Towards resilience: Differences in management practices between land managers adopting conventional approaches and Holistic Management™

by
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Thesis presented in partial fulfilment of the requirements for the degree of Masters of Science in Conservation Ecology at Stellenbosch University

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March 2013

Declaration

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Date: March 2013

Acknowledgments

I express sincere gratitude to the following persons and institutions for their contribution and support for this thesis:

- The farming community of Aberdeen, Graaff Reinet and the Sneeuberg Mountains who despite the pressures of managing a farm were still willing to sacrifice their time and energy to share their experiences with an eager student.
- The National Research Fund (NRF) for granting a scholarship for this study (2011-2012).
- My supervisors, Prof Karen Esler and Dr Andrew Knight for their guidance and mentorship both on a professional and personal level.
- The following individuals who were willing to share advice and experience: James Puttick, Mike Peel, Nick Salafsky, Patrick J. O'Farrell, Richard Margolius, Sue Milton, Susi Vetter, Timm Hoffman, Vinaya Swaminathan and Wendy Engel
- Representatives of the Holistic Management community including Jozua Lambrechts (Holistic Management™ Educator), Roland Kroon (President of the Graaff Reinet Holistic Management Club), Wayne Knight (Community Dynamic's representative to Holistic Management International) and the staff members of the Savory Institute and the Africa Centre for Holistic Management (Astrid Huelin, Elias Ncube, Misheck Japuary and Precious Phiri).
- Dr Justin Harvey (Centre for Statistical Consultation, Stellenbosch University) for his assistance with statistical analysis.
- Staff and fellow students at the Department of Conservation Ecology and Entomology, for being a reliable source of information and the occasional chit-chat.
- My family and friends who were always waiting for me at home while I was off on my adventures.
- And finally, to every person who I met on this journey who expressed interest in my project and offered encouragement.

Abstract

Reductionism, an approach to understanding complex systems based on reducing the system to its individual components and the interactions between these components, is the linear and rigid approach to traditional management and research that allows us to understand complicated systems. Yet its application to complex systems has likely added to the degradation of social-ecological systems. In recognition of this, there is currently a shift to holism: the concept that a system is *greater* than the sum of its components and that the system has emergent properties that are only present through the complex interactions of the whole system. The inclusion of this natural complexity within social-ecological systems is thought to promote resilience – the ability of a system to absorb shock and thus promote sustainability. However, these concepts are largely theoretical and few examples exist that demonstrate ways of transferring them to pragmatic land management. Holistic Management™ (HM) could potentially be such a working example. It is a decision-making framework that provides a holistic context for the adaptive management of natural resources. However, limited peer-reviewed research has been applied to this potential to promote sustainability. Thus the current study aimed to address this apparent gap by determining if HM land managers were a distinct group from non-HM (NHM) land managers in regards to their management practices and if HM land managers had a greater adaptive capacity (the management of resilience) than non-HM land managers.

The study was conducted in a community of livestock farmers in the arid rangelands of the Karoo, South Africa. Data were mainly gathered through face-to-face interviews with land managers – including 20 self-defined HM land managers and 20 self-defined NHM land managers. To compare the reported management approaches of land managers, two scoring systems were developed. The HM Adoption Index measured the extent to which participants were aligned with key principles and practices of HM (including having a holistic goal, testing decisions, applying the Holistic Planned Grazing, demonstrating continuous learning and innovation). The Adaptive Capacity Index measured the extent to which participants demonstrated key traits of adaptive capacity as identified from the literature. In addition, participants were also asked to describe the strategies they apply to deal with local livestock farming challenges including parasite control, predation management and drought management.

A significant difference was found between HM and NHM land managers for both the HM Adoption Index and Adaptive Capacity Index ($p<0.01$). The majority of HM land managers adopted “true holistic” and “adaptive” management practices (80%) while NHM land managers were mostly “semi holistic” and “coping” (65%). HM land managers also notably tended to report more innovative and environmentally aware methods in dealing with farming challenges and were more likely to be part of study groups which build social capital and promote social learning. Results imply that HM provides a framework that introduces holistic principles to land management, making the holistic context and resilience accessible to individual managers for practical day-to-day decision-making.

Opsomming

Reduksie, ‘n benadering om komplekse sisteme te verstaan deur om die sisteme te besnoei tot sy individuele komponente en interaksies tussen die komponente, is die liniêre en rigiede benadering tot tradisionele bestuur en navorsing. Dit laat ons toe om komplekse sisteme te verstaan. Tog het die toepassing van reduksie op komplekse sisteme waarskynlik bygedra tot die degradasie van sosiaal-ekologiese sisteme. In herkenning van laasgenoemde is daar tans ‘n skuif na holisme: die konsep dat ‘n sisteem groter is as die somtotaal van al sy komponente en dat die sisteem voortkomende eienskappe het wat net navorekom deur die komplekse interaksies van die sisteem. Die insluiting van die natuurlike kompleksiteit binne sosiaal-ekologiese sisteme bevorder moontlik weerstandigheid; die vermoë van ‘n sisteem om ‘n skok te absorbeer en so volhoubaarheid te bevorder. Hierdie konsepte is egter meestal teoreties en min voorbeelde bestaan wat metodes demonstreer om die konsepte oor te dra na pragmatiese grondbestuur. Holistiese Bestuur™ (HB) kan moontlik so ‘n werkende voorbeeld wees. Dit is ‘n raamwerk vir besluitvorming wat ‘n holistiese konteks verskaf vir die aanpasbare bestuur van natuurlike hulpbronne. Daar is min eweknie-hersiende navorsing wat HB se potensiaal om volhoubaarheid te bevorder ondersoek. Dus het die huidige studie beoog om die gaping aan te spreek deur te bepaal of HB praktiseerders onderskei kan word van ‘n groep van nie-HB (NHB) praktiseerders in terme van bestuurspraktyke en of HB praktiseerders ‘n groter aanpasbaarheid (die bestuur van weerstandigheid) toon as NHB praktiseerders.

Die studie het plaasgevind in ‘n gemeenskap van veeboere in die dorre veld van die Karoo, Suid Afrika. Data was versamel deur aangesig tot aangesig onderhoude met grondbestuurders; 20 self-geïdentifiseerde HB praktiseerders en 20 self-geïdentifiseerde NHB praktiseerders. Twee puntestelsels is ontwikkel om die gerapporteerde benaderings van grondbestuurders te vergelyk. Die HB Toepassing Puntelys het gemeet tot watter mate ‘n deelnemer inskakel met die kern beginsels van HB (insluitend om ‘n holistiese doelwit te hê, om besluite te toets, om Holistiese Beplande Bewyding™ toe te pas en om ‘n voortsetting van leer en innovasie te demonstreer). Die Aanpasbaarheid Puntelys het gemeet tot watter mate ‘n deelnemer die kern kenmerke van aanpasbaarheid, soos geïdentifiseer in literatuur, demonstreer. Bykomend was deelnemers ook gevra om die strategieë te beskryf wat hulle

toepas om die uitdagings van plaaslike veeboerdery tegemoed te kom insluitend die beheer van parasiete, die bestuur van roofdiere en die bestuur tydens droogtes.

‘n Betekenisvolle verskil was gevind tussen HB en NHB praktiseerders vir die HB Toepassing Puntelys en die Aanpasbaarheid Puntelys ($p<0.01$). Die meederheid van HB praktiseerders het “ware holistiese” en “aanpasbare” praktyke toegepas (80%) terwyl NHB praktiseerders se metodes meestal “semi-holisties” en “korttermyn probleem hantering” was (65%). HB praktiseerders het ook ‘n waarneembare neiging gehad om innoverende en omgewingsbewuste metodes te rapporteer in verband met veeboerdery uitdagings en was meer waarskynlik deel van ‘n studie groep wat sosiale kapitaal gebou en sosiale leer bevorder het. Die resultate het aangedui dat HB ‘n raamwerk voorsien wat holistiese beginsels oordra na grondbestuur en so die holistiese konteks en weerstandigheid toeganklik maak vir die individuele bestuurder vir daaglikse praktiese besluitneming en toepassing.

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Abbreviations

HM	Holistic Management™
HPG	Holistic Planned Grazing
NHM	Non-Holistic Management™
SDG	Short Duration Grazing

Chapter 1: Introduction

"This work deals with some of the problems which fall within the debatable borderland between Science and Philosophy."

Jan Smuts

Holism and Evolution

The Macmillan Company, New York, 1926

The shifting paradigm

Despite all humankind's technological advancements and achievements, published literature still laments the continued degradation of our natural resources and the challenges this poses for the communities that depend on them (Millennium Ecosystem Assessment, 2005; Jabbour et al., 2012). A rapidly emerging argument claims that the central cause for this apparent paradox is not a lack of knowledge or ability, but faulty mental models (Huesemann and Huesemann, 2008; Gorobets, 2011; van Egmond and de Vries, 2011).

The conventional approach to research, management and decision-making is based on reductionism (Bell and Morse, 2000; Vance et al., 2007). Reductionism is an approach that simplifies complex systems by reducing the system to its individual components and the interactions between these components (Bell and Morse, 2000; Plummer and Armitage, 2007; Vance et al., 2007). It has been fundamental to the advancement of science and technology through its linear, rigid and predictable approach.

However, this approach is limited when applied to complex systems such as ecosystems and human communities (Berkes et al., 2003; Blann et al., 2003; Folke et al., 2003; Walker and Salt, 2006). Like other complex systems, these systems are highly dynamic with multiple non-linear relationships between components that ensure unpredictability, especially when examined using a reductionist approach (Walker and Salt, 2006; Stirzaker et al., 2010). Complex systems are self-organizing as components are arranged without any external input and have emergent properties that are only present through the interactions amongst the components (Lichtenstein and Benyamin, 2000; Newth and Finnigan, 2006; Prokopenko et al., 2009). Thus complex systems cannot be defined by only examining their individual components in isolation. In recognition of this, a paradigm shift away from reductionism to a

more holistic approach is encouraged for the management of complex systems (Capra, 1984; Mulej, 2007; Taylor, 2009).

Holism is the principle that the whole complex system is *greater* than the sum of its components – it appreciates the interconnected and dynamic nature of complex systems and recognises the emergencies of its components (Capra, 1984; Andersen, 2001; Mulej, 2007). It was first described by Smuts (1926) philosophising about evolution and consciousness, but has been applied as an alternative approach to the management of complex systems within the context of various disciplines (Capra, 1984). The emergence of systems thinking (Bertalanffy, 1950, 1973; Sterman, 2002) and complexity science (Cilliers, 1998; Mikulecky, 2001; Richardson and Cilliers, 2001) are some of the notable manifestations of this paradigm shift regarding the approach to managing complexity.

The concepts of complexity, systems thinking and holism now manifest within natural resource management as well (Haimes, 1992; Bell and Morse, 2000; Sayer and Campbell, 2004a) and has resulted in the reassessment of established concepts and theory within this field (Pahl-Wostl, 2009). Societies and ecosystems are now considered to be intimately linked as part of one whole, namely social-ecological systems (Gunderson and Holling, 2001; Beddoe et al., 2009). The traditional command-and-control approach of sustainability has been reinterpreted as well. The focus has shifted from sustaining a maximum yield to nurturing resilience, a system's ability to rebound after a shock (Holling, 1996; Holling and Meffe, 1996; Walker and Salt, 2006). Resilience recognizes that a complex system does not have a single stable state but a series of potential stable states – of which some are more favourable than others according to the values and desires of the stakeholders (Holling, 1996; Walker and Salt, 2006). The management of resilience involves preventing a system from transitioning into a less favourable state by cultivating diversity and flexibility within the system so that it has the elasticity to absorb shocks and not breach any fundamental thresholds (Biggs and Rogers, 2003).

Adaptive management was developed in recognition that the traditional reductionist approach to management would not be able to maintain resilience within the highly dynamic and unpredictable context of social-ecological systems (Holling, 1978; Walters, 1986; Walters and Holling, 1990; Lee, 1993). Adaptive management is a decision-making process that applies a "learning by doing" principle that intends to decrease the uncertainty involved in

managing social-ecological systems (Walters and Holling, 1990). It relies on feedback loops and modifies actions accordingly (Holling, 1978; Walters and Holling, 1990). It also encourages a cooperative multidisciplinary approach (Holling, 1978; Walters, 1986). With such an emphasis on learning, creativity, social networks and monitoring, adaptive management is thought to support resilience in social-ecological systems (Allen et al., 2011). Yet without flexibility amongst stakeholders and ecological resilience, adaptive management is thought to be ineffective (Gunderson, 1999). Thus it is important for the management of social-ecological systems to maintain both resilience and adaptive management.

Finding working examples for land management

The development and application of the holistic approach is particularly relevant to agriculture (Boody and DeVore, 2006; Francis, 2009). It is through agriculture that humans arguably have had the greatest direct impact on the environment (Parker and Moore, 2008) with reportedly 40% of the earth's terrestrial surface transformed through agricultural activities (Foley et al., 2012). These agricultural landscapes do not function in isolation as it is a complex social-ecological system that includes the interconnected relationships between financial markets, social dynamics and ecosystems (Risser, 1985; Berkes and Folke, 1998). Agricultural activities have a universal impact, contributing to global climate change, the loss of biodiversity, water scarcity (Hertwich et al., 2010) and alarming rates of soil erosion (Montgomery, 2007). The decisions of individual land managers, collectively, have repercussions that extend far beyond the borders of their properties (Grothmann and Patt, 2005; Turner et al., 2007; Balmford et al., 2012).

Despite the apparent importance of applying holistic management principles, it is questionable if the philosophical shifts required to reframe the ways in which we conceptualise social-ecological systems can be feasibly transferred to the very real, pragmatic and complex challenges facing land managers. The concepts of resilience (Jones et al., 2010; Béné et al., 2011; Schwarz et al., 2011) and adaptive management (Feldman, 2008; Allen and Gunderson, 2011; McFadden et al., 2011) are still vigorously debated within literature and developing effective operational models that apply these concepts is a major challenge.

Holistic Management™ (HM) offers itself as a working example of adaptive management which aims to achieve resilience in social-ecological systems. It is a decision-making framework that provides an holistic context for the adaptive management of complex systems

(Savory and Butterfield, 1999). It aims to nurture the financial, ecological and social prosperity of social-ecological systems (Savory and Butterfield, 1999; Savory Institute, 2012a). Although it originated as an approach to rangeland management in southern Africa, the principles may apply to any complex system under human management, including institutions, towns or individual families (Savory and Butterfield, 1999). However, limited peer-reviewed research has been applied to examining the efficacy of HM. Research on HM has been distracted by the highly controversial grazing principles promoted by HM (Teague et al., 2008; Briske et al., 2011). The social and managerial aspects of HM, essential for a holistic approach, have been mostly ignored within the context of African rangelands. Recent studies in North America and Australia have reported that HM encourages adaptive management (McLachlan and Yestraue, 2009; Sherren et al., 2012) and the structure of HM is aligned with key concepts promoting resilience (Hosbach, 2012).

Aims and approach of thesis

This thesis aimed to determine if HM land managers: 1) represent a distinct group from non-HM (NHM) land managers regarding their management practices; and 2) demonstrate a greater adaptive capacity (i.e., the management of resilience) than non-HM land managers.

The thesis specifically focuses on the managerial aspects of achieving resilience in commercial farming enterprises through adaptive capacity which are primarily related to social and human capital. Quantifying the adaptive capacity of land managers and the resilience of their farming systems so as to compare HM and NHM approaches poses a substantial challenge given the considerable diversity and complexity of these systems. To aid comparison, scoring systems were developed to interpret these data. An Holistic Management Adoption score measured the extent to which a land manager practices were aligned with the main principles of HM, while an Adaptive Capacity Index measured the extent to which land managers adopted practices associated with adaptive capacity.

The main body of this thesis (Chapter 2 to Chapter 4) is presented as individual manuscripts destined for international peer-reviewed journals. Thus some overlap in content and references is unavoidable but will help the reader to re-cap on the context and focus of the thesis. The overall thesis structure is as follows:

Chapter 1: Introduction – Introduces the main themes of the thesis, namely the apparent paradigm shift currently taking place in society regarding the management of complex systems and relating this shift to land management.

Chapter 2: Literature Review - Past research on Holistic Management is used to illustrate the current shift in human thinking (including decision-making and research) from a reductionist view to a holistic approach. Decision-making in agricultural systems that has primarily applied reductionist concepts for managing complex systems is examined and the limitations and effects of such an approach to land management are identified.

Chapter 3 – Presents a study to determine if HM land managers can be clearly defined as a distinct group from non-HM land managers regarding the practices of their management approaches (i.e., are their farming practices significantly different). The chapter addresses the limited research on the HM practices across arid rangelands in South Africa.

Chapter 4 – This chapter determined if HM promotes resilience by comparing the adaptive capacity of HM and non-HM land managers. Adaptive capacity traits considered relevant to individual management approaches were quantified within a scoring system that was used to measure the adaptive capacity of participants.

Chapter 5: Conclusion – The summarizing chapter consolidates the findings of the thesis into a concluding message. The key findings, critique on the methods used and recommendations for future rangeland research and management are discussed.

Appendix 1, 2, 3 & 4 – These Appendices include the interview protocols used for conducting interviews with land managers.

Chapter 2: Literature Review - Evidence for the Relevance and Efficacy of Holistic Management™

"Is range management a science, an art, or both?"

Stoddart, L.A. and Smith, A.D.

Range Management

McGraw-Hill, New York, 1943

Introduction: The Reduction of Complex Systems

The modern world faces a multitude of dire challenges. Desertification, climate change, the decline of biodiversity, freshwater extraction and erosion are some of the major processes driving the collapse of ecosystem services that have led to poverty, political unrest and the disruption of human communities (Baechler, 1998; Millennium Ecosystem Assessment, 2005; Brauch, 2008). One of the fundamental causes of this degradation of ecosystems and the human communities that depend on them, are the inappropriate principles applied to natural resource management (Berkes et al., 2003; Trosper, 2003; Walker and Salt, 2006).

The conventional approach to decision-making and problem solving for natural resource management – whether for research or for management – has prevailingly been reductionist (Bell and Morse, 2000; Vance et al., 2007). Reductionism is linear thinking aiming to achieve a specific goal (Savory and Butterfield, 1999; Vance et al., 2007). It is based on the notion that a system can be described by the sum of its components (Vance et al., 2007). Thus, the components can be compartmentalized and studied individually to understand the greater system (Sayer and Campbell, 2004a; Vance et al., 2007; Stirzaker et al., 2010). By analogy, reductionism describes a system as a machine built of various individual components that function together to constitute a mechanical system. In practical application, it represents the application of the classical scientific method which is used to isolate the factor(s) studied by removing all perceived external variables (Stirzaker et al., 2010). It allows researchers to simplify the world to make information more interpretable and quantification of variables (and hence statistical analysis) possible. This "mechanistic" approach has been fundamental to the development of science and indeed many major discoveries and technological

advancements can be attributed to this approach including the works of Galileo Galilei, René Descartes and Isaac Newton (Capra, 1984). Applying reductionism to complex systems has not, however, resulted in the same level of success (Stirzaker et al., 2010).

To analyse a system according to the reductionist approach requires a researcher to assume systems as rigid, comprehensible and quantifiable, and thus predictable (Bell and Morse, 2000; Plummer and Armitage, 2007). This mechanistic perspective is well suited when dealing with complicated systems whose connected components do not change (Walker and Salt, 2006), or where systems function is linear and hence predictable ways (e.g., an internal combustion engine). However, complex systems are notoriously unpredictable, having dynamically changing components that cannot always be quantified or truly known due to multiple non-linear relationships among components s (Walker and Salt, 2006; Stirzaker et al., 2010). These systems have emergent properties that are only present through the complex interactions of the whole system – thus the system cannot be truly comprehended by only examining the components in isolation (Andersen, 2001; Newth and Finnigan, 2006; Prokopenko et al., 2009)

Despite these stark contrasts, researchers and managers have continued to approach complex systems, such as social-ecological systems, from a reductionist view point (Odum, 1982; Berkes et al., 2003; Walker and Salt, 2006). Conventional reductionism has increasingly been regarded as inappropriate for developing an understanding of, and managing, complex systems, because it not only limits our understanding of a system, but also because its application can prove detrimental to a system itself (Berkes et al., 2003; Blann et al., 2003; Folke et al., 2003). As an illustration, it is the complex "intangible and interacting" systems of the world (e.g., ecosystems, economies and societies) that are deteriorating in the modern age while the complicated mechanistic systems (including engineering and chemical technology) are increasingly advancing (Savory and Butterfield, 1999; Walker and Salt, 2006).

The urgent need to improve the management of complex systems by promoting more inclusive integrated approaches is specifically evident in the context of agricultural systems (Odum, 1982; Risser, 1985; Haimes, 1992; Sayer and Campbell, 2004a; Boody and DeVore, 2006; Francis, 2009) which is a major exploiter of natural resources (Millennium Ecosystem Assessment, 2005; Hertwich et al., 2010; Foley et al., 2012).

Holism: the Solution to Degradation?

Since at least the 1940's mind-sets within various fields of science including biology and sociology have notably shifted away from reductionism to an approach that appreciates the complex interconnected non-linear relationships of the components of interacting social-ecological systems: namely the holistic approach (Haimes, 1992; Andersen, 2001; Norton and Steinemann, 2001; Boody and DeVore, 2006; Shiferaw et al., 2009). Holism, as first defined by Jan Smuts (1926), does not view a system as a total sum built up by its separate components, but rather views it as wholes functioning within greater wholes (Capra, 1984) (see Figure 2.1). A whole is a synergy of components within a unit defined across temporal and spatial scales. The concept of a whole can be applied at different levels from an atom, to an organic cell, to an individual organism to an entire ecosystem (Smuts, 1926; Capra, 1984). Wholes function as individual entities, but cannot be separated from the greater whole (or system) of which they are part of. By definition, holism seems to recognize and appreciate the self-organising and emergent properties of complex systems, unlike reductionism (Andersen, 2001; Newth and Finnigan, 2006; Prokopenko et al., 2009). Holism has had a favourable rise in popularity in the fields of biological evolution (Fondi, 2006), medicine (Freeman, 2005), linguistics (Weigand, 2011), engineering (Sherwin, 2010), human resource management in businesses (Treven and Matjaž, 2005) and organizational management in general (Li et al., 2004; Melé and Sanchez-Runde, 2011).

