapse and seemingly 'irrational' responses of local people during the political crisis of 1990. By 1990,

villages in the former Ciskei had experienced thirty years of strict command and control resource management from the outside. Rules governing access to resources were created and enforced through fines by external institutional bodies. From this perspective, disturbance within the social system was reduced over the thirty-year period, which undermined the ability of local institutional structures to learn how to deal with disturbance. As a result, collective memory of coping with crisis was undermined, because external institutions a) de-validated local knowledge and management functions, and b) either removed the possibility of a crisis, or coped with crises on behalf of the communities, for example through the provision of irrigation water to cope with drought. In 1990, when these external institutions collapsed, the local social systems entered a phase of rapid and severerelease. This release was further aggravated by the economic decline and drought prevalent at the time.

Maintaining flexibility and adaptability

Contrary to external command and control resource management approaches, local institutions and livelihoods actively manage risk by maintaining flexibility and adaptability. People at Mt Coke have ensured flexibility in almost all aspects of their lives, from land use choices and species preferences, to cultural practices and traditional gender roles. In terms of land use, the previous chapter demonstrated the dynamism of forces acting on local choices, and the various shifts that have occurred in land use preferences in response to these forces. These shifts would not be possible under strict command and control management regimes. Evidence from other areas of the former Ciskei has indicated that people seek flexibility in resource management arrangements, actively seeking to avert strict controls over access rights (Ainslie, 1999).

Maintaining and ensuring flexibility goes beyond simple preferences and land use choices; cultural and institutional flexibility play a major role as well. The short term coping strategies discussed previously require a great deal of cultural flexibility, ensuring this cultural flexibility is an adaptive response (Berkes and Folke, 1998). The declining importance of the amagoqo is just one such example of cultural flexibility (see Section 4.3.3b).

However, maintaining this flexibility and adaptability may have negative trade-offs. The Xhosa people have never been particularly competitive in commercial agriculture, as attested by the various state lead interventions intended to encourage precisely this (Houghton, 1956; DBSA, 1988; refer to Section 2.2, Chapter 2). In addition, as was discovered with the PFM initiative, it is difficult to get long-term projects off the ground at Mt Coke because people are continuously hedging their bets and not willing to put all of their "eggs in one basket".

Letting go of knowledge as an adaptive response

Cultural flexibility also involves letting go of practices no longer considered important to ensure a livelihood. This is a key concept in adaptive management; identifying how 'knowledge' is created, what processes allow for innovation and novelty and what processes smother it (Holling, Gunderson and Ludwig, 2002). The loss of local knowledge regarding the location of sacred pools in the local streams, and taboo areas in the local woodlands is one such example. Since the arrival of reticulated water and alternative fuels, taboos on natural areas as key resource areas have become less important to local people.

The traditional role of women is also changing with their new role of provider since the decline in agriculture, and the concomitant growth in importance of home gardens (Section 3.3.2, Chapter 3; see also Campbell et al., 2002b). The ability of local institutions governing gender roles to change is an important adaptive strategy, which has allowed households to maintain their food security in the face of declining agricultural pursuits (see Chapter 3).

Managing risk by investing in diversity

Managing risk by investing in diversity is a key adaptive strategy that ensures resilience in social-ecological systems (Folke and Colding, 2001). At Mt Coke, people invest in diversity in all spheres of their lives, from sources of household income, household food, the variety of crops cultivated, to an investment in many different species of livestock. The diversity of sources of food provides a useful illustration of this diversification. Table 4.8 illustrates that various sources of household food exist,

and that for almost every food group there is more than one source. Significantly, the sources inevitably involve one source that relies on financial capital (shops), and another than relies on natural capital (for example home gardens and fields). This variety of options allows people to switch between different sources as they are forced to shift emphasis between different types of capital in order to cope with the types of trends crises discussed previously. Switching between these types of capital is well explained through the livelihoods framework, however it is the contribution of ideas around resilience that enables the identification of the adaptive nature of these local practices.

4.4.3 The role of institutions in responding to short and long term change

Institutions provide the framework and the social context within which local coping and adaptive responses take place. Both the livelihoods framework and the resilience approach support evidence from local irrigation institutions in Taiwan that a dynamic exists between individual choice, institutional design, and incentives from the broader institutional environment (Lam, 2001). Folke (1998) argues that social mechanisms such as institutions prevent the build up of large-scale crises by allowing for small-scale disturbances within a social-ecological system, thereby building resilience.

In this sense, short-term responses to crises such as drought and crop failure build resilience in a linked social-ecological system (Berkes and Folk, 1998); resilience to the risk and uncertainty thus created is expressed through long term adaptive strategies, such as investing in diversity, and maintaining flexibility. Institutions provide the social fabric within which these coping strategies take place (Scherr, 2000), and therefore play a key role in determining the resilience of a system, in terms of shaping local livelihoods, and mediating between external trends and shocks, and local livelihood responses (Lambin et al., 2001).

Experience of disturbance is stored in the collective memory of the household, group or village. This memory interacts with external processes and crises to mediate responses deemed appropriate by local people. This is called institutional learning (Berkes and Folke 1998). Institutional learning does not however, occur only at the level of the community; institutions are nested within broader institutions, and

therefore change at broader levels can cause change at local levels and visa versa (Gunderson and Holling, 2002).

The ways in which local people respond to crises and processes have been categorised in three ways; 1) response with experience, on other words with institutional memory, 2) response without experience, 3) no effective response (Berkes and Folke, 1998). The latter two provide some insight into what have been labelled elsewhere 'irrational' responses. When a group responds with experience, or institutional memory, as can be seen in this case study with shifting preferences, land use practices, and food sharing during droughts at Mt Coke, the response is considered 'rational'. However, when people are confronted with a crisis or disturbance never before experienced, they may behave either without experience, or have no effective response at all. In 1990, the seemingly 'irrational' responses of rule breaking, degrading the resource base, risk taking, and abandoning arable field cultivation at a time when food security was at low point, are explained to some extent by the absence of institutional memory of how to deal with that type of crisis. Made even more difficult by the existence of other drivers, such as rainfall and economic depression, changing at different rates over time.

4.5 Conclusion

This chapter has demonstrated the dynamic interaction between local people, their immediate environment, and processes and surprises outside of their control. However, the scale of analysis and the mental models that are used to understand these interactions affect the management responses considered appropriate. Many synergies exist between the livelihoods framework and the resilience approach, and these should be harnessed for an improved understanding of appropriate management responses.

Both approaches identify exogenous drivers or forces of change; the livelihoods framework calls this the 'vulnerability context'. Both identify the importance of feedbacks and non-linearity. The models also have comparative strengths that should be explored. The livelihoods framework is most useful in its analysis of short term coping strategies and livelihood responses, while the resilience approach allows the

analyst to explore the broader context of institutional adaptions, and the role of institutions in shaping livelihoods. In this sense, the Entitlements approach also becomes essential, particularly in acknowledging the role of institutions at various scales. It is therefore in the combination of these three frameworks that some understanding of local responses can be found (Figure 1.4, Chapter 1).

Thus far, this study has described the interactions between macro level processes, local livelihoods and resource utilisation patterns (refer to Figure 1.4, Chapter 1), and has explored local livelihood and institutional responses to these factors. The next chapter brings this analysis full circle by exploring the impacts of these issues on local ecosystem change, and on the ability of ecosystems to provide the desired goods and services in local livelihoods.

Plates

Plate 4.1 A typical public water collection point at Qongqota

Plate 4.2 An example of a rainwater tank in Machibi

Plate 4.3 An example of a rainwater tank in Machibi

Chapter 5. Ecosystem dynamics

5.1 Introduction

A paradigm shift has occurred in the theoretical landscape of ecosystem dynamics (Scheffer et al., 2001; Gunderson and Holling, 2002; Gunderson and Pritchard, 2002). Traditional notions of carrying capacity, linear progression and succession (Clements, 1916; Cowles, 1899), which have governed ecosystem management for almost a century (see for example Acocks, 1953; Kuchler, 1964), have given way to the idea of non-equilibrium ecosystems with multiple stable states (Holling, 1973; May, 1977; Nystrom et al., 2000; Carpenter, 2001). This shift has precipitated a new emphasis on building and ensuring resilience within ecosystems to cope with external shocks and surprises (Scheffer et al., 2001; Gunderson and Holling, 2002, Bellwood et al., 2004).

The concept of 'carrying capacity' emerged from early debates around the relationship between the demand for resources and human population growth (Malthus, 1798), and emphasised the inherent ecological limits to this growth (Meadows et al., 1972). Notions of ecological carrying capacity held considerable currency until recent evidence that the early 'doom and gloom' theories and models did not take into account the sharp increase in agricultural production and the decrease in birth rates, or the adaptive capabilities of local farmers (Tiffen et al., 1994), and therefore considerably underestimated the complexity of human-environment interactions (Janssen, 2002). The 'new' paradigm has been born from four major critiques of the 'old', mainly from within the field of rangeland ecology.

Firstly, the concept of 'carrying capacity' is considered of little use unless it is defined according the management objectives of the particular ecosystem (Burke, 2004). Ecosystem 'health' (or condition), for example, is regarded as a highly value-laden interpretation of ecosystem change, which can only be assessed qualitatively and according to a specific context (Wilson and Tupper, 1982; Eldridge and Koen, 2003). According to this critique, there is no 'objective' carry capacity that can be identified for, for example, all rangelands in the same climatic zone; the definition depends on

the purpose for which the land or resource is being used (Behnke and Scoones, 1993; Tongway and Ludwig, 1997).

Secondly, calculating carrying capacity relies on the assumption that the conditions for plant growth, i.e. rainfall and temperature, are constant. In semi arid areas, with rainfall of between 250-500mm per annum and an annual rainfall variability of between 30 and 40 % or more (Ellis, 1994; Walker, 2002), climate, and not biomass, has been found to be the ultimate determinant of rangeland productivity and 'health'. Thus, the variability caused by the spatial and temporal distribution of rainfall, rather than herbivory and consumptive use is considered the main driver of ecosystem change (Behnke et al., 1993; Scoones, 1995). Some scholars disagree however (Illius and O'Connor, 1999; Brits et al., 2002) and feel that herbivores do indeed have an important impact on the long term shaping of arid ecosystems.

Thirdly, carrying capacity assumes that ecosystems have fixed boundaries (Rohlin and Batabyal, in press). However, in non-equilibrium ecosystems flexible boundaries and tenure arrangements are a more rational option (Banks, 2001), in part because this allows for 'opportunistic stocking' (Sandford, 1983). In many parts of Southern Africa, flexible boundaries are the norm rather than the exception (Perkins, 1998), and Chapter 4 has already demonstrated the flexibility of boundaries at Mt Coke when local people are left to their own devices in resource management.

Finally, it is becoming clear that landscape dynamics cannot be understood without an understanding of social dynamics at various scales (Scheffer et al., 2002). This is contrary to traditional approaches to rangeland ecology, which have been based on a presumed ability to predict local management responses to exogenous drivers, and where the endogenous drivers, such as management practices, are perceived to be outside of the system in question (Walker et al., 2002). The approach of this chapter therefore, and indeed this entire study, is that ecosystem changes are partially explained through shifts in local management systems, or endogenous drivers (see Chapter 4) (Banks, 2001), and partially through trends in exogenous drivers, which are linked to broader political, economic and biophysical forces (refer to Figure 1.4, Chapter 1, and see Chapter 3 for a discussion of these drivers).

Ecosystem dynamics within this new paradigm however remain poorly understood, and therefore attempts to assess degradation in terms of vegetation change alone are regarded as "precarious undertakings" (Ho, 2001:104). Alternative methods for assessing ecosystem change must therefore be sought, and various analysts are calling for clearly defined and larger temporal scales of analysis (Abel et al., 2000; Burke, 2004). From other disciplines, for example anthropology and historical ecology, successful analyses of ecosystem change have been achieved through historical analyses and local perspectives (Leach and Fairhead, 2000).

5.1.1 Managing change in non-equilibrium ecosystems

In light of this new paradigm, resource managers now face the challenge of devising management strategies that allow them to adapt and respond to shifts in ecosystems in such a way that the resilience of the system in question is not diminished (Westley, 2002). Constraining variability in the short term has been shown to reduce ecological resilience in the long term (Holling and Gunderson, 2002; Walker, 2002; Walker and Abel, 2002). Similarly, the findings of the previous chapter indicated that social resilience was equally reduced by state lead management strategies that sought to reduce rangeland and woodland variability through command and control tactics (Section 3.3.1, Chapter, 3).

Some have questioned however whether it is possible for individuals or groups to manage complex systems characterised by continuous change, learning, non-linearity, variability and unpredictability (Westley, 2002). Essentially, the argument is that range managers, for example, function in a stochastic environment where surprise is the rule rather than the exception (Walker and Abel, 2002). Therefore, while the state of a particular system is dependent on the management decisions of local managers, it is equally influenced by unpredictable factors outside of the local realm of influence (Hoffman et al., 1998), referred to here as exogenous drivers. In order to manage rangelands within this paradigm, analysts have proposed 'state and transition models' (see for example Westoby et al., 1989).

This approach is based on the idea that non-equilibrium ecosystems can exist in a number of different states, and that the management objectives for this type of ecosystem should not be to maintain equilibrium, but rather to maximise opportunities and minimise threats (Rohlin and Batabyal, in press). Local managers can for example never be certain about the effectiveness of their management decisions in the face of these exogenous drivers, and the emphasis, it is believed, should therefore lie on adaptive management approaches that emphasise; openness to diversity, change and new information, and, in terms of rangelands in particular, opportunistic stocking, (Westoby et al., 1989; Gufu et al., 2000; Banks, 2001, Westley, 2002).

Reports of ecological crisis in communally managed ecosystems in the former homelands of South Africa have abounded for decades (see for example Houghton, 1956). The externally driven management strategies, such as Betterment Planning (Section 2.2.1, Chapter 2), that responded to this perceived threat were founded on traditional ecological models of succession and equilibrium, where over-stocking was seen as the primary cause of ecological crisis (see for example Houghton, 1956). According to the new paradigm, however, and as argued in Chapters 3 and 4, these actions may have been ill founded, and even reduced the resilience of the social and ecological systems at Mt Coke.

5.1.2 Learning and adaptation in linked social-ecological systems

This study takes the view that the distinction between social and ecological systems is arbitrary (Section 1.1.2, Chapter 1), and therefore any discussion of resilience in ecological systems would be incomplete without a consideration of how these changes are affected by, and affect, social systems (Berkes and Folke, 1998). Chapter 4 has presented evidence, and discussed at length, the coping and adaptive strategies employed by local people at Mt Coke to deal with both social and biophysical exogenous drivers of change over time. What Chapter 4 did not expand upon, however, is the dynamic interaction between people and ecosystems at the local level, and the key role played by learning and adaptation in building resilience (Berkes et al., forthcoming, refer to Figure 1.4 and its explanation, Chapter 1).

Learning and adaptation from a resilience perspective, also referred to as 'institutional learning' (Berkes and Folke, 2002), refers to the generation, accumulation, use, and adaptation of knowledge and experience at the level of the group or society (a social constructivist view, refer to Table 1.3, Chapter 1). Analysts have argued that knowledge and institutions at the local level have in many instances developed through a dynamic process of trial and error that enables them to cope with crisis and change in the ecosystems on which they depend (Gadgil et al., 1993; Berkes, 1999; Ramakrishnan, 2001). Evidence from other areas of Southern Africa suggests that this process is no longer as effective as it was in the past, due in large to interventions by the state in resource management functions (Ainslie, 1999; Campbell et al., 2001; Twyman, 2001; Fabricius and De Wet, 2002). A key concern in this chapter then, is whether communities at Mt Coke have internalised changes taking place in the ecosystems on which they depend (Section 2.4, Chapter 2), and if not, what does this mean for the resilience of the system in question.

This chapter therefore seeks to explore local interpretations of changes in communal ecosystems over time in an attempt to a) evaluate the potential contribution of local knowledge to the development of ideas about ecosystem dynamics in South Africa, and b) to assess whether learning and adaptation is taking place in response to ecosystem change.

Toward this end, this chapter assesses ecosystem 'health' at Mt Coke through a combination of time series aerial photography and local knowledge about changes in the ability of ecosystems to support local needs. This chapter acknowledges that definitions of the ability of ecosystems to provide for specific needs will vary according to the observer, and the goods and services that the individual requires from the ecosystem in order to meet his or her livelihood needs. This challenge was overcome through various workshops with different user groups in order to a) gain a consensus view of change, while b) allowing for heterogeneity in perceptions to come to the fore. Rangelands are defined as consisting of a grass layer and in most cases a woody plant layer of trees and/or shrubs (Walker and Abel, 2002; Eldridge and Koen, 2003). In this chapter, natural streams are included in the holistic ecosystem, referred to as a multiple use ecosystem, in accordance with local perspectives.

Objective and key questions

The objective of this chapter is to determine the ways in which ecosystems have changed in response to the exogenous drivers identified in Chapter 3, and how the social responses identified in Chapter 4 have impacted on the ability of ecosystems to provide the desired goods and services to local people. In order to address these issues, the following questions were asked in this chapter;

1. How is ecosystem health defined in the local setting?
2. How has the perceived health of communally managed ecosystems (including woodlands, grasslands, and natural streams) been affected by changes in land use patterns and demarcations described in Chapter 3?
3. Have these changes in ecosystems had any impact on local rules and practices governing livelihoods?

5.2 Study area

Each village at Mt Coke (See Chapter 2) is surrounded by communally managed, multiple use ecosystems, including woodland areas, grasslands, natural streams and springs (see Plates 5.1 and 5.2). The role played by natural resources in rural livelihoods at Mt Coke is described in Section 2.4.2, Chapter 2, and the various uses of woodland resources in particular are summarised in Table 2.8 of that chapter. These woodlands form part of the thicket biome, described as having variable proportions of trees, shrubs, succulents and herbaceous species (Evans et al, 1997). This kind of vegetation has a very slow recovery rate after disturbance (Midgely and Cowling, 1993; Fabricius, 1997). Grasslands are used primarily as grazing areas, but also as a source of thatching grass. Natural streams are used primarily during periods when municipal taps break, and natural springs are used for livestock when dams dry out during droughts (See Chapter 4 on coping strategies).

The management of these ecosystems has changed drastically over the past 40 years. Prior to Betterment Planning and the Tribal Authority system instituted in the 1960's (see Section 2.2, Chapter 2 and Section 3.3, Chapter 3 for a detailed description),

access to communal ecosystems was governed through village headmen and local taboo systems that prevented the harvesting of certain locally important species (eg *Ptaeroxylon obliquum*), allocated areas for grazing, and designated places along the natural streams where people were not permitted to collect water.

Between the mid 1960's and early 1990's, however, management became increasingly state controlled through the Betterment system and concomitant state extension services in existence at the time (Section 2.2.1, Chapter 2). In the woodland ecosystem for example, a ranger system was initiated in which a local person was employed by the government to patrol the woodlands and prevent access to people not in possession of a "ticket" from the headman. A rotational grazing system was instituted at the same time, land allocated for this purpose was fenced off by the state, and extension officers informed local people where they could graze their cattle at certain times of the year.

These controls fell away in the early 1990's, when political unrest in the former Ciskei lead eventually to a military coup (see Section 2.2, Chapter 2). The ensuing four years after the coup, prior to the homeland's re-incorporation into the New South Africa, witnessed the collapse of the ranger system, and state extension services all but disappeared (Section 3.3.1b, Chapter 3). Fences were stolen from grazing areas and were never replaced. The political collapse left a void in the management of communal ecosystems at the local level that has to this day not fully been filled by any emergent means of resource management.

5.3 Methods

A combination of methods, including comparisons between historical remotely sensed images, combined with local perspectives regarding past events, can shed light on vegetation history (Fairhead and Leach, 1996; Leach and Fairhead, 2000). This temporal dimension is considered vital in understanding resilience to change in ecosystems (Walker et al., 2002). Therefore, a broad combination of Participatory Learning and Action (PLA) (IIED, 2003), time series aerial photography (Andrew, 1993; Fairhead and Leach, 1996), historical and archival records, in-depth interviews, and household surveys (Christiaensen et al., 2001) were employed to identify

ecosystem change from a local perspective. The range of methods as well as the questions they were intended to answer are summarised in Table 5.1, and a detailed step-by-step description of each technique is provided in Appendix 1.

PLA, and its predecessors, Rapid Rural Appraisal and Participatory Rural Appraisal, have all played a significant role in understanding human-environment interactions at the local level, for a detailed discussion refer to Section 3.2, Chapter 3 and Section 4.2, Chapter 4. PLA methods have also been used in research on South Africa's rangelands (Wigley, 1998). In terms of the PLA portion of the fieldwork, four user groups were identified; two in Machibi and two in Qongqota. Both villages decided to break up into two user groups based on gender. The female user groups held knowledge about water quality, fuelwood and woodland condition, while the male user groups held knowledge regarding arable field cultivation and rangelands. The range of techniques employed is discussed below.

