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Investigating land use change in the Eastern Cape as a regime shift, a case study of Amakhala game reserve.

By

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Declaration

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Abstract

Livestock farming in the Eastern Cape, South Africa, has recently undergone a shift to game farming. This research uses a regime shift lens to analyse the change in structure and function of the broader social-ecological system and identify the drivers of the change. The impacts of this land use change and the feedback mechanisms that lock the system into these alternate regimes are also explored. This is important because it has implications for the provision of ecosystem services and human well-being, and the resilience of the system. This research used a case study approach in Amakhala game reserve to understand how the shift from livestock to game farming affects ecosystems and different stakeholders, using participatory mapping and remote sensing approaches. A change in land cover over time indicates a newly vegetated state, which is an indicator of conservation. Results also indicate that the transition from livestock to game farming had different costs and benefits for landowners and farm workers. Social, cultural and even economic structures that held greater value to individuals on livestock farms, a condition that was definable as a community, have been traded off to economic and social structures that hold more value to an external group of people, usually visitors, than the value it holds to individuals on game farms, not definable as a community. The use of a social narrative approach, derived through the participatory methodologies, reveals an important understanding of how the shift of such a social-ecological system impacts differently on various groups of stakeholders.

Opsomming

Veeboerdery in die Oos-Kaap, Suid-Afrika, het onlangs 'n verskuiwing na wildsboerdery ondergaan. In hierdie navorsing is 'n lens van stelselverskuiwing gebruik om die verandering in struktuur en funksie van die breër sosio-ekologiese stelsel te ontleed en die dryfvere van die verandering te identifiseer. Die impak van hierdie verandering in grondgebruik en die terugvoermeganismes wat hierdie alternatiewe stelsel ondersteun, is ook verken. Dit is belangrik omdat dit implikasies vir die verskaffing van ekostelseldienste en mense se welstand, asook die veerkragtigheid van die stelsel, inhou. 'n Gevallestudie in die Amakhala-wildreservaat is uitgevoer in 'n poging om begrip te verkry van hoe die verskuiwing van vee- na wildsboerdery ekostelsels en verskillende belanghebbendes beïnvloed deur gebruik van deelnemende kartering- en afstandswaarnemingsbenaderings. 'n Verandering in landbedekking met verloop van tyd dui op nuwe plantegroei, wat 'n aanwyser van bewaring is. Die resultate het ook getoon dat die oorgang van vee- na wildsboerdery verskillende koste en voordele vir grondeienaars en plaaswerkers meegebring het. Sosiale, kulturele en selfs ekonomiese strukture wat groter waarde vir individue op veeplase ingehou, 'n toestand wat as 'n gemeenskap omskryf kan word, is verruil vir ekonomiese en sosiale strukture wat meer waarde vir 'n eksterne groep mense inhou, gewoonlik besoekers, as vir individue op wildsplase, wat nie as 'n gemeenskap omskryf kan word nie. Die gebruik van 'n sosiale narratiewe benadering, wat van deelnemende metodologieë verkry is, het belangrike begrip in die hand gewerk van die manier waarop die verskuiwing van so 'n sosio-ekologiese stelsel verskillende gevolge vir die onderskeie groepe belanghebbendes inhou.

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Data acquired for this research would have never been possible without the consent and participation of the game reserve manager and landowners in Amakhala. I very much appreciate farm workers of the reserve with whom I got the privilege to engage in discussions. Much thanks to the two translators who passionately dedicated their time to help engage with farm workers to explore their narratives.

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List of Acronyms and Abbreviations

SDGs	Sustainable Development Goals
SESs	Social-Ecological Systems
MEA	Millennium Ecosystem Assessment
GDP	Gross Domestic Products
PCA	Principle Component Analysis
ACC	Amakhala Conservation Centre
GIS/RS	Geographic Information System & Remote Sensing
MaDCAT	Mapping Device Change Detection Tool
LCCS	Land Cover Classification System
Qgis	Quantum geographic information system
ENVI	Environment for Visualizing Images
FGDs	Focused Group Discussions

Chapter one: Introduction

1.1 Introduction

Land use change has major implications for biodiversity and ecosystem services, motivating its centrality in the debate of sustainable development (Sun & Müller, 2014). Land use change refers to a transformation in the use of the land such as a shift from agriculture to conservation. The concept of land use emphasises the functional role of land for economic activities (Paul & Rashid, 2017). Changes in land use can also lead to changes in land cover; i.e., the change in natural cover of a landscape, e.g., from savannah or forest to cropland (Lambin *et al*., 2001). It is these changes in land cover that directly impact biodiversity (Lambin *et al*., 2001; Müller *et al*., 2014). Land use changes are characterised by intrinsic complexity embedding multi-scale feedbacks, self-organization, non-linear dynamics and emergence (Müller *et al*., 2014; Sun & Müller, 2014). Because of the impacts of land use change on the ecological, social and economic functions of the land, land use changes can also be understood as social-ecological regime shifts (Sun & Müller 2014).