Holistic Management™ (HM) is a decision-making framework for managing social-ecological systems founded on the philosophy of holism (Savory and Butterfield, 1999). According to Allan Savory, the founder of HM, land managers must introduce holistic principles into their decision-making to ensure that they simultaneously consider the ecological, social and economic implications of their management decisions across different temporal and spatial scales (Savory and Butterfield, 1999). Although holistic management can be applied to any defined complex system or "whole", its origin lies in rangeland management (Savory and Butterfield, 1999). Savory developed the principles of HM in the 1960's while managing rangelands in southern Africa (Savory and Butterfield, 1999).

Central to HM is the holistic goal (also known as the holisticgoal™ or holistic context™) which incorporates the quality of life a land manager wishes to obtain, the forms of production to support this quality of life and his or her vision of the future (Savory and

Butterfield, 1999; Savory, 2012). Ideally, this holistic goal also includes the input of all decision-makers relevant to the specific system under management – resulting in a shared goal and vision (Savory and Butterfield, 1999). HM defines the major ecosystem services, the tools available for land management, includes testing and management guidelines and emphasizes the importance of continuous monitoring, evaluation and adaptive management (Savory and Butterfield, 1999). Furthermore, HM encourages continuous innovation, learning and creative problem solving (Savory and Butterfield, 1999). This is specifically nurtured on both an individual and collective level through the establish of so-called HM clubs that form networks of learning and support amongst HM land managers (McLachlan and Yestraue, 2009; Sherren et al., 2012). HM ultimately aims to provide a sustainable livelihood to human communities in agricultural landscapes while maintaining and enhancing ecosystem services (Savory and Butterfield, 1999).

As complex systems, rangeland ecosystems have suffered under reductionist management styles. Rangelands are predominately arid to semiarid regions characterized by limited and variable rainfall (Griffin, 2002; Reynolds and Smith, 2002; Weber and Horst, 2009) with vegetation mainly composed of grasses, forbs and shrubs (Weber and Horst, 2009). These areas cover a considerable portion of the planet's terrestrial surface with estimates ranging from 31 – 51% (Reynolds and Frame, 2005) and support a human population of hundreds of millions (Griffin, 2002; Verón et al., 2006) who use rangelands mainly for livestock grazing (Grice and Hodgkinson, 2002). The continued degradation of rangelands, despite many sustainable land management initiatives, is of dire concern from an ecological, social and economic view point (Akhtar-Schuster et al., 2011; Buenemann et al., 2011). Rural communities are vulnerable due to their immediate dependence on the ecological systems for their livelihoods (Williamson et al., 2003; Verón et al., 2006). The degradation of rangelands has been linked to increased pressure on water resources by burgeoning stock numbers, a loss in biodiversity and a loss of carbon stocks which further contributes to global climate change (Cowie et al., 2011). Poor management particularly in reference to livestock grazing practices has been cited as the notorious cause for the erosion and ultimately degradation of rangelands (Hoffman and Ashwell, 2001; Cowie et al., 2011).

HM was developed as a solution for rangeland degradation and general environmental decline (Stinner et al., 1997). Advocates claim that it not only maintains ecosystems but actively restores them, with benefits including increased production, increased biodiversity

and happy families (Savory and Butterfield, 1999). In recent times, there has been a marked increase in interest in the potential of HM, specifically for African rangelands (Fynn, 2008).

Review of Past Research on HM

Rangeland research has traditionally mainly been occupied with determining the "best" grazing system in terms of optimal use of ecological resources and superior economic returns (Grice and Hodgkinson, 2002). Historically, research into HM has predominantly been focused on comparative studies of the widely-advocated Holistic Planned Grazing™ (HPG) system and other grazing systems through rangeland experiments. HM's recommended grazing principles have been known by various terms including Savory's Grazing Method (SGM) and Holistic Resource Management (HRM) as HM developed over time (Savory, 1983; Savory and Butterfield, 1999). HPG is the current terminology used by HM land managers.

Grazing systems were developed to manage the grazing of livestock by dictating stocking densities, duration and frequency of both grazing and rest periods in order to maximize production per unit area in a manner that produced greater livestock returns for lower rangeland degradation (Dormaar et al., 1989; Jacobo et al., 2006; Teague et al., 2008). A vast array of grazing systems is available to modern managers, each with its own set of variants and off shoots. Grazing systems can be generally divided into two main approaches: continuous grazing and rotational grazing (Tainton et al., 1999). The primary difference between the two is the management intensity of livestock movement. In a continuous grazing system, livestock are allowed to roam freely within a designated area for the entire grazing period (Tainton et al., 1999). This is a simple and easily manageable system, but has been vilified in rangeland literature as a major cause of rangeland decline (Keay-Bright and Boardman, 2007; Teague et al., 2008). The rotational grazing system was developed assuming some degree of structured management is required if rangelands are to be used sustainably (Teague et al., 2008). In a rotational grazing system the movement of livestock is controlled with regards to the spatial and temporal distribution of the herd: one or more livestock herds are moved in sequence through a multi-paddock system throughout the grazing period with each paddock exposed to alternating periods of grazing and rest (Vallentine, 2001; Briske et al., 2008). The variations of rotational grazing again differ in stocking rates, number of camps and time periods of rotations (Tainton et al., 1999).

HPG, the grazing plan encouraged by HM, encourages the planned rotation of livestock in combination with the application of the "herding effect" (Savory and Butterfield, 1999). The "herding effect" or "herd effect" aims to mimic the constant movement of the large herds of herbivores that once roamed most semi-arid and arid rangelands (Savory and Butterfield, 1999). It is thought that the intensive non-selective grazing and trampling of a high density of stock animals for a short time is a necessary disturbance to promote healthy rangelands in so-called "brittle" environments – areas characterised by unpredictable rainfall, the slow weathering or oxidation of plant material and the sluggish development of plant succession on bare patches if not disturbed (Savory and Butterfield, 1999). Savory has attributed much of the foundation of his concepts for HPG to John Acocks' Non-Selective Grazing (Acocks, 1966) and André Voisin's work regarding intensive grazing systems (Voisin, 1988).

HPG and the "herding effect" have been associated with a series of other terms including the Wagon Wheel System, Cell Grazing System, Short Duration Grazing, Intensive Short Duration Grazing, Rapid Rotation Grazing and Non-selective Grazing (Savory, 1983). It should be noted that these terms are used interchangeably in literature with evidence both for and against the principles of the "herding effect" applied to all the systems above mentioned (which are characterized by trampling and high stocking rates) and rotational grazing in general.

The core concepts associated with HPG conflicts with the conventional wisdom of grazing management which states that large herds and trampling degrade rangelands (Savory and Butterfield, 1999; Vorster, 1999). This has resulted in major controversies hampering the already limited past research on the potential of HM as an approach to rangeland management.

Confounding Initial Success

The initial implementation of HPG in the arid rangelands of southern Africa in the 1970's and later in New Mexico in the 1980's to 1990's reportedly had favourable results and increasingly drew the attention of rangeland scientists and managers (Savory and Parsons, 1980; Savory, 1983; Skovlin, 1987; Holechek et al., 2000; Joseph et al., 2002). Perhaps the most frequently cited trial for HPG is the Charter Grazing Trial conducted between 1969 and 1975 in Zimbabwe in cooperation with various stakeholders including the Zimbabwean

Minister of Agriculture and Savory himself (Joseph et al., 2002). Despite the considerable investment in effort, the trial delivered mixed results which were used to both defend and oppose HPG (Skovlin, 1987; Joseph et al., 2002).

Inconclusive results shed doubt on the success of the early HPG pioneers. The favourable results achieved by HPG in the late decades of the 20th century have been attributed to high rainfall periods and increased cattle prices with the benefits dissipating following periods of average rainfall or drought (Holechek et al., 2000; Joseph et al., 2002). Holechek et al. (2000) also claimed that the appeal of HM was more related to Savory's charisma and promise of higher profits than any tangible benefit. Similarly, Galt et al. (2000) attributed HM's appeal to ranchers' aversion towards stock reduction: Savory's philosophy encourages the exact opposite by emphasising increased stocking rates.

Lack of Evidence for Claims

Researchers have also questioned the beneficial claims of the "herding effect" (Holechek et al., 2000) with studies often reporting no notable benefit (Weltz and Wood, 1986; Weigel et al., 1990; Hart et al., 1993) or even detrimental effects (Warren et al., 1986; Dormaar et al., 1989). The general consensus is that grazing, specifically intensive grazing, with trampling increases soil compaction (Skovlin, 1987; Weigel et al., 1990), leads to loss of palatable plant species (Dormaar et al., 1989) and degrades soil organism communities (Milton et al., 1994). In a recent review, experts on southern Africa's rangelands concluded that high intensive grazing (as associated with HPG) by cattle or a mix of cattle and sheep was the most ecologically detrimental grazing regime analysed (O'Connor et al., 2010). Biodiversity, the spread of alien plants, landscape structure, soil erosion, hydrological functions and general landscape functioning were specifically implicated.

Six decades of research across a spectrum of grazing experimental design, individuals and geographic variables have concluded that rotational grazing had no notable "superiority" for ecological or livestock production over continuous grazing (Briske et al., 2008). The conclusion is supported by O'Reagain and Turner (1992) as based on the results of 50 grazing experiments in southern Africa and by others (Warren et al., 1986; Abdel-Magid et al., 1987; Hart et al., 1988; Cohen et al., 1989; Quirk, 2002). To summarize, there is a considerable lack of scientific evidence for the beneficial ecological claims of HPG and

related grazing systems and these have even been identified as contributors to rangeland decline (Skovlin, 1987; Holechek et al., 1999, 2000; O'Connor et al., 2010).

Expensive and labour intensive

In addition to a lack of clear scientific evidence of benefits directly related to HPG, HPG requires a considerable initial investment of capital (Quigley, 1987; Alfaro-Arguello et al., 2010). Von Bach and Groenewald (1991) have stated that HPG is a system feasible only for financially well-to-do individuals specifically within the context of African rangelands. The intensive labour required and controversy surrounding HPG could also discourage adoption of HM (Quigley, 1987).

A Mismatch with Reality

Despite the controversies, the lack of scientific support and the financial requirements, HM continues to flourish amongst land managers in South America, North America, Australia, Europe and Africa (Savory Institute, 2012b). Surveys amongst HM land managers in the United States of America have reported increases in biodiversity, profits and in the general health and vigour of landscapes as both anecdotal evidence (Favre and Shea, 2010) and in published scientific papers (Stinner et al., 1997; Jacobo et al., 2006; Sanjari et al., 2009). Applying this new approach to rangeland research, recent studies on HM have reported results contradicting the conclusions of the previous conventional research. Studies conducted on established "real-world" farms reported other results contradicting the conclusions of previous conventional research including increased ground cover (Sanjari et al., 2009), increased carrying capacity (Jacobo et al., 2006) and the promotion of sustainable production (Otzen, 1990; Alfaro-Arguello et al., 2010). The Savory Institute, which promotes HM, and Savory himself, have received international recognition for their contribution to the rangeland management including the Banksia International Award in 2003, the Buckminster Fuller Award in 2010 and are currently shortlisted for the Virgin Earth Challenge 2012 (Savory Institute, 2012c). To date, the total land under HM is reported to exceed 16 million ha with over 10 000 land managers (Savory Institute, 2012b). The international acclaim for HM and the passionate support of its land managers – whose livelihoods are dependent on the effectiveness of their land management – imply that there are benefits associated with HM despite research results indicating otherwise.

This contradiction in results between top-down scientific research and the bottom-up reports of applied HM is noted by land managers (Gill, 2009) and some researchers (Norton, 2008; Brunson and Burritt, 2009).

Limitations of Science

Farm versus Experiment

Like all sciences, rangeland science has weaknesses which can produce errors. Rangeland experiments are simplified versions of reality by reducing the conditions and spatial and temporal scales that rangeland managers experience (Briske, 2012). The reduced context excludes important components that in practice could have a fundamental impact on results.

As an example of this oversimplification, livestock (with specific reference here to cattle) are not merely automatic lawn mowers, but "cultured" social animals (Brunson and Burritt, 2009). Cattle develop different grazing habits and behaviour under different grazing systems (Teague et al., 2008). When introduced to a new grazing system, cattle need time to adjust (Teague et al., 2008). However, rangeland experiments do not typically consider this within the limited time period of experiments (Teague et al., 2008). Furthermore, researchers often neglect the social dynamics of cattle. Herds used in rangeland experiments often consist of "strangers" put together merely for the sake of the study (Brunson and Burritt, 2009). This causes a stressed and dysfunctional herd as cattle demonstrate fearful and aggressive behaviour when forced together with unfamiliar companions (Rault, 2012).

HM supporters have also specifically criticised the size of herds used in experiments, arguing that the sheer number of cattle used were too low to produce the "herding effect" (Savory and Butterfield, 1999). In general, some research has been criticised for creating herds that have little similarity in behaviour to herds on real farms (Brunson and Burritt, 2009).

Livestock aside, there are numerous other variables that could confound comparisons of grazing systems. Stocking rate and weather patterns are predominantly cited as having a more notable impact on rangelands than specific grazing systems (Weltz and Wood, 1986; Bartolome, 1993; Quirk, 2002; Briske et al., 2008) especially in African rangelands (Vallentine, 2001; Joseph et al., 2002). Arid to semi-arid rangelands are characterised by erratic rainfall patterns, causing an inconsistent pattern of plant growth (Briske et al., 2008).

Furthermore, stocking rates have a fundamental impact on the soil hydraulics which also influences the growth of grass independent of the specific grazing system used (Briske et al., 2008).

The management of rangelands is another confounding variable that appears to be frequently neglected (Briske et al., 2011). Management varies in terms of land managers commitment, abilities, goal setting as well as available opportunities, and fluctuates as ecological factors do in rangelands (Perrings and Stern, 2000; Briske et al., 2011). Wilson et al. (1987) observed that increasing stocking rates – as required by HPG and similar intensive rotation systems – would only yield higher profits if other factors of grazing and financial management were improved. A well-managed "inferior" grazing system can have yields equal to a poorly managed "superior" grazing system, as success and sustainability is more dependent on management than the specific grazing system used (Hart et al., 1993). As summarized by Heady in Vallentine (2001): "Good managers can make any grazing system successful!".

In the light of these conclusions, traditional approaches to comparative rangeland grazing experiments appear to be an exercise in futility. Rangeland research in general cannot be approached with the same philosophy as in highly controlled laboratory experiments as rangelands appear to be highly complex and contextualised systems.

Controversy

When researching a controversial issue, caution should be exercised to account for people's inherent resistance towards innovation, change and paradigm shifts (Kuhn, 1962). Despite the often proclaimed objectivity of science, the personal biases of researchers cannot entirely be removed from their studies (Noss, 2007; Chan, 2008). The controversy surrounding HM, specifically in reference to HPG and its radical requirements, along with the passionate support of HM advocates may have compromised the objectivity of researchers.

Agriculture generally appears to be slow to accept and adopt innovative practices due to individual human factors, including aversion to risk and private investments in the conventional paradigm (Teague et al., 2008; Francis, 2009). As an illustration, a review of grazing systems by O'Connor et al. (2010) concluded that grazing systems similar to HPG were detrimental to the environment. However, this review was based on the perceptions of

experts whose biases could be questioned. With the controversy surrounding HM, personal biases appear to be a particular concern for HM research.

Short-Duration Grazing Plagiarism

Research on HM is hampered by a confusion of terms. Various terms are associated with HM; specifically SDG (Short Duration Grazing) is used as an equivalent of HPG. Savory (1983) claims that these other grazing systems that apply the "herding effect", plagiarized his ideas. Though he admits that SDG might be derived from HPG, he strongly objects to SDG being used as a synonym for HPG.

SDG and other intensive rotation systems lack the essential elements of the HM philosophy, specifically its unique foundation: the holistic goal. The other systems can thus not be used interchangeably with HM, as is commonly practiced in literature. Despite this, results on SDG and other rotation systems continue to be applied both as supportive and apposing evidence for HM. This apparent mix-up severely muddles any review, questioning the applicability of research results that do not clearly define if HM has been applied in its "true sense".

The Importance of Management

A further complication regarding comparisons between research studies is that HM is not presented as simply a grazing system: Savory (Savory, 1983, 1991, 1993; Savory and Butterfield, 1999) clearly states that HM is a "management process". HPG is viewed as merely one component within a greater whole of a decision-making framework (Savory and Butterfield, 1999). HM includes a management philosophy coupled with specific strategies which, despite originating from rangeland management, are collectively promoted as being applicable to any type of complex system, be it a farm, an organization, a business or a household (Savory and Butterfield, 1999).

However, the established scientific research on HM has predominantly been limited to conventional comparisons of grazing systems. This approach is problematic because HM is a management process comprising not just ecological, but also economic and social dimensions (Savory and Butterfield, 1999). Work on HPG before 1984 produced short term gains but long term losses because the importance of an holistic goal – the core management philosophy of HM – was yet to be effectively integrated with the HPG (Savory and

Butterfield, 1999). Savory and Butterfield's (1999) observation that decisions made by individual managers had great influence upon rangeland condition indicated that the decision-making process and its context had also to be refined, along with the implementation of HPG, for long-term success. In short, HM land managers farming systems may be more successful not because they have a superior grazing system, but because they are, individually, superior managers.

The actual process of management within the context of rangelands has been under-researched despite its influence on results (Briske et al., 2011). This neglect may account for the enduring absence of "best practice" rangeland management (O'Farrell et al., 2007), the escalating degradation of rangelands despite sustainability initiatives (Akhtar-Schuster et al., 2011; Buenemann et al., 2011) and the apparent disparity between scientific research and practicing managers (Susman and Evered, 1978; Brunson and Burritt, 2009). The gap between scientific researchers and managers is not unique to rangeland science: it is a well-established phenomenon in research related to practical landscape management (Susman and Evered, 1978; Knight et al., 2008; Esler et al., 2010).

Perhaps a fundamental cause for the disconnect between the theory and practice of rangeland management is that academic researchers and managers approach problems very differently. Reductionist researchers adhere to rigid scientific methods (Brunson and Burritt, 2009), are usually limited to a single academic field (Teague et al., 2008; Svejcar and Havstad, 2009) and are mostly focused on ecological indicators (Briske et al., 2011). In addition researchers are hampered by financial and temporal and spatial scale limitations (Svejcar and Havstad, 2009). However, managers are required to be flexible (Vallentine, 2001; Brunson and Burritt, 2009) and have to consider a broad spectrum of indicators (Teague et al., 2008; Briske et al., 2011). Active rangeland management compels the combination of both ecological and socio-economic systems which interact within a unified whole (Huntsinger and Hopkinson, 1996; Berkes and Folke, 1998). In addition, managers – at least good ones – are consistently experimenting and monitoring their activities (Zimmermann and Smit, 2008). They have access to a much larger scale of data, including both spatial and temporal aspects, than a researcher would have with the average rangeland experiment. Managers appear to be inherently more interdisciplinary and adaptable than conventional scientists. In essence, conventional researchers generally follow a reductionist approach, while managers are required to be more holistic in their method.

HM appears to recognize the fundamental importance of management with its central focus on shifting the manager's decision-making process towards a holistic framework that incorporates the social-ecological complexities involved in rangelands (Savory and Butterfield, 1999). Yet it is specifically this aspect of rangeland management that has been neglected within research. It is still questionable if self-claimed HM land managers actually apply the holistic principles advocated by this framework.

Resilience-based management

The ecological and social context of rangelands have become considerable more complex with diversifying land-uses (including mining and wildlife conservation), an intensifying ecological crisis (including the soil erosion and climate change) and changes in markets and policies (Bestelmeyer and Briske, 2012). In recognition of this change, rangelands are now regarded as social-ecological systems (Li and Li, 2012) and rangeland management is shifting from a steady state approach (the traditional command and control framework) to resilience-based management (Chapin et al., 2009; Bestelmeyer and Briske, 2012). Unlike steady state management, resilience-based management does not perceive a system to have a single stable state but multiple potential stable states into which the system can shift if certain thresholds are breached (Holling, 1996; Chapin et al., 2009). Resilience is the ability of a system to absorb shocks and thus prevent itself from shifting into another state (Holling, 1996; Holling and Meffe, 1996; Walker and Salt, 2006). These thresholds are not only based on ecological factors but also include social dimensions (Schlüter et al., 2012). As an example, social learning institutions are regarded as essential to promoting resilience (Pelling et al., 2008; Pahl-Wostl, 2009). The integration of social factors (Briske et al., 2011), adaptive management (Lynam and Smith, 2004) and a call for more qualitative research (Sayre, 2004) testify to the paradigm shift currently taking place within rangeland science. To truly promote resilience within rangeland management, rangeland research needs to expand beyond the grazing systems debate. Studies now include measures of human capital, social capital and financial capital to assess the adaptive capacity of managers (Swanson et al., 2009; Brown et al., 2010; Nelson et al., 2010) along with an increasing interest in land managers' decision-making and values in regards to actions that promote conservation (Burton, 2004; Edwards-Jones, 2006; Seymour et al., 2010).