Ranking is often used by social scientists, and increasingly by community development workers, as a means of prioritising or ranking lists prepared by communities (Russel, 1997). Quite simply, ranking implies placing something in order (Theis and Grady, 1991). Ranking can be used to determine the relative importance attached to various species, activities, environmental attributes, and stakeholders (see for example Richards et al., 1999; Department for International Development, 2000). In this case, the different species used for fuelwood were ranked according to local preferences by asking the female user groups in each village to list, in no particular order, all of the different fuelwood species used on a daily/weekly/monthly basis. The list was then revisited and pair-wise comparisons of the different items in the list were conducted. For example, participants were asked whether species 1 was used more than species 2, and then, whether species 2 was used more than species 3, and so on, writing down the ranked list on a separate sheet of flipchart as answers were given. Participants were then asked for reasons for their ranking. This exercise was intended to support the findings of the group discussions around the same theme, as well as the household survey findings (see below).

Trend-lines are sets of key dates in chronological order with a score representing relative changes in key variables over time. Trend-lines can be used to discuss issues

varying from ecological histories to changes in land use (Chambers, 1992). In this case, three different trendlines were constructed:

Exercise 1: Trend-lines to depict changes in the quantity of fuelwood used from the local woodlands (Appendix 1).

Exercise 2: Trend-lines to depict changes the quantity of water utilised from natural streams surrounding the villages. These exercises were intended to demonstrate the level of reliance on local ecosystems for local livelihoods.

Exercise 3: The participants were asked to relate the condition of the woodlands, natural streams and grazing land over five year intervals from 1975 to 2000. The dates were written on cards that were then placed on the floor, and stones were used to rate the condition of the ecosystems with 10 stones representing very good and 1 stone representing a very poor state.

Following the advice of local participants, the female user groups in Machibi and Qongqota constructed trend-lines for changes in water quality, while the male user groups in each village constructed the trend-lines for grazing land condition. Combined male and female user groups in each village constructed trend-lines for the changing condition of woodlands, because they felt that both men and women used the woodlands to an equal degree. Each user group consisted of between 5 and 10 people, and the exercises were conducted in each village separately.

Group discussions - are semi structured or unstructured discussions around a key theme. These discussions are conducted in a relaxed setting, and are usually used to follow up on sensitive issues raised during other exercises (Chambers, 1992; Sithole, 2002). Group discussions were held for a number of themes, including; changes in water quality, changes in local preferences for key fuelwood species, changes in the condition of grazing areas, and the formal and informal rules or institutions governing the management of woodlands, grazing land and natural streams. This was intended to provide an indication of ecosystem change, and whether feedback from the environment has been internalised into local rules and practices.

Key informant interviews are semi-structured interviews with key individuals who are knowledgeable about a particular issue (Borrini-Feyerabend, 1997). In this case, three elderly women and four elderly men who had either collected fuelwood from the

woodlands, or had grazed livestock in the grazing areas for many decades were interviewed to discuss changes in the health, extent and density of the woodlands and grazing areas. The interviewees were members of either the male or female user groups in Machibi or Qongqota, and were approached on an ad hoc basis during lunch breaks during workshop days in each village. Interviews were conducted outside so that the interviewees could point out particular areas were ecosystems had changed.

Household-based resource surveys when conducted on a random basis, surveys are a well-known technique that enables researchers to make inferences about various aspects of the population in question (Christiaensen et al., 2001). In this case, surveys were used to identify the most commonly used fuelwood species. This was intended to test results from group discussions and ranking exercises. This was achieved through school projects, where grade 10 learners inspected fuelwood piles and *amagoqo* in their own homesteads, and recorded the first and second most common plants in the pile with the assistance of the person who collected the wood for the pile, or their parents or grandparents. Learners then asked their parents and grandparents what the fuelwood pile would have looked like in the past (see Appendix 1). A total of 70 households were sampled in this way, 36 in Machibi and 34 in Qongqota.

Transect walks were organised to determine the validity/accuracy of local knowledge about key fuelwood species, and to further triangulate the findings from group workshops and the household surveys. Three transect walks were conducted in each village. The emphasis was on fuelwood species, and therefore willing members of the female user groups were taken along as guides. The intention was to observe the accuracy of individuals' knowledge about the plants identified in other exercises. Thus, participants were asked to find samples of the species previously listed and discussed in the ranking and trend-line exercises. The Xhosa names provided by participants were recorded, and the samples collected were then formally identified, and local names assigned by participants compared with documented Xhosa names of the same species. The Samples thus collected are stored in the Grahamstown herbarium.

Analysis of historical orthographic photographs – 1:10 000 orthographic photographs from 1979 were compared with more recent photographs from 1998 to evaluate local

claims that tree cover in the woodlands had increased in recent years. Due to time and resource constraints, comparisons were done manually by the researcher using a regular 1 cm² grid to assess the proportion of tree cover by assigning percentage cover in each cell in four selected woodland patches (McMaster, 2002); two in Qongqota and two in Machibi.

Table 5.1: Key questions and methods used for determining changes in ecosystem health and its impacts at Mt Coke

Key Questions	Combination of methods
How has the perceived health of communally managed ecosystems (including woodlands, grasslands, and natural streams) been affected by changes in land use patterns and demarcation described in Chapter 5?	Group discussions In-depth interviews Time series orthophoto comparisons In-depth interviews
Have these changes in ecosystems had any impact on local rules and practices governing livelihoods?	Trendlines Group discussions In-depth interviews Ranking Household surveys

5.4 Results

5.4.1 Ecosystem health

Results from user group discussions with the fuelwood, water and livestock user groups (see Appendix 1 for a description of how these user groups were formed) indicated that local participants considered ecosystems to be 'healthy' when:

a. There is enough forage for their livestock
b. Herders do not have to walk long distances to find forage for their livestock

c. There is enough fuelwood and construction wood in the woodlands to meet local needs
d. Fuelwood collectors do not have to walk long distances to find the desired species
e. The rivers are clean and not covered with "green slime"

It was not possible to place these points in order of importance, as different groups considered these attributes to hold different degrees of importance. For example, herders felt that forage was the key indicator of ecosystem health, whereas women felt that fuelwood species provided the most important indicator of ecosystem health.

a) Short-term fluctuations

Local workshop participants claimed that the ecosystems surrounding their villages have undergone various non-permanent cyclical changes, largely in response to changes in rainfall, and some more permanent changes linked to or even caused by various political events that have lead to changes in land use and demarcations. For this reason, respondents were not comfortable using trendline exercises to depict these changes, and preferred instead to discuss as a group how condition had changed.

During drought years, for example in 1982 and 1994, the condition was considered 'bad', but this improved shortly afterward within one or two years of the event. The rotational grazing system, instituted by the state through Betterment Planning between 1963 and 1990, is also considered to have caused multiple spells of 'good' and 'bad' rangeland condition. State extension officers would allocate a particular grazing area for pasturage, once that area was no longer able to support the livestock, the local headman would inform the extension officer, and he would give permission for the livestock owners to graze their cattle in a different allocated area. The changes would therefore occur in one grazing area (or camp), and then the livestock would be moved and the affected areas allowed to recover.

Local participants claimed that, during the droughts of 1982 and 1994 (cf Figure 4.1, Chapter 4), the quality of river water declined because a green slime (identified as an indicator of water quality) increased. Participants could not identify any long-term

changes in water quality. However, more permanent changes are considered to have taken place in ecosystems over the past ten years, particularly in relation to changes in land use and resource utilization patterns (see Chapters 3 and 4 for a description of these changes)

b) Lasting change

Many of the long term changes identified are related to the exogenous and endogenous drivers of change discussed previously in this thesis. These are briefly revisited here in relation to impacts of these drivers on ecosystem dynamics.

Firstly, after 1990, as described in the previous chapters, fences that separated the different grazing areas were stolen when people rebelled against the Ciskeian government, and boundaries between different land uses became more blurred (see Section 3.3.3, Chapter 3). Participants expressed concern that droughts are no longer easy to cope with. There is very little control over where livestock graze, and rules are difficult to enforce without fences to indicate the different grazing areas. For this reason, while rangeland condition currently continues to fluctuate according to climatic changes, livestock owners struggle to cope with these fluctuations due to political changes.

Secondly, more long-term changes in the health of communal woodlands have also been noticed; woodland health is considered to have declined. However, whether or not this is perceived locally as a negative change is discussed in Section 5.4.2. Local participants in Machibi felt for example that the availability of key fuelwood species was a good indicator of woodland health. Three species considered key to local livelihoods were identified during workshops: *Acacia karroo, Scutia myrtina,* and *Acacia ataxacantha.* The use of these species was corroborated by household surveys (N=67, see Appendix 5), where *Acacia karroo* and *Scutia myrtina* were found to be the most abundant species in fuelwood piles at homesteads in both Machibi and Qongqota (Table 5.2). This was determined by documenting the most common species, and the second most common species in each fuelwood pile. The data presented in Table 5.2 indicates the species most often found to be the "most common" and the "second most common".

Table 5.2: Species found in fuelwood piles at Mt Coke (N = 67, see Appendix 5 for original frequency table)

	Species name	Observed frequency
Most common	*Acacia Karroo*	46
Second most common	*Scutia myrtina*	15

Respondents claim that the availability of *Acacia karroo* has increased dramatically since Betterment Planning in the early 1960's because the species has invaded the land that was once used for homesteads prior to 1960, and also the arable fields abandoned since 1990. This is consistent with other findings about the function of *Acacia* species in ecosystem change (La Cock, 1992). Respondents also claimed that there is, although less abundant than in the past, ample *Scutia myrtina* in the woodlands.

Despite the perceived overall decline in woodland health, initial participatory interviews indicated that there has been an increase in tree cover. Analysis of orthographic photographs from 1979 and 1998 using regular 1 cm grids and visually determining the percentage tree cover in each confirmed this finding (Table 5.3). An increase in tree cover was observed in all four woodlands, however the difference between the two data sets was not significant as determined by a Wilcoxon matched pairs test (Wilcoxon, 1945) as implemented in Statistica (Statsoft, 2003; $Z = 1.83$, $P = 0.07$). The small sample size dictated the selection of this nonparametric test and the non-significant result may be a artefact of this small sample size. The greatest increases were observed in woodlands 3 and 4, and have taken place on formerly cultivated land along side woodland areas. Plates 5.3, 5.4, 5.5 and 5.6 clearly indicate this change in tree cover for woodlands 3 and 4 respectively, particularly on abandoned arable fields. Respondents claimed that this increase is due mainly to the invasion of *Acacia karroo*, and this corroborates earlier claims that woodland health has declined due to the increase in this species.

Table 5.3: Percentage increase of tree cover in four selected woodlands in Machibi and Qongqota using time series orthographic photographs

Woodland	Percentage tree cover in 1979	Percentage tree cover in 1998	Percentage increase
1	17	32	15
2	36	54	18
3	36	60	24
4	10	29	19

5.4.2 Implications for local livelihoods and institutions regulating resource use

The biophysical, political and economic changes that took place over the past 50 years have had a number of important implications for peoples' livelihoods and institutions at Mt Coke. These are described below as an adjunct to those implications already discussed in the previous chapters.

a) Fuelwood is more abundant and less in demand

The potentially negative livelihood impact of the perceived cyclical and more permanent changes in ecosystem health already described has been tempered by other economic and political changes taking place at the same time. On the whole, people no longer require the full set of ecosystem goods and services in order to maintain their livelihoods. People believe that there has been a rapid decline in the use of fuelwood since the late 1960s, because of the availability of alternatives such as paraffin and electricity (Table 5.4; and Figure 4.6, Chapter 4). 'Increaser' species such as *Acacia karroo* have become an important fuelwood source, which means that fuelwood is never in short supply. The ability of the woodlands to provide the desired levels of goods for local livelihoods, such as fuelwood, has therefore not declined, despite a perceived decline in woodland health (see Section 5.4.1b).

Table 5.4: Results of a trendline exercise where participants were asked to indicate changes in the quantity of fuelwood used by households in Machibi. Many 'stones' indicate that the quantity was more, while fewer stones indicate a decrease in the level of use.

Years	Number of stones	Explanation
Before 1967	9	People were dependent solely on fuelwood. In these days (before 1963) people also lived closer to the woodlands and therefore collection was easier. This was changed after [Betterment Planning] when people were moved "over the river".
1967 – 1998	6	People started to use paraffin in 1967. While the level of fuelwood use did decrease in this period, it was not an enormous change as people continued to use fuelwood.
1998 – 2003	3	Most people have electricity boxes in their houses now, however fuel wood is still used, especially for rituals.

However, peoples' ability to take advantage of these alternatives requires increased involvement in the formal economy, and therefore these changes in the availability of species key to local livelihoods have occurred in tandem with other more salient economic and political trends that have decreased reliance on these species (cf. Chapter 3).

Participatory interviews revealed yet another reason for the decline in fuelwood use. Prior to the resettlement associated with Betterment Planning in the early 1960's, people lived closer to the woodlands and therefore used more wood and had larger fuelwood piles and *amagoqo* (refer to Glossary) outside their homes. The size of these piles has declined because;

1. Directly after resettlement fuelwood collection declined as homes were moved further away from the woodlands,

2. At around the same time, paraffin became more commonly used as a substitute for fuelwood for cooking and lighting because it was more readily available and people became more involved in the cash economy through migratory labour,
3. More recently, electricity has become available (see also Table 5.4). Household surveys corroborate this finding, with 98 % of households at Mt Coke stating that their fuelwood piles would have been larger in the past (Section 4.3.2b, Chapter 4). The majority of respondents claiming that reasons behind this were the arrival of paraffin and electricity, and a resultant change in culture where amagoqo are no longer considered important markers of womanhood.

Group discussions (Table 5.5) and ranking exercises (Table 5.6) show that *Acacia karroo* is currently the most used and the most preferred fuelwood species, and this is corroborated by the household survey results outlined in Section 5.4.1, where *Acacia karroo* was found to be the most abundant species in fuelwood piles in both villages. The difference between 'preferred' and 'used' species was explained carefully, and the guided group discussion summarised in Table 5.5 illustrates the attempt to differentiate between 'preferred' species, which are summarised in this table, and the species actually used on a daily basis, which are summarised in Table 5.6. The most preferred and used species at present is *Acacia karroo*, while *Acacia mearnsii* is the least used species in the list.

Table 5.5: Summary of guided group discussions regarding most and least preferred fuelwood species in Qongqota

Questions	Answer
Which species, if it were more readily available, would you use more intensively than you are currently using it?	*Acacia karroo,* followed by *Scutia myrtina* and then *Acacia caffra.*

If electricity and paraffin were cheaper, which species would you stop using first, second…?	*1) Acacia mearnsii, 2) Eucalyptus c. f. grandis, 3) Zanthoxylum capense*
Which species would you never stop using, even if electricity was cheaper?	*Acacia karroo, Scutia myrtina, Olea eurpaea Subsp. africana* (for rituals)

Table 5.6: Results of a ranking exercise demonstrating the currently most used (1) and least preferred (6) fuelwood species at Mt Coke

Ranking	Species
1.	*Acacia karroo*
2.	*Scutia myrtina*
3.	*Acacia caffra*
4.	*Zanthoxylum capense*
5.	*Eucalyptus c. f. grandis*
6.	*Acacia mearnsii*

The reasons offered for the selection of *Acacia Karroo* as the most preferred species included the fact that; a) the species is considered environmentally detrimental to the grazing areas, and b) there is too much of it in the woodlands, c) that it is a good fuelwood because its coals last for a longer time than other species, and d) its abundance means that collectors do not have to walk far distances to collect wood. For all of these reasons, fuelwood collectors harvest *Acacia Karroo* whenever possible. In the past, *Scutia myrtina* was more preferred, or at least on a par with *Acacia karroo. C*urrently, however, people choose *Acacia karroo* over *Scutia myrtina* for the reasons just stated.

b) People are less reliant on 'natural' water,

Water: People's reliance on natural streams has followed a similar over-all trend to that of fuelwood (Table 5.7), due almost exclusively to the installation of reticulated water on a communal basis in early 2000. This has occurred as part of broader

national level programmes toward improved service provision, already discussed in Chapter 4. Thus, while droughts had serious impacts on local livelihoods prior to the installation of taps, this is no longer the case. However, although the over-all reliance on natural streams has declined, they remain an important resource during times of crisis (see Section 4.3.2a, Chapter 4), such as when there is a break down in water reticulation services, as happened in July 2000, and in 2003 (Table 5.7).

Table 5.7: Results from a trendline exercise where participants were asked to indicate changes in the quantity of water used from natural streams and springs in Machibi. Many 'stones' indicate that the quantity was more, while fewer stones indicate a decline in the level of use.

Year	Number of stones	Explanation
1960's	7	Boreholes were operational at this time. However, boreholes worked only in the mornings, and therefore river water was being used
1990's	11	In the 1990's there were no boreholes working, and the taps had not yet arrived. Therefore, all water used was collected from the natural streams
1994	4	This was a drought year. Many of the streams dried out and people were forced to dig holes near the stream beds in order to get to the water. Many cattle died in search of water
2000 (January)	2	Very little river water was used during this period because taps were installed and almost all of them were working
2000 (July)	5	In July there was a problem with tap water quality, and the authorities came and tested the water and informed the community that it was not fit for drinking. As a result, some people turned back to using the streams

2002	2	This year was highlighted to illustrate the use of natural streams in a normal year when all taps are working. The level of use is not very high
2003	4	At present there is only one tap working. Some people have therefore started using river water again, however, dependence on the rivers has declined, as people would rather wait in a line for tap water than walk all the way to the river where there is a steep slope. Some people use river water only for washing, and collect tap water for drinking

c) Local institutions have been formed to regulate ecosystem use

People observe a number of traditional and new sets of rules or codes of conduct in response to their observed changes in the ecosystems. For example, people will not usually collect fuelwood on the banks of rivers or streams. Local reasons for this taboo include the fact that the river is a place to communicate with the ancestors and is therefore not open to everyone. Another reason is the belief that the roots of the trees near the rivers 'hold water', therefore if the trees disappear so will the river. Taboos also exist that prevent people from harvesting slow growing species on a daily or weekly basis. *Olea eurpaea Subsp. africana*, for example, is a slow growing species that may not be harvested other than for traditional rituals and ceremonies, and for kraal building. This taboo is aimed at conserving the species, and respondents in Qongqota feel that this rule is still enforced and that the species is as abundant as ever before.

5.5 Discussion

5.5.1 Ecosystem trends and dynamics

Landscape health or condition is a highly value-laden and context dependant concept that can only be described qualitatively (Eldridge and Koen, 2003). Therefore, the

weightings applied to the availability of forage, fuelwood, construction materials and clean water at Mt Coke are likely to vary from place to place depending on the level of reliance on these different ecosystem goods. Nonetheless, inferences can be made about changes in landscape or ecosystem health at Mt Coke.

Ecosystems at Mt Coke have undergone various short-term cyclical changes in their ability to provide the desired goods and services largely in response to rainfall fluctuations, and some longer-term changes linked to political events and trends that have affected management practices and local institutions over time. In the short term, the most significant driver of ecosystem change appears to be rainfall. It is difficult, however, to separate rainfall changes from management-induced change in semi arid regions that experience wide spatial and temporal variability (Eldridge and Koen, 2003).

Nevertheless, land use changes associated with various politically motivated state interventions into rural agriculture, such as Betterment Planning and the Ciskei Co-operatives programme (refer to Section 3.3.1, Chapter 3), have lead to a more lasting down turn in ecosystem health according to local people. In particular, these trends are linked the declining ability of local institutions to cope with change and regulate access to common pool resources following the withdrawal of state assistance (refer to Section 2.2, Chapter 2; Section 3.4.1, Chapter 3). On the whole, these longer term trends have reduced the ability of local decision makers and resource managers to cope with the shorter term fluctuations, such as rainfall, making events such as drought ever more difficult to cope with (Section 4.4.2, Chapter 4).

In the woodland ecosystem in particular, fast-growing, spiny plants with a high resilience, such as *Acacia karroo*, have become increasingly abundant. This trend is particularly evident on abandoned fields, and is leading to increases in woody plant species cover, or bush encroachment. Evidence from Botswana (Moleele et al, 2002) suggests that bush encroachment can result from two key factors that apply to this study. The first is the opening up of the herbaceous or grass sward by livestock, which results in bare soil patches. While this process occurred in the Moleele et al. (2002) study as a result of trampling at foci points, in this study the process of field abandonment over the past ten years has probably had the same effect. The selective

grazing of livestock was identified as the second key factor in Botswana, in which species such as *Acacia karroo* are avoided due to the presence of thorns, with the result that these species are able to persist despite high stocking densities.

The bush encroachment literature has however generally failed to consider the possibility that in the long-term ecosystem, and particularly woodland, health could benefit from the presence of these opportunistic species. Established trees create sub-habitats, acting as nursing species, and providing perch sites of birds and therefore seed dispersal, as well as a protective canopy for seedlings (La Cock, 1992; Abule et al., in press; Asferachew et al., 1998). When woodland and grassland ecosystems are seen as alternative stable states (Walker, 2002), a longer time horizon is applied, and local needs are considered (ie the demand for fuelwood and construction materials), then "bush encroachment" is not necessarily a negative shift in the ecosystem, but part of a dynamic process in which ecosystems respond to human use and demand, and people adapt their practices and preferences in respond to feedback from the environment. For example, in the long term, while bush encroachment is a negative development for livestock owners due to a decrease in grazing land, it also presents the opportunity for the re-establishment of woodland ecosystems, a positive development for herbalists and wood collectors, particularly women who often have to walk very long distances to collect fuelwood. Therefore, determining the 'positive' or 'negative' nature of a shift between alternative stable states in ecosystems in ultimately value-laden, and necessitates a consideration of trade-offs for certain livelihood clusters.