Social-ecological systems are complex and adaptive, consisting of human interaction with nature or ecological systems (Perez-Soba, 2016). The interlinked social and ecological dynamics in social-ecological systems produce a range of ecosystem services, including provisioning (e.g., food and water), regulating (e.g., water purification and control of soil erosion) and cultural (e.g., recreation and aesthetic values) (MEA, 2010). These services support biodiversity and contribute to a better human well-being. Understanding the structure of social-ecological systems and how they function is important to prevent changes with negative implications on the range of ecosystem services they provide (Folke, 2006; Folke *et al*., 2016).

Regime shifts can be defined as abrupt changes between contrasting and persistent states of any complex system, including ecosystems, social systems and social-ecological systems (Biggs *et al*., 2012; DeYoung *et al*., 2008). Complex systems are organised in certain structures which, when exposed to incremental changes or sudden shocks, might flip into an alternative structure with a different set of functions (Biggs *et al*., 2015). Such sudden or unexpected changes that lead to regime shifts could result from large external shocks such as natural events, slow changes already present in the system, or a combination of these driving a system towards a tipping point (Scheffer *et al*., 2012). Regime shifts in ecosystems and social-ecological systems often have large impacts on the ecosystems, and

on the services they generate, with consequent implications to human economies, societies and human well-being (Folke *et al.*, 2016; Haines-Young & Potschin, 2009).

In the Eastern Cape province of South Africa, there has been a switch from livestock farming to game farming (Lloyd *et al*., 2002). This switch illustrates a land use change, which has resulted in land cover change. According to Smith & Wilson (2002), the predominant switch in land use from pastoralism to game farming commenced in the early 1980s and increased by 25% per annum with respect to both area coverage and income generated from game farming. Game ranching in the region recorded high in 2000, where 48% of private landowners had signed into the commercial game industry (Smith & Wilson 2002). Jones *et al*. (2005) assert that this trajectory may have been incentivized by certain preconditions, both originating from within and outside (intrinsic and extrinsic) that rendered the livestock regime less economically viable. However, this change in land use has not always been unanimously beneficial across all stakeholders.

Brandt & Spierenburg (2014) argue that the conversion of livestock farms to game farms has benefited a section of farmers in terms of secondary income generated from the preparation of game products. Pasmans & Hebinck (2017) also assert that although game farming has generated new opportunities and new forms of added value to available resources, including eco-tourism, trophy hunting and even game meat production, it is still contested in the Eastern Cape. This is because it has led to skewed income distribution and created minimal employment opportunities needed in the province (Cocks & Wiersum, 2016; Pasmans & Hebinck, 2017). The growth in game farming was boosted by free market policies and renewed conservation interests in the 1970s, coupled with the introduction of stock reduction schemes after the prolonged drought of the 1960s, which lowered cattle prices (Smith & Wilson, 2002). This trend has continued in recent decades, accelerated by political, socio-economic and ecological factors (Brandt & Spierenburg 2014). It is against this backdrop that a systems thinking, regime shift approach was used as a conceptual tool to understand whether the land use change in Amakhala game reserve in the Eastern Cape of South Africa can be seen as a regime shift.

1.2 Study area

Dryland ecosystems are defined as areas where the ratio of total annual precipitation to potential evapotranspiration or aridity index ranges from 0.05 to 0.65 (Lal, 2004). Dryland ecosystems cover about 41% of the global land surface and are inhabited by more than two

billion people, lagging behind the rest of the world on human well-being and development indicators (Safriel et al., n.d). Ninety percent of this population are in developing countries in Asia and Africa, covering extensive areas of about 11 million km^2 and 13 million km^2, respectively (White & Henninger, 2002).

In Africa, dryland regions predominantly occur in Northern and South-western regions of the continent (Gibbs & Salmon, 2015). Although dryland ecosystems cover a significant amount of land in the continent with diverse land uses, including small-scale agriculture and rising urbanisation, grazing forms the predominant land use in these regions (White & Henninger, 2002). However, these conventional land uses in the arid and semi-arid ecosystems in Africa are changing, caused by many factors, including shifts in general land management practices and economic motives (Naidoo, 2012). Specifically, agricultural lands have attracted what appears to be long-term land use: a transition to game farming from livestock farming, with the establishment of fences and permanent water sources, forming privatised and securitised spatial spaces (Mkhize, 2014).

The Eastern Cape province in South Africa comprises dryland ecosystems, containing grasslands, Nama Karoo, thicket and extensive savanna, which provide various ecosystem services (Hamann & Tuinder, 2012). Grazing and dryland agriculture is the dominant land use in the province (Hamann & Tuinder, 2012). Historically, agricultural practices were characterised by intensive beef and fruit farming, especially on the South-western parts, and cattle, maize and sorghum in the North-eastern region (Lehohla, 2011). In the inland areas, extreme climate conditions limit agriculture to sheep farming. Although the population of this province makes up 13.5% of South Africa's population, the Eastern Cape only contributes seven percent of the country's Gross Domestic Product (GDP) (Lehohla, 2011). This percentage is mainly portioned to agriculture and forestry, with a small percentage to aquaculture and fishing (Knight, 2007). These are categorised as primary sectors, while the secondary segments constitute transport equipment and minor industries including food and beverages. This was attributed to a lack of mining sectors, as present in other provinces (Lehohla, 2011).