The framework of HM is thought to promote resilience as it includes key concepts of resilience namely applying systems thinking to land management and that change is inevitable (Hosbach, 2012). The few studies that have delved into the much neglected managerial potential of HM reported that HM land managers were more proactive and adaptive when facing a crisis (Duram, 1997; McLachlan and Yestraue, 2009; Sherren et al., 2012) and characterised by supportive social networks (Stinner et al., 1997; McLachlan and Yestraue, 2009).

This holistic adaptability required for sustainable management of rangelands (Steiner et al., 2009) can be overlooked in rigid scientific experiments that have dominated rangeland science until recently. Thus despite HM being actively practiced in rangelands since the 1960's (Savory and Butterfield, 1999), its potential in fostering social-ecological resilience has received little attention within peer-reviewed literature. The considerable lack of social research comparisons between HM and non-HM approaches is a major shortcoming within literature.

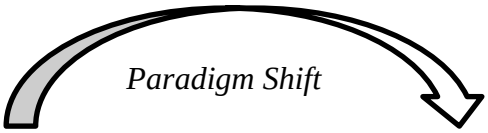
Conclusion

Reductionism is not "wrong" (Bell and Morse, 2000). It has been instrumental to the development of modern technologies that have delivered many benefits to human society. Even Smuts (1926), who coined the term holism, acknowledged that reductionism and holism both "have their proper scope and sphere of usefulness". By definition, some reduction is unavoidable when conducting scientific research. However, reductionism has overwhelmingly dominated traditional research and management of rangelands without appreciating their holistic context. The limitations and controversies within rangeland research is probably a reflection of the inappropriate application of a "command and control" reductionist approach to the intimately complex and contextualised systems of rangelands, particularly at the individual farm scale.

The emergence and expansion of HM has produced much controversy, much of which stems from the predominantly reductionist nature of past research, specifically regarding both the results and methods used. This has probably contributed to the discussed disparity between research findings and the testimonies of managers – perhaps even hampering the alleged potential utility of HM to the sustainable management of rangelands. Indeed, its philosophy

has much in common with current developments in sustainable development. It is in line with the rising emphasis on transdisciplinary, adaptive and participatory approaches to research and management (Béné et al., 2011; Williams, 2011). However, there is still little evidence to conclusively state that HM is more beneficial than traditional rangeland management approaches. Limited if any research has been done to compare HM with non-HM approaches in regards to social aspects.

The reduction-holism paradigm shift in regards to the management of complex social-ecological systems has impacted some of the most fundamental concepts within rangeland science. The potential of decision-making frameworks such as HM to promote adaptability and systems thinking should be considered seriously for rangeland management.



Reductionism System is *equal* to the sum of its components	**Holism** System is *greater* than the sum of its components
Traits of system • Linear • Quantifiable & Knowable • Rigid • Comprehensible • Predictable	Traits of system • Non-linear • Frequently Unquantifiable & Unknowable • Dynamic • Changing • Unpredictable
Conventional approach • Single disciplinary • Fixed • Authoritative Compartmentalization & artificial boundaries	Emerging research for complex systems • Transdisciplinary • Adaptable • Participatory Appreciate and include complexity
Recommended approach for complicated systems of mechanical technology	Recommended approach for complex social-ecological systems

Figure 2.1: Illustration of the paradigm shift and key traits associated with the conventional reductionist approach and the holistic approach to decision-making. The traits of the concepts were derived from Smuts (1926) and others (Capra, 1984; Savory and Butterfield, 1999; Bell and Morse, 2000; Norton and Steinemann, 2001; Sayer and Campbell, 2004a; Vance et al., 2007; Francis, 2009; Stirzaker et al., 2010).

Chapter 3: The Adoption of Holistic Management™ by Land managers in the Karoo rangelands, South Africa

"Ultimately, these problems must be seen as just different facets of one single crisis, which is largely a crisis of perception."

Fritjof Capra

The web of life: a new scientific understanding of living systems

Anchor Books, New York, 1996

Abstract

Holistic Management (HM) is a decision-making framework that introduces a holistic context to land management – for land managers to consider their actions within the context of the greater "whole". I set out to determine if HM land managers were a distinct group from non-HM (NHM) land managers in relation to their management practices and actions in dealing with challenges related to livestock farming. Data were collected through interviews with 20 self-defined HM land managers and 20 NHM land managers, all livestock farmers of the Karoo rangeland, South Africa. An HM Adoption Index was developed to determine the extent to which management approaches of participants resembled the five main traits of HM. I found a spectrum of "holistic management" amongst all participants, but holistic practices and actions were amplified within the self-defined HM group. The majority of HM land managers (80%) were "truly Holistic" (scores >= 0.70) while the majority NHM land managers (65%) were "semi Holistic" (0.40 =< scores < 0.70). HM land managers also tended to report more adaptive, innovative and environmentally considerate actions in dealing with challenges regarding parasite control, livestock predation and drought management. In conclusion, results implied that HM provides a structure that introduces holistic principles to land management, making the "whole" accessible to individual managers for daily practical decisions.

Keywords: decision-making, rangeland management, adaptive management

Introduction

Agriculture is one of humankind's principle interactions with the natural environment (Parker and Moore, 2008) and yet is perhaps the most destructive of all its relationships (Millennium Ecosystem Assessment, 2005; Balmford et al., 2012). Agriculture is a major cause of ecosystem transformation leading to critical social-ecological challenges including global climate change, the loss of biodiversity, declining water quality and availability, and reduced carbon storage, in addition to the loss of cultural and socio-economic benefits (Hertwich et al., 2010; Giovannucci et al., 2012).

Approximately 40% of the terrestrial surface of the earth is committed to agricultural activities making it "one of the largest terrestrial biomes on the planet" (Foley et al., 2012), yet only about 15.5% is under formal protection for conservation (Soutullo, 2010). Given this vast spatial extent and the limited funding for the purchase of formally protected areas (and despite its historically ruinous reputation), agriculture is increasingly viewed as a potential "solution" to environmental degradation (Morris and Pottert, 1995; Christiansen, 2002; Tscharntke et al., 2005). A shift in the thinking of the conservation fraternity from strictly formally protected areas to conservation on private land has occurred (Knight, 1999) which has reframed the agricultural landscape as perhaps an undervalued and potentially vital partner in the conservation of biodiversity and the management of ecosystem services (Boody et al., 2005). This is recognised through the International Union for Conservation of Nature (IUCN) protected area categories (Dudley, 2008), the expansion of agri-environment schemes in Europe (Kleijn and Sutherland, 2003; Burton and Schwarz, 2013) and the increasing reliance by conservation organisations upon voluntary and contractual agreements with rural landowners (e.g. McDonald, 2001; Jones et al., 2005; Fishburn et al., 2009).

In line with this rising appreciation for the contribution of farmland to achieving conservation goals, there is a growing recognition of the far-reaching influence of the actions of private landowners. The day-to-day management decisions of land managers have accumulative impacts on various spatial and temporal scales (Turner et al., 2007; Balmford et al., 2012). It is now considered essential to understand and engage with private land management decision-making to ensure the maintenance of ecosystems (Grothmann and Patt, 2005). The increasing number of peer-reviewed publications examining motivations, attitudes and behaviours further demonstrates a growing recognition of the importance of conservation

organisations engaging private land managers in agricultural landscapes (Ernst and Wallace, 2008; Knight et al., 2010).

The behavioural approach has been a leading research tool in exploring the link between land managers' decision-making and conservation action (Morris and Pottert, 1995). This tool aims to explain a specific behaviour by examining the attitudes, values, motivations and perceptions leading to a specified action (Morris and Pottert, 1995; Burton, 2004). An array of factors may influence decision-making including traits of the individual (e.g., age, education, gender and other personality traits), the household (e.g., inheritance, the spouse's career), the farm (e.g., farm type and size) and the general community (e.g., levels of trust, culture and social capital) (Edwards-Jones, 2006; Knowler and Bradshaw, 2007; Ahnström et al., 2008). Two major paradigms have emerged from the behavioural approach to explain conservation intent and behaviour: the value-belief-norm theory (VBN) (Stern, 2000) and the theory of planned behaviour (TPB) (Fishbein and Ajzen, 2009). Both theories describe how an individual's perceptions and world-view influence their attitudes, norms and sense of control which in turn determines their intentions which lead to specific actions (Ajzen, 1991; Stern, 2000). The theories have been used to explore the conservation behaviour of land managers (Beedell and Rehman, 1999; Seymour et al., 2010; Wauters et al., 2010) and the uptake of agricultural technology (Herath, 2010) and organic farming (Kaufmann et al., 2009).

However, the decision-making of land management goes beyond the individual. As previously mentioned, the impacts of a land manager's decisions are not limited by the boarders of his or her property. Yet in practice land management does not seem to appreciate this as the apparently small and unconnected decisions of individual land managers have, over time, accumulated to result in large-scale unintended consequences including water pollution, desertification and the general deterioration of agricultural land (Odum, 1982). This "tyranny of small decisions" – as first described by Kahn (1966) and applied to environmental degradation by Odum (1982) – emphasises the recognized importance of collective action and social learning amongst land managers for sustainability (Reed et al., 2010; Schlüter et al., 2012).

The apparent disconnect between individual land managers, the broader community, and the unintended consequences thereof, stems from the traditional reductionist approach to

management (Bell and Morse, 2000; Vance et al., 2007). Subsequent authors have encouraged a more "holistic view" (see Chapter 1 and 2) in relation to decision-making in the management of natural resources (Odum, 1982; Risser, 1985; Haimes, 1992; Gunderson and Holling, 2001; Norton and Steinemann, 2001; Buenemann et al., 2011), specifically in agriculture (Boody and DeVore, 2006; Francis, 2009).

Yet the adoption of such alternative or innovative practices for land management is challenged by various barriers including socio-economic factors, information factors and the perceptions of managers (Tey and Brindal, 2012). Land managers are particularly vary of unfamiliar practices (Gillespie et al., 2007) which could particularly hinder the adoption of approaches that challenge the conventional beliefs of land management.

Holistic Management™ (HM) is a framework that establishes a holistic foundation to guide decision-making and so to minimise unintended negative consequences and promote resilience in the use of natural resources (Savory and Butterfield, 1999). It was developed by Allan Savory in the 1960's in response to the damage traditional reductionism-based management was causing to arid rangelands in southern Africa (Savory and Butterfield, 1999). HM guides land manager decision-making by facilitating a comprehensive perspective of an agricultural, specifically grazing, system across temporal and spatial scales to identify potential social, economic and ecological impacts. HM provides a holistic context for the factors that influence the decision-making of an individual, specifically their values and perceptions. This context is provided through the development of an "holistic goal" (also written as holisticgoal™) that includes a description of the quality of life which the decision-maker desires, how to support this quality of life and a vision for the future (Savory and Butterfield, 1999; Savory Institute, 2012a). This holistic goal is used to guide decisions to reflect decision-maker's values and aspirations.

The adoption of HM is said to improve problem-solving and decision-making leading to financial, ecological and social prosperity (Savory and Butterfield, 1999; Savory Institute, 2012a). It incorporates concepts that are encouraged in both conservation and sustainable agriculture, including implementing conservation action with an holistic understanding of a social-ecological system (Cowling and Wilhelm-rechmann, 2007), the importance of biodiversity (Tscharntke et al., 2012) and an emphasis on adaptive management (Salafsky et

al., 2001). HM land managers reportedly number over 10 000 and are active in the Americas, Australia, Europe and Africa (Savory Institute, 2012b).

However, despite its widespread adoption, the peer-reviewed research regarding HM has been limited, mostly focusing on the controversial grazing principles promoted by HM (Teague et al., 2008; Briske et al., 2011). It should be noted that HM is not a grazing system, but a decision-making process – as advocated by HM proponents (Savory, 1983; Savory and Butterfield, 1999). The holistic grazing plan (HGP) is regarded as a subset of HM. Yet the grazing system debate has mostly overshadowed the holistic framework of HM in the literature (Holechek et al., 2000; Joseph et al., 2002; O'Connor et al., 2010). Recent studies that have explored the attitudes and motivations of the HM land managers have found favourable results when compared to traditional land managers including improved time and labour management in the USA (Stinner et al., 1997) and the promotion of self-reliance, proactiveness and adaptability in both Canada (McLachlan and Yestraue, 2009) and Australia (Sherren et al., 2012).

HM has been adopted throughout southern African rangelands, however very little research exists beyond grazing system comparisons (e.g., Holechek et al., 2000; Joseph et al., 2002; O'Connor et al., 2010). This is perhaps surprising, given the importance of livestock farming, specifically in South Africa. It is the largest agricultural sector in South Africa and extensive livestock farming accounts for 80% of all agricultural land (Bhaktawar et al., 2011), and is the major land use in the arid Karoo region of South Africa (Nel and Hill, 2008). The Karoo has been subjected to a "tyranny of small decisions" for over 200 years, which is amplified by the drought-prone character of the region (Keay-Bright and Boardman, 2007; Keay-bright and Boardman, 2009). The related ecological and socio-economic impacts have made it increasingly challenging to sustain viable rural communities (Keay-Bright and Boardman, 2007; Keay-bright and Boardman, 2009). Land managers claiming to practice HM have been active within the Karoo for at least three decades (pers. comm. with HM land managers).

Given the claimed benefits of HM, the factors describing the difference between land managers who do, and do not, adopt HM was investigated. The study aimed to explore whether HM land managers could be distinguished from non-HM (NHM) land managers (i.e., land managers adopting more traditional approaches) in relation to their management

practices and actions in dealing with livestock farming challenges. To fulfil this aim, this study set out to meet four objectives:

1. Determine if there were notable differences in the perceptions and interpretations of HM between self-identified HM land managers and NHM land managers.
2. Develop an HM Adoption Index that can quantify the extent to which self-identified HM and NHM land managers resemble key HM characteristics;
3. Determine if demographic factors were notable different between HM land managers and NHM land managers;
4. Determine if there are differences between HM land managers and NHM land managers when reporting actions taken to combat challenges regarding parasite control, livestock predation and drought; and

Methods

Study Area

One of the first HM communities in South Africa was established more than three decades ago in the Graaff-Reinet magisterial district of the Eastern Cape Province (pers. comm. with Wendy Kroon and Roland Kroon). The area is an arid to semi-arid rangeland comprising biomes of Nama Karoo, spekboom thicket and mountain grassland (Mucina et al., 2007). Specifically the Sneeuberg Mountains of the area has a notable ecological value, recently recognized as a "centre of floristic endemism" (Clark et al., 2009).

Livestock farming, the predominant land use for over 200 years, has traditionally focused on the rearing of sheep and goats, although more recently it has expanded to include cattle, game farming and ecotourism (including hunting) (Archer, 2000; Nel and Hill, 2008). The region has experienced notable socio-economic and ecological challenges including the consolidation of economically unviable land units, fluctuating markets, dramatic shifts in demographics, political marginalisation (Nel and Hill, 2008) and most recently regular droughts, including a three to four year event that ended just prior to the initiation of the current study (pers. comm. with land managers). Stock predation has also reportedly escalated in recent years, forcing land managers to confine their lambs and goat kids for

longer periods of time to paddocks which could increase parasite loads on the animals (pers. comm. with land managers).

Design of the Interview Protocol

Two structured interview protocols were developed and included a combination of open items, dichotomous items and Likert statements. Items focused on the following four key information:

1) Demographics, including age, level of education and land use practices.

2) Perceptions of, and experience with, HM, specifically regarding definitions of HM and its perceived advantages and disadvantages.

3) Self-reported behaviour that manifest the principles of HM regarding the control of parasites, livestock predation (CapeNature, 2012; Conradie, 2012) and drought (Esler et al., 2006). Responses were evaluated in reference to available manuals on best practice within the Karoo (Nama Karoo Foundation, 2008; Smuts, 2008; National Woolgrowers Association of South Africa, 2009; Scotcher, 2009; Todd et al., 2009). Items relating to notable increases or decreases in parasites or predation events were set within the time frame of the individual's experience on the current property under management. Items regarding drought strategies referred to the land managers' past experience and future plans in dealing with drought.

4) Reported actions and strategies describing the general managerial framework applied by the land manager which were used to determine if the individual applied key traits associated with the HM Adoption Index

HM Adoption Index

The HM Adoption Index comprised five core characteristics that a HM land manager should exhibit, as identified from the HM handbook (Savory and Butterfield, 1999) and personal communication with HM trainers. A set of items was used to quantify the presence or

absence of each characteristic (see Table 3.1). Literature was consulted in the construction of the interview protocol regarding human and social capital (Harper and Kelly, 2003; Grootaert et al., 2004), with the Innovation and Risk Aversion Scales adapted from Vesala et al. (2007) and (Knight et al., 2008):

1) Use of an holistic goal

   The holistic goal is central to HM as it serves as both a compass and context to guide effective decision-making (Savory and Butterfield, 1999). It promotes the development of a common vision amongst decision-makers that incorporates their aspirations and creates the context in which their cultural, material and personal needs interact with their base capitals (i.e., natural, financial, social, built). The three pillars of sustainability (i.e., economic, ecological and social) were used to determine if goals were holistic in character.

2) Application of the Holistic Planned Grazing™ (HPG)

   The HPG includes specific principles for livestock management promoted by HM. Data on land managers self-reported attitudes and behaviours in applying the HPG principles were collected, including belief in the "herding effect" (i.e., that the trampling of herded herbivores stimulates rangeland regeneration), the establishment of seasonal grazing plans, and the simultaneous herding of different stock.

3) Demonstrated innovation

   Innovation and the testing of new ideas are regarded as integral to HM through implementation of the feedback loop to implement what is effectively adaptive management (Holling 1978) (see Chapter 1). Sub-scales measured innovation and risk aversion. Information on innovative behaviour through past, present and future projects was also captured. A distinction was made between innovations promoting on-going development on the farm (e.g., an improved irrigation system) and 'radical' innovations (e.g., adopting land uses new to the area).

4) Testing of decisions

   Structured decision-making underpins the HM framework by providing seven items used to "test" intended decisions to ensure that any proposed action enriches the manager's holistic goal. Aspects including identifying cause and effect, sustainability,

the apparent weak link, the energy or funding source, the society and cultural context, the marginal reaction and the gross profit analysis. Scoring was quantified as: i) inclusive decision-making (i.e., involvement of the land manager's spouse and staff), and ii) the degree of structured decision-making as described in the HM framework (including responses such as "SWOT analysis).

5) Demonstrated active learning

   The importance of continuous and active learning is emphasized by HM and the following were considered to demonstrate this trait: participation in study groups, recent attendance of seminars or workshops, and the number of different information sources consulted.

Two to five items comprised each of the five traits, depending on the character of each trait. Responses were scored and ranked across three categories: "0" (response diverges from HM principles), "1" (response somewhat aligned with HM principles) and "2" (response aligned with HM principles). Dichotomous responses (which were not common) were interpreted as either "0" or "2" (see Table 3.1 and Appendix 4). Scores were summed for individual traits. Each trait was then weighted (0.20) and summed to produce a final score. The final scores of individual land managers were then categorised indicating the degree to which a land manager was aligned with HM principles: "non-Holistic" (HM Adoption Index < 0.40), "semi Holistic" (HM Adoption Index between 0.40 and 0.70) and "true Holistic" (HM Adoption Index >= 0.70).

A pilot study was conducted, which included a "fact-finding" excursion to the intended study site prior to the initiation of the main data collection, which included a meeting with representatives of the HM community in Graaff Reinet as a formal introduction to the study. Additional qualitative interviews were also conducted with individuals who could provide background and context related to the intended study site and HM in general. Subsequently 10 individuals were interviewed to ensure the utility of the interview protocol. Adjustments were made where to improve the flow and structure.

Table 3.1: HM Adoption Index traits used to quantify land managers adoption of Holistic Management. It is assumed that all traits contribute equally to measuring HM adoption and so each of the five traits was weighted 0.2.

	Score		
Traits	**0**	**1**	**2**
1) Has an Holistic/Overarching "goal"			
Manager has a holistic / overarching goal	No	n.a.	Yes
The holistic / overarching goal is in writing[1]	No	n.a.	Yes
Description of "goal".	Mentions one of three pillars of sustainability	Mentions two of three pillars of sustainability	Mentions all three pillars of sustainability
[1]example of dichotomous responses that could only be interpreted as either "0" or "2			
2) Applies Holistic Planned Grazing (HPG)			
Applies HPG	No	Take inspiration from it	Yes
Develops an annual seasonal grazing plan	No	Sometimes	Yes
Supports and applies the "herding effect"	No	Maybe	Yes
Herd different stock animals together during grazing	No	Sometimes	Yes

Traits	0	1	2
3) Demonstrates innovation			
Innovation [2] (score out of 100)	10 to 30 (Low innovation)	40 to 60 (Intermediate innovation)	70 to 100 (Highly innovative)
Risk Aversion [2] (score out of 100)	70 to 100 (High risk aversion)	40 to 60 (Intermediate risk aversion)	10 to 30 (Low risk aversion
Future Innovation	None	Development	Novel
Current Innovation	None	Development	Novel
Past Innovation	None	Development	Novel
[2]Sub-scales with responses of different levels of scoring that could be counted as "0", "1" or "2			
4) Tests decisions			
Individuals included in the decision-making	Manager only	Includes family member(s) (e.g. spouse)	Includes family and staff member(s)
Process of making important decisions	Mostly vague (e.g. "ask advice"; "opinions"; "search for info")	Structured (e.g. "compare pros and cons"; "financial tests")	HM approach (e.g. using the testing guidelines of HM or similar system)

Traits	0	1	2
5) Demonstrates active learning			
Member of a study group	No	was in a group	Yes
Attended a workshop/seminar in the last 2 years	No	n.a.	Yes
Sources of information (e.g., magazines, internet, colleagues)	1 - 2 sources	3 - 4 sources	5 - 6 sources

Interviews

After obtaining ethical clearance (see Acknowledgements), the interview protocols were used to interview land managers twice – once in November to December 2011 and again in the period June-July 2012. Each phase of interviews had two interview protocols – one for HM land managers (see Appendix 1 and 3) and one for NHM land managers (see Appendix 2 and 4). Separate interview protocols were administered for HM and NHM land managers as the HM interview protocol contained items which were only relevant to HM land managers, for example items on their personal experience with HM. However, the contents of the interview protocols were kept as similar as possible to ensure uniformity. Land managers signed a consent form during the initial interviews that informed them about the research study, what was required for their participation and their rights to, and assurance of, confidentiality and anonymity.