5.5.2 Conventional vs observed understandings of ecosystem dynamics: the role of local knowledge

Clementsian notions of linear succession and climax plant communities (Clements, 1916; Cowles, 1899) do not fit comfortably with local interpretations of cyclical change in ecosystem health at Mt Coke. Equally, Malthusian notions of population pressure and the associated unmitigated demand for resources, being a primary driver of ecosystem change does not account for the observed cyclical changes. Both the Clementsian and Malthusian interpretations ignore four key factors identified in this and other chapters: 1) the role of institutions in shaping access to resources (see for

example Section 4.4.3, Chapter 4), 2) the demand for resources in the construction of rural livelihoods (Section 2.4, Chapter 2), 3) the dynamism of the interaction between social and natural systems, and 4) the interaction between social and natural systems across scales of analysis (refer to Figure 1.4, Chapter 1 for an explanation of how these points are conceptualised in this study).

Local knowledge at Mt Coke supports the new rangeland ecology paradigm to the extent that spatial and temporal variation in environmental attributes, such as rainfall, constitutes the major driver of ecosystem change in the short term (Scoones, 1995). This emphasis on rainfall in the short term is supported by evidence from Namibia, which suggests that short-term changes in stocking densities and rangeland condition are strongly correlated with rainfall patterns in communal semi-arid areas (Burke, 2004). However, although stocking rates have been found elsewhere to have a significant impact on rangeland condition (Brits et al., 2002), and in particular bush encroachment (Moleele et al., 2002), it was considered only a proximate driver of ecosystem change in this study because stocking rates have for many decades been linked to outside interventions such as Betterment Planning (Section 2.2.1, Chapter 2). In this sense, understanding the ways in which local institutions governing access and use of resources are affected by these external interventions is fundamental to understanding ecosystem change and to making management recommendations.

Significantly, the findings presented here, and in Chapters 3 and 4, point to the need to consider endogenous and exogenous drivers of change simultaneously. Ecosystems respond to both biophysical changes such as rainfall, and to local changes in management arrangements. As Chapters 3 and 4 demonstrated however, these management changes have been linked to a) changes in the effectiveness of local level institutional structures (Chapter 4), and b) external political interventions, which are in turn nested within political ideologies at broader scales (Chapter 2 and Chapter 3). Therefore, there is a need to look beyond simple biophysical drivers, such as rainfall, and toward the broader political and socio-economic environment within which those drivers are situated. In the long term, multiple use ecosystems at Mt Coke have been influenced by the management capacities of local decision makers. For example, declining levels of co-operation between farmers and livestock owners (Tables 3.6 and 3.7, Chapter 3) has reduced the ability of people to cope with rainfall fluctuations

because of the lack of institutions governing grazing rights, which has in turn meant that the resilience of ecosystems to drought has been reduced due to uncontrolled stocking rates (Section 4.4.2, Chapter 4).

Local Knowledge of ecosystem change at Mt Coke places emphasis on non-permanent cyclical change in both the long and the short term. Exogenous and endogenous drivers are afforded equal emphasis in explaining these changes, although forces outside of the local sphere of influence are more often blamed for ecosystem decline than local management practices. For example, change is seen to occur in the short term in response to unreliable rainfall, and in the long term in response to political and economic change that affects local management practices. The political upheaval in 1990 (Section 2.2, Chapter 2) is most often cited by local people as an example of local management arrangements changing in response to political crisis. This fits comfortably with the 'new ecology' paradigm to the extent that rainfall is considered a significant driver of change in ecosystems.

However, although local interpretations of ecosystem change fit more easily with the 'new ecology' paradigm, there are some marked differences. In particular, the new ecology paradigm has not shifted sufficiently toward acknowledging the role played by exogenous socio-economic and political processes in triggering change in local ecosystems (Ho, 2001). Many of the analyses focus primarily on ecosystem change and on building resilience in ecosystems (Scheffer et al, 2001; Janssen et al, 2004), while comparatively less emphasis has been placed on the role of institutions in building this resilience (Anderies et al., 2004).

Local people, however, understand quite clearly that the drivers of ecosystem health are exogenous, and frame responses to questions about changes in ecosystem health with stories about political and economic changes in the former Ciskei. These causal factors were linked time and time again to the political changes that have occurred over the past few decades (see Chapters 2 and 3). Analysts working in West Africa (Fairhead and Leach, 1996) and China (Ho, 2001) corroborate this and argue that the 'new range ecology' takes too narrow a view of rangeland ecosystems by failing to consider broader socio-economic and institutional context of change. Indeed, as has been argued elsewhere in this thesis, land use areas at the local level are social spaces,

embedded within a history of political and economic changes at broader scales (see Section 3.4.3, Chapter 3), and politically contested, economically interpreted, and socially constructed by the resource users and managers at the local level (Section 3.4.4, Chapter 3). This being true, local knowledge has a potentially powerful role to play in understanding such systems because it is precisely at this local level where resource users and managers interact with ecological systems to cause land use change and therefore ecosystem change (Wilbanks and Kates, 1999).

The true promise for the management of these multiple use, communally managed ecosystems lies not in one interpretation of the system, but in the combination of local and scientific knowledge through an adaptive management approach (Holling et al., 1998). It is clear that local knowledge about ecosystem processes has been eroded through decades of state involvement in rural agriculture and resource use at Mt Coke, and it is equally clear that interventions based on 'sound' scientific understandings of the time (e.g. Betterment Planning) have lead to an erosion of local social-ecological resilience. Analysts have argued that in order for rangeland ecosystems in particular to be managed effectively in the current paradigm of non-equilibrium ecology, existing scientific information and prior managerial experience should be combined to identify the minimum standard of the ecosystem that is acceptable before it flips into an irreversible state (Rohlin and Batabyal, in press). Thus, the extensive experience of rangeland management and observation that manifests as 'local knowledge' at Mt Coke, despite years of marginalisation, represents a potentially powerful contribution to rangeland management in the communal areas of South Africa.

The shortcomings of local knowledge

The paradox when dealing with local knowledge is that its strength, which is the fact that it is fine-grained and context-specific, is also its shortfall when it comes to extrapolating and using the information outside of the local context (Forsyth, 1999; Lovell et al., 2002; Fabricius, 2004). Local respondents at Mt Coke for example found it difficult to draw causal links between management and ecosystem changes that have occurred gradually over long periods of time, for example gradual changes in water quality and woodland health were difficult to identify. People also judge ecosystem health according to use values; ecosystems are considered 'healthy' when

they provide a desired set of goods and services (Section 5.4.1). Therefore, protection is unlikely to be afforded to species that, although perhaps performing a vital ecosystem function, have no practical use to local people.

5.5.3 The impact of ecosystem trends on rural livelihoods at Mt Coke

Ecosystem goods and services play a well-documented role in rural livelihoods around the world (Wollenberg and Ingles, 1998; Cunningham, 2001; Koziell and Saunders, 2001), and specifically in Southern Africa (Cavendish, 2000; Campbell et al., 2002b), as discussed in the previous chapter. At face value however, the people in this study appear increasingly independent of ecosystems to secure their livelihoods, as Tables 5.3 and 5.6 indicate for fuelwood and the use of natural streams respectively. This is significant since most studies on the role of natural resources in rural livelihoods in South Africa have not looked at trends in local dependence (e.g. Obiri and Lawes, 2000; Timmermans, 2000; Ham and Theron, 2001).

The fluctuating, and overall declining, reliance on natural resources at Mt Coke, identified in this and other chapters, has tempered the potentially negative impact of declining ecosystem health on local livelihoods. A superficial analysis of this declining trend of reliance on natural systems however might lead to the logical conclusion that ecosystem health is not as important as it was in the past. A fool might say: 'let it go to waste'. However the data presented here shows that there are critical periods when ecosystems matter (Section 4.3.2, Chapter 4), particularly during times of crisis. At the household level this manifests through the use of natural streams when taps break, or when the household has no money, cannot afford electricity or paraffin, and therefore falls back on fuelwood as the major source of heating, lighting and cooking. Chapters 3 and 4 have indicated that livestock are the "Xhosa bank", and are used as a means to store wealth. The slaughter or sale of these livestock are reserved for a) times of food crisis, b) financial crises, or c) during rituals to connect with the ancestors (Shackleton et al., 2001; Ainslie, 2002b; Kepe, 2002) This makes the condition of the rangeland ecosystem particularly important to these 'livelihood clusters', and indeed the whole community.

Therefore, although the significance of multiple use ecosystems in rural livelihoods may be declining in some instances, such as woodlands and natural streams, and increasing in others, for example grazing areas (Figure 3.5, Chapter 3), the role played by these ecosystems during crisis means that they remain key resources in rural livelihoods.

5.5.4 Local adaptations to change

Chapter 4 has dealt extensively with local responses to external processes and surprises, in this section specific adaptations to changes in ecosystem health are expanded upon. People at Mt Coke appear to respond to changes in the abundance of ecosystem components, such as fuelwood and natural streams, by adapting their preferences (for example between species), switching to alternatives (for example substituting paraffin and electricity for fuelwood), and/or relying on technology (for example investing in rainwater tanks during drought periods), and adapting their institutions to accommodate these changes. As highlighted in Chapter 4 however, people respond to both long and short-term changes. This section therefore begins with an example of how people have adapted preferences in the short term, and thereafter deals with long-term adaptations.

The apparent decrease in preference for *Ptaeroxylon obliquum*, provides a useful example of how people change preferences in response to feedback from the environment. Research from other areas of the Eastern Cape suggests that *Ptaeroxylon obliquum* is an important species for fuelwood, fencing, poles, kraal building and rituals (Grundy and Cocks, 2002; Cocks and Wiersum, 2003; Shackleton et al., 2004), yet respondents in this study did not even mention the species (Table 5.5). One explanation is that people have 'switched' out of pragmatism; as more preferred species become more scarce, species that serve the same purpose and are closer to homesteads (for example *Acacia karroo* on abandoned fields) have become the species of choice. This suggests that people have internalized the ecosystem changes that are taking place.

Feedback from the environment is also internalised over much longer periods, in a process that has been referred to as 'institutional learning' (Berkes and Folke, 2002).

A number of informal rules exist for the collection of fuelwood that suggest that feedback from the woodland ecosystem has been internalised and incorporated into local institutions over many generations. These rules manifest in cultural taboos, such as people not being allowed to harvest certain species if fuelwood, not being allowed to collect wood on the banks of rivers, or women not being allowed to collect water at certain points along the river for fear of water spirits. These cultural and spiritual values have played a key role in protecting biodiversity important to rural livelihoods in many areas across Africa (Little and Brokensha, 1987; Sibanda, 1997), and specifically South Africa (Bernard, 2000; Bernard and Kumalo, 2004; Todd et al., 2004).

The findings of this research, however indicate that adaptation to ecosystem change is not uniform across livelihood clusters, or over time. In terms of livelihood clusters, while fuelwood collectors have alternative or substitute species to choose from (Shackleton et al., 2004), other clusters such as livestock owners may find it more difficult to adapt to drought, for example, in the absence of fences to separate grazing areas, or management functions that govern access to the different areas. Political and economic processes have in particular been shown to affect local people's ability to adapt to change by reducing the process of local learning and adaptation through the removal of control over the use and allocation of resources from local institutional structures (see Section 4.4.2, Chapter 4). While interventions such as Betterment Planning were effective in protecting ecosystems in the short term, in the long term they lead to the erosion of social-ecological resilience through the exclusion of the 'social' component of the system in management functions. The exclusion meant that when state assistance collapsed in the early 1990's, the fragility of the system was exposed and ecological degradation ensued.

5.6 Conclusion

This chapter has highlighted and discussed the ways in which ecosystems have changed in response to the exogenous drivers identified in Chapter 3, how the social responses identified in Chapter 4 have impacted on the ability of ecosystems to provide the desired goods and services to local people, and the contribution of local knowledge in understanding these processes. Finally, the ways in which these changes

in ecosystems have impacted on local livelihoods and institutions have been considered.

This chapter therefore fills the final piece of the framework presented and described in Chapter 1 (Figure 1.4). The link between ecosystem change, rural livelihoods and land use change is indeed nested within the broader political, economic and biophysical context and changes. Institutions at various scales play a key mediating role between livelihoods, land use and ecosystems. At times, for example in the early 1990's, the erosion of local institutions was detrimental to local ecosystems, whereas at other times, the intervention of institutions at broader scales (for example the Tomlinson Commission, refer to Table 2.1, Chapter 2) meant that people did not have access to ecosystems or a choice in land use pursuits, and ecosystems benefited (in the short term) as a result. Temporal scale therefore becomes a vital consideration when attempting to identify causality and trends in ecosystem change.

However, these findings point equally toward the need to consider the interactions between social ad ecological systems at different rates over time. 'Slow change', such as institutional weakening, is cumulative, whereas 'fast change' is a sudden alteration in environmental variables such as rainfall (Lovell et al., 2002). The ability to detect these patterns depends on the temporal resolution at which a process is viewed. An historical perspective is therefore vital in understanding ecosystem change at the local level.

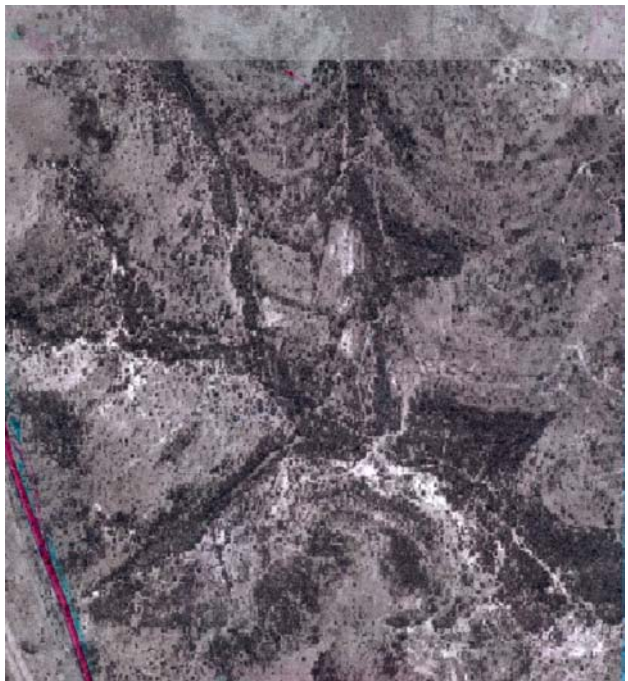
Plates

Plate 5.1: A participatory map showing the location of communally used rangeland resources around Qongqota Village.

Plate 5.2: A participatory location map showing the position of various communally used woodlands surrounding Machibi Village

Plate 5.3: Scanned orthographic photograph showing tree cover in woodland 3 in 1979

Plate 5.4: Scanned orthographic photograph showing clear increase in tree cover in woodland 3 in 1998



Chapter 6. Conclusions and recommendations

Through a combination of theoretical discussion and case study analysis from two villages in the Eastern Cape, this thesis has argued that common pool resource areas are social spaces, where local values attached to resources are institutionally mediated, politically nuanced, economically interpreted and, perhaps most importantly, historically situated. From this basis, this thesis has also demonstrated the dynamic interaction between social and ecological systems, and the role played by institutional learning and adaptation in order to cope with these changes (Folke et al., 1998).

Patterns of resource use and ecosystem dynamics at the local level are influenced by local institutions which interact with their local and external environment through a process of learning and adaptation. These institutions constantly respond to feedback from economic and political processes. The findings of this study support the notion that institutional learning is vital in the development of resilient institutions; when this process of learning is interrupted or eroded, for example by inappropriate state lead interventions such as Betterment Planning and the Ciskei Co-operatives Programme (cf Chapter 3), local institutions become brittle, as demonstrated by the breaking of rules in the early 1990's (cf Chapter 4). Institutions also become more vulnerable to collapse in response to disturbance (sensu Berkes et al., 2003), for example following the political collapse of 1990. When the resilience of institutional structures is degraded in this way, this study suggests that common pool resources become more vulnerable to natural disturbances such as drought due to poor management arrangements. For example, woodland and rangeland health was also degraded following the collapse of 1990 (cf Chapter 5).

The findings of this thesis corroborate the Millennium Assessment approach in the sense that historical, political, economic and biophysical processes, or the 'drivers of change', play a major role in ecosystem and social dynamics at the local level. The findings also corroborate the Resilience perspective in the sense that these processes are nested across scales (or 'Panarchies', sensu Gunderson and Holling, 2002), and

that feedback between these different scales affects the ability of local people and ecosystems to cope with uncertainty and change.

The disproportionate role played by state agricultural policies in affecting local land use practices at Mt Coke has brought to the fore the importance of the Entitlements approach in acknowledging the issue of power in regulating access to resources in South Africa. Finally, the Sustainable Livelihoods approach provided the vital link, conceptually, between a) the drivers of change and local people, and b) the link between local people and their immediate environment. This approach in particular 'grounded' this study in the daily realities of rural people at Mt Coke. Therefore, each of these approaches provided unique perspectives that were vital to my understanding of current resource use, livelihoods and institutions at Mt Coke.

The novelty of combining these four conceptual approaches, however, and of conducting an analysis of social-ecological system dynamics from an institutional perspective required a learning process approach throughout the study. Previous analyses have ignored this type of integration. This novelty also provided some new insights, and challenged some of the assumptions that underpin complex systems research of this nature. The findings therefore challenge scholars, policy makers and practitioners alike to incorporate a multi-scale and interdisciplinary systems perspective. The study has therefore challenged a number of misconceptions and conventional understandings of complex social-ecological systems.

6.1 Challenging common conceptions about communities, resources, and complex systems

By combining the four approaches of Resilience, Sustainable Livelihoods, Environmental Entitlements and the Millennium Assessment with local knowledge about ecosystems dynamics, some clear misconceptions about communities, resources and complex systems were exposed in this study.

The first misconception is that of spatially definable 'communities' and 'land use' areas. While the idea that 'communities' cannot be spatially defined is not a new one in the social science literature (see for example Bell and Newby, 1971; Guijt and

Shah, 1998; Leach et al., 1999), this idea does not adequately feature in the ecosystem management literature. Resource areas, and specifically the initiatives aimed at managing them, are still considered inherently 'local'. When a linked social-ecological system perspective is applied, however, resource areas can no longer be considered 'local' when communities are considered within the larger context of change. If local relationships with resources, are politically nuanced and historically influenced, then landscapes should likewise be regarded as social spaces. Effective natural resource management therefore depends on an understanding of the broader social and biophysical context and trends within which they are nested.

A second misconception is that local people are passive spectators in the face of exogenous forces outside of their control. This assumption stems from the short time horizons often applied to research of this nature, and to the mental models that researchers apply to understand this interaction (Mortimore and Adams, 2001). This study has demonstrated that local people respond to uncertainty and change both reactively and proactively. In a proactive sense, people manage risk and uncertainty by investing in a diversity of livelihood options, and by ensuring flexibility in almost all aspects of their lives. Through a process of social or institutional learning, local customs such as reciprocity, social networks and institutions have evolved to cope with crisis and risk in the long term.

A linked misconception challenged by this study is that it is easy to distinguish between long and short term coping strategies. However, as demonstrated in Chapter 4, what appears to be a short-term response is often part of a broader resilience building adaptation such as livelihood and cultural flexibility and livelihood diversification.. Therefore, research into rural livelihoods must consider broader time horizons in their analysis of coping strategies, and in so doing acknowledge that temporal scale is as important as spatial scale in understanding local responses to risk and uncertainty.

A third misconception is the belief that predictions can be made based on contemporary resource use and ecosystem trends. A systems approach reveals constant feedbacks between social and ecological components. For example, while ecosystem health is considered to have declined at Mt Coke, people are becoming less

and less reliant on ecosystems, and this declining reliance is tempering the potentially negative impact that a degraded ecosystem might have on local livelihoods. In addition, it is very possible that this declining reliance on ecosystems will have a positive impact on ecosystem health in the future. People also switch preferences in response to scarcity by e.g. incorporating exotic plants when selecting fuelwood, and fall back on technology such as rainwater tanks when ecosystem services are scarce. This is a dynamic rather than a linear interaction, which makes the projection of current trends into the future problematic.

A final assumption is the belief that a systems approach alone, based on sound scientific data, is sufficient to understand people-ecosystem interactions at the local level. This study has demonstrated that while a systems approach is indispensable, its true strength lies in combination with local knowledge and with other approaches that deal explicitly with the daily interactions between people and ecosystems. While social-ecological systems interact at a variety of spatial and temporal scales, it is at the local level, and on daily basis, that this interaction takes place. Therefore, while acknowledging that macro level forces and processes affect local livelihood and land use choices and practices, it is at the level of the 'community' that complex system approaches find their strength by exposing the nested character of social-ecological systems across scales in a field of research that has traditionally focused on short time horizons and localised spatial scales.