Ecosystems in the Eastern Cape province have experienced degradation (Gibbs & Salmon, 2015; Hannah *et al*., 2002). Land degradation has been attributed to intensive grazing by cattle to supply the country's meat market (Meissner *et al*., 2013). The thicket vegetation is not only threatened by overgrazing from domestic livestock, but also from various activities

including bush clearing for agriculture and urban development, coastal resort development and invasion by alien species (Knight, 2007; Smith & Wilson, 2002). As a proposed measure to restore some of the natural environments, livestock farms have been converted to game farms. This argument is premised on the finding that game farming allows the biodiversity to restore itself while satisfying the economic need for tourists (Maciejewski, 2012).

As social-ecological systems, both livestock and game farm regimes underpin the life support systems of users who rely on the major ecosystem services they provide (Hamann & Tuinder, 2012; Knight, 2007), including provisioning, supporting, regulatory and cultural services (MEA, 2010). Alteration of these systems due to certain adjustments or modifications could potentially diminish functions and value of the services but can also arguably bring new services of equal or more significant value (Crépin *et al*., 2012). This study investigated whether the land use change can be seen as a regime shift. This was assessed in terms of the provision of ecosystem services in both regimes, potential implications of the change to human well-being and perceived drivers, all identified by the social-ecological system stakeholders.

1.3 Rationale

A significant number of documented studies investigating regime shifts have focused on ecological systems with limited acknowledgement of their social and economic implications to societies. Occurrence of regime shifts is not limited to ecological systems but cuts across social systems and interlinked social-ecological systems (Crépin *et al.*, 2012; Quinlan *et al.*, 2016; Walker *et al*., 2015) by impacting human livelihoods, wellbeing and potentially the Sustainable Development Goals. In this study, land use change is recognised as taking place in interlinked social-ecological systems subject to naturally triggered or human-driven disturbances. Understanding the drivers and impacts of social-ecological regime shifts is important for management, specifically to help build adaptive strategies to help cope with the impact of regime shifts on human well-being and strengthen the systems' resilience - i.e., the capacity of the social-ecological system to deal with unexpected change and disturbance in ways that continue to support human well-being (Biggs *et al.*, 2015; Folke *et al.*, 2016).

In cases where regime shifts that will reduce human well-being are likely to occur, management actions that increase resilience and reduce the chances of the regime shift are

necessary (Crépin *et al.*, 2012; Walker *et al.*, 2015). Understanding regime shifts is important due to its potential profound impacts on present and future well-being, including the distribution of well-being between different groups of people as well as between different generations. Such differences may lead to intense conflicts over resource use.

Game farming in the Eastern Cape presents an opportunity to restore biodiversity of an ecosystem degraded by overstocking of livestock (Maciejewski, 2012). On the other hand, livestock farming is characterized by intensive beef production that employs more people (Hamann & Tuinder, 2012; Lehohla, 2011). Brandt & Spierenburg (2014) argue that in converting livestock farms to game farms, ecosystem services such as food and water, which are key to local livelihoods, are likely to be traded or altered for other commercial services, not necessarily adding up to better livelihood options. This study helps to clarify these trade-offs.

By using systems thinking and applying this to a real-world situation, investigating whether the land use change can be seen as a regime shift would allow for the identification of potential drivers. It would also provide a better understanding of feedbacks maintaining each land use or 'regime', which in turn enables the identification of leverage points, or places to intervene to increase the resilience of this system.

1.4 Research problem statement and research questions

This study assumes that social-ecological systems underpin key aspects of human economies and human well-being. Understanding how these social-ecological systems operate is vital to strengthen the resilience of these systems to avoid unwanted regime shifts, and to manage the distribution of benefits across different societal groups and generations. This research aimed to investigate how the change from livestock farming to game farming has impacted on ecosystem services and consequent implications to human well-being. To understand whether this change can be seen as a regime shift, this research used a conceptualisation by Biggs *et al.*, (2018), which offers a criteria summarised into the following research questions:

- How has land use in the Eastern Cape changed from 1980 to 2017?
- What are the ecosystem services provided by livestock and game farm regimes?
- What are the social, economic and cultural implications of the change from livestock to game farming?

- What are the perceived drivers responsible for the change from livestock to game farming?

1.5 Research design, methodology and methods

This research used both quantitative and qualitative research methodologies. Quantitative methods employed included geographic information systems (GIS) and remote sensing time series analysis, while qualitative methods included literature analysis, participatory mapping, focus group discussions, key stakeholder interviews/narratives and qualitative modelling. Detailed description of how these specific methods were used to achieve the study's objectives and address each research question is described in Chapter three.

1.6 Thesis structure

The thesis is composed of five chapters. This first chapter introduces the concept of regime shifts and its relevance in the context of social-ecological systems. This chapter also gives a background of the study area and highlights the problem statement and research questions. Specific methodologies and methods used to investigate the key research questions are alluded to but, described in more detail in Chapter three. Chapter two provides a literature review, synthesising key literature to establish crucial linkages and ideas underpinning the motive behind this investigation. Chapter three gives a detailed description of specific methodologies and methods employed in this study. It also elaborates on the sampling framework, research strategy and data analysis procedures used. Results and discussions are presented in Chapter four, addressing each research question. The thesis concludes with Chapter five, highlighting the conclusions emerging from the research.