HM land managers were first identified from a local HM group membership list provided with consent from the club's president, and then approached to participate. Snowballing was used to identify additional HM and NHM land managers. Land managers approached were asked if they were willing to volunteer for the study and if they identified themselves as practicing either HM or NHM. Prerequisites for participation were that they were active managers (but not necessarily the owner) of a livestock farm. Forty land managers were interviewed including 20 self-defined HM land managers and 20 NHM land managers. Selection of NHM participants favoured neighbours of HM land managers to ensure similar landscapes and context to land management for effective comparisons. Interviews gathered self-reported attitudes and behaviours and were conducted in English or Afrikaans or both (depending on participant preference) and typically took place on farm properties managed by the participants both in the farm residence and on the rangeland.

Data Analysis

The demographic data and the HM Adoption Index were analysed using Statistica 10 (StatSoft, 2001). The demographic data were used to detect if any notable differences found in approach to management by land managers could be related to specific demographic traits. Analysis included descriptive statistics and measures of significant differences using Pearson chi-square, Mann-Whitney U test and T-tests. Items included in the Innovation and Risk Aversion Scales were tested for internal consistency using Cronbach's α (Cronbach, 1951)

and McDonald's ω_h (McDonald, 1999; Zinbarg et al., 2005). Internal consistency was considered acceptable with values of $\alpha > 0.70$ and $\omega_h > 0.60$ (Nunnally, 1978; Knight et al., 2010). Both measures were used as the statistical reliability of Cronbach's α has been questioned though it remains widely used within literature (Zinbarg et al., 2005; Knight et al., 2010).

Data on the perceptions and interpretations of HM and reported actions in relation to livestock farming challenges were qualitatively analysed. Frequencies of certain responses were observed within and across the two participating groups. These data were intended to provide context to the HM Adoption Index.

The HM Adoption Index for the individual land managers was determined by summing the scores of each sub-scale. Each of the five sub-scales was given an equal weight of 0.2 contributing to the final and total HM Adoption Index for each participating land manager.

Results

Demographic Profile

HM and NHM land managers were found to have very similar demographic profiles. The vast majority of both groups were both the land manager and land owner (18 of HM land managers and 19 NHM land managers). All participants were male and of a similar age range (NHM land managers 26 to 61 years and HM land managers 27 to 72 years) with the mean 46 years for NHM land managers and 47 years for HM land managers. About half of the participants have lived on a farm their whole lives – excluding time spent at tertiary educational institutions (50% HM land managers and 55% NHM land managers). The majority claimed an annual turnover of R1 000 000 to R1 999 999 (50% HM land managers and 50% NHM land managers). No significant difference was found for level of education ($p > 0.05$) or marital status ($p > 0.05$). The majority of participants in groups had some tertiary education (85% HM land managers and 65% NHM land managers) and were married (95% of both HM and NHM land managers). Land management experience was also comparable between the two groups ($p > 0.05$) with HM land managers having 20.9 years of experience and NHM land managers a mean of 17.5 years.

The only significant difference that was found was with primary home language ($p < 0.05$) and area of farmland under management ($p < 0.05$). HM land managers were mostly English speaking and had smaller farms (mean = 5933 ha) than the predominantly Afrikaans speaking NHM land managers (mean = 8945 ha).

Land-use Profile

The two groups were very similar in the type of farming business they run. The majority in both groups farmed an assembly of goats, sheep and cattle on their properties (60% HM land managers and 50% NHM land managers) including some crop production (75% HM land managers and 85% NHM land managers), which was mostly lucerne.

Perceptions and Interpretations of "HM"

The majority of HM land managers (40%) have practised HM for 20 years or less, though four individuals had been practicing it for over 30 years. The majority chose to adopt HM because it "made sense" (55%) and specifically wanted to improve their rangeland management (80%).

The majority of NHM land managers reported first hearing about HM from the general community (65%) while HM land managers heard from their families (50%). No NHM land managers mentioned family members as an original source. Some divergence was found in how participants defined HM. Descriptions from HM land managers mostly concerned the principle of balancing social, ecological and economic needs (100%) while the majority of NHM respondents described HM as a grazing system (65%). This was also reflected in HM land managers' responses when asked how distinct HM is from other land management approaches, with 45% of respondents identifying the emphasis on planning and structured decision-making.

Although both groups identified concerns with HM being followed as a "recipe" (45% HM land managers and 35% NHM land managers), for HM land managers the main drawback was the intensive management and planning effort required (55%), while NHM land managers were most concerned about the perceived higher costs of infrastructure required to manage stock according to Holistic Planned Grazing principles (40%). However, both NHM and HM land managers cited improvements in the rangeland to be the top potential benefit of HM – although this was more prevalent with HM land managers (80% HM land managers

and 45% NHM land managers). Both groups mentioned benefits regarding improved rangeland management (55% HM land managers and 35% NHM land managers). HM land managers emphasised improved decision-making and time management. In addition, 50% of HM land managers mentioned that HM encouraged learning, with responses including being challenged to be innovative, to seek new information and to continue to improve. NHM land managers favourably mentioned the increased attention given to livestock and flexibility of management. Of the NHM land managers, 35% reported that they have tried out some aspects of HM, but did not adopt it as they still doubted if HM truly was beneficial.

HM Adoption Index

The Risk Aversion Scale presented an acceptable internal consistency ($\alpha = 0.742896$; $\omega h = 0.63$), whilst the Innovation Scale was variable ($\alpha = 0.712869$; $\omega h = 0.49$). The scale was included in the HM Adoption Index given the acceptability of the Cronbach's α value.

A highly significant difference was found between values for self-reported HM or NHM identity in regards to the scores of the individual sub-scales and the total index ($p < 0.01$). Whilst the vast majority of HM land managers fell within the "true Holistic" category (80%), none of the NHM land managers classified as "true Holistic" though the majority fell within the "semi Holistic" category (65%) (see Figure 3.1). The mean scores for HM and NHM land managers were 0.80 and 0.47, respectively.

Despite its defining importance for HM, three HM land managers did not to a holistic goal, though the majority did (80% HM land managers and 75% NHM land managers). There was lower similarity between the two groups as regards having a "goal" in writing (60% HM land managers and 10% NHM land managers).

Parasite Management Challenges

The majority of land managers reported no change in the abundance of external parasites (65% HM land managers and 85% NHM land managers) or in internal parasites (50% HM land managers and 75% NHM land managers), though 45% of HM land managers reported a decrease in abundance of internal parasites. Both HM and NHM land managers stated they tried to limit the use of chemicals to control parasites with the majority of both groups only applying treatment "if there was a real health problem" (70% HM land managers and 60% NHM land managers). However, HM land managers (20%) specifically mentioned using

environmentally friendly chemical treatments (no NHM land managers did) and non-chemical control methods including rotational grazing (55% HM land managers and 1 NHM land manager), breeding and using resistant animals (40% HM land manager and 20% NHM land managers) and specifically the use of an alternative method – dosing stock with sap from a local succulent plant (*Aloe* spp.) (25% HM land manager and no NHM land managers).

Predator Management Challenges

Most participants reported increase livestock predation over their management career (60% HM land managers and 95% NHM land managers), with most attributing it to the careless land managers (60% HM land managers and 95% NHM land managers) including failure to maintain fences, limited, if any, cooperation amongst neighbours, and absentee land managers. However, almost 50% of HM land managers explained the increase within the context of disruptions to natural processes with explanations including a lack of natural prey, a breakdown of the social structure of predators, or a population increase following a good rain season. Only 2 NHM land managers mentioned any of these "natural" causes.

The majority of both groups reported using a combination of passive (e.g., fence maintenance, guard animals) and lethal (e.g., trapping, night culling) methods to manage predators, however this majority was larger in the HM group (75% HM land managers and 60% NHM land managers). Only within the NHM group did individuals report relying solely on lethal methods (30%). This difference in management of predators was also reflected in the use of guard animals: while 55% of HM used guard animals only 15% of NHM reported using this method.

Drought Management Challenges

NHM land managers utilised extra fodder during droughts, with 55% utilising prickly pears (*Opuntia* spp.), maize or lucerne grown on the farm (20% of HM) and 30% providing off-farm feed (0% of HM). By comparison, only 20% of HM land managers used prickly pears, maize or lucerne, while none utilised off-farm feed. Both groups used licks to support their livestock when grazing on natural rangeland (45% HM respondents and 30% NHM respondents). NHM land managers were more likely to go into crisis mode (50%) and abandon any planning to their grazing (45%) – whereas only one HM land manager reported such actions. HM land managers emphasised adjusting their grazing periods (90% HM land

managers and 50% NHM land managers), and benchmarking or budgeting the available grazing in their rangeland (35% HM land managers and 1 NHM land manager).

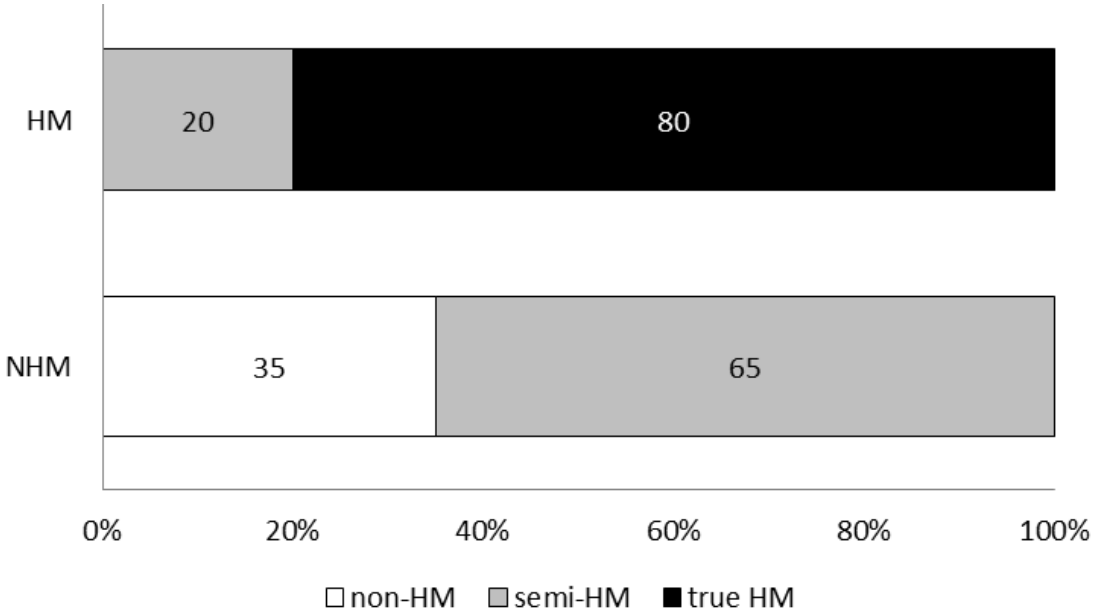


Figure 3.1: Distribution of HM Adoption Index of HM (n=20) and NHM land managers (n=20). Most HM land managers fit the "true Holistic" category (score >= 0.70) while 13 NHM land managers were classified as "semi-Holistic" (score <=0.40 to < 0.70) and the remaining 7 NHM land managers as "non-Holistic" (score < 0.40).

Discussion

An emerging theme in literature has been the need to collectively change our thinking in relation to the management of natural resources towards a more holistic framework (Odum, 1982; Naeem, 2002; Boody and DeVore, 2006; Francis, 2009). However, holistic decision-making is challenging due to the integrated and dynamic complexities defining social-ecological systems. It would be of great benefit then to find approaches for structured decision-making that promote land management that is aligned with holistic principles. HM was explored as such a potential example by examining if self-defined HM land managers applied holistic management principles as described in the HM manual (Savory and Butterfield, 1999) and if their approach to management was distinct from self-defined NHM land managers.

A spectrum of "holistic styled" management was found amongst the HM Adoption index of individual participants, with HM land managers dominating the high scores ("true Holistic") and NHM land managers the mid-levelled scores ("semi-Holistic"). Self-defined HM land managers apply the prescribed HM framework, and are generally distinct from NHM land managers. This could be simply attributed to NHM land managers not having received HM training as the HM land managers had. However, there is probably more depth to this distinction than simply a lack of training. Further research is required to explain why there was such a notable difference.

Demographic and Land-use Profiles

Demographic characteristics of land managers have been commonly used to explain differences between conservative land managers (here assumed to be mainly based on reductionist philosophies) and alternative land managers using practices such as organic farming and HM. Typical alternative land managers in comparison to conservative counterparts tend to be younger and more educated (Knowler and Bradshaw, 2007; Ahnström et al., 2008; Prokopy et al., 2008; Kings and Ilbery, 2010; Bohnet et al., 2011). Such land managers are possibly more entrepreneurial and thus receptive to innovative conservation initiatives such as HM. Other studies comparing HM with NHM land managers indicate that HM land managers tended to be more educated and more likely to include female managers (McLachlan and Yestraue, 2009) in addition to having larger farms (Alfaro-Arguello et al., 2010). Contradicting previous research, this study revealed none of these distinctions in

demographics or in land-use. The only notable differences found were with primary language and area of farmland under management.

The tendency of HM land managers to be English-speakers and NHM to be Afrikaans-speakers is most likely an historical artefact: HM was first introduced to the study area by an English-speaking family (identified from the interviews). Indeed, the important role of family networks was also indicated by how the majority of HM land managers learned about HM from family members while NHM land managers mostly heard about it from the general community. However, there could be a cultural context as well. Conradie et al. (2013) found that Afrikaans-speaking land managers were less likely to participate in conservation – relating this negative relationship to a cultural resistance to values perceived as being different to their own. This apparently conservative attitude of Afrikaans-speakers was also mentioned during interviews of the current study. Although gross generalizations should be avoided, the results suggest that such a cultural resistance could have hindered the spread of HM amongst Afrikaans-speakers in comparison to English-speakers.

The finding that HM land managers generally managed smaller areas of land contrasted with results reported by Alfaro-Arguello et al. (2010), but this could be attributed to a different local context. Owning smaller properties may have encourage HM land managers to explore alternative and intensive farming practices, motivating them to adopt HM. Literature has implied that the size of a property fundamentally impacts its economic viability (Nel and Hill, 2008). Some HM land managers did state during interviews that their farms would have been economically unviable had they not practiced the intensive livestock management promoted by HPG.

Although these differences were notable, they were probably not the main drivers for the distinction found between HM land managers and NHM land managers in regards to their approach to management. Reviews of literature have concluded that there are limited, if any, links between specific demographics and environmental behaviour in land management (Knowler and Bradshaw, 2007; Ahnström et al., 2008). Thus I assumed that the components responsible for the distinction in management approach could be explained by other factors.

An Holistic Context

HM resembles other frameworks used in natural resource management to improve decision-making including structured decision-making (Martin et al., 2009; Espinosa-Romero et al., 2011) and integrated ecosystem assessment (De Groot et al., 2010). These frameworks include steps of problem definition, setting objectives and weighing alternative actions against each other considering the trade-offs (Margoluis and Salasky, 1998). HM also includes adaptive traits, specifically the feedback loop which is key to adaptive management (Margoluis and Salasky, 1998; Allen et al., 2011).

What distinguishes HM from other approaches is that it provides a holistic framework for decision-making. At the time of the study, HM respondents used the term holistic goal or holisticgoal^{TM} for the framework of their decision-making process, but recently this has been renamed as a holistic context^{TM} (Savory, 2012). This emphasises that the intended principle is more than simply setting goals and objectives. Although goal setting is indeed an essential part of land management (Margoluis and Salasky, 1998; Sayer and Campbell, 2004b; Lindenmayer et al., 2011), Savory (2012) argues that such an approach is still reductionist as it does not provide a context for the objectives or challenges, making it difficult to judge the appropriateness or wisdom of any action. The holistic context^{TM} incorporates the values, aspirations and needs of an individual into a statement that guides all decision-making (Savory, 2012). Research has confirmed that the underlining motivations of farmers are lifestyle orientated, influenced by family values and ethics (Pannell et al., 2006; Greiner and Gregg, 2011). Even if a farmer described his "goal" as "financial survival", this does not necessarily imply that he is solely driven by financial motivations. Indeed, the emphasis that farming was not "a job" but a lifestyle was a common statement during interviews for the current study. The VBN and TPB paradigms have also emphasised the fundamental influence of these personal values and perceptions on decision-making (Stern, 2000; Fishbein and Ajzen, 2009; Seymour et al., 2010; Lokhorst et al., 2011). What the holistic context^{TM} does seem to do is to bring these fundamental values to the forefront – so that managers are consciously aware of them when making a decision. The additional requirement that the holistic context^{TM} should be written out and reviewed regularly (Savory and Butterfield, 1999) encourages reflection on these personal aspirations.

Since the concept of a holistic context™ (or holistic goal) is central to HM, it was essential to test if participants in the current study had developed and were using such a "goal". It was simple enough to ask a participant if their "goal" was in writing, but to determine if their "goal" resembled a holistic context™ without revealing the concept was difficult. Thus in analysing these "goals", elements were sought that could indicate a holistic awareness in the context of land management. If participants mentioned economic, ecological and social elements in their descriptions without prompting, they were at least aware of these different dimensions in their decisions. For additional insight, participants were also asked to describe their desired quality of life and visions for the future to insight into participants' motivations and values.

Evidence of a holistic mind-set was further detected in sections of the HM Adoption Index- demonstrating innovation, seeking new knowledge, applying planned grazing and testing decisions. The holistic context™ serves as a compass when making every day management decisions, thus encouraging managers to think through their decisions and the social, economic and ecological implications across various scales (Savory and Butterfield, 1999). This probably prevents reactive responses to solving challenges - McLachlan and Yestrau (2009) did link the adoption of a "holistic goal" with diversified farming practices and proactive strategic decision-making amongst HM land managers. Having such a holistic mind-set could encourage continuous learning, innovation, testing decisions and strategic planning, leading to a high HM Adoption Index. Such creativity and proactiveness has been associated with other frameworks - namely value-focused thinking - that advocates the use of written statements of decision-makers' values ("what matters") to guide decision-making (Keeney, 1994, 1996, 2008). Others have also recognized that adaptive management requires context and a goal that is shared by all decision-makers and continuously reviewed and adjusted, which encourages learning and creativity (Gunderson, 1999; Armitage et al., 2012; Cundill et al., 2012).

Linking thought to action

Part of the motivation for this study was to determine if HM principles were also reflected in the actions taken by HM land managers and if these actions were notably different from NHM land managers when dealing with challenges. HM land managers emphasised structured and flexible planning in drought management to a greater degree than NHM land managers. HM land managers were less dependent on providing extra fodder for their

livestock during drought and chose to rather adjust their grazing plan than abandon their plan or system. It is of particular interest how few HM land managers claimed to revert to a "crisis mode" – especially since the current study took place just after a 3 to 4 year drought.

A central claim of HM is that it intends to work in partnership with nature, basing its land management on models found within ecosystems (Savory and Butterfield, 1999; Savory Institute, 2012a). Both HM and NHM land managers reported use of environmentally conscious methods in their land management including limiting the use of chemicals for parasite control and using a combination of lethal and non-lethal methods for predation management. HM land managers specifically demonstrated an attempt to co-exist with natural systems through their actions (e.g., the use of livestock resistance and rotation grazing to control parasite loads) and attitudes (e.g. almost half of the HM land managers related the increase of predators to either natural population fluxes or the human disruption of these processes). This appreciation for natural systems was also noted in Australian HM communities (Sherren et al., 2012). However, it should be noted that land managers could have over reported these values as they probably viewed as community-favoured responses (Babbie, 2012).

Such holistic conscious action from land managers is precisely what has been cited to counter the "tyranny of small decisions". Odum (1982) emphasised that although one would expect the solution to come from the top-down decision makers including policy makers and scientist, these institutions are still too restricted by reductionist bureaucracy to initiate any substantial change (Holling and Meffe, 1996). A combination of bottom-up and top-down decision-making would be required for land management. As concluded from the current study, HM does appear to promote holistic principles within pragmatic actions of land management.

Misconceptions

Despite the potential for holistic principles to improve land management, the spread of HM has been hampered by misconceptions, as confirmed in this study. NHM land managers generally perceived HM as an expensive grazing system. This has been identified by von Bach and Groenewald (1991) who reviewed the HM grazing plan within the South African context and concluded that it was ony feasible for individuals with sufficient financial resources. Such perceptions of financial cost discourage the adoption of innovations (Pannell

et al., 2006), and possibly even more so with HM that requires a considerable paradigm shift away from conventional rangeland management. HM land manangers countered these agruemtns during interviews, claiming that HM improved their financial manangment and increased their production per ha for which there is some support (Joseph et al., 2002). Excluding the financial concerns, there was the impression that NHM land managers also doubted the fundamental claims of HM, sharing the general negative perception of HM within rangeland science (see Chapter 2)**.**

HM land managers described HM as more than just a grazing system even though a perceived improvement in rangeland was the dominant motivation behind its adoption. HM land managers emphasised its management principles and facilitation for learning. However, HM land managers did indicate that this intensive planning and management could be taxing. Stinner et al. (1997) noted that this intensive management was possible a deterrent for the adoption of HM.