However, the issue of scale is a major challenge when one seeks to combine these very different approaches, particularly because different perspectives find relevance at different scales. While many social science studies have shied away from the complexity involved in acknowledging the role of scale on research outcomes, this study has demonstrated the need to deal with scale as an integral part of the system being analysed. Identifying cross-scale interactions and causal linkages in particular was extraordinarily difficult, because the conceptual guides and applicable theories are quite different at the different levels. Therefore, the implication for future research is that analysts, researchers and policy makers alike must consider, at the outset of the research process, the scales at which the system in question is to be analysed, and to consider very carefully the trade-offs involved in that selection. This issue of trade-offs is returned to in Section 6.4.

6.2 Implications for policy and practice

Natural resource management is typically aimed at reducing uncertainty and maintaining stability by removing shocks and surprises (Holling and Meffe, 1996). The evidence presented here however supports the argument that this type of strategy has the long-term effect of removing social and institutional learning from the social-ecological system. This reduces the ability of the system to cope with shocks and surprises (Folke et al., 1998).

By removing this learning process, the ability of the system to cope with shocks and surprises is reduced, leading in the long term to a more vulnerable system than before the intervention. For example, while Betterment Planning was an effective short-term measure that encouraged the sustainable use of ecosystems, it was an intervention that did not acknowledge the coupled nature of people and ecosystems in rural areas. As a result, ecosystem functions were preserved while the resilience of the social system to external trends and surprises was eroded. This in turn undermined ecosystem health in the long term precisely because of the linked nature of the social and ecological system in question. Therefore, the sustainable management of common pool resources in South Africa's rural areas requires and alternative approach characterised by a) capacity development of local institutions to cope with change, b) policies that encourage participation and do not remove decision making powers and custondianship, c) an institutional environment that encourages learning.

Of particular concern is the fact that local people and ecosystems appear to become more vulnerable when various drivers overlap at one time, as suggested by the institutional collapse that coincided with the withdrawal of state assistance, severe drought and economic depression in 1990 (cf Chapter 4). The vulnerability of local people was increased by state institutional structures and policies that sought to remove disturbance from the local setting through a 'fines and fences' approach and top down management prior to this event. As a result, the withdrawal of state assistance in the early 1990's lead to an institutional response 'without memory' (Sensu Berkes and Folke 1998), with the effect that now, ten years after the disturbance, local institutional structures are still recovering. Therefore, policy should

ensure custodianship over key resources that are used on a daily basis at the local level, such as water, woodlands and rangelands. As already stated however, this recommendation is not intended to encourage a wholesale devolution of management functions to the local level, but rather policy frameworks that encourage context specific strategies that are founded on an understanding of current institutional strength, and the history of change in this regard.

Secondly, interventions should encourage both horizontal (across space) and vertical (across levels of organisation) linkages between institutions and individuals (Andries et al., 2004; Berkes et al., in press). Much of the weakness identified in institutional structures at Mt Coke came from poorly developed and even absent links with district level institutional structures and organisations, such as municipalities, agricultural departments and district and national government.

At the management level, the twin aims of managing resilience are; a) to prevent the system from moving toward undesirable configurations in the face of stress and disturbance, and b) to encourage the elements of the system that enable renewal and reorganization following a disturbance (Walker et al., 2002). In order to achieve these two objectives, an adaptive management approach is necessary (Holling et al., 1998), specifically with an emphasis on learning and flexibility in local institutional and organisational structures (Berkes et al., forthcoming).

Land use at Mt Coke is embedded within a history of state intervention, subsequent political isolation, and more recent improvements in basic service delivery. Agricultural pursuits and natural resource management strategies in the area must therefore acknowledge this history, and attempt to build strategies for resource management based on an understanding of this context. Until recently, state officials have become frustrated by failed attempts to initiate PFM at Mt Coke. After three years of failed attempts to establish working committees and operational management rules in the villages, officials and researchers have all but given up. The blame for this failure has been laid variously at the feet of government extension officers, the nature of academic research, and even the committee members themselves. However, participatory forest management in the area was based on the assumption that forests, woodlands, rangelands, and rivers are spatially discrete entities, that can be mapped

using participatory methods, and thereafter managed successfully by local people who take control of management functions. Very little consideration has yet been given to the antecedents of state enforced rules for woodland management, the erosion of local institutional structures as a result of Betterment Planning, or the more recent provision of basic services that has lead to declining significance attached to natural streams and woodlands.

The challenge for natural resource management initiatives that deal with common pool resources in the future will be to acknowledge this history, accept that resource areas are not only 'local', spatially definable units, but also equally politically nuanced, economically interpreted, and socially constructed by the resource users and managers. This is a tall order for managers who have not been trained in complex systems thinking. Capacity development is therefore required.

6.3 Making predictions amid change and uncertainty

This study suggests that resource managers, whether they are local resource users or government extension officers frequently or invariably confronted with imperfect knowledge about the system in question (Walker et al., 2002). While the approach to this imperfect knowledge in the past was to reduce complexity and to focus on the facts that were known, this study has demonstrated that this approach is simply no longer adequate. What makes it even more difficult to predict the future of social-ecological systems is the ability of managers to learn and to adapt. This means that projecting current trends into the future will not provide an accurate picture of the future (Walker et al., 2002).

Therefore, what is needed are new and creative ways of thinking about the future, and of challenging the mental maps that people take with them into any management situation (van der Heijden, 1996). These maps are based equally on experiences that people have had in the past, as they are on people's understanding of how the future will look. Local level scenarios can achieve this type of creative thinking (Section 1.1.3, Chapter 1), provided they are situated very carefully in the historical context of change in a particular setting. Scenarios represent a tool that enables people to unlock the power of creative foresight (Wack, 1985), and it is this forward-looking capacity

of people that is considered crucial to the resilience of social-ecological systems. At the community level, this forward-looking capacity is situated in the context and history of experiences in the particular setting, making Scenario planning uniquely promising for resource managers who seek to acknowledge uncertainty and change as a mean to build resilience to future changes.

6.4 Participation and local knowledge: Some ethical and practical challenges

A combination of local and scientific knowledge is key to research that seeks to understand management practices and ecosystem dynamics at the local level (Berkes and Folke, 2002; Olsson and Folke, 2001). However, despite the recognition of the role of local people in this type of research, from a purely research-based perspective, the participation of rural communities and their knowledge brings with it a number of both ethical and practical challenges, and many were encountered during this study.

Ethically, questions about tangible and intangible benefits to the 'communities' involved in this research were a major consideration. In the first instance, the issue of benefits is multi-faceted. On the one hand, difficulties were encountered in identifying the 'community' that should benefit from the research. On the one hand, I was responsible to those individuals who were involved in the research process, and whom dedicated much of their time to assist in this study. On the other hand however, this research aimed to be beneficial to the entire Mt Coke 'community', but delineating an imagined community of this nature based on geography and bureaucratic lines and an 'equal share of benefits' was highly problematic. If I had taken it upon myself to ensure an even spread of benefits, then who would really have been in control, and how participatory would my research process have been? The decision in the end was to allow the user groups with whom I worked to decide on how benefits would be shared and spread throughout the villages.

Once this difficult question had been answered, the next step was to ask whether intangible benefits such as capacity development and confidence building were adequate benefits. If one asks a local community member what they consider to be 'adequate' benefits, they almost invariably mention jobs and money. Certainly an outsider would argue the opposite; that skills are a long-term investment, and more

sustainable than the alternative. However, if these intangible benefits hold sway, against the desires of local people, then the research can hardly be considered 'participatory'.

Another ethical challenge related to intangible benefits was the issue of reflexive learning within the participatory process. Time constraints introduced some urgency into this research to ensure the prompt and rigorous delivery of results, but this affected my ability to facilitate reflexive learning in participatory workshops. The pre-designed nature of the study, in terms of the questions to be asked and conceptual frameworks used, helped to get the project off the ground rapidly but there was little time in the research to facilitate meaningful space for participatory learning. For example, when dealing with scenarios, the time constraints allowed only for community responses to the possible futures, in terms of how the community would cope with new challenges implicit in these futures. No time was available to explore how feasible or appropriate the community responses were, or to evaluate responses to allow for critical thought. While all of the methods were, to some degree, useful to both researchers and local participants, all failed to develop in-depth reflections as part of the research process. This challenge relates back to the trade-offs discussed in Chapter one (Section 1.2), where the issue of inclusiveness versus superficiality was discussed.

On a practical level, the participation of local people also brought with it some major practical challenges. The first of these challenges involved the different levels of organisation between and within villages. While Machibi proved difficult to motivate to become involved in the research process, due perhaps to research fatigue, Qongqota proved extremely eager and organised, with all participants on time for workshops. In addition, while Qongqota made every effort to ensure that user groups consisted of knowledgeable individuals, Machibi placed individuals in groups based on willingness to participate, and often changed people in the middle of a series of workshops. While these differences actually added richness to the types of information gathered, they also meant that there was a high level of uncertainty with regard to the comparability of information gathered at different sites.

A second practical challenge stemmed from the researcher's pledge to provide benefits in the form of capacity development and help with community development projects. Capacity development made heavy demands on my time for activities outside of the research, this involved for example facilitating communication between government officials and local leaders, and facilitating the development of local proposals and management plans for potential development projects. These activities also lead to jealousy between villages, because many of the potential projects were vying for the same funding.

Material benefits, on the other hand, resulted in power plays and conflict within villages. A key example of this was the donation of computers to local high schools. This resulted in power plays between village organizations, key individuals, and school teachers, all of whom felt a sense ownership over the computers, although only the schools had the funds to repair and upgrade them. In Machibi in particular, when the school eventually invested in upgrading their computer, serious conflicts arose over whom the computer really belonged to.

Working through a translator, for example, posed the challenge of trust. The translator's understanding of important issues and key objectives was key for successful and meaningful communication with participants and respondents. This was particularly important when dealing with issues such as informal institutions, which is a difficult concept to grasp, and certainly not easy to identify. This necessitated regular feedback meetings with translators, a dedicated research group that remained the same throughout the fieldwork process, and handing over control to translators in many situations.

Workshop dynamics were another key challenge in the field. Everyone has good days and bad days, including the researcher, translators, and workshop participants, this affects the types of information shared and the willingness of workshop participants to participate. A related challenge was the fact that while the ideal situation would be to have workshops and exercises that are identical in both villages to ensure comparability; this was often impossible, as workshops had to flow with the dynamic

of the given group, and therefore if a group felt uncomfortable with a given exercise then another had to be conducted.

Finally, the decision to involve local school pupils in the household surveys lead to some practical difficulties. The decision was made for both ethical and practical reasons. The involvement of learners took the research outside of workshop spaces, and provided a means to a) involve local school children in environmental issues, b) provide experience and skills in Xhosa-English translation at secondary school level, and c) obtain a larger sample size. However, the reliability of the data thus received was sometimes questionable. For example it was suspected that a few learners copied their data sheets, and there was no way to ensure that they had the correct names for the species. This was addressed to some extent through training workshops, prizes offered as rewards for the most detailed data sheets, and through random household surveys conducted by the research team to test, for example, the wide variety of crops that were coming out of the Grade 8 projects as being grown in home gardens.

6.6 The way forward

The implication of this study for future research into common pool resource management is that a multi-scale and transdisciplinary approach is required. Researchers are challenged to explore conceptual and practical approaches outside of the current disciplinary lines that exist for complex systems research. In particular, the future of sustainable common pool resource management lies in the ability of researchers and practitioners to shake off the mental constructs that they have inherited from a knowledge system that is founded on arbitrary lines between 'natural' and 'social' systems.

The focus in South Africa in particular needs to be on the restoration of degraded natural capital and institutional structures. There can be very little space for talk of CBNRM and devolution until the history of dispossession and alienation of local people from the resources that they use every day is acknowledged, and strategies developed to build capacity to manage these resources.

Reference List

Abel,N., Ive, A., Langston, A., Tatnell, B., Tongway, D., Walker, B., & Walker, P. (2000) Resilience in NSW rangelands: A framework for analyzing a complex adaptive system. *Management for Sustainable Ecosystems* (eds Hale,P., Petrie,A., Moloney,D., & Sattler,P.), pp. 59-71. The Center for Conservation Biology, University of Queensland, Brisbane

Abule,E., Smit, G. N., & Snyman, H. A. (in press) The Influence of Woody Plants and Livestock Grazing on Grass Composition, Yield and Soil Nutrients in the Middle Awash Valley of Ethiopia. *Journal of Arid Environments*

Acocks,J.P.H. (1953) Veld types of South Africa. *Mem.Bot.Surv.S.Afr.* **28,** pp. 1-128

Adams,M., Cousins, B., & Manona, S. (2000) Land Tenure and Economic Development in Rural South Africa: Constraints and Opportunities. *Land and Agrarian Reform in South Africa into the 21st Century* (ed Cousins,B.), Programme for Land and Agrarian Studies, University of the Western Cape, Belville

Adger,W.N. (1999a) Evolution of Economy and Environment: An Application to Land Use in Lowland Vietnam. *Ecological economics* **31,** pp. 365-379

Adger, W.N. (1999b) Social Vulnerability to Climate Change and Extremes in Coastal Vietnam. *World Development* **27**, pp. 249 - 269

AGIS. Agricultural Geo-Referenced Information System. 2004. Available online: www.agis.agric.za

Agrawal,A. (2001) Common Property Institutions and Sustainable Governance of Resources. *World Development* **29,** pp. 1649-1672

Ainslie, A., Cinderby, S., Petse, T., Ntshoma, Z., and Bradley, P. Rural Livelihoods and Local Level Natural Resource Management in the Peddie District. 1997. Rhodes University, South Africa, Institute of Social and Economic Research.

Ainslie,A. (1998) *Managing Natural Resources in a Rural Settlement in Peddie District.* Masters thesis, Rhodes University, South Africa

Ainslie,A. (1999) When 'community' is not Enough: Managing Common Property Natural Resources in South Africa. *Development Southern Africa* **16,** pp. 375-401

Ainslie,A. (2002a) *Cattle ownership and production in the communal areas of the Eastern Cape, South Africa*, Research report no. 10 edn. University of the Western Cape, Cape town: Programme for Land and Agrarian Studies

Ainslie,A. (2002b) A Review of Cattle Production in Peddie District. *Cattle Ownership and Production in the Communal Areas of the Eastern Cape, South Africa* (ed Ainslie,A.), Programme for Land and Agrarian Studies: University of the Western Cape., Cape Town

Alcorn,J.B. (1989) Process as Resource. *Advances in Economic Botany* **7,** pp. 63-77

Alcorn,J.B. (2000) Keys to Unleash Mapping's Good Magic. *PLA Notes* pp. 10-13. Available online: http://www.iied.org/sarl/pla_notes/pla_backissues/documents/plan_03902.pdf

Allen,C.R. & Holling, C. S. (2002) Cross-scale structure and scale breaks in ecosystems and other complex systems. *Ecosystems* **5,** pp. 315-318

Anderies,J.M., Jansson, M. A., & Ostrom, E. (2004) A framework to Analyse the Robustness of Social-ecological Systems from an Institutional Perspective. *Ecology and Society* **9,** pp. 18

Andrew,M. (1992) *A Geographical Study of Agricultural Change Since the 1930s in Shixini Location, Gatyana (Willowvale) District, Transkei.* Masters thesis, Rhodes University, South Africa

Andrew,M., Ainslie, A., & Shackleton, C. (2003) *Land Use and Livelihoods*. Programme for Land and Agrarian Studies, School of Government, University of the Western Cape, Cape Town

Andrew,M. & Fox, R. (in press) 'Under-farming' and the Growth of Homestead Garden Cultivation in the Transkei: A Case Study of Intensification in Shixini. *Development Southern Africa*

Asferachew,A., Masresha, F., & Zerihun, W. (1998) Investigations of Canopy Feature of Three Indigenous Woodland Tree Species of Ethiopia. *SINET: Ethiopian Journal of Science* **21,** pp. 113-132

Baber,R. (1996) Current Livelihoods in Semi-Arid Rural Areas of South Africa. *Land, labour and livelihoods in rural South Africa, Volume two: Kwa Zulu natal and Northern Province* (eds Lipton,M., Ellis,F., & Lipton,M.), pp. 269-302. Indicator Press, Durban.

Balee,W. (1998) *Advances in historical ecology*. Columbia University Press, New York

Banks,T. (2001) Property Rights and the Environment in Pastoral China: Evidence from the Field. *Development and change* **32,** pp. 717-740

Barrett,C., Brandon, K., Gibson, C., & Gjertsen, H. (2001) Conserving Tropical Biodiversity Amid Weak Institutions. *Bioscience* **51,** pp. 497-517

Behnke,R. & Scoones, I. (1993) Rethinking Range Ecology: Implications for Rangeland Management in Africa. *Range ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannahs* (eds Behnke,R., Scoones,I., & Kerven,C.), Overseas Development Institute, London

Behnke,R., Scoones, I., & Kerven, C. (1993) *Range Ecology at Dis-equilibrium: New models of Natural Variability and Pastoral Adaptation in African Savannas*. Overseas Development Institute, London

Beinart,W. (1992) Transkeian Smallholders and Agrarian Reform. *Journal of Contemporary African Studies* **11,** pp. 178-199

Beinart,W. & McGregor, J. (2003) *Social History and African Environments*. James Curry Ltd, Oxford

Bell,C. & Newby,H. (1971) *Community Studies*. Unwin, London

Bellwood,D.R., Hughes, T. P., Folke, C., & Nystrom, M. (2004) Confronting the Coral Reef Crisis. *Nature* **429,** pp. 827-833

Berkes,F. & Folke, C. (1998) *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press, Cambridge

Berkes, F. (1999) *Sacred Ecology – Traditional Ecological Knowledge and Resource Management.* Taylor & Francis, Philadelphia.

Berkes,F., Colding, J., & Folke, C. (2000) Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological applications* **10,** pp. 1251-1262

Berkes,F. & Jolly, D. (2001) Adapting to Climate Change: Social-Ecological Resilience in a Canadian Western Arctic Community. *Ecology and Society* **5,** pp. 18. Available online: www.ecologyandsociety.org/vol5/iss2/art18/

Berkes,F. & Folke, C. (2002) Back to the Future: Ecosystem Dynamics and Local Knowledge. *Panarchy: Understanding transformations in human and natural systems* (eds Gunderson L. & Holling,C.S.), pp. 121-144. Island Press, Washington D.C.

Berkes,F., Colding, J., & Folke, C. (eds) (2003) *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge University press, Cambridge

Berkes, F., Lebel, L., Marschke, M., Lobe, K., and (forthcoming). Resilience Perspectives for Exploring Sustainable Livelihoods. Human Ecology . 5.

Bernard,P. (2000) Water Spirits. Indigenous People's Knowledge Programme: The Relevance of Indigenous Beliefs for River Health and Wetland Conservation in Southern Africa. *Wetlands Newsletter* **11,** pp. 12-16

Bernard, P. & Kumalo, S. (2004) Community Based Natural Resource Management, Traditional Governance and Spiritual Ecology in southern Africa: The case of Chiefs, Diviners and Spirit Mediums. *Rights, Resources and Rural Development* (eds Fabricius,C., Koch,E., Magome,H., & Turner,S.) pp.115-126

Black Farmer. January, 1984. Johannesburg, African Business Publications (PTY.) LTD.

Black Farmer. June, 1985. Johannesburg, African Business Publications (PTY.) LTD.

Bloschl,G. & Sivapalan, M. (1995) Scale Issues in Hydrological Modelling: A Review. *Hydrological processes* **9,** pp. 251-290

Bohensky,E., Reyers, B., van Jaarsveld, A. S., & Fabricius, C. (2004) *Ecosystem Services in the Gariep Basin: A Basin-Scale Component of the Southern African Millennium Assessment*. Sun Press, Stellenbosch, South Africa

Borrini-Feyerabend,G. (1997) *Beyond Fences: Seeking Social Sustainability in Conservation*. IUCN, Kasparek Verlag, Gland, Switzerland

Boserup,E. (1965) *The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure*. Aldine, Chicago

Brinkerhoff,D.W. (1995) African State-Society Linkages in Transition: The Case of Forestry Policy in Mali. *Canadian Journal of Development Studies* **XVI,** pp. 201-228

Brits,J., van Rooyen, M. W., & van Rooyen, N. (2002) Ecological Impact of Large Herbivores on the Woody Vegetation at Selected Watering Points on the Eastern Basaltic Soils in the Kruger National Park. *African Journal of Ecology* **40,** pp. 53-60

Bruck, T. Coping Strategies in Post-War Rural Mozambique. (2003) Berlin, Germany, German Institute for Economic Research.

Bundy,C. (1979) *The rise and fall of the South African peasantry*. Heinnemann, London

Burke,A. (2004) Range Management Systems in Arid Namibia - What can Livestock Numbers Tell Us? *Journal of Arid Environments* **59,** pp. 387-408

Burningham,K. & Cooper, G. (1999) Being constructive; social constructivism and the environment. *Sociology* **33,** pp. 297-316

Burt, J. and Copteros, A. Dramatic Futures: A Pilot Project of Theatre for Transformation and Future Scenarios. 2004. Environmental Education Department, Rhodes University, South Africa.