Chapter two: Conceptual framework

2.1 Introduction

This chapter critically reviews and synthesizes existing literature on regime shifts to introduce this concept and associated theories. Specifically, it aims to unpack different views and identify existing gaps with regard to regime shifts in social-ecological systems and their complexity, and the implications for human well-being and resilience of these systems. The chapter is structured around the key concepts that frame this study.

2.2 Regime shifts in social-ecological systems

Biggs *et al.* (2013) define regime shifts as large, abrupt and persistent changes in the structure and function of ecosystems, or simply the shift of a system from one basin of attraction to another upon surpassing a critical threshold. Arising from these definitions is a transformation of a system originally recognised with certain properties to a new state identified by unique processes from the previous state. While such changes are mostly recognised with negative implications, Crépin *et al*. (2012) allude that not all regime shifts are negative. Studies have shown that certain substantial reorganisation in a system's structure, its functions and feedbacks can potentially lead to positive changes in the provision of ecosystem services to improve human well-being (Crépin *et al*., 2012; Folke, 2006). The significance of understanding regime shifts is not only a prerequisite due to their potential impacts on human societies and economies (Biggs *et al.*, 2013), but also due to the emphasis put across by Biggs *et al*. (2016) that they are often difficult to predict and costly, and sometimes even impossible to reverse.

A ball and cup metaphor adopted from Biggs *et al*. (2013) is used to illustrate the occurrence of regime shifts in ecosystems, where the cups or valleys represent different regimes or ways in which the system can function and be structured (Figure 1). The ball represents the regime in a particular state being impacted on by various internal and external pressures, which pushes or pulls the ball towards a threshold or tipping point. In a particular regime or domain of attraction, the system is highly dynamic, characterised by mutually reinforcing or balancing feedbacks. Dominant feedbacks maintain a regime, to self-organise and function in a particular way (regime 1). However, if these balancing feedbacks experience a driver or pressures, usually large shocks or gradual changes, the initial regime flips into an alternative state (regime 2) characterised by new balancing feedbacks, resulting in a new structure and functions (Biggs *et al*., 2013). The ability of a system to persist in regime 1

rather than being pushed into regime 2 can be defined as resilience of the system (Folke, 2006), which depends on the depth and steepness of the valley/cup (Peterson, 1998). The deeper the valley, the more resilient the system is to perturbations because strong disturbances will be required to move the ball from the bottom of the valley to regime 2. Steepness of the slope on the other hand indicates how strong the balancing feedback processes maintaining the ecosystem are, near a tipping point. The steeper the slope therefore, the stronger the balancing feedback processes, hence the likelihood of the system not flipping into a new domain of attraction (Peterson, 1998).

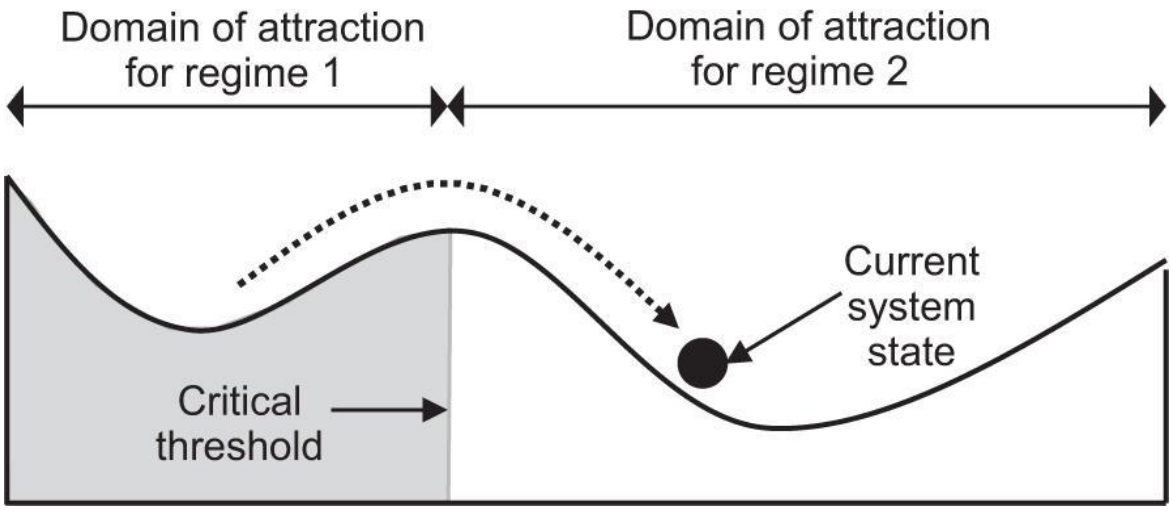

Figure 1: An illustration of regime shift using a ball and cup metaphor (adopted from Biggs *et al.*, 2013)

In this study, the two different land uses may be seen as two regimes, livestock and game farming, each associated with certain feedbacks maintaining it. The livestock regime occurs under those conditions conducive for livestock production, that is, profitable market conditions and adequate land quality to generate pasture for livestock production. A decision by landowners to continue investing in livestock farming is thus driven by livestock profit feedback characterised by high market demands and high profit, locking the system in its dynamic but stable state. Should this balancing state experience changes that directly affect livestock feeds, for instance, less water for pasture production with the potential to significantly lower profit, the system is likely to flip into an alternative state.