Attitudes towards HM within the southern African context appear to be changing. The application of HM has been advocated in Namibia (Otzen, 1990) and the rangeland science community in South Africa have also shown a more receptive interest to HM both in terms of research and application (Short and Du Toit, 2005; Kirkman, 2012).

Conclusion

Both NHM and HM land managers subscribed to holistic principles and demonstrated environmentally conscious farming practices. This is particularly encouraging for the future prospects of building a resilient rangeland community. However these traits and behaviours were more prominent within the self-defined HM group. HM appears to provide a structure that introduces holistic principles within a land management framework, making the "whole" accessible to land managers for their daily practical decisions.

Acknowledgements

The described study would not have been possible without the funding and support provided by the National Research Fund (NRF) of South Africa and the Department of Conservation Ecology and Entomology, Stellenbosch University through their ethics approval committee (Ref. no. DESC:DEVILAC/2012). Dr Justin Harvey assisted with statistical analyses and Jozua Lambrechts provided invaluable assistance in connecting with the Holistic

Management™ community. The authors specifically express their gratitude to the Graaff Reinet farming community for their willingness to sacrifice their time and patience to partake in the study.

Chapter 4: Sharing Values and Ideas – Managing for resilience in the Karoo rangelands, South Africa.

"The more one studies the living world the more one comes to realize that the tendency to associate, establish links, live inside one another and cooperate is an essential characteristic of living organisms. As Lewis Thomas has observed, 'We do not have solitary beings. Every creature is, in some sense, connected to and dependent on the rest.'"

Fritjof Capra

The turning point: Science, society, and the rising culture

Bantam, New York, 1984

Abstract

As challenges facing modern society become increasingly complex, there is a recognized need to find working examples of structures that transfer the abstract concept of resilience to practical action for land management. Holistic Management™ (HM) is a decision-making framework that is potentially such an example of an adaptive land management approach practiced within arid rangelands. This study determined if HM promoted adaptive capacity in comparison to conventional approaches to land management within the context of the Karoo rangeland surrounding Graaff Reinet, South Africa. An Adaptive Capacity Score was developed which measured the extent to which practices of land managers were aligned with six key traits of adaptive capacity. Data were collected through face-to-face interviews with 20 self-defined HM land managers and 20 self-defined non-HM (NHM) land managers. Social capital amongst participants was explored using social network analysis. HM land managers were predominantly "adaptive" (80%) and NHM land managers mostly "coping" (65%). Furthermore, the networks of family and friends, information sharing and support were more cohesive amongst HM land managers than amongst NHM land managers. HM seemed to promote adaptive planning, learning and innovation which was facilitated by a network of study groups. By facilitating a social learning network in the form of study groups, HM possibly builds resilience by connecting individual decision-making to collective decision-making.

Keywords: adaptive capacity, holistic management, social networks

Introduction

Current society has progressively become embedded within highly complex networks (Scholz et al., 2006). Although this connectivity can facilitate the distribution of knowledge and resources, it also increases vulnerability to shocks as demonstrated by the recent global financial crisis and political upheavals that had repercussions from international to local scales (Ball, 2011). The increasing regularity, severity and unpredictability of these shocks (Francis, 2010) have been partly attributed to the traditional "command-and-control" approach to the management of social-ecological systems (Holling and Meffe, 1996; Gunderson, 2000; Folke et al., 2003). In this context, "sustainability" was interpreted as the ability to produce a maximum sustainable yield of a specific product over a period of time, while suppressing potential change to prevent "complications" (Berkes et al., 2003; Trosper, 2003). Resilience in this context – termed "engineering" resilience – described the rate at which a system returned to a single equilibrium state after a disturbance (Holling, 1996). This conventional approach to managing systems aimed to suppress all change and forcefully maintain systems within an equilibrium state (Folke, 2006).

However, the limitations of this approach have been recognized (Berkes et al., 2003; Davidson, 2010). Social-ecological systems are complex and describe dynamic interactions of interdependent, non-linear and multiple relationships between human societies and ecosystems (Beddoe et al., 2009). Change is an intrinsic factor, so the obsession with control and stability has likely degraded the integrity – and ironically the sustainability – of these complex systems (Gunderson, 2000). Managers are now recommended to embrace the inherent instability in systems and to work with change through adaptive and creative approaches (Folke et al., 2003).

There is no single stable equilibrium in complex systems: rather, there are a suite of multiple states – referred to as stability domains – into which a system can be pushed by certain drivers (Holling, 1973; Perrings and Stern, 2000). A system's ability to buffer shocks and "bounce back" to a stability domain is termed resilience (Holling, 1996; Walker et al., 2002, 2004). Managers are encouraged to maintain this rebound ability by developing adaptive capacity which is the active management of resilience (Walker and Salt, 2006). It is a social, ecological and economic process manifesting the ability to adjust to erratic, fluctuating conditions by reducing detrimental impacts while taking full advantage of available options

(Brooks and Adger, 2004). It administrates the threshold between the multiple stability states of a complex system (McDonald, 2007). It can either prevent a system tipping into an unfavourable state (Fabricius et al., 2007; Bohensky et al., 2010) or into a more favourable state (Walker and Salt, 2006) building positively perceived resilience or reduce negatively perceived resilience (Walker et al., 2009). Accordingly, the importance of developing and maintaining adaptive capacity has received considerable attention (Armitage, 2005; Bohensky et al., 2010) especially for climate change studies (Grothmann and Patt, 2005).

Despite the apparent fundamental value of "resilience thinking" to the management of social-ecological systems (Walker and Salt, 2006), resilience and adaptive capacity are still underdeveloped both as concepts and as pragmatic applications (Folke, 2006; Jones et al., 2010). Resilience remains mostly restricted to theoretical discussions (Béné et al., 2011). A highly complex concept, it is difficult to relate resilience to practical action (Schwarz et al., 2011). One key issue is that adaptive capacity is context specific and changes according to local conditions, scale (Smit and Wandel, 2006; Pelling et al., 2008) and perceptions (Bohensky et al., 2010). Schwarz et al. (2011) pointed out that there is a need for the "development and field-testing of robust and measurable indices of resilience".

Determining a set of recognized characteristics of adaptive capacity could contribute to the application of adaptive capacity concepts by developing ways to assess the level of adaptability in communities. This is specifically important in determining if a system is truly adapting by focusing on long term sustainability or merely coping with an emphasis on short term survival (Fabricius et al., 2007). Thus there is essential value in observing working examples of adaptive management frameworks that apply adaptive capacity in real world situations.

Holistic Management™ (HM) is one such working example. HM proposes that the traditional reductionist management style should shift to a more holistic approach (Savory and Butterfield, 1999). Others have supported such a paradigm shift (Odum, 1982; Capra, 1984; Naveh, 2000; Mulej, 2007; Vance et al., 2007; Crona and Hubacek, 2010). In essence, HM is a decision-making framework that emphasizes an holistic context for adaptive management (Savory and Butterfield, 1999). HM encourages various traits of adaptive capacity including monitoring, active learning, inclusive decision-making and an emphasis on the importance of biodiversity (Savory and Butterfield, 1999). What distinguishes HM from other approaches is

that it encourages land managers to develop a written statement which describes the quality of life they desire, how to support this quality of life and a vision for the future. This statement is the holistic context™ (previously known as the "holistic goal" or holisticgoal™) which HM land managers use to guide their land management decisions and actions (Savory, 2012). It allows managers to think through their decisions and consider the economic, social and ecological impacts of their actions across time and space.

Although HM has potential as an adaptive approach to land management, past research on HM has been limited, with the majority of peer-reviewed studies focusing on the controversial grazing principles associated with HM (Holechek et al., 2000; Briske et al., 2008; O'Connor et al., 2010). The lack of research on topics beyond the grazing principles has been recognized (Briske et al., 2011) with recent studies linking HM with building resilience by facilitating the sustainable use of rangelands (Jacobo et al., 2006; Sanjari et al., 2009; Alfaro-Arguello et al., 2010), fostering proactive and adaptive responses to challenges (McLachlan and Yestraue, 2009) and encouraging supportive social networks (Stinner et al., 1997; McLachlan and Yestraue, 2009). A recent analysis of the theoretical structure of HM found that the framework promotes the management of whole systems and the management for change – key principles associated with resilience (Hosbach, 2012).

Despite these encouraging findings, limited peer-reviewed studies have focused on this potential within the context of rangelands in southern Africa - although HM originated from this region, specifically Zimbabwe, and has been actively practiced for at least three decades (Savory and Butterfield, 1999). The rangelands of South Africa have been severely degraded (Hoffman and Ashwell, 2001) specifically in the Karoo biome due to poor land management practices (Kraaij and Milton, 2006). O'Farrell et al. (2008) recently assessed the resilience of the Little Karoo, a sub-region of the Karoo, and concluded that the socio-ecological resilience had been degraded to such an extent that the system was on a tipping point which would result in major changes in land-use impacting the local socio-economy and ecology. Thus it has become essential for land managers within the Karoo to be able to assess and manage the resilience of their communities.

This study aimed to determine if the decision-making framework of HM promoted adaptive capacity in comparison to conventional approaches to land management within the context of a Karoo rangeland. For this purpose, the following objectives were set:

1) Develop an Adaptive Capacity Score that could indicate to what extent land managers demonstrate key traits associated with adaptive capacity.
2) Compare the individual scores of land managers to determine if there is any notable distinction between self-defined HM land managers and non-HM land managers.
3) Analyse the social networks of land managers particular in regards their role in facilitating learning and innovation.

Methods

Study Area and Context

The interpretation of resilience should take place across temporal, social and spatial scales (Carpenter et al., 2001). Defining such context is specifically important for an agroecosystem which essentially is an amalgamation of subsystems and itself embedded in larger systems (Darnhofer et al., 2010). Cabell and Oelofse's (2012) definition of resilience was adopted for this study: "the capacity to maintain the ability to feed and clothe people in the face of shocks while building the natural capital base upon which they depend and providing a livelihood for the people who make it function". This interpretation of resilience was applied within the context of land management specifically in the semi-arid rangelands surrounding the town of Graaff Reinet in the Eastern Cape province of South Africa. The time scale of the resilience analysis was approached as a snapshot within the mentioned study site within a timeframe from 2011 to 2012.

The local farming community faces various ecological and socio-economic challenges. The landscape is characterized by shrubby vegetation, erosive soils and is prone to stochastic events notably periods of drought (Mucina et al., 2007). Livestock farming is the predominant land use but poor management practices have degraded the rangelands (Archer, 2004; Keay-Bright and Boardman, 2007). Fickle markets, increasing input costs and political marginalization have further contributed to the struggle of maintaining viable rural livelihoods (Nel and Hill, 2008; Nel et al., 2011). Although the total area classified farmland has remained generally constant in the Eastern Cape, the number of farms has decreased (Nel and Hill, 2008). The abandonment and consolidation of farms and a generally transition from historically predominant livestock farming to ecotourism and game farming, have become

common trends within the region (Archer, 2004; Nel and Hill, 2008). The downscaling and land-use change associated with local farming activities have considerable implications for the region already characterised by poverty and welfare dependence (Nel et al., 2011). Although in some areas economic development has stalled and towns have severely depopulated, local socio-economic centres such as Graaff Reneit have continued to grow (Nel and Hill, 2008; Nel et al., 2011). Despite the socio-economic and ecological challenges, the study area does appear to still have potential to promote viable livelihoods.

Context of approach

O'Farrell et al. (O'Farrell et al., 2008) recently assessed the social-ecological resilience of the Klein Karoo – a nearby arid region facing challenges similar to the study area – by applying the procedures of the Resilience Alliance (2008). The Resilience Alliance describes four steps to assess the resilience of a system: 1) describe the system under management (including the main processes and drivers, ecosystem services, historical background and stakeholders); 2) define plausible futures (including external shocks); 3) conduct a resilience analysis (during which key traits of resilience and adaptive capacity are observed in a community); and 4) stakeholder evaluation of findings (Resilience Alliance, 2007). The conclusions of this assessment were used as a contextual reference for this study which is focused on the resilience assessment of individual land managers.

In total, 40 land managers participated of which 20 were self-defined HM land managers and 20 self-defined Non-Holistic Management (NHM) land managers. Participants were not necessarily the land owners but were responsible for the day-to-day management of farming properties. With the assistance of the local HM community, individuals identified as practising HM were approached and asked if they were willing to participate. If they agreed, a snowballing approach (Silverman, 2000) was adopted to identify other HM or NHM land managers, particularly neighbours. All participants were provided a consent form which stipulated their participation rights including confidentiality and anonymity. Participants also indicated their preferred language of communication as Afrikaans or English. Each participant was interviewed on two separate occasions during excursions for data collection in November to December 2011 and June to July 2012. The interviews were semi-structured and face-to-face. Both periods of interviews had distinct interview protocols: one customized for HM land managers (see Appendix 1 and 3) and one for NHM land managers (see Appendix 2 and 4). HM and NHM land managers had different interview protocols because

some content was only relevant to HM land managers, but the overall content was kept similar for both land manager groups.

Prior to data collection, a pilot study was conducted which included testing the questionnaires with 10 volunteers, a "fact-finding" excursion to meet representatives of the local HM community, and qualitative interviews with individuals knowledgeable of the local history and context of HM within the study area and South Africa more generally.

The questionnaires were constructed to provide data for the following three main topics: an Adaptive Capacity Score, a social network analysis and insights into the dynamics and function of local study groups.

Adaptive Capacity Score

Cabell & Oelofse (2012) constructed a set of behaviour-based indicators by reviewing literature on key traits associated with adaptive capacity. If elements of these key traits are reported in the behaviour of land managers, it is assumed that adaptive capacity is present. A quantitative scoring process aids the comparison of adaptive capacity between individuals (Gupta et al., 2010).

Following these examples, an Adaptive Capacity Score was developed for the context of the current study to measure and compare the adaptive capacity of HM and NHM land managers. It was based on the Resilience Alliance process of assessment (2007) in combination with a list of adaptive capacity traits compiled from literature (see Table 4.1). Particularly relevant were studies that have attempted to measure the adaptive capacity of rural communities and individual land managers (e.g., Swanson et al., 2009; Brown et al., 2010; Schwarz et al., 2011). The Adaptive Capacity Score included six traits of individual land managers relevant to the management activities of participants (see Table 4.2). Each trait was quantified through responses to a set of items addressing self-reported attitudes, behaviours or perceptions relevant to the specific trait. The response to each question was scored as "0" (regarded as deviating from the adaptive capacity trait), "1" (somewhat demonstrating the adaptive capacity trait) and "2" (demonstrates the adaptive capacity trait). The score for each question was then summed to give a total score for each trait.

The total scores of the traits were given equal weight (0.167) by dividing 1 by 6. A final score including all the total scores of the traits was then determined for each participant. The final score of each participant was then categorised as "powerless" (score < 0.40), "coping" (= < 0.40 to < 0.70) or "adaptive" (score >= 0.70) based on those described by Fabricius et al. (2007) – "powerless spectator", "coping actor" and "adaptive manager".

Social Network Analysis

To collect data for the social network analysis, each individual land manager was provided with a list of all 40 study participants and asked to describe their relationship with each individual (for example, indicate who are family members or close friends), specify who they would approach for advice (as an indication of knowledge exchange) and who they would call in a time of crisis (as an indication of their support system).

The connections between participants were determined using the Pajek social network analysis software (Batagelj and Mrvar, 2004). Three networks were considered, namely the whole network (which included all participants), a HM network (which included only HM land managers) and a NHM network (which included only NHM land managers). Of particular interest were the cohesion of the three networks regarding the exchange of information, support during a crisis and the level of familiarity amongst participants. Cohesion was used as a concept to compare the connectivity of the different networks, defined as the number of ties within a network (Nooy et al., 2005). Cohesion was measured as density (the percentage of all possible ties present in a network) and average degree (the mean number of ties of an individual to others within the network) (Nooy et al., 2005).

Study groups

To gain further insight into learning networks within the community, participants were asked if they were members of any local "study groups". Study groups refer to any informal institution where members of the local community come together and engage in discussion for the purpose of learning to improve their land management activities. Participants in study groups were asked to describe the activities of these institutions, what topics were discussed, and of what value the study group was to the participant.

Data Analysis

Data analysis included descriptive statistics and tests for significant differences between participants' demographic information, their total Adaptive Capacity Scores and the scores of the six sub-sections using T-tests and Pearson Chi-square tests.

Cronbach's α (Cronbach, 1951) and McDonald's ω*h* (McDonald, 1999; Zinbarg et al., 2005) were used to test the internal consistency of the four sub-scales used within the Adaptive Capacity Score (i.e. the Risk Aversion Scale, the Innovation Scale, the Leadership Scale and the Locus of Control Scale). Values of $\alpha > 0.70$ and $\omega h > 0.60$ were regarded as indicating an acceptable internal consistency (Nunnally, 1978; Knight et al., 2010) (see Chapter 3).

Correlations were also used to test for a relationship between the Adaptive Capacity Score and the HM Adoption Score of individual participants (see Chapter 3). A complementary study had developed and applied an HM Adoption Score that quantified the extent to which participants were aligned with the five main traits of HM: presence of a written holistic goal, reports testing decisions, demonstrated continuous learning, demonstrated innovation, and application of holistic planned grazing. These traits were derived from the HM manual (Savory and Butterfield, 1999). Two correlations were performed, the firstly with the HM Adoption Scores and Adaptive Capacity Scores, and the secondly with modified scores where overlapping sections (including the innovation measure and some data regarding learning) was removed to avoid biases. The overlap was due to shared characteristics between the framework of HM and adaptive capacity, as HM is an adaptive management approach within a holistic context. Statistica 10 software (StatSoft, 2001) was used for data analysis.

Table 4.1: Six key traits associated with adaptive capacity as derived from peer-reviewed literature. The traits were applied as sub-scales within the Adaptive Capacity Score quantifying the degree of adaptive capacity demonstrated by individual land managers.

	Trait	Description	References
1)	Personal Control	Proactive and empowered attitudes about one's own ability to facilitate adaptation. Measures included the participants' perceptions of their impact in the community, reported active community participation (e.g., notifying authorities of local issues or participating in elections) and how individuals scored on a personal control scale.	Brooks and Adger, 2004; Fabricius et al., 2007; Norris et al., 2008; Brown et al., 2010
2)	Record Keeping & Monitoring	Continuous monitoring underpins adaptive management. Participants were asked to report if, and what, records they kept and if they have structured grazing plans. Evidence of adaptive planning was specifically sought.	Carpenter et al., 2001; Brooks and Adger, 2004; Armitage, 2005; Fabricius et al., 2007; Resilience Alliance, 2007
3)	Learning	Learning is fundamental to adaptability. Participants' level of formal education and of actively seeking out learning opportunities were measured.	Carpenter et al., 2001; Folke et al., 2003; Armitage, 2005; Norris et al., 2008; Pelling et al., 2008; Pahl-Wostl, 2009; Allen and Holling, 2010; Brown et al., 2010

Trait	Description	References
4) Innovation	Comprised two scales: the Innovation Scale and Risk Aversion Scale. These scales were complemented further with any reported innovation demonstrated in past, currently or future projects. Differences were identified between projects that were truly innovative (e.g., investigating land-use options not widespread or present in the region) and projects that simply improved or advanced established practices (e.g., refining irrigation systems).	Folke et al., 2003; Eakin and Lemos, 2006; Norris et al., 2008; Allen and Holling, 2010; Jones et al., 2010
5) Leadership and Group Participation	The Leadership Scale measured the number of leadership positions a land manager held in the local community, whether (s)he was identified by others as a "community leader", and the number of groups an individual participated in.	Yohe and Tol, 2002; Eakin and Lemos, 2006; Fabricius et al., 2007; Resilience Alliance, 2007; Norris et al., 2008; Pahl-Wostl, 2009; Bohensky et al., 2010; Brown et al., 2010; Sherrieb et al., 2010
6) Diversity of income and land-use	Participants were asked to report the number of land-uses they practiced and sources of income.	Fabricius et al., 2007; Norris et al., 2008; Sherrieb et al., 2010

Table 4.2: The structure of the scoring approach used to calculate Adaptive Capacity Scores. The six traits each contributed a weight of 0.167 to the final score of each participant.

	Score		
Six Traits	**0**	**1**	**2**
1) Personal Control			
Perceived Community Impact	0 = unsure; 1 = no impact	2 = moderate impact; 3 = impact	4 = big impact; 5 = tremendous impact
Community Participation (e.g., participation in local elections)	1 - 3 activities	4 - 5 activities	6 - 8 activities
Personal Control Sub-scale (score out of 100)	10 to 39 (Low personal control)	40 to 69 (Intermediate personal control)	70 to 100 (High personal control)
2) Record keeping & monitoring			
Records kept (e.g., financial, rainfall, livestock, grazing)	0 - 2 types	3 types	4 types
Grazing & Rangeland records	None	Record livestock count & rotation	Grazing charts, plans & budgeting grazing

Six Traits	0	1	2
3) Learning			
Member of a study group	No	Formerly in a group	Yes
Attended a workshop/seminar in the last 2 years	No	n.a.	Yes
Sources of information (e.g., magazines, internet)	1 - 2	3 - 4	5 - 6
Tertiary Education	None	Diploma	Degree
4) Innovation			
Innovation Sub-scale (score out of 100)	10 to 39 (Low innovation)	40 to 69 (Intermediate innovation)	70 to 100 (Highly innovative)
Risk Aversion Sub-scale (score out of 100)	70 to 100 (High risk aversion)	40 to 69 (Intermediate risk aversion)	10 to 39 (Low risk aversion
Future Innovation	None	Development	Novel
Current Innovation	None	Development	Novel
Past Innovation	None	Development	Novel

Six Traits	0	1	2
5) Leadership and Group participation			
Leadership Sub-scale (score out of 100)	10 to 39 (Low leadership)	40 to 69 (Intermediate leadership)	70 to 100 (High leadership)
Identified by others as a community leader	0 nominations	<10 nominations	>=10 nominations
Highest level of leadership positions	None	Council position	Chairman
Number of leadership positions	0	1 - 2	>2
Number of groups of which a member	0 - 2	3 - 6	>=7
6) Diversity of income			
No. of land-use activities	1	2	>2
No. of agricultural income sources	1	2	>2
Off-farm or non-agricultural income	Only agricultural	Off-farm investments	Non-agricultural business (e.g. eco-tourism)

Results

Demographics

The demographic characteristics of HM and NHM land managers were very similar. HM and NHM land managers had a similar age distribution (HM mean = 47 years; NHM mean = 46 years), annual financial turnover (mean of both HM and NHM land managers was R100 000 – R 999 999), land management experience ($p > 0.05$; HM mean = 20.9 years; NHM mean = 17.5 years) and marital status ($p > 0.05$; 95% of both HM and NHM land managers were married).