Callicot,J.B. (1994) *Earths Insights. A survey of ecological ethics from the Mediterranean basin to the Australian outback*. University of California Press, Berkeley

Campbell,B., Mandondo, A., Sithole, B., De Jong, W., Luckert, M., & Matose, F. (2001) Challenges to the Proponents of Common Property Resource Systems: Despairing Voices from the Social Forests of Zimbabwe. *World Development* **29,** pp. 589-600

Campbell,B. (2002) A Critical Appraisal of Participatory Methods in Development Research. *Social Research Methodology* **5,** pp. 19-29

Campbell,B.M., Jeffery, S., Kozanayi, W., Lucket, M., Mutamba, M., & Zindi, C. (2002) *Household Livelihoods in Semi-Arid Regions: Options and Constraints*. Center for international forestry research, Jakarta, Indonesia

Carney,D. (ed) (1998) *Sustainable Rural Livelihoods - What Contribution can we Make?* Department for International Development (DFID), London

Carney,D. (1998) Implementing the Sustainable Livelihoods approach. *Sustainable Rural Livelihoods. What Contribution can we Make?* (ed Carney,D.), pp. 3-26. Department for International Development, London

Carpenter,S. (2001) Alternate States of Ecosystems: Evidence and its Implications. *Ecology: Achievement and challenge* (eds Huntly,N. & Levin,S.A.), Blackwell, London

Carter, M. and May, J. Poverty, Livelihood and Class in Rural South Africa. 1997. Johannesburg, Land and Agriculture Policy Centre. Poverty and Rural Livelihoods Conference.

Casti,J.L. (1994) *Complexification: Explaining a Paradoxical World Through the Science of Surprise*. Harper Collins, New York

Cavendish,W. (2000) Empirical Regularities in the Poverty-Environment Relationship of Rural Households: Evidence from Zimbabwe. *World Development* **28,** pp. 1979-2003

Chakraborty,R. & N. (2001) Stability and outcomes of common property institutions in forestry: evidence from the Terai region of Nepal. *Ecological economics* **36,** pp. 341-353

Chambers,R. (1992) *Rural Appraisal: Rapid, Relaxed and Participatory*. Institute of Development Studies, Brighton

Chambers,R. & Conway, G. (1992) *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. Discussion Paper 296.* Institute for Development Studies, Brighton

Chambers,R. (1994) Participatory Rural Appraisal (PRA): Analysis and Experience. *World Development* **22,** pp. 1253-1268

Charton,N. (ed) (1980) *Ciskei : economics and politics of dependence in a South African homeland.* Croom Helm, London

Chase-Dunn,C. & Hall, T. D. (1997) *Rise and Demise: Comparing World-systems*. Westview Press, Boulder

Chase,T.N., Pielke, R. A., Kittle, T. G. F., Nemani, R. R., & Running, S. W. (1999) Simulated Impacts of Historical Land Cover Changes on Global Climate in Northern Winter. *Climate Dynamics* **16,** pp. 93-105

Christiaensen,L., Hoddinott, J., & Bergeron, G. (2001) Comparing Village Characteristics Derived from Rapid Rural Appraisals and Household Surveys: a Tale from Northern Mali. *The Journal of Development Studies* **37,** pp. 1-20

Chung,K., Haddad, L., Ramakrishna, J., & Riely, F. (1997) *Identifying the Food Insecure: The Application of Mixed-Method Approaches in India*. International Food Policy Research Institute, Washington, DC

Ciskei Census. 1988. *Statistical Abstract of Ciskei* . Directorate of Planning Office of the Presidency, Bisho, Ciskei Central Statistical Service.

Clayton,A.M.H. & Radcliffe, N. J. (1996) *Sustainability: A Systems Approach*. Earthscan, London

Clements,F.E. (1916) *Plant succession: An Analysis of the Development of Vegetation*. Carnegie Institute Publications, Washington, D.C.

Cocks,M. & Wiersum, K. F. (2003) The Significance of Plant Diversity to Rural Households in Eastern Cape Province of South Africa. *Forests, Trees and Livelihoods* **13,** pp. 39-58

Colding,J. (1998) Analysis of Hunting Options by the Use of General Food Taboos. *Ecological Modelling* **110,** pp. 5-17

Colding,J., Elmqvist, T., & Olsson, P. (2003) Living with Disturbance: Building Resilience in Social-Ecological Systems. *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change* (eds Berkes,F., Colding,J., & Folke,C.), pp. 163-186. Cambridge University Press, Cambridge

Coleman,J.S. (1990) *The Foundations of Social Theory*. Harvard University Press, Cambridge

Convention on Biological Diversity (2003) *Handbook on the Convention of Biological Diversity. 2nd Edition.* CBD, Montreal

Conway,T., Moser, C., Norton, A., & Farrington, J. (2002) *Rights and Livelihoods Approaches: Exploring Policy Dimensions*. Overseas Development Institute, London

Costanza,R.L., Wainger, L., Folke, C., Mäler, & K.G. (1993) Modeling Complex Ecological Economic Systems: Toward an Evolutionary, Dynamic Understanding of People and Nature *Bioscience* **43,** pp. 545-555

Cousins,B. (1996) Livestock Production and Common Property Struggles in South Africa's Agrarian Reform. *Journal of Peasant Studies* **23,** pp. 166-208

Cousins,B. (1999) Invisible Capital: The Contribution of Communal Rangelands to Rural Livelihoods in South Africa. *Development Southern Africa* **16,** pp. 301-318

Cowles,H.C. (1899) The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan. *Botanical Gazette* **27,** pp. 97-117

Cundill,G. (2002) *Can Participatory Forest Management Work? A Comparative Analysis of Factors Influencing Institutions in Two Villages in the Eastern Cape, South Africa.* BAH dissertation, Rhodes University, South Africa

Cundill, G. (2004) Foghorns to the Future: Using Knowledge and Transdisciplinarity to Navigate Complex Systems. Conference proceedings: Alexandria, Egypt, 'Bridging Scales and Epistemologies'. Available online: www.millenniumassessment.org/ documents/bridging/papers/cundill.georgina.pdf

Cunningham,A.B. (2001) *Applied Ethnobotany: People, Wild Plant Use and Conservation*. Earthscan, London

Daniels,R. & Bassett, T. J. (2002) The Spaces of Conservation and Development Around Lake Nakuru National Park, Kenya. *The Professional Geographer* **54,** pp. 481-490

Davies,S. (1996) *Adaptable Livelihoods: Coping with Food Insecurity in the Malian Sahel*. MacMillan/St Martins Press, Basingstoke, New York

DBSA. Ciskei Agricultural Data. 1988. Bisho, Development Bank Southern Africa.

de Bruyn,T.D. (1998) The Condition, Productivity and Sustainability of Communally Grazed Rangelands in the Central Eastern Cape. *Communal Rangelands in Southern Africa: A Synthesis of Knowledge* (eds de Bruyn,T.D. & Scogings,P.F.), pp. 248-257. Department of Livestock and Pasture Science, University of Fort Hare, Alice, South Africa

de Wet, C., Manona, C., and Palmer, R. Local responses to political policies and socio-economic change in the Keiskammahoek District, Ciskei: Anthropological perspectives. 55. 1992. Grahamstown, Institute of Social and Economic Research. Development Studies Working Papers.

de Wet,C. (1995) *Moving Together, Drifting Apart: Betterment Planning and Villagisation in a South African Homeland*. Witwatersrand University Press, Cape Town

Demeritt,D. (1994) Ecology, objectivity and critique in writings on nature and human society. *Journal of Historical Geography* **20,** pp. 22-37

DFID (2000) Sustainable Livelihoods Guidance Sheets. Department for International Development. Available online: www.livelihoods.org

Department of Agriculture. File Number 6/8/2/5/23. 1987. Department of Land Use Planning, Bisho, The Director General: Agriculture and Rural Development.

Department of Water Affairs and Forestry, Directorate of Water Resources and Planning. Eastern Cape Water Resources Situation Assessment: Main Report. 1999. Ninham Shand, Consulting Engineers.

du Toit,J., Walker, B., & Campbell, B. (2004) Conserving tropical nature: current challenges for ecologists. *Trends in Ecology and Evolution* **19,** pp. 12-17

Durning,A. (1990) *Apartheid's Environmental Toll*. World Watch Institute, Washington D.C.

Duvel,G. & Afful, D. (1996) Socio-cultural Constraints on Sustainable Cattle Production in Some Communal Areas of South Africa. *Development Southern Africa* **13,** pp. 429-440

DWAF. A Monitoring System for Community Forestry: Combining Scientific and Local Knowledge in the Eastern Cape. First interim Report. DWAF Project: RU 1/100. 2000a.

DWAF. Water Supply Service Levels: A Guide for Local Authorities. 2000b. Pretoria, Department of Water Affairs and Forestry: Directorate Water Services Intervention and Operations Support.

DWAF. Field Trip Report 5. Department of Water Affairs and Forestry, project number RU1/100. 2001.

DWAF. Participatory Forest Management Strategy. 2002a. Republic of South Africa, Pretoria, Department of Water Affairs and Forestry.

DWAF. Description of the Communities Surrounding Mount Coke State Forest, Eastern Cape. Field Trip report. DWAF project: RU1/100. 2002b.

Eldridge,D.J. & Koen, T. B. (2003) Detecting Environmental Change in Eastern Australia: Rangeland Health in the Semi-Arid Woodlands. *The Science of the Total Environment* **310,** pp. 211-219

Ellis,F. (1998) Livelihood Diversification and Sustainable Rural Livelihoods. *Sustainable Rural Livelihoods. What Contribution can we Make?* (ed Carney,D.), pp. 53-66. Department for International Development, London

Ellis,F. (2000) *Rural Livelihoods and Diversity in Developing Countries*. Oxford University Press, Oxford

Ellis,J.E. (1994) Climate Variability and Complex Ecosystem Dynamics: Implications for Pastoral Development. *Living with Uncertainty: New Directions in Pastoral Development in Africa* (ed Scoones,I.), Intermediate Technology Publications, London

Evans,N.V., Avis, A. M., & Palmer, A. R. (1997) Changes to the Vegetation of the Mid-Fish River Valley, Eastern Cape, South Africa, in Response to Land-use, as Revealed by a Direct Gradient Analysis. *African Journal of Range and Forage Science* **14,** pp. 68-74

Fabricius,C. (1997) *The Impact of Land Use on Biodiversity in Xeric Succulent Thicket, South Africa.* PhD dissertation, University of Cape Town, South Africa

Fabricius,C., Koch, E., & Magome, H. (2001) *Community wildlife management in Southern Africa: Challenging the assumptions of Eden*. Evaluating Eden Series. IIED, London

Fabricius,C. & de Wet, C. (2002) The Influence of Forced Removals and Land Restitution on Conservation in South Africa. *Conservation and Mobile Indigenous*

Peoples: Displacement, Forced Resettlement and Conservation (eds Chatty,D. & Colchester,M.), pp. 149-165. Berghahn Books, Oxford

Fabricius,C., Koch, E., Magome, H., & Turner, S. D. (eds) (2004) *Rights, resources and rural development: community-based natural resource management in southern Africa*. Earthscan, London

Fabricius,C. (2004) The Fundamentals of Community-Based Natural resource Management. *Rights, Resources and Rural Development* (eds Fabricius,C., Koch,E., Magome,H., & Turner,S.), pp. 3-43. Earthscan, London

Fabricius, C., Folke, C., Schulze, L. & Cundill, G. (forthcoming). Community based Assessments. In: *Multi-Scale Assessments: Findings of the Sub-Global Assessment Working Group (Millennium Ecosystem Assessment).* Island Press, Washington.

Fairhead,J. & Leach, M. (1996) Enriching the landscape: Social history and the management of transition ecology in the forest-savannah mosaic of the Republic of Guinea. *Africa* **66,** pp. 14-36

FAO. Potential population-supporting capacities of lands in the developing world. Higgins, G. M., Kassam, A. H., Naiken, L., Fisher, G., and Shah, M. FPA/INT/513. 1982. Rome, Food and Agriculture Organisation of the United Nations.

Fatman,Z. (2002) *The Influence of Social Dynamics on Resource Management in Machibi Village.* Bsc Rhodes University, Grahamstown, South Africa

Feyerabend,P. (1970) Against Method: Outline of an Anarchistic Theory of Knowledge. *Minnesota studies in the philosophy of science* (eds Feigl,H. & Maxwell,G.), pp. 17-130. University of Minnesota Press, Minneapolis

Feyerabend,P. (1987) *Farewell to Reason*. Verso, London

Folke,C. (1996) Conservation, Driving Forces, and Institutions. *Ecological Applications* **6,** pp. 370-372

Folke,C., Berkes, F., & Colding, J. (1998) Ecological Practices and Social Mechanisms for Building Resilience and Sustainability. *Linking Social and*

Ecological Systems (eds Berkes,F. & Folke,C.), pp. 414-436. Cambridge University Press, Cambridge

Folke,C. (1998) Ecosystems Approaches to the Management and Allocation of Critical Resources. *Successes, Limitations and Frontiers in Ecosystem Science* (eds Groffman,P.M. & Pace,M.L.), pp. 313-345. Insititute of Ecosystem Studies, Millbrook and Springer, New York

Folke,C. & Colding, J. (2001) Traditional Conservation Practices. *Encyclopedia of Biodiversity* **5,** pp. 681-693

Folke,C., Colding, J., & Berkes, F. (2003) Synthesis: Building Resilience and Adaptive Capacity in Social-Eological Systems. *Navigating Social-Ecological Systems: Building Resileince for Complexity and Change* (eds Berkes,F., Colding,J., & Folke,C.), pp. 352-387. Cambridge University Press, Cambridge

Ford,R. & Thomas-Slayter, B. (2001) Alternatives to Anarchy: Africa's Transition from Agricultural to Industrial Societies. *Progress and Planning* **56,** pp. 61-120

Forsyth, T., Leach, M., and Scoones, I. Poverty and Environment: Priorities for Research and Policy. 1998. UK, Institute of Development Studies. Prepared for the United Nations Development Programme and European Commission. Available online: http://www.iied.org/sarl/pla_notes/pla_backissues/documents/plan_03808.pdf

Forsyth,T. (1999) Science, Myth and Knowledge: Testing Himalayan Environmental Degradation in Thailand. *Geoforum* **27,** pp. 375-392

Foss,N. & Aune, L. (2000) PLA as a Tool in Participant Process-Orientated Evaluation in the Field of Drug Prevention Psychiatry in Norway . *PLA Notes* pp. 32-36. Available online: http://www.iied.org/sarl/pla_notes/pla_backissues/documents/plan_03808.pdf

Fraser,E.D. (2003) Social Vulnerability and Ecological Fragility: Building Bridges between Social and Natural Sciences Using the Irish Potato Famine as a Case Study. *Ecology and Society* **7,** pp. 9. Available online: www.ecologyandsociety.org/vol7/iss2/art9/

Funtowicz,S. & Ravets, J. R. (1990) *Uncertainty and Quality in Science for Policy*. Kluwer Academic, Dordrecht

Funtowicz,S. & Ravets, J. R. (1992) Post-Normal Science: A New Science for New Times. *Scientific European* pp. 95-97

Gadgil,M., Berkes, F., & Folke, C. (1993) Indigenous Knowledge for Biodiversity Conservation. *Ambio* **22,** pp. 151-156

Gadgil,M., Seshagiri Rao, P., Utkarsh, G., Pramod, P., Chhatre, A., & and members of the People's Biodiversity Initiative (2000) New Meanings for Old Knowledge: The People's Biodiversity Registers Program. *Ecological applications* **10,** pp. 1307-1317

Gadgil,M., Olsson, P., Berkes, F., & Folke, C. (2003) Exploring the Role of Local Ecological Knowledge in Ecosystem Management: Three Case Studies. *Navigating Social-ecological Systems: Building Resilience for Complexity and Change* (eds Berkes,F., Colding,J., & Folke,C.), Cambridge University Press, Cambridge

Giannecchini,M. (2001) *Landscape Changes in the Communal Lands of the Bushbuckridge District, Northern Province, South Africa.* PhD Dissertation, University of Witwatersrand, South Africa

Gibson,C., Ostrom, E., & Ahn, T. (2000) The Concept of Scale and the Human Dimensions of Global Change: A Survey. *Ecological economics* **32,** pp. 217-239

Grundy, I and Cocks, M. Community Use and Management of Woody Vegetation in the Eastern Cape, South Africa. Mossop, L. Natural Forest and Woodlands Symposium III. 2002. Department of Water Affairs and Forestry.

Gufu,O., Stenseth, N., & Lusigi, W. (2000) New Perspectives on Sustainable Grazing Management in Arid Zones of Sub-Saharan Africa . *Bioscience* **50,** pp. 35-52

Guijt, I. & Shah, M.K. (eds) (1998). *The Myth of Community: Gender issues in Participatory Development*. Intermediate Technology Publications, London

Gunderson L. & Pritchard, L. (2002) *Resilience and the Behaviour of Large-Scale Ecosystems*. Island Press, Washington, DC

Gunderson L.H., Holling, C. S., & Light, S. (1995) *Barriers and Bridges to the Renewal of Ecosystems and Institutions*. Columbia University Press, New York

Gunderson L.H. (1999) Resilient management: comments on ecological and social dynamics in simple models of ecosystem management by S.R. Carpenter, W.A. Brock, and P. Hanson. *Ecology and Society* **3,** pp. 7. Available online: http://www.ecologyandsociety.org/vol3/iss2/art7/

Gunderson L.H. & Holling, C. S. (eds) (2002) *Panarchy: Understanding Transformations in Human and Natural Systems.* Island Press, Washington

Gunderson L.H. (2003) Adaptive Dancing: Interaction Between Social Resilience and Ecological Crises. *Navigating Social-ecological Systems: Building Resilience for Complexity and Change* (eds Berkes,F., Colding,J., & Folke,C.), Cambridge University Press, Cambridge

Ham,C. & Theron, F. (2001) Community Forestry Resources: A Case Study of Selected Woodlots in the Eastern Cape. *Southern African Forestry Journal* **191,** pp. 65-74

Hannigan,J.A. (1995) *Environmental Sociology: A Social Constructivist Perspective*. Routledge, New York

Haysom,N. (1983) *Ruling with the Whip*. Development Studies Group and the Southern African Research Service, Braamfontein, South Africa

Healy,S. (2003) Epistemological pluralism and the 'politics of choice'. *Futures* **35,** pp. 689-701

Ho,P. (2001) Rangeland Degradation in North China Revisited? A Preliminary Statistical Analysis to Validate Non-Equilibrium Range Ecology. *Journal of Development Studies* **37,** pp. 99-133

Hoffman,M.T., Magole, L., Wyn Jones, R. G., Young, E. M., Peterson, A., Arntzen, J., & Majoro, M. (1998) Global Change and Subsistence Rangelands in Southern Africa: An Outline of a European Funded Project. *Communal Rangelands in Southern Africa: A Synthesis of Knowledge* (eds de Bryn,T.D. & Scogings,P.F.), pp. 30-37.