The game farm regime on the other hand is largely driven by opportunities in the ecotourism sector. This regime is maintained by game farming profit feedback where landowners benefit from ecotourism-related activities. For profit maximization, investments are channelled to activities that attract tourists, which includes overstocking charismatic

species and introducing non-indigenous or extralimital species, species historically not found in the Eastern Cape (Maciejewski & Kerley, 2014). These attract more tourists visiting to enjoy exquisite serenity, which generates optimal profit in the game farming sector. With maximum profit generated from tourist activities, there is potential for maintaining tourist facilities and employing workforce in the sector. This locks ecotourism industry into this regime. These two regimes impact differently on ecosystem services and consequently human well-being.

Social-ecological regime shift is a human-centred approach to looking at ecosystems, where human components interact with ecological systems to obtain a service or ecosystem services (Biggs *et al.*, 2016; Folke *et al.*, 2016). Understanding changes in social-ecological systems are important due to implications of the changes to ecosystem services, and subsequently human well-being (Folke, 2006). Specifically, changes in ecosystems have implications for people/society and consequences for livelihood options, poverty alleviation, and adaptive and coping strategies needed by societies in the face of long-term environmental changes. According to Haines-Young & Potschin (2009), human well-being relies on how ecosystems function, and should be managed for people. Utilitarian values have awakened ideas and various views on how to prevent or intervene where changes have negatively impacted on human well-being. However, the notion of utilitarianism alone seems obsolete without environmental considerations. Understanding social-ecological regime shifts is critical to scientific and policy perspectives (Biggs *et al.*, 2016). This helps establish a framework for visualising non-linear interactions inherent in social-ecological systems (Folke, 2006; Folke *et al*., 2016).

The concept of social-ecological systems emerges from a recognition that understanding dimensions of resource management is insufficient for sustainable outcomes without a holistic account of the dynamics and complex processes that support and at the same time undermine resilience (Hughes et al., 2005). As linked systems, social-ecological systems are thus areas to be emphasised specifically due to the human component constituting it (Haines-Young & Potschin, 2009; Perez-Soba, 2016). Although regime shifts in ecology have been acknowledged, social-ecological regime shifts have not received adequate attention and are still reported to have unclear conceptualisation (Biggs *et al.*, 2016).

The components of social-ecological systems being investigated are simplified into three perceptions (Biggs *et al.*, 2016): (i) looking at changes in ecology and linking such

dynamism to social and economic impacts; (ii) those changes arising from social systems and their consequences to the environment; and (iii) interactional change where the shift is a result of interactions from social and ecological components, e.g., harvesting of common pool resources. This is a broad view of social-ecological systems from ecological changes triggered by natural events to changes in social interactions to the environment. It implies that in order to identify a particular social-ecological regime shift, succinct definition of systems being investigated, variables of interest and their spatio-temporal characteristics are a prerequisite; a view that contextualises social-ecological regime shifts (Crépin *et al*., 2012). Haines-Young & Potschin (2009) note that the structure of social-ecological systems is best comprehended in terms of implicit linkages between resources, resource users and governance systems.

Land uses are social-ecological systems, which can be understood as nested systems and utilised with the knowledge of its 'wholeness' and 'partness' in the ever-changing environment (Nooteboom, 2007). According to Nooteboom (2007), survival of a system requires sustainability; therefore a sustainable system is that which has development that enables it to maintain its wholeness as an integral system, while maintaining its role as part of the larger system on which it relies. The habit of holistic use, taking into account a system as a whole while being cognizant of its parts, is a practice promoted for its potential to build stronger resilience in natural systems (Alongi, 2008). This applies also to the value of ecosystem service provision and consequent impacts on human well-being.

2.3 Ecosystem services and human wellbeing

Sandifer *et al.* (2015) define ecosystem services as conditions and processes of ecosystems that generate benefits for human well-being. Similarly, Duraiappah *et al.* (2005) regard ecosystem services as benefits provided by ecosystems, which include provisioning, regulatory, cultural and supporting services. The typology of ecosystem services as suggested by Millennium Ecosystem Assessment (MEA, 2010) describes provisioning services as those direct benefits or those that cover material use. Regulatory services are those that regulate how the ecosystem functions. Cultural functions are those related to spiritual values, or societal norms. Supporting services are those functions that underpin the operation of the other three (MEA, 2010).

Ecosystems are complex adaptive systems characterised by: dependency, multiple attractions, nonlinear dynamics, threshold effects and limited predictability (Folke et al.,

2004). The concept of ecosystem services is a growing discourse in the conservation paradigm. Natural resource management fields have mapped ecosystem services at national, regional and local scales, evidenced by growing frameworks that have developed to understand regime shifts (Ramankutty & Coomes, 2016). The purpose of such mapping is to help identify and avoid undesirable regime shifts with negative impacts on ecosystem service provision and consequently human well-being.