Primary home language ($p < 0.05$) and area of farmland under management ($p < 0.05$) were found to be significantly different. The majority of HM land managers were English speaking and the majority of NHM land managers were Afrikaans speaking. HM land managers generally managed smaller areas of land (HM mean = 5933.55 ha; NHM mean = 8945.25 ha).

Internal Consistency

The four scales within the Adaptive Capacity Score presented variable degrees of acceptable internal consistencies. The Risk Aversion Scale ($\alpha = 0.742896$; $\omega h = 0.63$) was the only scale where both the α and ωh exceeded the acceptable thresholds ($\alpha > 0.7$; $\omega h > 0.6$). The Innovation Scale ($\alpha = 0.712869$; $\omega h = 0.49$) and Leadership Scale ($\alpha = 0.79954$; $\omega h = 0.56$) had acceptable α values, but low ωh values. The Locus of Control Scale ($\alpha = 0.662196$; $\omega h = 0.54$) had low internal consistency for both the α value and ωh value.

Adaptive Capacity Scores

The mean Adaptive Capacity Score for HM land managers was 0.758 (Std dev. = 0.101) and 0.598 for NHM land managers (Std dev. = 0.122). Though scores were distributed across a continuum, the 80% of HM land managers were “adaptive” while 65% of NHM land managers were “coping” (see Figure 4.1). Only two NHM participants scored as “powerless”. As two separate groups, the scores of the HM land managers and NHM land managers were also highly significantly different ($p < 0.01$).

When comparing the scores of the individual sections of the Adaptive Capacity Score, no significant difference was found between HM land managers and NHM land managers for personal control, leadership and group participation and diversity of income ($p > 0.05$). However, the differences between HM and NHM land managers regarding record keeping and monitoring were significant ($p < 0.05$) and highly significant for learning and innovation ($p < 0.01$).

To evaluate a possible relationship between the Adaptive Capacity Score and HM Adoption Score, a correlation was performed with the original scores of participants ($r = 0.7541$) and after removing data sections that overlapped ($r = 0.5309$). Both correlations were highly significant ($p < 0.001$).

Social Network Analysis

Overall, the HM network had a greater cohesion than the NHM network regarding asking for advice, support in a crisis, and friendship and family ties (see Table 4.3). The density of the HM network was higher than both the NHM and the whole network. The HM network also had a higher average number of ties than the NHM network. The whole network had the most average ties, but this was expected simply because the whole network included more participants (n=40) than the HM and NHM networks (n=20).

The cohesion of the HM network was further supported by the mean of HM land managers who knew (mean > 14) or had a close relationship (mean >5) with other HM land managers in comparison with NHM land managers' relationship with each other (see Table 4.4). The average HM land managers had slightly more numerous family relations within the HM network (mean > 1) than the average NHM land manager in the NHM network (mean < 1).

Study groups

Study group membership was dominated by HM land managers. Where only three NHM land managers reported being part of a study group or equivalent group, 18 of HM land managers (90%) confirmed to be part of such an institution.

A total of seven study groups were identified – of which five were considered HM groups. Study group membership ranged from four to nine individuals (mean = 6). Club members

were predominantly livestock farmers, though two clubs included "non-farmer" members who were local businessman. The HM study groups meet typically on a quarterly basis. Each member was provided an opportunity in turn to host a meeting on their farm. Though all members are welcome to suggest topics for the agenda, the main focus of each meeting is on the issues and challenges the host wishes to discuss. In essence, each member is provided the opportunity for a "think tank" on the challenges they are facing.

At least 50% of respondents mentioned the following topics as major discussion points during study group sessions: livelihoods (e.g., concerns with shale gas prospecting in the area; legislation impacting on agriculture), social issues (e.g., labour relations; rural schools), agricultural activities (e.g., farming practices; livestock diseases) and strategic planning (e.g., local town future; inheritance arrangements for individual farms). Study group activities included comparing farm records, discussing issues in the local community, going on learning excursions to farms, and socializing, including family activities. Participants specifically emphasize the value of these study groups as forums to exchange ideas and advice (18 responses out of 18 HM club members) and the clubs' supportive role including references to friendship, encouragement and trust (12 responses out of 18 HM club members).

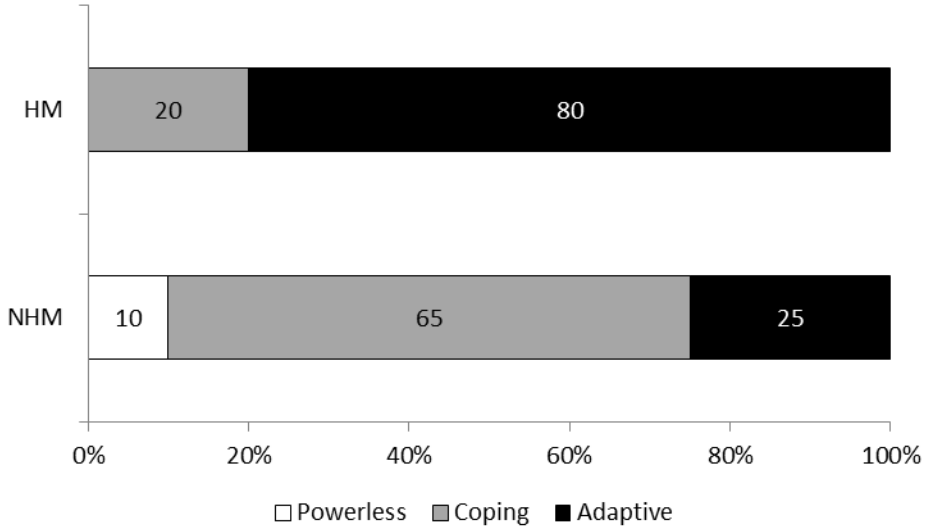


Figure 4.1: Distribution of Adaptive Capacity Scores of HM land managers and NHM land managers. Individual scores were classified into three groups, "adaptive" (score >= 0.70), "coping" (score < 0.70 to >= 0.40) and "powerless" (score < 0.40). As a group, HM land managers had the greater adaptive capacity (80% of HM land managers were "adaptive") than the NHM land managers (25% of NHM land managers were "adaptive").

Table 4.3: Cohesion of the HM network, NHM network and whole network regarding knowledge exchange, support during a time of crisis and familiarity. The cohesion of the three networks was compared by measuring density and average degree.

	Asking Advice		Support in Crisis		Family & Friends	
Network	Density	Average degree	Density	Average degree	Density	Average degree
Whole (n=40)	0.388	15	0.219	12.7	0.224	8.75
HM (n=20)	0.545	13	0.332	8.4	0.276	7.5
NHM (n=20)	0.308	8.5	0.168	4.8	0.113	2.9

Table 4.4: Mean relationships amongst participants in the whole network, HM network and NHM network. Relationships were explored in regards to participants knowing each other, being friends or family and only family.

Network	Know about each other	Are Family or Friends	Are Family
Whole (n=40)	22.28	6.21	1.20
HM (n=20)	14.25	5.25	1.25
NHM (n=20)	9.25	1.95	0.35

Discussion

The Karoo's social-ecological systems are highly susceptible to stochastic events including drought and fluctuations in international markets (Archer, 2004; Keay-Bright and Boardman, 2007), thus land management is notoriously challenging. To promote sustainability in environments facing times of uncertainty, it is essential to find structures that foster adaptive capacity in land management (Jones et al., 2010; Béné et al., 2011; Schwarz et al., 2011). Results of the current study suggest that HM is possibly such a framework.

It was not unexpected to find so few study participants having a "powerless" level of adaptive capacity. The capricious circumstances of the Karoo have likely selected for adaptive management strategies as demonstrated by the general shift towards diversified land-use and income sources noted in the region (Archer, 2000, 2004). In the current study, both HM and NHM land managers demonstrated similar levels of diversification. Yet overall adaptive capacity was accentuated with HM land managers. The results suggest that if the management approach of a land manager was aligned with the main traits of HM, the manager also tended to demonstrate a high adaptive capacity.

As noted by Sherren et al. (2012), it is not clear whether it is HM specifically that promotes adaptive behaviour or if resilient and holistic thinking managers are attracted to HM as a management approach that resonates with them. General demographic characteristics and some personality aspects were not distinguishable between HM and NHM land managers Overall, participants had a similar distribution of personality traits of leadership and sense of personal empowerment regarding social participation, although varying levels of internal consistency for the scales used to measure leadership and personal control may have contributed to this lack of distinction.

Differences between NHM and HM land managers were, however, linked to planning, learning and innovation, as described below.

Adaptive planning with grazing charts

Monitoring, planning and re-planning are cited as foundational to HM (Savory and Butterfield, 1999). These traits are also key to adaptive management and building adaptive capacity (Walters and Holling, 1990; Fabricius et al., 2007). The typical NHM land manager

mostly reported only recording livestock rotations through camps and livestock numbers. HM land managers applied elaborate grazing charts which included information on stocking rates, rainfall, ratings of the grazing quality of each camp, when and why certain camps would not be available for livestock and other specific dates of note. These charts were then adjusted as conditions changed and required input of continuous monitoring data which actively encourages land managers to keep records.

This planning process requires considerable investment in time, effort and discipline and has been implicated as a possible deterrent for HM adoption (Stinner et al., 1997). Yet the majority of the current study's HM land managers actively used grazing charts. Indeed, some mentioned that they were essential when managing for dry periods by anticipating and budgeting for grazing during drought.

The framework of HM does seem to foster adaptive planning amongst land managers as noted by others (McLachlan and Yestraue, 2009; Sherren et al., 2012). Such a planning structure could possibly encourage creative problem solving, but structured and cohesive social networks amongst HM land managers have potential to enhance innovation and learning.

Networks of Learning and Innovation

Social networks amplify learning and innovation by facilitating access to new ideas and discussion amongst peers (Newig et al., 2010; Reed et al., 2010; McCarthy et al., 2011; Luthe et al., 2012). Such social learning allows individuals to engage with the collective and can ultimately lead to a change in the collective's mental model which impacts the land-use of entire landscapes (Newig et al., 2010). In addition, social networks contribute to quality of life of individuals (Parker and Moore, 2008). Social networks – and thus social capital – are essential to maintaining resilience and sustainability (Grootaert and Bastelaer, 2001; Keogh et al., 2011).

Connectivity was notable amongst HM land managers as shown in the cohesion regarding knowledge exchange, support in a crisis and close-knit relationships. Others have also confirmed the notable role of social networks amongst HM land managers (Stinner et al., 1997; McLachlan and Yestraue, 2009). Though family networks certainly played a notable role within the HM network, the reported results of the current study did imply that family

relations could not fully explain the cohesion of the HM network in comparison with the NHM network. What distinguished HM land managers from NHM land managers specifically is the formation of study clubs (Keay-Bright and Boardman, 2007; McLachlan and Yestraue, 2009).

Study clubs appear to support both types of social capital as defined by Grootaert and Van Bastleaer (2001) as structural social capital – which facilitates information sharing and decision-making – and cognitive social capital – which includes concepts of trust and values. Study clubs facilitate learning as members engage with others with varying levels of experience and knowledge. Members share multiple "trials and errors" of their experiences across the landscape (Kennedy and Brunson, 2007). In addition, such social networks also seem to help members to keep each other in check (Grootaert and Bastelaer, 2001). HM land managers in the current study noted that they shared their goals and plans with club members who then helped them to stay on track. Such sharing would only be feasible if there were high levels of trust. The regular face-to-face interactions of the study groups probably contribute to building such trust (Low et al., 2003) which is essential in establishing relationships within networks (Blann et al., 2003). Participants did report that one of the main benefits of a study club was its supportive and encouraging role. In addition, the social network analysis indicated more ties within the HM network regarding close relationships; socialization specifically involving the whole family was a main activity of the study clubs – further emphasising the maintenance of cognitive social capital. These benefits have also been reported in similar social organizations of land managers including the Grasshoppers, a group of dairy farmers in the UK (Pelling et al., 2008) and LandCare, an initiative that promotes sustainable land-use practices which originated in Australia (Cullen et al., 2003). Such groups report similar characteristics to HM study clubs including regular meetings, sharing information and problems, learning excursions to farms and a strong group identity that unifies participants (Curtis and Lacy, 1996; Lockie, 2006; Pelling et al., 2008; Compton and Beeton, 2012). These activities have been related to enhancing trust, learning and innovation (Curtis and Lacy, 1996; Cullen et al., 2003; Lockie, 2006; Pelling et al., 2008; Compton and Beeton, 2012). Attendance of these groups have also been associated with increasing adaptive capacity by building social capital which then aids the distribution and application of land practices that enhance conservation (Mues et al., 1998; Cullen et al., 2003; Lockie, 2006; Pelling et al., 2008). Social capital indeed appears to be both "an important ingredient" and "outcome" of these organizations (Curtis, 2003).

Despite the apparent benefits of study groups, there are some concerns. Building social capital requires investment of time and effort (Grootaert and Bastelaer, 2001) which could discourage a land manager from joining a study club. This was pointed out by some participants of the current study. Participants also mentioned that due to the high degrees of trust involved in study clubs, it is very difficult for an outsider to join a group. A contributing factor could also be the diverging approaches to grazing management amongst participants. HM is associated with a controversial approach to grazing management which could then discourage NHM land managers from engaging with HM clubs. Few alternatives to the HM study clubs were present in the area which could then further explain why so few NHM land managers were engaged with study clubs.

The effectiveness of social networks for adaptive capacity is dependent on the values and views of the individuals. Compton and Beeton (2012) warned that strong bonding networks – specifically in reference to LandCare groups - could impair the flexibility of communities. Defined as "rigidity traps", such networks could promote resistance to shifting a system to a state that would be more beneficial for the whole community but one which the network members does not support (Carpenter and Brock, 2008). Resilience itself is, after all, a qualitative term describing preferred or less preferred states (Eakin and Wehbe, 2009).

Why measure Resilience?

No "check-list" of key adaptive capacity traits could ever fully describe the state of resilience since systems are so highly complex and contextualized. However, the use of a scoring system in the current study provided a method to compare the adaptive capacity of land managers (Brown et al., 2010; Gupta et al., 2010; Nelson et al., 2010).

The Adaptive Capacity Index used in the current study was not all inclusive. Neither measures of ecological nor economic resilience were included. Since these aspects of resilience are intimately related to social resilience (Grothmann and Patt, 2005; Fabricius et al., 2007), further research should incorporate such measures. Literature yields mixed sentiments regarding the ecological and economic benefits of HM both in favour (Otzen, 1990; Jacobo et al., 2006; Sanjari et al., 2009; Alfaro-Arguello et al., 2010) and against (Sartorius von Bach and Groenewald, 1991; Holechek et al., 2000; O'Connor et al., 2010). Recent research within the study area reported an unfavourable relationship between grazing

management that applied HM and vegetation cover – a possible indication of reduced ecological resilience (Archer, 2004; Keay-Bright and Boardman, 2007).

There is growing evidence that HM promotes social resilience. If this is indeed linked to social networks as described in this study, then I would recommend the further development of study clubs that facilitate learning for NHM land managers and other members of the local community. Casual learning networks are already well established amongst land managers as concluded from participants' remarks and personal observation during the study. Land managers claimed that they could approach almost any one of their neighbours for advice or for help in a time of crisis. This network can be further facilitated and structured by establishing study clubs.

Building such social capital is essential for the local community as it is currently facing considerable challenges. The region is expected to continue experiencing political and economic marginalisation with dramatic demographic shifts as the socio-economic centres such as Graaff Reinet increasingly urbanize with the influx from the surrounding depopulating rural areas (Nel and Hill, 2008). The region has been put under additional stress by the highly controversial proposal to explore the potential use of hydraulic fracturing to access the shale gas reserves of the Karoo which will have a substantial impact on the community – for better or worse (De Wit, 2011). Adaptive capacity and resilience is thus of considerable contemporary value to the region.

Conclusion

HM appears to be a working example of a land management framework that promotes adaptive capacity within the context of a real-world agroecosystem. HM conceivably connects individual decision-making to collective decision-making through facilitating a social learning network in the form of study clubs. The development of such study clubs within the communities of arid rangelands is thought to promote learning and innovation which is key to building adaptive capacity.

Acknowledgements

Funding was provided by the National Research Fund (NRF) of South Africa and the Department of Conservation Ecology and Entomology, Stellenbosch University, provided both support and ethical approval (Ref. no. DESC:DEVILAC/2012). Numerous individuals

provided invaluable assistance to the author, specifically Dr. Justin Harvey who assisted with statistical analyses and Jozua Lambrechts, who represented the Holistic Management™ community in South Africa. This study would not have been possible without the considerable support and guidance offered by the Graaff Reinet farming community.

Chapter 5: Conclusion

"We don't really own the land, Son; we hold it and pass away.
The land belongs to the nation, to the dawn of Judgement Day.
And the nation holds you worthy, and if you are straight and just
You'll see that to rob the land is betraying a nation's trust."

Anonymous Poet
The Law of the Land, quoted from a roadside café near Heidelberg, South Africa
Adapted by Mark Swilling and Eve Annecke
Just Transitions: Explorations of sustainability in an unfair world
United Nations University Press, 2012

Managers and researchers share the challenge to find land management frameworks that incorporate the holistic principles to manage social-ecological systems in a sustainable way. This thesis aimed to contribute to this knowledge by exploring the potential of HM to actively promote the concepts of resilience and holism within the context of an arid Karoo rangeland. The current chapter synthesises the key findings and conclusions, provides critique on the methods used and recommendations for both future research and management.

Key Findings and Conclusions

Limited Distinguishing Demographic Traits

Hardly any significant difference was found for demographic traits of HM and NHM land managers (see Chapter 3 and 4). As confirmed in literature, there appears to be a limited connection between specific demographic traits and land management (Sayre, 2004; Knowler and Bradshaw, 2007). The thesis concluded that any managerial differences found between HM and NHM land managers was not related to any specific demographic trait.

Continuum of HM principles and adaptive capacity

A continuum of HM Adoption Index and Adaptive Capacity Index was found within both groups of HM and NHM land managers and when observed as a whole (see Chapters 3 and 4). This indicated that the principles of holistically managing rangelands and adaptive capacity are not exclusive to the self-defined HM and seemed to be well established within

the community. However, these scores were specifically amplified within the HM group, implying that HM's framework enhances these principles.

HM land managers "farming the talk"

The majority of HM land managers actively applied the five key HM traits within their management frameworks: 80% of HM land managers were "truly Holistic" (HM Adoption Index >= 0.70) while the majority NHM land managers (65%) were "semi Holistic" (0.40 =< HM Adoption Index < 0.70) (see Chapter 3). The apparent holistic and systems thinking of HM land managers was also demonstrated in reported actions when dealing with farming challenges. Strategic, long term and flexible planning in drought management and the use of innovative and passive methods to manage parasites and predators were more frequently reported amongst HM land managers than NHM land managers. This suggested that the approach to managing land in synergy with natural processes and complexity as advocated by the HM manual was reflected in real practice by HM land managers. Others have also noted that HM land managers "farm the talk" (Hosbach, 2012; Sherren et al., 2012).

HM promotes adaptive capacity

Correlations suggested that a high HM Adoption Index was linked to a high Adaptive Capacity Index – even after accounting for overlap between the scores (see Chapter 4). Results also reported that 80% of HM land managers were "adaptive" (score >= 0.70) and 65% of NHM land managers were "coping" (0.40= < score < 0.70). This suggested that HM – or at least management that applies holistic principles - promoted adaptive capacity which is in agreement with the reported results of others (McLachlan and Yestraue, 2009; Sherren et al., 2012). HM land managers were specifically prominent in regards to record keeping and monitoring, innovation and learning. It was concluded that the strong emphasis on planning within the HM framework and the social network amongst HM land managers facilitated these key traits. Study clubs (which HM land managers were specifically associated with) provided a supportive network and assisted the exchange of ideas leading to collaborative adaptive management (Curtis and Lacy, 1996; Stinner et al., 1997; Lockie, 2006; Pelling et al., 2008; McLachlan and Yestraue, 2009; Compton and Beeton, 2012).

Although the key findings are in agreement with the reported results of others, there are certain aspects of the methodology that in hindsight can be improved.

Shortcomings

Distinguishing Adaptive Capacity Index from HM Adoption Index

Precautions were taken and adjustments were made where necessary to limit any possible bias to a specific group within the scoring systems used. Yet it was a challenge to distinguish the traits of the Adaptive Capacity Index from the HM Adoption Index as the concepts of resilience, adaptive capacity and holism flow in and out of each other. HM's framework incorporates key traits of adaptive management and resilience including whole systems thinking and managing for change (Hosbach, 2012). Thus some overlap was inevitable and so by default it was likely that an individual that scored high in the HM Adoption Index would also score high in the Adaptive Capacity Index.