Department of Livestock and Pasture Science, University of Fort Hare, Alice, South Africa

Hoffman,M.T. & Ashwell, A. (2001) *Nature Divided. Land Degradation in South Africa*. University of Cape Town Press, Cape Town

Holecheck,J.L., Pieper, R. D., & Herbel, C. H. (2001) *Range Management*, 4 edn. Prentice Hall, Upper Saddle River, NJ

Holling,C.S. (1973) Resilience and Stability of Ecological Systems. *Annual review of ecology and systematics* **4,** pp. 1-24

Holling,C.S. (1986) The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change. *Sustainable development of biosphere* (eds Clarke,W.C. & Munn,R.E.), Cambridge university press, Cambridge

Holling,C.S. & Meffe, G. K. (1996) Command and Control and the Pathology of Natural Resource Management. *Conservation Biology* **10,** pp. 328-337

Holling,C.S., Berkes, F., & Folke, C. (1998) Science, Sustainability and Resource Management. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* (eds Berkes,F. & Folke,C.), pp. 342-362. Cambridge University Press, Cambridge

Holling,C.S. (2001) Understanding the Complexity of Economic, Ecological and Social Systems. *Ecosystems* **4,** pp. 390-405

Holling,C.S., Gunderson L., & Peterson, D. (2002) Sustainability and panarchies. *Panarchy: understanding transformations in human and natural systems* (eds Gunderson L. & Holling,C.S.), pp. 63-102. Island Press, Washington

Holling,C.S., Gunderson L., & Ludwig, D. (2002) In Quest of a Theory of Adaptive Change. *Panarchy: understanding transformations in human and natural systems* (eds Gunderson L. & Holling,C.S.), pp. 3-24. Island Press, Washington

Holling,C.S. & Gunderson L. (2002) Resilience and Adaptive Cycles. *Panarchy: Understanding Transformations in Human and Natural Systems* (eds Gunderson L. & Holling,C.S.), pp. 25-62. Island Press, Washington

Hood, G.M. (2004) PopTools Version 2.6.2. Available online: http://www.cse.csiro.au/poptools

Houghton,D.H. & Walton, E. M. (1952) *Keiskammahoek Rural Survey Volume Two: The Economy of a Native Reserve*. Shuter ans Shooter, Pietermaritzburg

Houghton,D.H. (1956) *The Tomlinson Report: A Summary of the Findings and Recommendations in the Tomlinson Commission Report*. The South African Institute of Race Relations, Johannesburg

Houghton,R.A., Hackler, J. L., & Lawrence, K. T. (1999) The US Carbon Budget: Contribution from Land Use Change. *Science* **285,** pp. 574-578

Hughes T., Baird, A., Bellwood, D. R., Card, M. C. S., Folke, C., Grosberg, R., Hoegh-Guldberg, O., JacksonJ., Kleypas, J., Lough, J., Marshall, P., Nystrom, M., Palumbi, S., Pandolfi, J., & Rosen, B. (2003) Climate Change, Human Impacts, and the Resilience of Coral Reefs. *Science* **301,** pp. 929-933

Hulme,D. & Shepard, A. (2003) Conceptualising Chronic Poverty. *World Development* **31,** pp. 403-423

Hume,D. (1739) *A Treatise of Human Nature: Being an Attempt to Introduce the Experimental Method of Reasoning into Moral Subjects*. Published anonymously

IIED (2003) *Participatory Learning and Action*. IIED, London. Available online: http://www.iied.org/sarl/pla_notes/

Illius,A.W. & O'Connor, T. G. (1999) On the Relevance of Nonequilibrium Concepts to Arid and Semiarid Grazing Systems. *Ecological applications* **9,** pp. 798-813

IUCN (2000) *Ecosystem Management: The Ecosystem Approach*. Available online: http://www.iucn.org/themes/cem/ea/index.htm

Janssen,M.A. (2002) A Future of Surprises. *Panarchy: Understanding Transformations in Human and Natural Systems* (eds Gunderson L. & Holling,C.S.), pp. 241-260. Island Press, Washington

Janssen,M.A., Lebel, J., Norberg, G. D., Peterson, D., & Pritchard, R. (2002) Resilience management in social-ecological systems: a working hypothesis for a participatory approach. *Ecology and Society* **6,** pp. 14 available online: http://www.consecol.org/vol6/iss1/art14

Janssen,M.A., Anderies, J. M., & Walker, B. (2004) Robust Strategies for Managing Rangelands with Multiple Stable Attractors. *Journal of Environmental Economics and Management* **47,** pp. 140-162

Jassenoff,S., Colwell, R., Dresselhaus, s., Golden, W., Goldman, R., Greenwood, M., Huang, A., Lester, W., Levin, S., Linn, M., Lubchenco, J., Nicholson, R., Novacek, M., Roosevelt, A., Taylor, J., & Wexler, N. (1997) Conversations with the Community: AAAS at the Millennium. *Science* **278,** pp. 2066-2067

Jewitt, G. P. W. and Gorgens, A. H. M. Scale and model inferences in the context of integrated water resources management for the rivers of the Kruger National Park. 627/1/00. 2004. Pretoria, South Africa, Water Resources Commission.

Jodha,N. (2001) *Life on the Edge: Sustaining Agriculture and Community Resources in Fragile Environments*. Oxford University Press, New Delhi

Johannes,R.E. (1998) The case for data-less marine resource management: examples from tropical nearshore fisheries. *Trends in ecology and evolution* **13,** pp. 243-246

Johnson,S. (2004) The Tchumo Tchato Project in Mozambique: Community Based Natural Resource Management in Transition. *Rights, Resources and Rural Development: Community Based Natural Resource Management in Southern Africa* (eds Fabricius,C., Koch,E., Magome,H., & Turner,S.), pp. 210-222. Earthscan, London

Jones,S. (2002) Social constructionism and the environment: through the quagmire. *Global environmental change* **12,** pp. 247-251

Kapoor,I. (2002) The devils in the theory: a critical assessment of Robert Chambers' work on participatory development. *Third World Quarterly* **23,** pp. 101-117

Kay,J., Regier, H., Boyle, M., & Francis, G. (1999) An ecosystem approach for sustainability: addressing the challenge of complexity. *Futures* **31,** pp. 721-742

Kepe,T. (1997a) Communities, Entitlements, and Nature Reserves: Challenges for the Land Reform Programme in Rural South Africa. *IDS Bulletin* **28,** pp. 47-58

Kepe, T. Environmental entitlements in Mkambati: livelihoods, social institutions, and environmental change on the Wild Coast of the Eastern Cape. Research report No. 1. 1997b. Cape Town, Programme for Land and Agrarian Studies, University of Western Cape.

Kepe,T. (2002) The Dynamics of Cattle Production and Government Intervention in the Communal Areas of Lusikisiki District. *Cattle ownership and production in the communal areas of the Eastern Cape, South Africa* (ed Ainslie,A.), pp. 59-79. Programme for Land and Agrarian Studies: University of the Western Cape, Cape Town

Koch,E., Cooper, D., & Coetzee, H. (1990) *Water, Waste and Wildlife*. Penguin, London

Korten,D. (1980) Community Organization and Rural Development: A Learning Process Approach. *Public Administration Review* **40,** pp. 480-510

Kowero,G. (2003) The Challenge to Natural Forest Management in Sub-Saharan Africa Rural Development: Experiences from the Miombo Woodlands of Southern Africa. *8* (eds Kowero,G., Campbell,B., & Sumaila,U.R.), pp. -1. CIFOR, Jakarta, Indonesia

Kozeill,I. & Saunders, J. (2001) *Living off Biodiversity: Exploring Livelihoods and Biodiversity*. IIED, London

Kuchler,A.W. (1964) Potential Natural Vegetation of the Conterminous United States, New York. *American Geographical Society* **36,** pp. 156

La Cock,G.D., Palmer, A. R., & Everard, D. A. (1990) Re-Assessment of the Area and Conservation Status of Subtropical Transitional Thicket (Valley Bushveld) in the

Eastern CApe South Africa. *South African Journal of Photogrammetry* **15,** pp. 231-235

La Cock,G.D. (1992) *The Conservation Status of Subtropical Transitional Thicket, and Regeneration Through Seeding of Shrubs in the Xeric Succulent Thicket of the Eastern Cape.* PhD Dissertation, Rhodes University, South Africa

Lam,W.F. (2001) Coping with Change: A study of Local Irrigation Institutions in Taiwan. *World Development* **29,** pp. 1569-1592

Lambin,E.F. & et al (2001) The Causes of Land Use and Land Cover Change: Moving Beyond Myths. *Global environmental change* **11,** pp. 261-269

Latour,B. (1987) *Science in Action*. Harvard University Press, Cambridge

Latour,B. (1988) *The Pasteurisation of France*. Harvard University Press, Cambridge

Leach,M., Mearns, R., & Scoones, I. (1997) Environmental Entitlements: A Framework for Understanding the Institutional Dynamics of Environmental Change. *Institute of Development Studies,* IDS discussion papers **359,** pp. 39

Leach,M., Mearns, R., & Scoones, I. (1999) Environmental Entitlements: Dynamics and Institutions in Community Based Natural Resource Management. *World Development* **21,** pp. 225-247

Leach,M. & Fairhead, J. (2000) Fashioned forest pasts, occluded histories? International environmental analysis in West African Locales. *Development and change* **31,** pp. 35-59

Lehohla,P. (2001) *South Africa in Transition: selected findings from the October household survey of 1999 and changes that have occurred between 1995 and 1999*. Statistics South Africa, Pretoria

Lele,S. (2000) *Godsend, Slight of Hand, or just Muddling Through: Joint Water Management in India*. ODI, Available online: www.odifpeg.org.uk/publications/ policybriefs/nrp/nrp-53.pdf

etsoalo,E.M. & Rogerson, C. M. (1982) Rural "Development" Planning Under Apartheid: Betterment Planning in Lebowa, South Africa. *Geoforum* **13,** pp. 301-314

Levin,S.A. (1992) The problem of pattern and scale in ecology. *Ecology* **73,** pp. 1943-1967

Levin,S.A. (1999) *Fragile Dominion: Complexity and the Commons*. Perseus Books, Reading

Lingard M., Nivo, R., Rabakonandrianina, E., Rakotoarisoa, J. A., & Elmqvist, T. (2003) The Role of Local Taboos in Conservation and Management of Species: The Radiated Tortoise in Southern Madagascar. *Conservation and Society* **1,** pp. 223-246

Little,P.D. & Brokensha, D. W. (1987) Local Institutions, Tenure and Resource Management in East Africa. *Conservation in Africa: People, Policy and Practice* (eds Anderson,D. & Grove,R.), pp. 193-209. Cambridge University Press, Cambridge

Lovell,C., Mandondo, A., & Moriarty, P. (2002) The question of scale in integrated natural resource management. *Ecology and Society* **5,** pp. 25. Available online: http://www.ecologyandsociety.org/vol5/iss2/art25/

Low,B.A. & Rebelo, T. G. (1996) *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria

Ludwig,D., Walker, B., & Holling, C. S. (1997) Sustainability, stability, and resilience. *Ecology and Society* **1,** pp. 7. Available online: www.ecologyandsociety.org/vol1/iss1/art7/

MA (2003) *Millennium Ecosystem Assessment. Ecosystems and Human Well-being: A Framework for Assessment*. Island Press, London

Macnaghten,P. & Urry, J. (1998) *Contested natures*. Sage, London

Malthus,T. (1798) *An essay on the principle of population as it affects the future improvement of society*. Johnson, London

Manning,J. (2001) *Eastern Cape: South African Wild Flower Guide 11*. NBD/Paarl Print, Cape Town, South Africa

Manona,C. (1992) Local Government. *Development Studies* No. 55. Grahamstown: Institute of Social and Economic Research. *Local Responses to Political Policies and Socio-Economic Change in the Keiskammahoek District, Ciskei: Anthropological Perspectives* (eds de Wet,C., Manona,C., & Palmer,R.C.G.), Institute of Social And Economic Research, Grahamstown

Manona, C. The Collapse of the 'Tribal Authority' System and the Rise of the Civic Organisations. 1995. South Africa, Rhodes University. ISER Seminar Series.

Manona,C. (1998) The Decline in Significance of Agriculture in the Former Ciskei Community: A Case Study. *Communal rangelands in southern Africa: A synthesis of Knowledge* (eds de Bryn,T.D. & Scogings,F.), pp. 113-118. University of Fort Hare, Alice

Marindo-Rangana,R. (1995) Diagrams for Demographic Data Collection: Examples from Tembomvura, Zimbabwe. *PLA Notes* pp. 53-61. Available online: http://www.iied.org/sarl/planotes/pla_backissues/22.html

Martello,M. (2001) A Paradox of Virtue?: "Other" Knowledges and Environment-Development Politics. *Global Environmental Politics* **1,** pp. 114-141

Martinez-Alier,J. & Schlupmann, K. (1991) *Ecological Economics: Energy, Environment, Society*. Blackwell Publishers, United Kingdom

Mauro,F. & Hardison, P. D. (2000) Traditional Knowledge of Indigenous and Local Communities: International Debate and Policy Initiatives. *Ecological applications* **10,** pp. 1263-1269

Maxwell,D., Ahaideke, C., Levin, C., Armar-Klemesu, M., Zakariah, S., & Lamptey, G. M. (1999) Alternative Food-Security Indicators: Revisiting the Frequency and Severity of 'Coping Strategies'. *Food Policy* **24,** pp. 411-429

May, H. et al. Rural Livelihoods and Natural Resource Management in Semi-Arid areas of South Africa: Leleifontein Reserve, Namaqualand. Final project report. 1997. Cape Town, Surplus People Project.

May,R.M. (1977) Thresholds and Breakpoints in Ecosystems with a Multiplicity of Stable States. *Nature* **269,** pp. 471-477

McMaster,A. (2002) *GIS in Participatory Catchment Management : A Case Study in the Kat River Valley, Eastern Cape, South Africa.* Masters thesis, Rhodes University, South Africa

Meadows,D., Meadows, D., Randers, J., & Behrens, W. (1972) *The Limits to Growth*. Universe Books, New York

Mearns, R., Leach, M., and Scoones, I. The Institutional Dynamics of Community-Based Natural Resource Management: An Entitlements Approach. Presented at "Crossing Boundaries, the seventh annual conference of the International Association for the Study of Common Property". 1998. Vancouver, British Columbia, Canada.

Meentemeyer,V. (1989) Geographical perspectives of space, time, and scale. *Landscape Ecology* **3,** pp. 163-173

Mendoza,E. & Dirzo, R. (1999) Deforestation in Lacandonia (South east Mexico): Evidence for the Declaration of the Northern Most Tropical Hot Spot. *Biodiversity and Conservation* **8,** pp. 1621-1641

Mertens,B., Sunderlin, W. D., Ndoye, O., & Lambin, E. F. (2000) Impact of Macroeconomic Change on Deforestation in South Cameroon: Integration of Household Survey and Remotely-Sensed Data. *World Development* **28,** pp. 983-999

Midgley,J.J. & Cowling, R. M. (1993) Regeneration Patterns in Cape Subtropical transitional thicket: Where are all the Seedlings? *South African Journal of Botany* **59,** pp. 496-499

Milton,K. (1996) *Environmentalism and cultural theory:exploring the role of Anthropology in environmental discourse*. Routledge, London

Moleele,N.M., Ringrose, S., Matheson, W., & Vanderpost, C. (2002) More Woody Plants? The Status of Bush Encroachment in Botswana's Grazing Areas. *Journal of Environmental Management* **64,** pp. 3-11

Mortimore,A. (1998) *Roots in the African Dust: Sustaining the Sub-Saharan Drylands*. Cambridge University Press, Cambridge, U.K.

Mortimore,A. & Adams, W. (2001) Farmer Adaptation, Change and 'Crisis' in the Sahel. *Global environmental change* **11,** pp. 49-57

Moser,C., Norton, A., Conway, T., Ferguson, C., & Vizard, P. (2001) *To claim our Rights: Livelihood Security, Human Rights and Sustainable Development*. Overseas Development Institute, London

Motteux, N. The Development and Co-ordination of Catchment Fora Through the Empowerment of Rural Communities. 1014/1/01. 2001. Grahamstown, Water Research Commission, South Africa

Munda,G. (2000) Conceptualising and Responding to Complexity. *Environmental valuation in Europe: Policy research brief, number 2.* (eds Spash,C. & Carter,C.), Cambridge Research for the Environment, United Kingdom

Murphree, M. W. Boundaries and borders: the question of scale in the theory and practice of common property management. 2000. Bloomington, Indiana, USA. Eighth Biennial Conference of the International Association for the Study of Common Property. 6-4-0000.

Musters,C.J.M., De Graaf, H. J., & Ter Keurs, W. J. (1998) Defining Socio-Environmental Systems for Sustainable Development. *Ecological economics* **26,** pp. 243-258

Nadasdy,P. (1999) The politics of TEK: power and the 'integration' of knowledge. *Arctic Anthropology* **36,** pp. 1-18

Nori,M., Hirpa, A., & Ferrari, G. A. (1999) Complementary Methods to Understand Land-Use Changes: An Example from the Ethiopian Rift Valley. *PLA Notes* pp. 16-20. Available online: http://www.iied.org/sarl/pla_notes/pla_backissues/documents/plan_03504.PDF

North,D.C. (1990) *Institutions, Institutional Change and Economic Performance*. University Press, Cambridge

North,D.C. (1994) Economic Performance Through Time. *American Economic Review* **84,** pp. 359-368

Ntsebeza,L. (2002) Cattle Production in Xhalanga District. *Cattle ownership and production in the communal areas of the Eastern Cape* (ed Ainslie,A.), pp. 46-58. University of the Western Cape, Cape Town: Programme for Land and Agrarian Studies

Nystrom,M., Folke, C., & Moberg, F. (2000) Coral Reef Disturbance and Resilience in a Human-Dominated Environment. *Trends in ecology and evolution* **15,** pp. 413-417

O'Neill,R.W. & King, A. W. (1998) Homage to St. Michael: Or why are there so many books on scale? *Ecological scale: Theory and applications* (eds Peterson,D.L. & Parker,V.T.), Columbia University Press, New York

O'Riordan,T. & Jordan, A. (1999) Institutions, Climate Change and Cultural Theory: Towards a Common Analytical Framework. *Global environmental change* **9,** pp. 81-93

Obiri,J. & Lawes, M. (2000) The Sustainable Use of Timber and Non-Timber Forest Products: A Case-Study from Umzimvubu District, Pondoland, South Africa. *Natural Forest and Woodland Symposium II: Towards Sustainable Management Based on Scientific Understanding of Natural Forests and Woodlands* (eds Seydack,A.H.W., Vermeulen,W.J., & Vermeulen,C.), Department of Water Affairs and Forestry, Knysna

Olsson, P. and C. Folke, 2001: Local Ecological Knowledge and Institutional Dynamics for Ecosystem Management: A Study of Lake Racken Watershed, Sweden. *Ecosystems*, **4**, pp. 85-104

Olsson,P. (2003) *Building Capacity for Resilience in Social-Ecological Systems.* Doctorate Stockholm Univeristy

Ostrom,E. (1990) *Governing the Commons: The Evolution of Institutions for Collective Action*. University Press, Cambridge

Ostrom,E., Burger, J., Field, C. B., Norgaard, R. B., & Policansky, D. (1999) Revisiting the Commons: Local Lessons, Global Challenges. *Science* **284,** pp. 278-282

Ostrom,E. & Hess, C. (2000) *Private and Common Property Rights*. Center for the study of institutions, population, and environmental change, Indiana University, Indiana

Palmer,A.R. (1988) Aspects of the Vegetation and Soil Relationship in the Andries Vosloo Kudu Reserve, Cape Province. *South African Journal of Botany* **34,** pp. 309

Palmer, R. Rural Adaptations in the Eastern Cape, South Africa. Working paper, no. 11. 1997. Roma: Institute of Southern African Studies, National University of Lesotho.

Perkins,J.S. (1998) Making a Tragedy of the Commons: Fencing Communal Rangeland in Botswana. *Communal Rangelands in Southern Africa: A Synthesis of Knowledge* (eds de Bruyn,T.D. & Scogings,P.F.), pp. 3-14. Department of Livestock and Pasture Science, University of Fort Hare, Alice, South Africa

Persson,A. (1995) A Dynamic Computable General Equilibrium Model of Deforestation in Costa Rica. *Biodiversity conservation: problems and policies* pp. 215-235. Kluwer Academic, Dordrecht, The Netherlands

Peterson,G.D., Beard, D., Beisner, E., Bennett, S., Carpenter, G., Cumming, L., & Dent, H. T. (2003) Assessing Future Ecosystem Services: A Case Study of the Northern Highland Lake District, Wisconsin. *Ecology and Society* **7,** pp. 1. Available online: www.ecologyandsociety.org/vol7/iss3/art1/

Popper,K.R. (1968) *The Logic of Scientific Discovery*. Harper and Row, New York

Pretty, J., Guijt, I., Scoones, I., and Thompson, J. A Trainer's Guide for Participatory Learning and Action. 55-87. 1995. London, Sustainable Agriculture Programme. IIED Participatory Methodology Series.

Ramakrishnan,P.S. (2001) *Ecology and Sustainable Development*. National Book Trust, New Delhi, India

Rao,K.S. & Pant, R. (2001) Land Use Dynamics and Landscape Change Pattern in a Typical Micro Watershed in the Mid Elevation Zone of Central Himalaya. *Agriculture, ecosystems and environment* **86,** pp. 113-123

Raynaut,C. (1977) Lessons of a Crisis. *Drought in Africa* (eds Dalby,D., Harrison-Church,R.J., & Bezzaz,F.), pp. 12-32. International African Institute, London

Reath, J. Department of Agriculture and Land Affairs. D:/ArcView/District project/Amatola District.apr. 2001. Cradock.

Reid,H. & Turner, S. (2004) The Richtersveld and Makuleke Contractual Parks in South Africa: Win-Win for Communities and Conservation? *Rights, Resources and Development: Community Based Natural Resource Management in Southern Africa* (eds Fabricius,C., Koch,E., Magome,H., & Turner,S.), pp. 223-234. Earthscan, London

Reid,R.S., Kruska, R. L., Muthi, N., Taye, A., Wotton, S., Wilson, C. J., & Mulatu, W. (2000) Land-use and Land-cover Dynamics in Response to Changes in Climatic, Biological and Socio-political Forces: The Case of Southwestern Ethiopia. *Landscape Ecology* **15,** pp. 339-355

Rhodes & et al. (2002) Consolidated Report: Combining Scientific and Local Knowledge in the Eastern Cape. DWAF project RU1/100. Rhodes University, University of Transkei and Fort Cox College of Agriculture and Forestry, South Africa

Richards,M., Davies, J., & Cavendish, W. (1999) Can PRA Methods be Used to Collect Economic Data? A Non-Timber Forest Product Case Study from Zimbabwe. *PLA Notes* pp. 34-40: http://www.iied.org/sarl/pla_notes/pla_backissues/documents/plan_03607.PDF

Rohlin,S.M. & Batabyal, A. A. (in press) A Theoretical Perspective on Managed Rangelands and Irreversible States. *International Review of Economics and Finance*

Rouget,M., Richardson, D., Cowling, R. M., loyd, J., & Lombard, A. (2003) Current Patterns of Habitat Transformation and Future Threats to Biodiversity in Terrestrial

Ecosystems of the Cape Floristic Region, South Africa. *Biological Conservation* **112,** pp. 63-85

Rowley,J. (1999) Tips for Trainers: Matrix ranking of PRA tools. *PLA Notes* pp. 47-48. Available online: http://www.iied.org/sarl/pla_notes/pla_backissues/documents/plan_03609.PDF

Ruben, R., Kruseman, G., Kuyvenhoven, A., and Brons, J. Climate Variability, Risk-Coping and Agrarian Policies: Farm Households' Food Supply under Variable Rainfall Conditions. 2000. Wye College, UK, Contributed paper for the 74th EAAE Seminar. Livelihoods and Rural Poverty: Technology, Policy and Institutions.