The concept of ecosystems and the services they provide, their implications to human well-being and key drivers is summarised in the Millennium Ecosystem Assessment framework, as illustrated in Figure 2 (Duraiappah *et al.*, 2005; MEA, 2010). This framework links these aspects of a regime within the domain of driving forces, such that indirect drivers can potentially reinforce direct driving factors to impact ecosystem services and consequently influence the different dimensions of human well-being. Within this conceptualization, benefits of ecosystems to people lie within the boundaries of their contribution to material welfare and livelihoods and also in security, health, social relations and the resilience of the system against disturbances (MEA, 2010). While this framework provides easy to understand interplays between and within these key concepts of an ecosystem or a particular regime, there are more complex interactions within each category, further compounded by non-uniform perceptions. For instance, individual stimuli and perception to certain changes that disrupt usual norms or rituals of people (human well-being) (Haines-Young & Potschin, 2009). While the MEA (2010) uses ecosystems services, it does not go far enough to account for non-linearity; this limitation can be overcome by adopting a systems thinking approach.

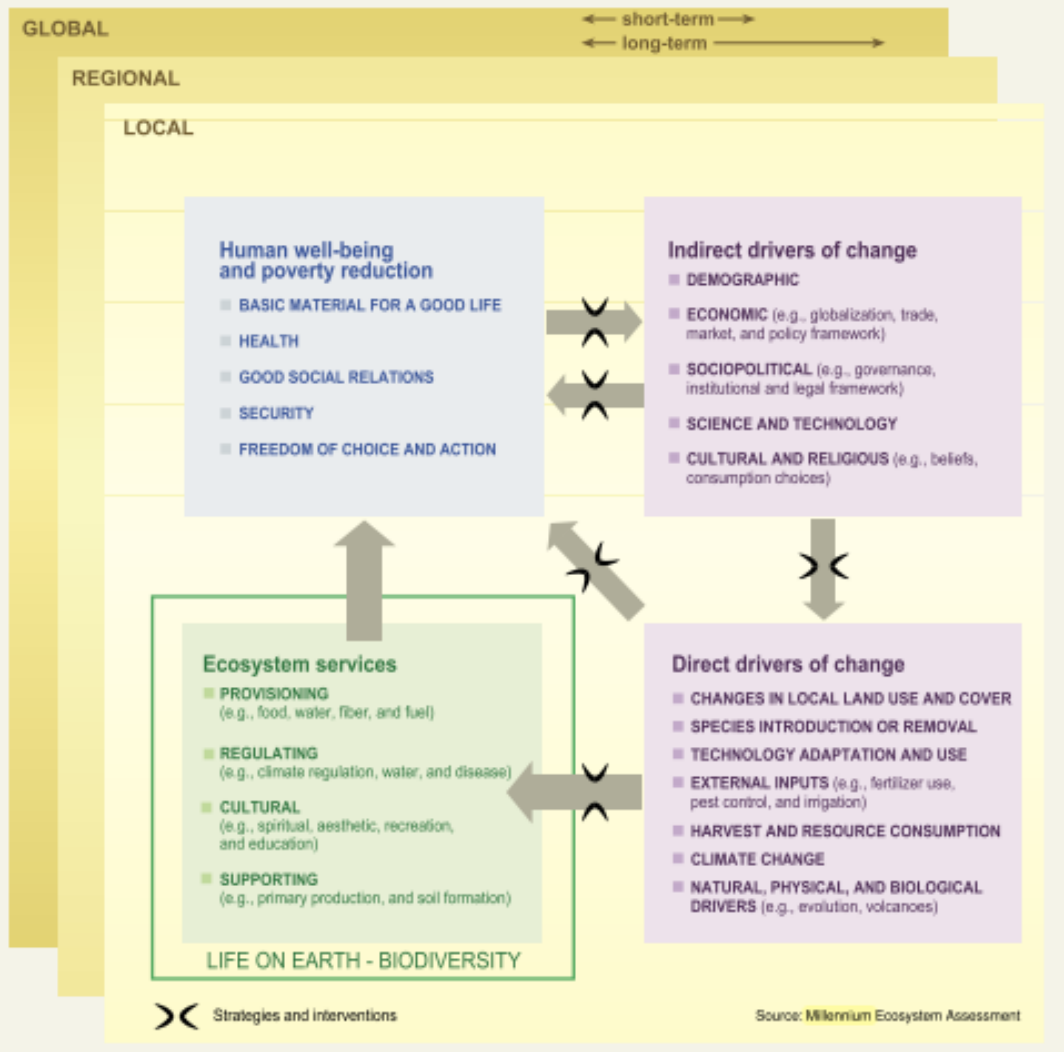

Figure 2: Framework for conceptualising ecosystem services and their linkages to human well-being (adopted from MEA, 2010)

2.4 Complex systems and systems thinking: a more pragmatic lens

Complex systems can be seen as a collection of parts that interact with one another to function as a whole (Maani & Cavana, 2007). A complex system is not therefore the sum of its parts, but rather the product of their interactions, implying that when a complex system is taken apart, it loses its essential properties, and so do the parts. Complex systems can be described as systems within systems that display nested functional interactions. Systems thinking can be used as a scientific tool to unpack this complexity. As defined by Maani & Cavana (2007), systems thinking is *"a scientific field of knowledge for understanding change and complexity through the study of dynamic cause and effect over time*".

Hughes *et al.* (2005) argue that the promotion of desirable regime shifts in social-ecological systems to achieve sustainable development requires an improved understanding of the

dynamics and complex processes that undermine resilience of the system against disturbances. The argument takes into account dynamic processes and thresholds of ecosystems. A systems approach can be used to better understand changes in social-ecological systems and explore leverage points for stronger resilience (Bennett *et al*., 2005). The contributions of mathematical models, such as time series analysis, to understand such changes have also been acknowledged (Biggs *et al.*, 2009).