However, this did not necessarily cause a bias in favour of HM land managers within the Adaptive Capacity Index. The groups of HM and NHM land managers that were compared were based on participants identifying themselves as either HM or NHM – the classification was independent of their HM Adoption Index. Results found that these self-identified HM land managers generally scored higher than NHM land managers, supporting the finding that HM promotes adaptive capacity. Furthermore, the correlation found between the two scoring systems also included NHM land managers who scored high in both, further emphasising a possible link between HM-styled management and adaptive capacity. So it was accepted that any biases were at least limited when assessing the management of participants.

Quantifying intangible concepts

To use quantifiable scores to interpret complex and intangible concepts such as resilience and holism does indeed smack of reductionism – countering the attempt of this thesis to address the inappropriate dominance of reductionism within rangeland research (see Chapter 2). Quantitative research does stand the risk to loose context and detail relevant to rangeland management (Sayre, 2004). This probably contributed to the weak internal consistencies of the scales used within the scoring systems of the thesis. Some subjectivity was also involved. Although based on a review of available and recent literature, it was still up to the researcher to choose *what* to record as an indication of a specific trait associated with HM and adaptive capacity.

Scientific research by definition requires some reduction and cannot be truly isolated from the subjectivity of the researcher (Noss, 2007). Thus, I do emphasise that the thesis should be interpreted as exploratory research regarding HM and adaptive capacity. More in-depth qualitative research regarding land management is highly recommended as it detects unforeseen factors, provides insights on the formation of mental models and extends over greater temporal scales (Sayre, 2004). However, the scoring method used in the thesis was useful to find general trends within a complex and diverse data set. Due to the novelty of the main research topics presented in the thesis, the approach had limited previous literature to build on. Yet finding frameworks to improve land management is a critical need (see Chapter 1).

Thesis did not include "full" resilience: ecological & economic resilience

Though promising, the findings of the thesis should not be interpreted as a definite confirmation that holistic management promotes resilience. Measures of ecological resilience and economic resilience were not included due to time constraints presented by a 2 year MSc. Neither was it possible to measure the adaptive capacity and holistic management of land managers before and after they adopted HM. The time period of the thesis also did not allow for the testing of the resilience and adaptability of participants while facing a crisis (before and after) – or to see who "bounced back" faster and more effectively after a major shock such as drought. These aspects of resilience should be thoroughly researched in future.

Recommendations

The concepts encouraged by HM are not extraordinary. Others have also proposed these ideas including managing complex systems within a holistic context (Odum, 1982; Walker and Salt, 2006), establishing shared values and goals amongst stakeholders (Keeney, 1996, 2008; Cundill et al., 2012) and learning with others through networks (Lockie, 2006; Pelling et al., 2008; McCarthy et al., 2011; Luthe et al., 2012). As previously discussed, traits associated with HM also characterise adaptive capacity and thus the maintenance of resilience (see Chapter 4). The mentioned continuum of scores amongst participants also further noted these traits were common amongst land managers.

However, what HM particularly seems to do is to package the concepts of holism and resilience into a framework that make these intangible ideas accessible and applicable to land management. An example specifically emphasised in the current thesis is the learning

network facilitated by HM through study clubs. The apparent important role of study clubs could be particularly empowering for emerging farmers. Land redistribution schemes in South Africa have had limited success due to controversies and various obstacles (Denison et al., 2009) including the severe lack of skills, knowledge and practical experience in managing a commercial farm amongst emerging farmers (MacLeod et al., 2008). Investing in social capital through establishing networks and collaborative associations would be invaluable to the viability of these projects (Jari and Fraser, 2009).

Both commercial and small-scale land management in South Africa face many challenges of variable and dynamic dimensions including political, economic and ecological (Wilk et al., in press). I hope that these findings will encourage policy-makers to consider encouraging more holistic approaches to land management and specifically aid the creation of networks of learning amongst stakeholders. But mostly, this change will have to come from the "ground-up". The collaborative and proactive decision-making of land managers directly addresses the degradation of social-ecological systems. HM has been characterised as being mostly a grass-roots initiative (McLachlan and Yestraue, 2009) that was side-lined by research (see Chapter 2). But sentiments have changed and there has been renewed interest in HM (Fynn, 2008; Kirkman, 2012).

The concepts of resilience and holism are as complex and dynamic as the system to which they apply. Introducing these concepts into management and research is challenging, as noted by the thesis. Collaborative learning of researchers and managers to develop workable frameworks that maintain resilience within the real-world context of land management should be encouraged and implemented (Knight et al., 2008; Gardner, 2012).

Conclusion

Though the practical application of holism and adaptive capacity is still quite novel and debated within literature, the findings of the current thesis does suggest that the HM framework as one optional approach to apply adaptive and holistic principles to decision-making can make a valuable contribution to land management. In essence, HM appears to connect the individual's decision-making to the collective decision-making of the local community.

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Appendix 1: 1st Interview protocol for Holistic Land Manager

Interview Code:_____ Date of Interview:_____

Interview location:_____

Landowner Name:_____

Land Manager Name:_____

Farm Name(s):_____

A. INTRODUCTION

A.1 General Information on Farm

A.1.1 How many years have you lived on this property? _____ years

A.1.2 How many years have you owned/worked on this property?

_____ years

A.1.3 Please indicate on the topographic map the borders of your land.

A.1.4 How many hectares of land do you own? _____ ha

A.2 Experience with HM

A.2.1 How and when did you first learn about HM?

_____

_____

A.2.2 When did you adopt HM in your farming practices? _____ years

A.2.3 Why did you decide to apply HM?

_____

_____

A.2.4 Was there something specific that you wanted to improve with HM?

_____

_____

A.2.5 What is your definition/understanding of HM?

_____

_____

A.2.6

A.2.6.1 Indicate how you received your training in HM:

Attended official HM training / workshops / seminars	
Someone taught me in a private casual setting	
Self-taught / Literature	
Other	

A.2.6.2 If applicable, from whom did you receive your training or who presented the workshops/seminars?

_____

A.2.7 Are any of your neighbours HM land managers? If so, indicate on map which of your neighbours are HM land managers and which are not.

A.2.8 Are there any drawbacks to using HM?

_____

_____

A.2.9 What has been the major benefit for you with using HM?

_____

_____

B. BUILDING A FARM

B.1 Introduction to management

B.1.1 Can you please briefly explain to me the activities which comprise a typical day on your farm?

_____

_____

B.1.2 Can you please briefly explain to me the activities which comprise a typical week on your farm?

_____

_____

B.1.3 Can you please briefly explain to me the things you do in managing your farm that demonstrate you are practicing HM?

_____

_____

B.2 Goal Setting

B.2.1 Holistic Goal

B.2.1.1 Do you have a formalized holistic goal?

Yes	
No	
Unsure	

B.2.1.2 If yes, is it in writing?

Yes	
No	

B.2.1.3 If no: follow non-HM questions

B.2.1.4 What is your three-part holistic goal?

Quality of life

_____

_____

Form of Production

_____

_____

Future Resource Use (including behaviour of people, vision of land, structures and resources)

_____

_____

B.2.1.5 Do you believe that, through your active management, your farm is evolving towards your chosen holistic goal?

Yes	
No	
Unsure	
Too early to say	

B.2.2 Testing Decisions

B.2.2.1 Who are the decision-makers on your farm?_____

B.2.2.2 Has the way you make decisions changed since adopting HM? If so, please explain.

_____

_____

B.2.2.3 Do you use the 7 testing questions (as described by HM) to guide your decision-making?

Yes	
No	
Unsure	

B.2.2.3. 1 If yes, what are these guidelines and what factors do you consider?

_____

_____

B.2.2.3. 2 If yes, how often do you use this guideline

Never	
Hardly ever	
Now and then	
For most decisions	
For every decision	

B.2.2.3.3 If yes, for what decisions do you use this guideline in regards to their importance (examples are in *italics)*

Small decisions (*Milk or cream in my coffee?*)	
Day-to-day decisions (*My to-do-list for the day*)	
Important decisions *(What should I give my wife for her birth day?)*	
Vital decisions (*Which medical insurance scheme should I get?*)	
Life Changing decisions (*Who will I marry?*)	

B.2.2.3.4 If yes, for what decisions do you use this guideline in regards to their subject matter

Family	
Personal Choice	
Lifestyle Choices	
Business / Financial	
Farming Practice	
Relationships	

B.2.2.3. 5 If yes, why do you use this guideline

_____

_____

B.3 Land Planning

B.3.1 Land-use

B.3.1.1 In the table, please provide the following information regarding land-use:

B.3.1.1.1 What land-use types are you currently using?

B.3.1.1.2 Rank the mentioned land uses according to their:

a) Financial importance for your income
b) Personal importance to you (referring to their cultural, aesthetic or inheritance value)

Rank from the most important (indicated as 1) to least important (indicated by the highest number).

B.3.1.2 Indicate on the map where the different land-uses are applied on your property.

Land-use Type	B.3.1.1.1) Type		B.3.1.1.2) Rank a)	B.3.1.1.2) Rank b)	1.3) Land-type
Crop					
Livestock					
Ecotourism	View				
	Hunting				
Direct Use / Harvesting	Wood				
	Medicinal plants				
	Hunting				
	Food plants				
Conservation					
Other					

B.3.1.3 Do you have any additional sources of income besides the mentioned activities?

_____

_____

B.3.2 Flexibility

B.3.2.1 Do you agree with the following statement: I believe that I have the ability to adjust my farming business to capitalise on emerging opportunities

strongly disagree	disagree	unsure	agree	strongly agree

B.3.2.2 Have there been any major changes in land-use or economic activity on the farm? Have any activities or practices been added or stopped?

_____

_____

B.3.2.3 Which of these changes were brought about by you?

_____

_____

B.3.2.4 Why were these changes made?

_____

_____

B.3.3 Infrastructure

B.3.3.1 Using the map as an assistance, please indicate the major water resources on your land and rate their value (in terms of quality and accessibility).

	No value / not used	Poor value	Moderate Value	Good Value	Tremendous Value
Springs					
Rivers					
Dams					
Boreholes					
Others					

B.3.3.2 How many operating windmills do you have? _____

B.3.3.3 How many operating water pumps do you own? _____

B.4 Grazing Planning

B.4.1 If more than one livestock type, do you herd different livestock together?

Yes	☐
No	☐
Sometimes	☐
Unsure	☐

B.4.2 What is your current stocking rate? _____

B.4.3

B.4.3.1 Has your stocking rate increased/decreased in comparison to the original stocking rate before starting HM on the property?

Increased	☐
Decreased	☐
Stayed the same	☐
Unsure	☐
Too early to say	☐

B.4.3.2 If changed, what was the original stocking rate?

_____

_____

B.4.3.3 If changed, why did the stocking rate increase/decrease?

_____

_____

B.4.3.4 If applicable, when did the de-stocking take place (with reference to drought and weather conditions)?

_____

_____

B.4.4 What grazing systems were previously used on your farm?

_____

_____

B.4.5

B.4.5.1 Are you using the grazing plan as described by the HM guidelines?

Yes	
No	
Unsure	

B.4.5.2 If yes, please describe the basic process.

_____

_____

B.4.5.3 If no, why not?

_____

_____

B.4.6

B.4.6.1 How often do you do a grazing plan.

_____

B.4.6.2 If applicable, describe the typical rotation/rest periods of your current grazing plan.

_____

_____

B.4.7 In regards to your grazing camps…

B.4.7.1 What type of fencing was used?

_____

B.4.7.2 What is the average size of your camps?

_____

B.4.7.3 How many camps do you have?

_____

B.4.8 Do you believe in the "herding effect": that (with good management) intense trampling of a large number of herded livestock for a short period of time can improve the soil condition?

Yes ☐
No ☐
Unsure ☐

B.5 Monitoring

B.5.1 General Information

B.5.1.1 How often do you assess your current progress towards your holistic goal?

Never ☐
Once a year ☐
Every six months ☐
Quarterly ☐
Every second month ☐
Monthly ☐
Weekly ☐
Daily ☐

B.5.1.2 Did you monitor your progress before adopting HM?

Yes ☐
No ☐
Unsure ☐

B.5.1.2.1 If yes, what economic indicators did you use? (e.g. cash flow?)

_____

_____

B.5.1.2.2 If yes, what quality of life indicators did you use? (e.g. time?)

B.5.1.2.3 If yes, what biological, chemical, or ecological indicators did you use? (e.g. soil tests?)

B.5.1.3 Of the mentioned indicators, which are the most important to you?

B.5.1.4 Now that you are using HM, what indicators do you use to monitor your progress in regards to:

B.5.1.4.1 Quality of Life

B.5.1.4.2 Economic Situation

B.5.1.4.3 Ecological Situation

B.5.1.5 Of the mentioned indicators, which are the most important to you?

B.5.1.6

B.5.1.6.1 What data do you include in your recording keeping?		B.5.1.6.2 From when were these records kept?
Financial		
Weather		
Animal Production		
Veld		
Other		

B.5.1.6.3 Of the mentioned records, which are the most important to you?

_____

B.5.1.7 How often do you monitor the changing variables important to your management?

Never	
Once a year	
Every six months	
Quarterly	
Every second month	
Monthly	
Weekly	
Daily	

C ENVIRONMENTAL ATTITUDE AND BEHAVIOUR

C.1 Environmental Attitude

Indicate if you agree or disagree to the following statements:		Strongly Disagree	Disagree	Neutral/Unsure	Agree	Strongly agree
1	We are approaching the limit of the number of people the earth can support					
2	Humans have the right to modify the natural environment to suit their needs					
3	When humans interfere with nature it often produces disastrous consequences					
4	Human ingenuity will insure that we do NOT make the earth unlivable					
5	Humans are severely abusing the environment					
6	The earth has plenty of natural resources if we just learn how to develop them					
7	Plants and animals have as much right as humans to exist					
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations					
9	Despite our special abilities humans are still subject to the laws of nature					
10	The so-called “ecological crisis” facing humankind has been greatly exaggerated					

11	The earth is like a spaceship with very limited room and resources					
12	Humans were meant to rule over the rest of nature					
13	The balance of nature is very delicate and easily upset					
14	Humans will eventually learn enough about how nature works to be able to control it					
15	If things continue on their present course, we will soon experience a major ecological catastrophe					

C.2 Environmental Behaviour

Indicate if you agree or disagree to the following statements:		Strongly Disagree	Disagree	Neutral/ Unsure	Agree	Strongly agree
1	I own a solar water heater.					
2	My geysers are fitted with an insulating blanket.					
3	I unplug cellphone chargers, shavers and electric toothbrushes from the wall when not in use.					
4	I own and use a gas stove.					
5	I turn off lights when not using them.					
6	I have installed energy-efficient lights in my house.					
7	I generate electricity with solar and/or wind power.					
8	I use diesel generators for electricity and/or waterpumps.					
9	I regularly check and adjust my tire pressure.					

10	I plan ahead to minimize driving with my car and car pool when possible.					
11	I have predominantly indigenous drought-resistant plants in my garden.					
12	My home has a grey-water system and/or rain water tanks.					
13	I turn off the tap while brushing my teeth.					
14	I recycle paper, tin, glass and plastic whenever possible.					
15	I use organic waste such as food scraps to make compost.					
16	I prefer to use re-usable shopping bags.					
17	I buy/use locally produced food.					
18	I prefer buying organic vegetables and fruit.					
19	I prefer buying/using grass-fed and free range meat products.					
20	I grow and produce some of my own food.					
21	I prefer buying/using seasonal fruits and vegetables.					
22	I buy/use bottled water.					

D. INTERVIEWEE PERSONAL AND PROPERTY INFORMATION

D.1 Gender:

male	female

D.2 Year of birth: _____

D.3 Cultural group:

English (White)	Afrikaans (White)	Xhosa	Coloured	Other

D.4 What language do you primarily use at home?

English	Afrikaans	Xhosa	Zulu	Other

D.5 What languages can you speak?

English	Afrikaans	Xhosa	Zulu	Other

D.6 Marital status

Single	Married	Divorced	Widowed	Other

D.7 Level of education completed:

Primary school	High school	Did Some University	Diploma	Full degree	MSc	PhD	Other

D.8 Would you be interested in receiving feedback of the current project?

Yes	No	Unsure

Please provide the following contact information:

Email: _____ Tel: _____

CONFIDENTIALITY CLAUSE

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of assigning a unique code to each individual interviewed. Only the code name will be used in all publications based on the study. Only one of the researchers (Ancois de Villiers) and her supervisors will have access to the link between the code and yourself. The study data will be kept on password protected software and a portable e-storage devise which only the participating researchers will be able to access. At the completion of the study, the raw data will be kept to support future research. However, all personal information that could link you as an individual to the data will not be published without your written consent

Appendix 2: 1st Interview protocol for Non-Holistic Land Managers

Interview Code:_____ Date of Interview:_____

Interview location:_____

Landowner Name:_____

Land Manager Name:_____

Farm Name(s):_____

A. INTRODUCTION

A.1 General Information on Farm

A.1.1 How many years have you lived on this property? _____ years

A.1.2 How many years have you owned/worked on this property? _____ years

A.1.3 Please indicate on the topographic map the borders of your land.

A.1.4 How many hectares of land do you own? _____ ha

B. BUILDING A FARM

B.1 Introduction to management

B.1.1 Can you please briefly explain to me the activities which comprise a typical day on your farm?

_____

_____

B.1.2 Can you please briefly explain to me the activities which comprise a typical week on your farm?

_____

_____

B.2 Goal Setting

B.2.1 Overarching Goal

B.2.1.1 Do you have a formalized and overarching ultimate goal for your management strategy?

Yes	
No	
Unsure	

B.2.1.2 If yes, is it in writing?

Yes	
No	

B.2.1.2 If yes, describe this goal:

_____

_____

B.2.1.3

B.2.1.3.1 Quality of life

_____

_____

B.2.1.3.2 Form of Production

_____

_____

B.2.1.3.3 Future Resource Use (including behaviour of people, vision of land, structures and resources)

_____

_____

B.2.1.4 Do you believe that, through your active management, your farm is evolving towards your chosen holistic goal?

Yes	
No	
Unsure	
Too early to say	

B.2.2 Testing Decisions

B.2.2.1 Who are the decision-makers on your farm?

_____

B.2.2.2 Do you use any general guidelines when making decisions?

Yes	
No	
Unsure	

B.2.2.2.1 If yes, what are these guidelines and what factors do you consider?

_____

_____

B.2.2.2.2 If yes, how often do you use this guideline

Never	
Hardly ever	
Now and then	
For most decisions	
For every decision	

B.2.2.2.3 If yes, for what decisions do you use this guideline in regards to their importance (examples are in *italics)*

Small decisions (*Milk or cream in my coffee?*)	
Day-to-day decisions (*My to-do-list for the day*)	
Important decisions *(What should I give my wife for her birth day?)*	
Vital decisions (*Which medical insurance scheme should I get?*)	
Life Changing decisions (*Who will I marry?*)	

B.2.2.2.4 If yes, for what decisions do you use this guideline in regards to their subject matter

Family	
Personal Choice	
Lifestyle Choices	
Business / Financial	
Farming Practice	
Relationships	

B.2.2.2.5 If yes, why do you use this guideline

_____

_____

B.3 Land Planning

B.3.1 Land-use

B.3.1.1 In the table, please provide the following information regarding land-use:

B.3.1.1.1 What land-use types are you currently using?

B.3.1.1.2 Rank the mentioned land uses according to their:

a) Financial importance for your income
b) Personal importance to you (referring to their cultural, aesthetic or inheritance value)

Rank from the most important (indicated as 1) to least important (indicated by the highest number).

B.3.1.2 Indicate on the map where the different land-uses are applied on your property.

Land-use Type	B.3.1.1.1) Type		B.3.1.1.2) Rank a)	B.3.1.1.2) Rank b)	1.3) Land-type
Crop					
Livestock					
Ecotourism	View				
	Hunting				
Direct Use / Harvesting	Wood				
	Medicinal plants				
	Hunting				
	Food plants				
Conservation					
Other					

B.3.1.3 Do you have any additional sources of income besides the mentioned activities?

_____

_____

B.3.2 Flexibility

B.3.2.1 Do you agree with the following statement: I believe that I have the ability to adjust my farming business to capitalise on emerging opportunities

strongly disagree	disagree	unsure	agree	strongly agree

B.3.2.2 Have there been any major changes in land-use or economic activity on the farm? Have any activities or practices been added or stopped?

_____

_____

B.3.2.3 Which of these changes were brought about by you?

_____

_____

B.3.2.4 Why were these changes made?

_____

_____

B.3.3 Infrastructure

B.3.3.1 Using the map as an assistance, please indicate the major water resources on your land and rate their value (in terms of quality and accessibility).

	No value / not used	Poor value	Moderate Value	Good Value	Tremendous Value
Springs					
Rivers					
Dams					
Boreholes					
Others					

B.3.3.2 How many operating windmills do you have? _____

B.3.3.3 How many operating water pumps do you own? _____

B.4 Grazing Planning

B.4.1 If more than one livestock type, do you herd different livestock together?

Yes	
No	
Sometimes	
Unsure	

B.4.2 What is your current stocking rate? _____

B.4.3

B.4.3.1 Has your stocking rate increased/decreased during your time of managing the property?

Increased	
Decreased	
Stayed the same	
Unsure	
Too early to say	

B.4.3.2 If changed, what was the original stocking rate? _____

B.4.3.3 If changed, why did the stocking rate increase/decrease?