Russel,T. (1997) Pair Wise Ranking Made Easy. *PLA Notes, IIED London* pp. 25-26

Rwelamira, J. and Kleynhans, T. SADC Agricultural Potential Assessment - Country Profiles. 1996. Halfway House, Development Bank of Southern Africa. Development Paper 124.

Sala,O.E., Chapin, F. S., Armesto, J. J., Berlow, E., Bloomfield, J., Dirzo, R., Huber-Sanwald, E., Huenneke, L. F., Jackson, R. B., Kinzig, A., Leemans, R., Lodge, D. M., Mooney, H. A., Oesterheld, M., Poff, N. L., Sykes, M. T., Walker, B., Walker, M., & Wall, D. H. (2000) Biodiversity: Global Biodiversity Scenarios for the Year 2100. *Science* **287,** pp. 1770-1774

Salmon,E. (2000) Kincentric Ecology: Indigenous Perceptions of the Human-Nature Relationship. *Ecological applications* **10,** pp. 1318-1326

Sandford,S. (1983) *Management of Pastoral Development in the Third World*. Wiley, Chichester

Sansom,B. (1974) Traditional Economic Systems. *The Bantu Speaking Peoples of Southern Africa* (ed Hammond-Tooke,W.D.), Routledge, London

SARB. South African Reserve Bank. 2004. Available online: www.reservebank.co.za .

Sarch,M.T. (2001) Fishing and Farming at Lake Chad: Institutions for Access to Natural Resources. *Journal of Environmental Management* **62,** pp. 185-199

Scheffer,M., Carpenter, S., Foley, J. A., Folke, C., & Walker, B. (2001) Catastrophic Shifts in Ecosystems. *Nature* **413,** pp. 591-596

Scheffer,M., Westley, F., Brock, W., & Holmgren, M. (2002) Dynamic Interaction of Societies and Ecosystems - Linking Theories from Ecology, Economy, and Sociology. *Panarchy: Understanding Transformations in Human and Natural Systems* (eds L.H.Gunderson & C.S.Holling), pp. 195-239. Island Press, Washington

Scherr,S.J. (2000) A Downward Spiral? Research Evidence on the Relationship between Poverty and Natural Resource Degradation. *Food Policy* **25,** pp. 479-498

Scholes,R.J. & Biggs, R. (2004) *Ecosystem Services in Southern Africa: The Regional-Scale Component of the South African Millennium Ecosystem Assessment*. CSIR, Pretoria, South Africa

Scholes,R.J. (2004) Woodlands of South Africa. *Indigenous Forests and Woodlands in South Africa* (eds Lawes,M.J., Eeley,H., Shackleton,C., & Geach,B.), pp. 3-29. University of Kwa-Zulu-Natal Press, Pietermaritzburg

Schulze,R. (2000) Transcending Scales of Space and Time in Impact Studies of Climate Change on Agrohydrological Responses. *Agriculture, ecosystems and environment* **82,** pp. 185-212

Scoones,I. (1995) *Living with Uncertainty: New Directions in Pastoral Development in Africa*. Intermediate Technology Publications, London

Scoones,I. (1997) The Dynamics of Soil Fertility Change: Historical Perspectives on Environmental Transformation from Zimbabwe. *The Geographical Journal* **163,** pp. 161-169

Scoones,I. (1998) *Sustainable rural livelihoods: A framework for analysis.* Institute for Development Studies, UK

Sen,A.K. (1981) *Poverty and Famines: An Essay on Entitlements and Deprivation*. Clarendon, Oxford

Sen,A.K. (1999) *Development as Freedom*. Oxford University Press, Oxford

Shackleton,C., Shackleton, S., & Cousins, B. (2001) The Role of Land-Based Strategies in Rural Livelihoods: The Contribution of Arable Production, Animal Husbandry and Natural Resource Harvesting in Communal Areas in South Africa. *Development Southern Africa* **18,** pp. 581-599

Shackleton,C., Grundy, I., & Williams, A. (2004) Use of South Africa's Woodlands for Energy and Construction. *Indigenous Forests and Woodlands in South Africa: People, Policy and Practice* (eds Lawes,M., Eeley,H., Shackleton,C., & Geach,B.), pp. 337-366. University of Kwa-Zulu Natal Press, Pietermaritizberg, South Africa

Shackleton,S., Shackleton, C., & Cousins, B. (2000) *Re-valuing the Communal Lands of Southern Africa: New Understandings of Rural Livelihoods*. Overseas Development Institute, London

Shackleton,S., Shackleton, C., Netshiluvhi, T., Geach, B., & Ballance, A. (2000) How Valuable are our Woodlands for Sustainable Rural Livelihoods? Local-Level Valuation of Woodland Resources from Three Villages in South Africa. *Natural Forest and Woodlands Symposium II: Towards Sustainable Management Based on Scientific Understanding of Natural Forests and Woodlands* (eds Seydack,A.H.W., Vermeulen,W.J., & Vermeulen,C.), Department of Water Affairs and Forestry, Knysna

Shackleton, S. and Campbell, B. Devolution in Natural Resources Management: Institutional Arrangements and Power Shifts. A synthesis of case studies from Southern Africa. 690-0251. 2001. Grahamstown, South Africa, CSIR.

Shand, N. Eastern Cape Water Resources Situation Assessment. NS Report No. 3018/7160. 1999. Department of Water Affairs and Forestry.

Sibanda,B. (1997) Governance and the Environment: The Role of African Religion in Sustainable Utilization of Natural Resources in Zimbabwe. *Firest, Trees and People Newsletter* **38,** pp. 8

Sithole, B. Where the Power Lies: Multiple Stakeholder Politics Over Natural Resources. A Participatory Methods Guide. 2002. Indonesia, Center for International Forestry Research.

Sithole,B. (2004) New Configurations of Power around Mafungausti State Forest in Zimbabwe. *Rights, Resources and Development: Community Based Natural Resource Management in Southern Africa* (eds Fabricius,C., Koch,E., Magome,H., & Turner,S.), pp. 259-270. Earthscan, London

Snel,E. & Staring, R. (2001) Poverty, Migration, and Coping Strategies: An Introduction. *Focaal: European Journal of Anthropology* **38,** pp. 7-22

Sokal, R. R. & Rohlf, F. J. (1995) Biometry. *The Principles and Practice of Statistics in Biological Research.* W.H. Freeman and Company, New York.

South African Government (2004) *Address to the National Assembly by the Minister of the National Treasury, Trevor Manuel: Budget Speech, 18 February*.

Sporton,D., David, T., & Morrison, J. (1999) Outcomes of Social and Environmental Change in the Kalahari of Botswana: The Role of Migration. *Journal of Southern African Studies* **25,** pp. 441-460

Statistics South Africa, (1993). National Population Census, Bisho

Statistics South Africa, (2001). National Population Census, Bisho

Statsoft, 2003. Statistica. Statsoft Inc., Tulsa, USA

Swynnerton,R.J.M. (1954) *Plan to Intensify the Development of African Agriculture in Kenya*. Colony and Protectorate of Kenya, Nairobi

Symanski,R. (2004) Contested realities: feral horses in outback Australia. *Annals of the Association of American Geographers* **84,** pp. 251-269

Theis,J. & Grady, H. (1991) *Participatory Rapid Appraisal for Community Development*. International Institute for Environment and Development, London, UK

Thomas,E.P., Seager, J. R., & Mathee, A. (2002) Environmental Health Challenges in South Africa. *Health and Place* **8,** pp. 251-261

Tiffen,M., Mortimore, M., & Gichuki, F. (1994) *More People Less Erosion: Environmental Recovery in Kenya*. John Wiley and Sons, Chichester

Tilly,C. (1984) *Big Structures, large processes, huge comparisons*. Russell Sage Foundation, New York

Timmermans,H. (2000) Reconciling Conservation and Rural Development: Social and Ecological Dynamics of Forest Resource Harvesting in the Cwebe Nature Reserve. *Natural Forest and Woodland Symposium II: Towards Sustainable Management Based on Scientific Understanding of Natural Forests and Woodlands* (eds Seydack,A.H.W., Vermeulen,W.J., & Vermeulen,C.), Department of Water Affairs and Forestry, Knysna

Timmermans,H. (2004) *Rural Livelihoods at Dwesa/Cwebe: Poverty, Development and Natural Resource Use on the Wild Coast, South Africa.* Masters thesis, Rhodes University, South Africa

Todd,C.B., Khorommbi, K., van der Waal, B. C., & Weisser, P. J. (2004) Conservation of Woodland Biodiversity: A Complementary Traditional and Western Approach towards Protecting *Brackenridgea zanguebarica*. *Indigenous Forests and Woodlands in South Africa: Policy, People and Practice* (eds Lawes,M., Eeley,H., Shackleton,C., & Geach,B.), pp. 737-752. University of Kwa-Zulu-Natal Press, Pietermaritzburg

Tongway,D. & Ludwig, J. (1997) The Conservation of Water and Nutrients within Landscapes. *Landscape ecology, function, and management: principles from Australia's rangelands* (eds Fruendenberger,D., Nobel,J., & Hodgkinson,K.), pp. 13-22. CSIRO Publishing, Collingwood, Victoria, Australia

Turner,B.L., Clark, W. C., Kates, R. W., Richards, J. F., Mathews, J. T., & Meyer, W. B. (1990) *The Earth as Transformed by Human Action: Global and Regional Changes in the Biosphere Over the Past 300 Years*. Cambridge University Press, Cambridge

Turner,S. (2004) Community Based Natural Resource Management and Rural Livelihoods. *Rights, Resources and Rural Development: Community Based Natural Resource Management in Southern Africa* (eds Fabricius,C., Koch,E., Magome,H., & Turner,S.), pp. 44-65. Earthscan, London

Twyman,C. (2001) Natural resource use and livelihoods in Botswana's Wildlife Management Areas. *Applied Geography* **21,** pp. 45-68

van der Heijden,K. (1996) *Scenarios: the art of strategic conversation*. John Wiley, New York

van der Leeuw,S. (2000) Land Degradation as a Socio-Natural Process. *The Way the Wind Blows: Climate, History, and Human Action* (eds McIntosh,R.J., Tainter,J.A., & McIntosh,S.K.), pp. 357-383. Columbia University Press, New York

Vásquez-León,M., West, C. T., & Finan, T. J. (2003) A comparative assessment of climate vulnerability: agriculture and ranching on both sides of the US–Mexico border. *Global environmental change* **13,** pp. 159-173

Veldkamp,A. & Lambin, E. F. (2001) Predicting Land-use Change. *Agriculture, ecosystems and environment* **85,** pp. 1-6

Vitousek,P.M., Mooney, H. A., Lubchenco, J., & Melillo, J. M. (1997) Human Domination of Earth's Ecosystems. *Science* **277,** pp. 494-499

von Bertalanffy,L. (1968) *General systems theory*. George Brazilier, New York

von Kotze,A. (1998) Monologues or dialogues? Missed learning opportunities in participatory rural appraisal. *Convergence* **31,** pp. 47-46

Wack,P. (1985) Scenarios: Shooting the Rapids. *Harvard Business Review* **63,** pp. 138-150

Walker,B., Ludwig, D., Holling, C. S., & Peterman, R. M. (1967) Stability of Semi-Arid Savanna Grazing Systems. *Ecology* **69,** pp. 473-98

Walker,B. & Abel, N. (2002) Resilient Rangelands - Adaptation in Complex Systems. *Panarchy: Understanding Transformations in Human and Natural Systems* (eds Gunderson L. & Holling,C.S.), pp. 293-313. Island Press, Washington

Walker,B., Carpenter, J., Anderies, N., Adel, G., Cumming, M., Lebel, J., Norberg, G. D., Peterson, G. D., & Pritchard, R. (2002) Resilience Management in Social-

Ecological Systems: A Working Hypothesis for a Participatory Approach. *Ecology and Society* **6,** pp. 14. Available online: www.ecologyandsociety.org/vol6/iss1/art14/

Walker,B. (2002) Ecological Resilience in Grazed Rangelands: A Generic Case Study. *Resilience and the Behaviour of Large-Scale Systems* (eds Gunderson L. & Pritchard,L.), pp. 183-193. Island Press, Washington

Walters,C. (1986) *Adaptive Management of Renewable Resources*. MacMillan, New York

Water Services Act. 108. 1997. Department of Water Affairs and Forestry, South Africa

Westley,F. (2002) The Devil in the Dynamics: Adaptive Management on the Front Lines. *Panarchy: Understanding Transformations in Human and Natural Systems* (eds Gunderson L. & Holling,C.S.), pp. 333-360. Island Press, Washington

Westoby,M., Walker, B., & Noy-Meir, I. (1989) Opportunistic Management for Rangelands Not at Equilibrium. *Journal of Rangeland Management* **42,** pp. 266-274

White,L.J. (1967) The Historical Roots of our Ecological Crisis. *Science* **155,** pp. 1203-1207

Whyte,A. (1995) *Building a New South Africa: Environment, Reconstruction and Development*. International Development Research Centre, Ottawa, Canada

Wicken,J.S. (1987) *Evolution, thermodynamics, and information: extending the Darwinian program*. Oxford University Press, Oxford

Wiggins,S. (1995) Changes in African Farming Systems Between the Mid-1970's and the Mid-1980's. *Journal of International Development* **7,** pp. 807-848

Wigley,T. (1998) Communal Rangelands from a Community Perspective. Some insights gained through PRA in the Eastern Cape. *Communal Rangelands in Southern Africa: A synthesis of Knowledge* (eds de Bryn,T.D. & Scogings,P.F.), pp. 105-110. Department of Livestock and Pasture Science, University of Fort Hare, Alice

Wilbanks,T. & Kates, R. W. (1999) Global Change in Local Places: How Scale Matters. *Climatic Change* **43,** pp. 601-628

Wilcoxon, F. (1945) Individual Comparisons by Ranking Methods. *Biometrics Bulletin* **1**, 80-83

Williams,T.O. (1998) Multiple Uses of Common Pool Resources in Semi Arid West Africa: A Survey of Existing Practices and Options for Sustainable Management. *Natural Resouces Perspectives ODI* **Number 38**

Wilson,A.D. & Tupper, G. J. (1982) Concepts and Factors Applicable to the Measurement of Range Condition. *Journal of Rangeland Management* **35,** pp. 684-689

Wollenberg,E. & Ingles, A. (1998) *Incomes from the Forest: Methods for the Development and Conservation of Forest Products for Local Communities*. CIFOR, Bogor

Wood,E.F. & Lakshmi, V. (1993) Scaling water and energy fluxes in climate systems: three land-atmosphere modelling experiments. *Journal of Climate* **6,** pp. 839-857

Woodley, E., Ericksen, P., Reid, W., Cundill, G., Vicente, L., Raudsepp-Hearne, C., Mogina, J., Olsson, P. (forthcoming). Using Multiple Knowledge Systems in Sub-global assessments: Benefits and Challenges. In: *Multi-Scale Assessments: Findings of the Sub-Global Assessment Working Group (Millennium Ecosystem Assessment)*. Island Press, Washington.

Worster,D. (1988) The ends of the earth: Perspectives on modern environmental history. Cambridge University press, Cambridge

Zimmerer,K. (2000) The Reworking of Conservation Geographies: Nonequilibrium Landscapes and Nature-Society Hybrids. *Annals of the Association of American Geographers* **90,** pp. 356-369

Appendix 1: Description of Methods

This appendix provides detailed descriptions of the various techniques used throughout this research, in addition to the information provided in Chapter 1, and Chapters 3, 4 and 5.

1.1 Participatory Learning and Action

Participatory Learning and Action (PLA) workshops were set up through the forestry committees in the villages of Machibi and Qongqota at Mt Coke. Meetings were held three weeks prior to the beginning of the workshops to ensure buy-in and support from the village chairperson and the forestry committee who was nominated to help the research team. When the different themes of water, fuelwood, food, agriculture and livestock were explained, the committee suggested a woman's group to discuss the first three themes, and a male group to discuss the final two. This would also ease the pressure on the participant's time as the groups could be split and dealt with on different fieldtrips, thereby giving one group a break at a time. This was agreed, and in the end each group consisted of six – eight people of mixed age categories, usually three older members, and then a range of age groups from 20 – 40 years.

Before any exercises began, the idea of indicators of change, and of drivers of change, was explained carefully to participants. It was explained for example that when someone is driving a car and wants to turn the corner, that person turns on the indicator. This indicator informs other people that the car is about to turn, but the indicator itself does not turn the car. The driver turns the car. The indicator helps those around the car by informing them in which direction the car is turning. It was then explained that the key themes of water, fuelwood, food, agriculture and livestock were indicators of change, but what we all really need to know is who the driver of the car is. These indicators could help us to identify in which direction the village is going, and hopefully tell us who is driving the car.

Each of the techniques used is discussed below. Many of these techniques were used for more than one exercise, therefore illustrative examples of how the exercises were conducted are provided, rather than exhaustive examples of every exercise.

Time series free-hand land use mapping

Maps are a powerful visual tool that can be used to convey a great deal of information quickly and effectively from local level actors to politicians and others outside of the local context (Alcorn, 2000). Free hand maps were used in this instance to demonstrate the different land uses in each village. Participants were asked to think very carefully about the lay out of the village as it is at the moment, considering residential areas, water bodies, arable fields, grazing lands, forests and any other important land uses in the village. Participants were then asked to provide a list of important dates or periods when significant changes occurred in the distribution of these different land uses.

Once dates had been highlighted and explanations provided, these dates were placed on a piece of flip chart. Certain years were then grouped together because the participants felt that three key maps would illustrate the changes that occurred. The groups were then divided into two and the older group drew the 1947 map, the younger members drew the 2003, and the whole group participated in drawing the 1958 map. Before commencing with the drawing of the maps, both groups were asked to agree on three or more key features that each map should have on it so that changes could be identified and the maps be comparable. The features selected included a large river, a bridge within the village, and a historical ruin.

Interactive role-playing

This method is extremely useful in creating a relaxed atmosphere, and provides participants with the opportunity to ask questions about where the facilitators come from too, rather than a one-way exchange. This is an important starting point, and was used during the initial stages of the PLA workshops to familiarize the facilitators and the workshop participants with one another.

The first step was to explain very carefully to participants what was about to happen – that the facilitators were going to pretend to be from that village, and would tell them all about their lives. Participants were encouraged to interrupt whenever they heard something that was incorrect. The facilitators were then expected to change their story and include these changes. After this, the roles would change, and the participants would pretend to come from the city, and the facilitators would correct them.

The next step was the role-play itself. Facilitators pretended that they are from the community; they told participants all about their lives in the village, how they collected water, fuel, food, what their troubles were, and what their joys were. Participants interrupted whenever the facilitators made a mistake. The roles were then reversed, and participants pretended that they were from an urban area. They were asked to explain to the facilitators what their everyday life is like, how they got water, the problems they faced, how they cooked, etc. Facilitators interrupted whenever the story is wrong. In the end each side had a good idea of what life was like for all involved.

Pie charts

Although pie charts were used in various aspects of the study, this section will use the example of using pie charts to demonstrate the changing importance of different land uses relative to one another over time.

The first step was illustrating what a pie chart was. In order to do this, the team made the analogy of a bowl of ‘samp and beans’ (a traditional Xhosa meal consisting of beans, maize, gravy and vegetables). It was explained that nobody makes samp and beans like your mother/wife, and everyone makes it differently. To some people beans are the most important ingredient, to others vegetables are the most important, to still others gravy is the most important ingredient. This was then illustrated in a pie chart, with facilitators pretending to argue about how bigger slice of the pie should be allocated to gravy. This analogy proved very successful, and participants quickly understood what was expected in the exercise.

Once everyone was comfortable, participants were asked to start by listing all the different land uses in the village, both past and present (taken from the previous exercise). Participants were then asked to list the key dates when the importance attached to these land uses changed. Participants suggested that they only needed to do two pie charts, one for 1947 and one for 2003. This they explained by suggesting that the change had been very gradual, and therefore a pie chart for 1960 would not show much at all. Once again, the group was divided into two, with the younger participants doing the pie for 2003, and the older members doing the pie for 1947. After both pie charts had been completed, the two groups rejoined and presented the pie charts to one another, with corrections being made by those who were not involved in the other exercise.

Ranking

Ranking exercises were used in conjunction with pie chart exercises in many instances. A useful example to demonstrate how ranking works is the exercise conducted to determine the daily division of time amongst women. Participants were asked first to list all their daily activities. Once this had been done, a pair-wise comparison was conducted for each item on the list. In this way, the activity that was placed first in the list by the end of the exercise represented the most time consuming activity, and the last in the list the least time consuming. This exercise was also conducted with fuelwood species to identify the most and least preferred species.