2.5 Resilience and its relevance in the context of social-ecological systems

Hughes *et al.* (2005) define resilience as "*the extent to which an ecosystem can absorb recurrent natural and human perturbations and continue to regenerate without slowly degrading or unexpectedly flipping into alternative states"*. Several factors can reduce or improve resilience, including climate change, pollution and alteration of the structure and composition of regimes, among others (Hannah *et al.*, 2002). Reduced or weakened resilience accelerates vulnerability of a system, pushing it towards tipping points or critical thresholds, which may cause regime shifts (Peterson, 1998). In addition, certain spatial configurations, including natural landscapes and modified spaces, have a role to play in a system's resilience due to connectivity in these spaces (Quinlan *et al.*, 2016).

The definition of resilience provided by Hughes *et al*. (2005) is an ecological description of thresholds exhibited by ecological systems in the event of disturbance. In social-ecological systems, however, it applies to the ability of societies and their intertwined environments to remain functional and adaptive despite changes, including political, ecological, social and economic changes with potential negative impacts on their structure and functions (Quinlan *et al.*, 2016). Ideally, it is a measure of persistence of these systems amid continuous predictable and unpredictable changes (Folke, 2006; Folke *et al.*, 2016).

2.5.1 Resilience of social-ecological systems and how to discover and manage them for sustainability

As linked systems that are often seen as complex and adaptive systems, resilience of social-ecological systems pivots on maintaining the elements needed for reorganization of a system in the event of a large disturbance affecting the structure and function of the system (Walker *et al.*, 2015). Understanding the attributes of these elements is a prerequisite for designing approaches or frameworks to build resilience in the system. According to Quinlan *et al*. (2016), effectiveness of these frameworks needs to reflect the system's structure and functions, unique to its social components. A social understanding of previous states to

future perceived visions should be explored with social-ecological system stakeholders. Walker *et al.* (2015) view this approach as the involvement of the social-ecological system stakeholders' technique; this technique encompasses developing stakeholder-led models of the systems they interact with, including capturing historical transition processes from their perspectives and assessing key drivers of such changes influencing provision of ecosystem services of value to them.

Conventional decision analysis frameworks targeting the management of resilience often executes their actions based on the best-candidate principle, where policies with maximum yields are intensified while those with losses are suppressed (Walker *et al*., 2015). While these approaches are relevant in ecological sciences or systems where the state of resources is focal to decision-making, they have limited value in social-ecological systems. The paucity of such optimal policy procedures in managing for resilience is constrained by uncertainties upon which such forecasting are based. The human component of social-ecological systems almost invalidates these projections due to the dynamism and non-linearity presumed by them, coupled by the fact that they have limited capture of human perspectives regarding futurity, while these ought to be the central points of such models (Walker *et al.,* 2015). Rather than living within the existing structure of the systems, these models have strived to control them. A key question is therefore, how to focus on maintaining the capacity of systems to adapt to future states without potential negative regime shifts occurring in these systems, that is, increasing the system's resilience against shocks and disturbances.

The behaviour of social-ecological systems can be unpredictable if focus is concentrated on very visible and major features of the system, while overlooking certain variables that significantly influence how the system self-organises. Complexity theory offers an understanding and describes underlying interactions giving rise to major changes in social-ecological systems (Walker *et al.,* 2015). Understanding the behaviour of complex systems can guide how possible scenarios for social-ecological systems can be envisioned, analysed and managed. Ideally, proper resilience assessment and management can prevent unwanted regime shifts or undesirable configurations (Quinlan *et al.,* 2016; Walker *et al.,* 2015). 'Proper' is used in this case to imply analysing the system to discover where resilience lies and moving to how it can be increased in a co-discovery manner and identifying leverage points to increase resilience. According to Walker *et al.*, (2015), co-discovery, that is, unravelling the system's losses, creation and maintenance with social-ecological system

stakeholders, is an approach that contextualises resilience-building to a particular social-ecological system. This approach contextualises resilience analysis and management, which is central to sustainability. It gives an understanding of possibly overlooked variables that significantly drive critical changes in social-ecological systems.

2.6 Existing perspectives on land use change in the Eastern Cape

According to Smith & Wilson (2002), the conversion of livestock farms to game farms in the Eastern Cape was heavily influenced by two major forces: increased foreign ecotourism and the hunting market in the region. Other studies in the region have suggested that the promotion of ecotourism is commendable as a means to support conservation of the ecosystem while generating maximum profit (Brandt, 2016; Brandt & Spierenburg, 2014). Although a number of farmers in the Eastern Cape have expressed positive attitudes towards the shift, the activity has remained contentious amongst some farm workers, specifically due to the fact that stock farming had been their key livelihood source (Brandt & Spierenburg, 2014).