_____

_____

B.4.3.4 If applicable, when did the de-stocking take place (with reference to drought and weather conditions)?

_____

_____

B.4.4 What grazing systems were previously used on your farm?

_____

_____

B.4.5 What is your current grazing system?

_____

_____

B.4.6

B.4.6.1 How often do you do a grazing plan.

_____

_____

B.4.6.2 If applicable, describe the typical rotation/rest periods of your current grazing plan.

_____

_____

B.4.7 In regards to your grazing camps…

B.4.7.1 What type of fencing was used? _____

B.4.7.2 What is the average size of your camps? _____

B.4.7.3 How many camps do you have? _____

B.4.8 Do you believe in the "herding effect": that (with good management) intense trampling of a large number of herded livestock for a short period of time can improve the soil condition?

Yes ☐
No ☐
Unsure ☐

B.5 Perceptions on HM

B.5.1 Have you ever heard of Holistic Management (HM)?

Yes	☐
No	☐
Unsure	☐

B.5.1.1 If yes, where/how did you first learn about HM?

_____

_____

B.5.1.2 If no, skip this section.

B.5.2 What is your understanding of HM?

_____

_____

B.5.3

B.5.3.1 Indicate how you received your training in HM:

Attended official HM training / workshop / seminars	☐
Someone taught me in a private casual setting	☐
Self-taught / Literature	☐
Other:_____	☐

B.5.3.2 If applicable, from whom did you receive your training or who presented the workshops/seminars?

_____

_____

B.5.4 Are any of your neighbours HM land managers? If so, indicate on map which of your neighbours are HM land managers and which are not.

B.5.5 Do you think there are any benefits in practicing HM?

_____

_____

B.5.6

B.5.6.1 Have you experimented with HM in regards to the grazing system or decision-making framework?

Yes	☐
No	☐
Unsure	☐

B.5.6.2 What were the results of those experiments?

_____

_____

B.5.6.3 Why did you decide to adopt HM?

_____

_____

B.5.7 Does HM have any drawbacks?

_____

_____

B.6 Monitoring

B.6.1 General Information

B.6.1.1 How often do you assess your current progress towards your holistic goal?

Never	☐
Once a year	☐
Every six months	☐
Quarterly	☐
Every second month	☐
Monthly	☐
Weekly	☐
Daily	☐

B.6.1.2 How do you monitor your progress?

B.5.1.2.1 What economic indicators did you use? (e.g. cash flow?)

B.5.1.2.2 What quality of life indicators did you use? (e.g. time?)

B.5.1.2.3 What biological, chemical, or ecological indicators did you use? (e.g. soil tests?)

B.6.1.3 Of the mentioned indicators, which are the most important to you?

B.6.1.4

B.6.1.4.1 What data do you include in your recording keeping?		B.6.1.4.2 From when were these records kept?
Financial		
Weather		
Animal Production		
Veld		
Other		

B.6.1.4.3 Of the mentioned records, which are the most important to you?

_____

B.6.1.5 How often do you monitor the changing variables important to your management?

Never	
Once a year	
Every six months	
Quarterly	
Every second month	
Monthly	
Weekly	
Daily	

C ENVIRONMENTAL ATTITUDE AND BEHAVIOUR

C.1 Environmental Attitude

	Indicate if you agree or disagree to the following statements:	Strongly Disagree	Disagree	Neutral/ Unsure	Agree	Strongly agree
1	We are approaching the limit of the number of people the earth can support					
2	Humans have the right to modify the natural environment to suit their needs					
3	When humans interfere with nature it often produces disastrous consequences					
4	Human ingenuity will insure that we do NOT make the earth unlivable					
5	Humans are severely abusing the environment					
6	The earth has plenty of natural resources if we just learn how to develop them					
7	Plants and animals have as much right as humans to exist					
8	The balance of nature is strong enough to cope with the impacts of modern industrial nations					
9	Despite our special abilities humans are still subject to the laws of nature					
10	The so-called “ecological crisis” facing humankind has been greatly exaggerated					
11	The earth is like a spaceship with very limited room and resources					

12	Humans were meant to rule over the rest of nature					
13	The balance of nature is very delicate and easily upset					
14	Humans will eventually learn enough about how nature works to be able to control it					
15	If things continue on their present course, we will soon experience a major ecological catastrophe					

C.2 Environmental Behaviour

Indicate if you agree or disagree to the following statements:		Strongly Disagree	Disagree	Neutral/ Unsure	Agree	Strongly agree
1	I own a solar water heater.					
2	My geysers are fitted with an insulating blanket.					
3	I unplug cellphone chargers, shavers and electric toothbrushes from the wall when not in use.					
4	I own and use a gas stove.					
5	I turn off lights when not using them.					
6	I have installed energy-efficient lights in my house.					
7	I generate electricity with solar and/or wind power.					
8	I use diesel generators for electricity and/or waterpumps.					
9	I regularly check and adjust my tire pressure.					
10	I plan ahead to minimize driving with my car and car pool when possible.					

11	I have predominantly indigenous drought-resistant plants in my garden.					
12	My home has a grey-water system and/or rain water tanks.					
13	I turn off the tap while brushing my teeth.					
14	I recycle paper, tin, glass and plastic whenever possible.					
15	I use organic waste such as food scraps to make compost.					
16	I prefer to use re-usable shopping bags.					
17	I buy/use locally produced food.					
18	I prefer buying organic vegetables and fruit.					
19	I prefer buying/using grass-fed and free range meat products.					
20	I grow and produce some of my own food.					
21	I prefer buying/using seasonal fruits and vegetables.					
22	I buy/use bottled water.					

D. INTERVIEWEE PERSONAL AND PROPERTY INFORMATION

D.1 Gender:

male	female

D.2 Year of birth: _____

D.3 Cultural group:

English (White)	Afrikaans (White)	Xhosa	Coloured	Other

D.4 What language do you primarily use at home?

English	Afrikaans	Xhosa	Zulu	Other

D.5 What languages can you speak?

English	Afrikaans	Xhosa	Zulu	Other

D.6 Marital status

Single	Married	Divorced	Widowed	Other

D.7 Level of education completed:

Primary school	High school	Did Some University	Diploma	Full degree	MSc	PhD	Other

D.8 Would you be interested in receiving feedback of the current project?

Yes	No	Unsure

Please provide the following contact information:

Email: _____ Tel: _____

CONFIDENTIALITY CLAUSE

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of assigning a unique code to each individual interviewed. Only the code name will be used in all publications based on the study. Only one of the researchers (Ancois de Villiers) and her supervisors will have access to the link between the code and yourself. The study data will be kept on password protected software and a portable e-storage devise which only the participating researchers will be able to access. At the completion of the study, the raw data will be kept to support future research. However, all personal information that could link you as an individual to the data will not be published without your written consent

Appendix 3: 2nd Interview protocol for Holistic Land Manager

Interview Code: _____ Date of interview: _____

Interview location: _____

Land Manager Name: _____

Farm Name(s): _____

_____

_____

A. PERCEPTIONS OF RANGELAND DEGRADATION

A1.What are the major challenges facing rural communities in South Africa today?

_____

_____

_____

A2.What are the major challenges facing your local community?

_____

_____

_____

A3.What are the major challenges you face in running your farm?

_____

_____

_____

A4.Do you think livestock farming provides a viable livelihood?

_____

_____

_____

A5.What do you think makes a resilient farm or farmer?

_____

_____

_____

A6.In the past 20 years, have you noticed any of the following changes on your land:

Indicator	Decreased a lot	Decreased	No change	Increased	Increased a lot
Internal parasite load of adult animals					
External Parasite load of adult animals					
Number of stock predation events					

A7.What have been the major causes for each of these changes?

Internal parasite load: _____
External parasite load: _____
Stock predation: _____

A8.How do you control these challenges?

Internal parasite load: _____
External parasite load: _____
Stock predation: _____

B. INNOVATION

B1. Please indicate to what extent you agree with the following statements:

Statements		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
B1.1	I consistently seek to develop new products and marketing ideas					
B1.2	I try to stay up to date with the newest innovations in my fields of interest					
B1.3	I prefer to keep doing things the way I am familiar with					
B1.4	I always try to find new, more effective and efficient ways of farming					
B1.5	I am always open to new ways of farming					
B1.6	There is no point trying new farming methods because my current methods are best					
B1.7	If needed, I will make major changes in my farming/business					

B2. Have you identified any new land-uses or business opportunities that you would like to try in the future? If so, please name them.

B3. Have you tested any new ideas for land management / farming / business in the past? If yes, please elaborate.

B4. What were the results these attempts and what did you learn?

B5. Are you currently trying anything new? If yes, please elaborate.

B6. Please indicate if you agree / disagree with the following statements:

		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
B6.1	I am more cautious with risk-taking compared to other farmers that I know					
B6.2	Risks are worth taking if the rewards are large enough					
B6.3	I take risks only when absolutely compelled to do so					
B6.4	I always avoid taking risks					
B6.5	I consciously take calculated risks to improve my farming					
B6.6	I believe that I can't achieve all my goals without taking some risks					

C. LEARNING

Please answer the following questions: To broaden my horizons, I…

Yes No

C1. Read magazines* ☐ ☐

*If yes, please give examples:

_____

_____

_____

Yes No

C2. Read text books* ☐ ☐

*If yes, please give examples of academic fields:

_____

_____

Yes No

C3. Attended workshops / seminars in the past 2 years?* ☐ ☐

*If yes, what workshops / seminars have you attended in the past 2 years?

_____

_____

	Yes	No
C4. Read informative websites		
C5. Talk to scientists / researchers		
C6. Talk to neighbours		
C7. Talk to experienced family members		
C8. Joined a study group / management club*		

*If yes, please answer the following:

C8.1. If applicable, what is the name of this club? _____

C8.2. How many members are there in the group? _____

C8.3. What do you do during these meetings/session? You may answer more than one:

	Yes	No
Compare farm records		
Visit other farms on learning excursions		
Discuss issues in the local community*		

*If yes, please give examples:

_____

_____

	Yes	No
Socialize		
Discuss issues in the broader society*		

*If yes, please give examples:

_____

_____

	Yes	No
Other activities*		

*If yes, please give examples:

_____

_____

_____

C8.4. What value do you get from these study groups (i.e. what have you learned)?

_____

_____

_____

_____

	Yes	No
C9. Other sources of learning / gaining knowledge*		

*If yes, please elaborate:

_____

_____

C10. What qualifications do you have?

Formal qualifications (e.g. university degree)	Informal qualifications (e.g. courses)

C11. Do you have any job experience besides farming? If yes, please elaborate.

_____

_____

C12. What would you say are your best skills which you have accumulated over the years?

_____

_____

C13. From where or how did you attain these skills?

_____

_____

D. GROUPS

Please complete the following table regarding participation in local organisations / groups / clubs:

Organisation Type	Name of Organisation	Daily	Weekly	Monthly	Every Second Month	Quarterly	Twice a year	Yearly	Leadership Position
Farmer Group									
Conservation									
Business Association									
Sport Club									
Social Club									
Religious/Church/ Spiritual									
Community Organisations									

E. LEADERSHIP

E1 Please complete the following table:

Can you identify 5 influential, well-respected people in your community? (The sort of people others look-up to.)	Does this person hold any leadership positions?	Why choose him/her?	Rank these individuals according to how you think they are regarded in the community

E2. Indicate if you agree/disagree with the following statements		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
E2.1	I enjoy being in leadership roles					
E2.2	I take responsibility for community issues					
E2.3	I'm committed to making my local community a better place to live					
E2.4	It is important that I attend meetings of local organisations					
E2.5	I keep myself informed with 'going-ons' in my community and the region					
E2.6	I would describe myself as "someone who gets things done"					
E2.7	In a group of farmers, I will usually take the lead on moving our ideas forward					
E2.8	People seem happy to follow me when I take the lead on an activity					
E2.9	I am very capable at organising a group of people towards achieving a common goal					
E2. 10	Once I set my mind on a task I will see it through to the end					

F. NETWORKS

F1. Please complete the networks table on the following pages…

List of participants	Familiarity			Relationship						
	Don't know	Know About	Know	Social comings & goings	Know through children	Work	Sport	Friend	Family	Other
*The names of the 40 land managers who participated in the current thesis were removed to protect their identity										

List of participants	What do you talk about							
	Everyday stuff / chatting	Local events, gossip	Business talk (markets, official)	Farming (general)	Environmental issues	Recreational Talk (sport, hobbies, share a beer, kids)	Personal & Family	Other
*The names of the 40 land managers who participated in the current thesis were removed to protect their identity								

List of participants	Who would you approach for advice ("o") or practical assistance ("x") with issues related to						
	Farming	Financial	Business	Environment	Community	Personal /Family	Crises
*The names of the 40 land managers who participated in the current thesis were removed to protect their identity							

F2. Are you in contact with any other HM communities?

Yes	
No	
Not sure	

F3. If so, where are these communities and what do you interact about?

_____

_____

_____

_____

F4. Do you feel that you receive enough support/communication from the broader HM community?

		None	Not Much	Neutral / Unsure	Some Support	Great Support
	The Savory Institute					
	African Centre for HM					
	Consultants / Educators					

G. LOCUS OF CONTROL

	G1.Do you agree with the following statements…	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
G1.1	I have control over all the decisions affecting the way my farm is run on a day-to-day basis					
G1.2	Nobody else has more influence over my farming enterprise than I do					
G1.3	I am in total control of my own destiny					
G1.4	I am able to manage my farm precisely the way I want to					
G1.5	I have total control over how productive my business is					

G1.6	I have the power to make important decisions that change the course of my life					

G2. Overall, how much impact do you think you have in making your community a better place to live?

Tremendous impact	
A big impact	
Unsure	
A small impact	
No impact	

G3. In the past 12 months, have you done any of the following?

Attend a neighbourhood council meeting, public hearing, or public discussion group	
Met with a politician, called him/her, or sent a letter.	
Participated in a protest or demonstration	
Participated in an information or election campaign	
Alerted newspaper, radio or TV to a local problem	
Notified police or court about a local problem	

G4. Did you vote in the last municipal election?

Yes	
No	
Not sure	

G5. Did you vote in the last state/national/presidential election?

Yes	
No	
Not sure	

H. FINANCIAL PLAN

H1.Please indicate your annual turn over

Less than R299 999	
R300 000 - R999 999	
R1 000 000 - R1 999 999	
R2 000 000 - R3 999 99	
R4 000 000 - R9 999 999	
R10 000 000 and more	

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Appendix 4: 2nd Interview protocol for Non-Holistic Land Manager

Interview Code: _____ Date of interview: _____

Interview location: _____

Land Manager Name: _____

Farm Name(s): _____

_____

_____

A. PERCEPTIONS OF RANGELAND DEGRADATION

A1.What are the major challenges facing rural communities in South Africa today?

_____

_____

_____

A2.What are the major challenges facing your local community?

_____

_____

_____

A3.What are the major challenges you face in running your farm?

_____

_____

_____

A4.Do you think livestock farming provides a viable livelihood?

_____

_____

_____

A5.What do you think makes a resilient farm or farmer?

_____

_____

_____

A6.In the past 20 years, have you noticed any of the following changes on your land:

Indicator	Decreased a lot	Decreased	No change	Increased	Increased a lot
Internal parasite load of adult animals					
External Parasite load of adult animals					
Number of stock predation events					

A7.What have been the major causes for each of these changes?

Internal parasite load: _____
External parasite load: _____
Stock predation: _____

A8.How do you control these challenges?

Internal parasite load: _____
External parasite load: _____
Stock predation: _____

B. INNOVATION

B1. Please indicate to what extent you agree with the following statements:

Statements		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
B1.1	I consistently seek to develop new products and marketing ideas					
B1.2	I try to stay up to date with the newest innovations in my fields of interest					
B1.3	I prefer to keep doing things the way I am familiar with					
B1.4	I always try to find new, more effective and efficient ways of farming					
B1.5	I am always open to new ways of farming					
B1.6	There is no point trying new farming methods because my current methods are best					
B1.7	If needed, I will make major changes in my farming/business					

B2. Have you identified any new land-uses or business opportunities that you would like to try in the future? If so, please name them.

B3. Have you tested any new ideas for land management / farming / business in the past? If yes, please elaborate.

B4. What were the results these attempts and what did you learn?

B5. Are you currently trying anything new? If yes, please elaborate.

B6. Please indicate if you agree / disagree with the following statements:

		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
B6.1	I am more cautious with risk-taking compared to other farmers that I know					
B6.2	Risks are worth taking if the rewards are large enough					
B6.3	I take risks only when absolutely compelled to do so					
B6.4	I always avoid taking risks					
B6.5	I consciously take calculated risks to improve my farming					
B6.6	I believe that I can't achieve all my goals without taking some risks					

C. LEARNING

Please answer the following questions: To broaden my horizons, I…

Yes No

C1. Read magazines* ☐ ☐

*If yes, please give examples:

_____

_____

_____

Yes No

C2. Read text books* ☐ ☐

*If yes, please give examples of academic fields:

_____

_____

Yes No

C3. Attended workshops / seminars in the past 2 years?* ☐ ☐

*If yes, what workshops / seminars have you attended in the past 2 years?

_____

_____

	Yes	No
C4. Read informative websites		
C5. Talk to scientists / researchers		
C6. Talk to neighbours		
C7. Talk to experienced family members		
C8. Joined a study group / management club*		

*If yes, please answer the following:

C8.1. If applicable, what is the name of this club? _____

C8.2. How many members are there in the group? _____

C8.3. What do you do during these meetings/session? You may answer more than one:

	Yes	No
Compare farm records		
Visit other farms on learning excursions		
Discuss issues in the local community*		

*If yes, please give examples:

_____

_____

	Yes	No
Socialize		
Discuss issues in the broader society*		

*If yes, please give examples:

_____

_____

	Yes	No
Other activities*		

*If yes, please give examples:

_____

_____

_____

C8.4. What value do you get from these study groups (i.e. what have you learned)?

_____

_____

_____

_____

	Yes	No
C9. Other sources of learning / gaining knowledge*		

*If yes, please elaborate:

_____

_____

C10. What qualifications do you have?

Formal qualifications	Informal qualifications

(e.g. university degree)	(e.g. courses)

C11. Do you have any job experience besides farming? If yes, please elaborate.

_____

_____

C12. What would you say are your best skills which you have accumulated over the years?

_____

_____

C13. From where or how did you attain these skills?

_____

_____

D. GROUPS

Please complete the following table regarding participation in local organisations / groups / clubs:

Organisation Type	Name of Organisation	Daily	Weekly	Monthly	Every Second Month	Quarterly	Twice a year	Yearly	Leadership Position
Farmer Group									
Conservation									
Business Association									
Sport Club									
Social Club									
Religious/Church/ Spiritual									
Community Organisations									

E. LEADERSHIP

E1 Please complete the following table:

Can you identify 5 influential, well-respected people in your community? (The sort of people others look-up to.)	Does this person hold any leadership positions?	Why choose him/her?	Rank these individuals according to how you think they are regarded in the community

E2 Indicate if you agree/disagree with the following statements		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
E2.1	I enjoy being in leadership roles					
E2.2	I take responsibility for community issues					
E2.3	I'm committed to making my local community a better place to live					
E2.4	It is important that I attend meetings of local organisations					
E2.5	I keep myself informed with 'going-ons' in my community and the region					
E2.6	I would describe myself as "someone who gets things done"					
E2.7	In a group of farmers, I will usually take the lead on moving our ideas forward					
E2.8	People seem happy to follow me when I take the lead on an activity					
E2.9	I am very capable at organising a group of people towards achieving a common goal					
E2. 10	Once I set my mind on a task I will see it through to the end					

F. NETWORKS

F1. Please complete the networks table on the following pages…

List of participants	Familiarity			Relationship						
	Don't know	Know About	Know	Social comings & goings	Know through children	Work	Sport	Friend	Family	Other
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List of participants	What do you talk about							
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List of participants	Who would you approach for advice ("o") or practical assistance ("x") with issues related to						
	Farming	Financial	Business	Environment	Community	Personal /Family	Crises
*The names of the 40 land managers who participated in the current thesis were removed to protect their identity							

F2. If applicable, are you in contact with any other farmer/management clubs?

Yes	
No	
Not sure	

F3. If so, where are these communities and what do you interact about?

_____

_____

_____

G. LOCUS OF CONTROL

	G1.Do you agree with the following statements…	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
G1.1	I have control over all the decisions affecting the way my farm is run on a day-to-day basis					
G1.2	Nobody else has more influence over my farming enterprise than I do					
G1.3	I am in total control of my own destiny					
G1.4	I am able to manage my farm precisely the way I want to					
G1.5	I have total control over how productive my business is					
G1.6	I have the power to make important decisions that change the course of my life					

G2.Overall, how much impact do you think you have in making your community a better place to live?

Tremendous impact	
A big impact	
Unsure	
A small impact	
No impact	

G3.In the past 12 months, have you done any of the following?

Attend a neighbourhood council meeting, public hearing, or public discussion group	
Met with a politician, called him/her, or sent a letter.	
Participated in a protest or demonstration	
Participated in an information or election campaign	
Alerted newspaper, radio or TV to a local problem	
Notified police or court about a local problem	

G4.Did you vote in the last municipal election?

Yes	
No	
Not sure	

G5.Did you vote in the last state/national/presidential election?

Yes	
No	
Not sure	

H. FINANCIAL PLAN

H1.Please indicate your annual turn over

Less than R299 999	
R300 000 - R999 999	
R1 000 000 - R1 999 999	
R2 000 000 - R3 999 99	
R4 000 000 - R9 999 999	
R10 000 000 and more	

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Thank you

for your time and attention

"You can't stop the waves, but you can learn how to surf"

Kabat-Zinn

Wherever you go There you are

Hyperion, New York, 1994