Trendlines

Trendlines were used many times to demonstrate trends in resource use, resource management, ecosystem health, co-operation between farmers, and so on. The example of the trendline constructed to illustrate changes in the number of fields cultivated provides a useful illustrative example.

Community members were first asked to suggest the years for which they clearly remembered changes in the number of fields cultivated by community members. The idea of an "indicator" was revisited (see above), and the example of the farmers association applying for a fence was suggested as an indicator that farmers were very

active during that time. Participants then provided several dates, and debate was encouraged over which were the most important dates that could demonstrate the trends that they were talking about. The earliest date identified was then written on a piece of card and placed on the ground. A group discussion was held during which participants agreed on the key dates to be used in the exercise. These dates were then written on card and placed on the floor in chronological order. Discussion was then again encouraged about field cultivation during the period, with particular emphasis being placed on the *changes*. The final step involved placing stones next to each date, many stones representing many fields and fewer stones representing fewer fields.

Matrices

Matrix exercises were used several times throughout PLA workshops, for example to demonstrate innovations in farming, sources of food, the types of livestock kept and the reasons for doing so, and so on. The innovation matrix provides a useful example of how a matrix exercise is conducted.

The Matrix tables were always drawn prior to an exercise, as this is a time consuming task and requires 4 – 6 pieces of large chart paper that are taped together. The table was always blank when the exercise commenced. The next step was to explain the purpose of the exercise, followed by a discussion about the term 'innovation' within the group. Much discussion was needed to clarify what exactly an innovation was as the Xhosa word equivalent could not be found. It was stressed that an innovation was not just something introduced by outsiders, but rather that innovations are made all the time by local people in order to cope with specific situations. Once satisfied that the group was comfortable, they were asked to list innovations that had occurred in farming in the village. This list was placed down the left had side of the table.

The next step was to place the key variables horizontally along the top row of the matrix. In this case, these variables included; when was the innovation introduced, who introduced it, why was it needed, how did it affect farming practices, and so on. Participants were then asked to indicate (either through the use of stones, or pictures, or ticks/crosses) the relationship between each variable. For example, for each type of innovation, they were asked who introduced it, why it was needed, etc.

In matrices, multiple variables exist, and therefore it is often useful to combine the exercise with a ranking exercise. For example, during the livestock matrix exercises, this additional step was to rank the importance of each reason for keeping a particular type of livestock. The question could be, for example, what is the most important reason for keeping cattle (and then sheep, and then goats)? The answers were then indicated with a star in the appropriate cell.

Seasonal calendars

Seasonal calendars were used to indicate changes in the amount of water utilised from natural streams, the crops grown at different times of the year in home gardens, as well as changing levels of reliance on woodland resources such as fuelwood at different times of the year.

The first step in this exercise was to place the topic under consideration, for example fuelwood use, in the left hand column of the table. The next step was to place the seasons, or the months of the year, in the top row of the table. Stones were then used to illustrate how the given theme changes over the year. For example, when talking about rainfall, stones can be used in a very similar way to trend lines (see previous explanation), more stones indicating more rainfall and visa versa. When talking about crops, pictures can be drawn to illustrate the various crops grown in each season or time of year, as was done with the home garden seasonal calendars.

The home garden seasonal calendars were developed as part of local school projects with Grade 8 learners. A drama team conducted a training session (2 hours) with the learners involved, teaching them how to make a seasonal calendar. The children then went home and developed the calendar with their parents, showing not only the types of crops cultivated, but also the times of year that each is cultivated. Learners were encouraged to be as creative as they liked with calendars, and prizes were awarded for the most detailed and beautiful calendars.

Timelines

Timelines are chronologies of events, and represent the major remembered events in a community with approximate dates (Chambers, 1992). At the beginning of each four-day workshop with a given group, a timeline was placed on the wall. It was explained that this was not an exercise on its own, but that important dates would be added as the workshop progressed. On the final day of workshops, the timeline was returned to and the results discussed in a group discussion.

Group discussions

Group discussions are useful exercises to both introduce new topics, and to get participants involved in thinking critically about key issues. More often than not, group discussions form part of various other methods (Chambers, 1992). In this case, group discussions were often combined either with timeline exercises, are used to introduce a given theme. On the final day of a set of workshops, the timeline that had been developing over the course of the week was returned to. Participants were asked to consider the timeline, and then to discuss what they felt was causing change in the village. The idea of drivers and of indicators was returned to.

Key informant and focus group interviews

Key informants were identified through a snow-ball technique, where names mentioned during workshops, other interviews, or casual interactions, were followed up and the individuals contacted. Key informants ranged from local shop owners discussing the changing economic situation of local people, to government officials discussing service provision and policy. Key informant interviews are useful in assessing the more sensitive issues of social relations, including how power and authority operate (Department for International Development, 2000). Semi-structured interviews involve lists of questions to be addressed by knowledgeable individuals or groups of knowledgeable individuals in a relaxed and informal way (Borrini-Feyerabend, 1997). Key informant and focus group interviews can entail having either a written or mental checklist, or they can be open-ended (Chambers, 1992).

Venn diagrammes

A Venn diagram exercise was conducted in both villages, and although directly aimed at identifying institutional and organisational factors affecting common pool natural resource management, the purpose was three-fold. Firstly, it aimed at identifying all the institutional actors (organisations) both inside and outside the village that could have an impact on the management of natural resources. The second was to identify which organisations had overlapping roles. The final, and possibly the most important, was to identify which organisations the community members felt had the most amount of power, and therefore the greatest capacity to influence the success or failure of common pool natural resource management.

The first step was to ask participants to list all the organisations that existed and had an influence in their village. They were asked to include those that were outside of the community, but that had an influence within the community. It was then explained that a large circle drawn on a piece of flip chart paper would represent the whole community. Each organisation was to be represented in the form of a circle within the bigger circle. The larger the impact that the organisation had on the village, the larger its circle should be. Where organisations worked together their circles should overlap, and where they had little contact their circles should be separated.

Participatory analysis of aerial and orthographic photographs

A 1:10 000 orthophoto was printed and laminated. The first step was for participants to get associated and comfortable with the map. To do this, members were first asked to look at the map and to point out key features that they recognised. Once comfortable with this, everyone moved outside and the different features were pointed out in the landscape. Participants were given different coloured pens, and the idea of a "map key" was explained to them. It was explained that a map with lots of colours drawn on it was like a locked door. A stranger looking at the map would not understand what they were looking at. Therefore a key was needed that would allow a stranger to open the door. Numbers were allocated for the different water uses, while different colours and patterns were given to the different land uses, including past land uses and abandoned fields.

Polygons where extracted from the maps made during these participatory mapping workshops, and captured using ArcView 3.2 at a scale of less than 1:2500. The orthophoto was projected in Transverse Mercator with WGS84 Datum.

1.2 Household surveys

Household surveys were used to test the information that came out of the PLA workshops. Where key or important statements were made, these were tested through household surveys. A total of 70 households were sampled, 36 in Machibi and 34 in Qongqota. The intention was that the surveys be used as an opportunity to involve local schools, and to share the information with younger members of the community. Therefore, "they do-it" household survey techniques were employed where community participants conduct the research, for example; interviews, transects, and observations (Chambers, 1992). This technique can prove very useful in getting local schools involved. School pupils benefit through translation and survey skills, while the research team gains through a random and often larger sample size that is less time consuming. The seasonal calendars described above were one such exercise, and household-based resource surveys were another.

Household-based resource surveys

Surveys were used to identify the most commonly used fuelwood species, the number of households with rainwater tanks and the reasons for purchase, and the crops cultivated in home gardens. This was intended to test results from PLA workshops. Schools were invited to take part in the surveys through school projects where grade 8, 10, and 12 learners would conduct the surveys and thereby gain experience in Xhosa-English translation, data sheet management and administering a questionnaire. After the surveys were completed, a computers were donated to the schools, and book prizes awarded for the most comprehensive datasheets.

1.3 Historical profiling

Historical records containing or referring to census data, local land use descriptions, national and regional agricultural conditions, Ciskei agricultural data, and

governmental policy information were employed in a snow-ball fashion to either validate, dispute, or extend the information gathered during PLA workshops. These records were obtained from the Cory Library in Grahamstown, Statistics South Africa in Bisho, the Department of Agriculture in Bisho, Local Government in Bisho, the Department of Agriculture in King Williamstown, the Mt Coke Hospital, and from the former Headmen and Chairmen of the villages involved.

1.4 Transect walks

Transect walks were used to determine the validity/accuracy of local knowledge about key fuelwood species, and to further triangulate the findings from group workshops and the household surveys. Three transect walks were conducted in each village. The emphasis was on fuelwood species, and therefore willing members of the female user groups were taken along as guides. The intention was to observe the accuracy of individuals' knowledge about the key species identified in other exercises. Thus, participants were asked to find samples of the species previously listed and discussed in the ranking and trend-line exercises. The Xhosa names provided by participants were recorded, and the samples collected were then formally identified, and local names assigned by participants compared with documented Xhosa names of the same species. The Samples thus collected are stored in the Grahamstown herbarium.

1.5 Analysis of historical orthographic photographs

1:10 000 orthographic photographs from 1979 were compared with more recent photographs from 1998 to evaluate local claims that tree cover in the woodlands had increased in recent years. Due to time and resource constraints, comparisons were done manually by the researcher using a regular 1 cm^2 grid to assess the proportion of tree cover by assigning percentage cover in each cell in four selected woodland patches; two in Qongqota and two in Machibi. A percentage figure was arrived at by adding the values assigned to each cell together, and determining a percentage value of tree cover for each woodland.

	codes	Arable fields?	Cultivated this year?	when last?	reason
1	arable fields?	1	1		0
2	1 = yes	2	2		1
3	2 = no	2	2		4
4		2	2		1
5	cultivated this year?	2	2	2001	6
6	1 = yes	2	2		1
7	2 = no	1	1		0
8		2	2		2
9	reason for not cultivating	1	2	2002	2
10	0 - they are cultivating	2	2		1
11	1 - dont own land	2	2	1988	2
12	2 - dont own oxes	2	2		1
13	3 - waiting for schools to close	1	2	1987	6
14	4 - cant afford tractors	1	2	2001	6
15	5 - too old, no assistance	1	2	2002	6
16	6 - combination of 2, 4, 5	1	2	1998	6
17		1	1		0
18		1	2	2000	4
19		1	2	2002	3
20		2	2		1
21		2	2		1
22		1	1		0
23		1	1		0
24		2	2		1
25		2	2		1
26		2	2		1
27		2	2		1
28		1	1		0
29		1	1		0
30		1	1		0
31		1	1		0
32		2	2		1
33		2	2		1

Appendix 2: Results from household surveys in Qongqota to determine the number of households with arable fields, the number actually cultivating these fields, and the reasons for not cultivating

Appendix 3: Frequency table showing results from household surveys in Machibi and Qongqota to determine the number of households that have home gardens, the number currently cultivating, and the reasons for not cultivating

	codes	kitchen garden? Machibi	kitchen garden? Qongqota	cultivated? Q	when last cultivated?	reason
1		1	1	1		
2		1	1	1		
3	yes - 1	1	1	1		
4	no - 2	1	1	1		
5		1	1	1		
6	reason:	1	1	1		
7	1 - no fences	1	1	2	2002	1
8	2 -materials too expensive	1	1	1		
9	3 - no assistance	1	1	1		
10		1	1	1		
11		1	1	1		
12		1	1	2	2002	2
13		1	2	2	1998	3
14		2	1	2	2002	2

15	1	1	1		
16	1	1	2	2002	3
17	1	1	1		
18	2	1	1		
19	1	1	1		
20	1	1	1		
21	1	1	1		
22	1	1	1		
23	1	1	2	1992	0
24	1	1	1		
25	1	1	2	2002	1
26	1	1	2	2001	2
27	1	2	2	0	0
28	1	1	1		
29	1	1	1		
30	1	1	1		

31	1	1	1
32	1	1	1
33	1	1	1
34	1		
35	1		
36	1		
37	1		
38	1		

Appendix 4: Frequency table showing results from a household survey in Machibi to determine the variety of crops cultivated in home gardens

	codes	Carrots	Maize	Cabbage	Turnip	Onion	Spinach	Parsley	Peppers	Beetroot	Marrow	Tomato	Potatoes	Butternut	Pumpkin	Apple	Pear
1		23	20	22	8	17	22	2	7	15	2	21	21	11	16	8	4
2	n=28																

	Banana	Mango	Beans	Peach	Pineapple	Chillies	Cucumber	Grapes	Lemons	Oranges	Strawberries	Watermelon	Spanspek	Avocado	Paw paw
1	8	2	9	5	10	7	4	6	1	9	6	7	1	2	1
2															

	Sweet potatoe	Cauliflower	Kiwi fruit	Guava	Peas
1	4	2	1	2	2
2					

Appendix 5: Results form a household survey to determine the number of households with a fuelwood pile, the average number of species in the piles, the most common species, second most common species, the species that would have been most common in the past, the size of the pile in the past, and the reasons for this

	codes	woodpile ?	no. of species?	most common?	second most common	past most common	past size	reason
1	Woodpile:	1	2	1	2	3	1	1
2	1 = yes	1	1	1	1	7	1	1
3	2 = no	2	0	0	0	4	1	1
4		2	0	0	0	1	1	4
5	no. of species:	1	3	1	2	10	1	5
6	no. of different	1	5	1	2	12	1	1
7	species identified	1	3	1	3	3	1	5
8		2	0	0	0	1	1	2
9	Most common	2	0	0	0	1	1	2
10	species: name	1	3	1	4	1	1	2
11	1 - umnga	1	5	1	5	4	1	2
12	2 - isiphingo	1	1	1	1	2	1	2
13	3 - umthathi	1	2	1	5	1	1	1
14	4 - ipandeshe	2	0	0	0	1	1	1
15	5 - umthole	1	2	1	1	1	1	1
16	6 - umqwashu	1	1	1	1	12	1	1

17	7 - umnquma	1	2	1	1	4	1	2
18	8 - umseliyana	1	4	1	6	1	1	1
19	9 - gum tree	1	5	1	2	4	1	1
20	10 - umqaqoba	1	3	1	2	4	1	1
21	11 - umbombemfene	2	0	0	0	1	1	1
22	12 - umbhongisa	1	1	1	1	1	1	1
23	13 - intsinde	2	0	0	0	0	0	0
24		1	1	1	1	4	1	2
25		1	5	1	7	7	1	1
26	bigger = 1	2	0	0	0	1	1	1
27	smaller = 2	1	4	1	2	1	1	2
28		1	8	1	4	1	1	2
29	reasons	2	0	0	0	1	1	1
30	1 - no electricity	2	0	0	0	1	1	1
31	2 - current laziness, old culture	2	0	0	0	1	1	2
32	3 - wood expensive now	1	4	1	2	1	1	2
33	4 - paraffin too expensive	2	0	0	0	1	1	2
34	5 - no elec and paraffin too expen.	1	7	1	3	1	1	2

35	6 - current scarcity	1	12	1	2	3	1	1
36		1	2	1	2	1	2	0
37	Past common:	1	8	1	8	1	0	0
38	Species most	0	0	0	0	0	0	0
39	common in the past	1	5	1	9	1	1	5
40		1	4	5	10	5	1	3
41	past size:	1	5	1	2	1	1	5
42	bigger = 1	1	5	7	11	7	1	1
43	smaller = 2	1	4	1	9	9	0	0
44		1	3	1	3	1	1	1
45	reasons:	1	3	1	5	3	1	6
46	scarcity = 1	1	3	1	12	7	1	6
47	alternatives = 2	1	3	1	7	10	1	1
48	scarcity + alternatives = 3	1	10	1	2	3	1	1
49		1	2	2	1	0	1	1
50		1	7	1	13	1	1	1
51		1	8	1	8	1	0	0

52	1	5	6	1	6	1	5
53	1	5	3	1	1	1	1
54	1	3	1	2	10	1	2
55	2	0	0	0	1	1	1
56	1	5	1	2	4	1	2
57	1	1	1	0	1	1	2
58	1	3	1	5	2	1	5
59	1	4	1	2	13	1	2
60	1	5	1	2	1	1	1
61	1	3	9	1	1	1	5
62	1	5	1	2	1	1	1
63	1	3	1	5	2	1	1
64	1	6	1	12	1	1	2
65	1	3	13	1	12	1	6
66	1	6	1	5	10	1	5
67	1	4	1		2	1	5

Appendix 6: Results from a households survey at Machibi to determine the number of households with rainwater tanks, the dates when these where purchased, and the reasons for investing in a tank

	Code	Rainwater tank?	When purchased?	Reason
1	yes = 1	1	1996	3
2	no = 2	1	1999	2
3		1	1994	3
4	When: given in years	1	1994	2
5	0 = dont have tank	1	1995	3
6		1	2001	3
7	Reason =	1	2000	3
8	1 = scarcity. eg drought, taps break, taps too far	1	1985	1
9	2 = pollution of rivers + dams	1	2003	1
10	3 = scarcity and pollution	1	1994	3
11	0 = dont have tank	1	1988	2
12		1	1994	1
13		1	1999	1

14	1	1992	3
15	1	1979	3
16	1	1989	2
17	1	1995	1
18	1	1998	1
19	1	1997	1
20	1	1994	2
21	1	1991	3
22	1	1997	1
23	1	1990	2
24	1	1985	3
25	1	1940	2
26	1	1989	1
27	1	1983	2
28	1	1992	2
29	1	1969	1

30	1	1980	1
31	1	1989	1
32	1	1969	2

Appendix 7: Metadata File of GIS work of two related villages and their respective land use.

Polygons where extracted from maps made during participatory mapping workshops and captured using ArcView 3.2 at a scale of less than 1:2500. The orthophoto was projected in Transverse Mercator with WGS84 Datam. The official boundaries were extracted from scanned images obtained from local government in Bisho. These where projected in Transverse Mercator with Clarke 1880 Datum.

Appendix 8 - Data sheets: Machibi and Qongqota

* note: surveys in Machibi were conducted by high school pupils as part of a skills development initiative. In Qongqota, the surveys were conducted by te project team. Therefore the data sheets differ in their level of detail.

Data sheet 1 : Machibi – Fuelwood (conducted by school pupils)

Question 1: Does my house have a fuelwood pile? YES NO

If NO, then log this worksheet as negative, and go to the house directly opposite and continue with a second questionnaire:
If YES, then answer the following questions for your household:

Question 2: What are the different species of fuelwood in the pile?
(Ask an older member of the household)

Question 3: Which are the first and second most common species in the woodpile?

Most common:

Second most common:

Question 4: How many sticks make up the woodpile?
(Equation: Length x Breadth.) Count the number of sticks along the side of the pile, and multiply this by the number of stick on the top of the pile.

Number of sticks along the side of the pile (length):

Number of sticks along the top of the pile (breadth):

Length x breadth:

Find an older member of the household and ask the following questions:

Question 5a: What kinds of species would have been the most common 20 years ago?

5b: What size would this woodpile have been 20 years ago? (bigger/smaller)

Data Sheet 2 : Machibi – Water (conducted by school pupils)

Does my house have a rain water tank? YES NO

If NO, then log this worksheet as negative, and go to the house directly opposite and continue with a second questionnaire:

If YES, then answer the following questions:

Question 1: When did the household get the water tank?

Question 2: What were the reasons for getting the water tank?

Question 3: What is the volume of the water tank (how much water can it hold)?

(Equation: πr^2 x height)

Radius = _____ Height = _____

Radius² = _____

πr^2 = _____

πr^2 x height = _____

Question 4: In winter, after the last summer rains, how long does the water in the tank last?

_____

_____

_____

Question 5a: How many of my steps are there in 10 meters? _____

Question 5b: How far is the nearest working water tap today?

Answer in meters: _____

Data sheet 3 : Machibi – kitchen gardens (conducted by school pupils)

Question 1: Does my family have a kitchen garden? YES NO

Question 2: What does my family grow in our garden?

(Go out into your garden with your mother and let her point out each type of plant)

Exercise:

Draw a seasonal calendar and show which crops are grown in each season.

After you have made your calendar, ask your mom to help you show which crops are grown in which season.

Data sheet : Qongqota

Water

Is there a rain water tank? Yes No

If yes:

When did the household get the tank? _____

Why did they get the tank?

Fuelwood

Is there an Igoqo at the household?

Yes No

What are the different species of fuelwood in the pile?

Which are the first and second most common species?

1st most common: 2nd most common:

What kinds of species would have made up the wood pile 20 years ago? Why?

What size would the wood pile have been 20 years ago? (bigger/smaller) Why?

Data sheet: Home gardens

Is there a home garden? Yes No

Is it being cultivated? Yes No

If not:

When was it last cultivated? _____

Why is it not currently cultivated?

_____

Fields

Does the household have arable fields? Yes No

Has the land been cultivated this year? Yes No

If not:

When was it last cultivated? _____

Why was it not cultivated this year?

Livestock

Livestock	Yes	No	How many?
Cattle			
Sheep			
Goats			