Smith & Wilson (2002) argued that the land use change patterns experienced in the Eastern Cape province was due to disenchantment with livestock farming rather than belief in the inherent superiority of game farming as a form of land use. Smith & Wilson (2002) believed that the switch to game farming in South Africa was specifically promoted by de-regulation of the agricultural sector by the World Trade Organisation as well as the lack of political leverage of the sector in parliament. Recent studies in the Eastern Cape and other provinces in South Africa however indicate that the unprecedented boom in game farming operations were experienced after 1996, with two major gateways being the establishment of conservancies and that of game farms (Mkhize, 2014). The reasons behind the growth in the game industry is thus attributed to economic, ecological and socio-political motivations, mainly expressed as a concern by landowners or managers (Brandt & Ncapayi, 2016; Mkhize, 2014).

Trophy hunting in the Eastern Cape contributes about 60-80% to the GDP in the province (Brandt & Spierenburg, 2014). Following recent altered labour legislation favouring increased wages for farm workers, game farming has been seen as an alternative to stock farming with respect to potentially lower labour costs (Brandt & Ncapayi, 2016). Stock farming has also been rendered less economically viable due to theft of small domestic

stocks. Such stock losses are worsened by 'vermin overflow', with jackals and caracal from proximate game farms killing the livestock (Brandt & Spierenburg, 2014).

The switch from livestock production to game farming is also justified on ecological (Maciejewski, 2012) and economic grounds (Brandt & Spierenburg, 2014). Overgrazing is identified as the main cause of rangeland degradation, which has consequently reduced livestock farming (Meissner *et al.*, 2013). On the other hand, it is argued that game farms contribute towards conservation of biodiversity by protecting natural tracts of land and preventing land use degradation caused by overstocking (Langholz & Kerley, 2006). According to Maciejewski (2012), reintroducing indigenous game species is an ecological intervention that may assist in the long-term restoration of the region.

The game reserves however, have since been viewed as contested places in the Eastern Cape as they deny local communities' sense of space, create dispossession of belongings and the loss of rights of access to land (Mkhize, 2014). Between 1994 and 2004 for instance, 2.35 million dwellers in the province were evicted from the commercial livestock farms (Brandt & Spierenburg, 2014). This occurred despite land reform programmes put in place by the state to secure people's rights of occupancy and access to land, to prevent forceful evictions and to regulate relations between dwellers and owners. Thus, while the government support towards this shift in land use won the confidence of landowners and business operators, it deprived farm workers and dwellers of their livelihood sources and sense of belonging to the land (Brandt & Spierenburg, 2014). The loss of livelihood sources and other benefits gained from livestock farms happened against the background that these same uses were incompatible with game farms, compelling relocations of farm dwellers. Socio-economic implications of this trend include the loss of residence, unemployment, sprawl of informal settlements and weakened social bonds (Brandt & Ncapayi, 2016).

Such outcomes have their roots in the histories of racism, sexism and capitalism -colonial and recent - in this region. These historical factors have determined land distribution, rights and negotiating power among landowners. The power battles on trophy hunting in the province have been confounded by aspects of racism, sexism and strong power dynamics shaping livelihoods either as a farm worker or those managerial and decision-making positions (Brandt, 2016). Brandt & Spierenburg (2014) are of the view that power dynamics and political reforms play a key role in configuration of land use in the Eastern Cape. Weak

local administration units, together with ineffective negotiation frameworks are part of the configuration of these power dynamics and political waves.

2.7 Contributing approaches to understanding regime shifts/complex systems

Dynamic systems theory is an empirical approach that has been used to study the behaviour of complex systems and observe regime shifts (Biggs *et al.*, 2013). According to this theory, all complex systems have feedback loops maintaining them, which can either be reinforcing or balancing loops. Reinforcing feedbacks are processes where variables influence each other in the same direction or produce amplifying actions causing decline or growth. Balancing feedbacks on the other hand are interaction processes where a change in the variables involved influence each other in the opposite direction, producing a balancing action (Crépin *et al.*, 2012). It is these feedbacks that evolve over time to self-organise the system towards its stable state (Biggs et al., 2011; Crépin *et al.*, 2012). Tennets of dynamical systems theory resonate with the argument that complex systems self-organise to a stable state and that dominant feedbacks evolve over time to constitute a specific regime (Biggs *et al.*, 2015). While investigating whether a change is a regime shift or not, understanding the process underlying the observed change is a prerequisite with regards to key system feedbacks. If these feedbacks happen to reinforce then balance a particular regime, then it is likely to be considered a regime shift (Biggs *et al.*, 2015).

While both mathematical and dynamical systems theory attempt to quantify regime shifts and investigate feedbacks maintaining them, systems thinking integrates a set of learning and modelling technologies. The modelling tools, represented by system dynamics in this case, can be used to holistically understand the structure of a system, inherent interconnections between its components and how temporal changes in its parts are likely to influence the whole system and its constituents, also known as forest thinking (Maani & Cavana, 2007). Through its closed-loop thinking and dynamic thinking paradigms, it recognises that cause and effect are non-linear as the end can influence the means, and that the world is constantly changing. It therefore provides grounds upon which complexity and dynamism underlying real world problems such as land use change can be better understood. This enables the identification of all drivers across different scales and from all actors, which can be used to identify leverage points - places to intervene to increase the resilience of this system.

In addition, system dynamics through causal loop modelling can unpack different perceptions allocated to the use of ecosystems services. Causal loop modelling is a modelling phase where conceptual models of the problem, known as causal loop diagrams, are created (Maani & Cavana, 2007). These provide a visual language that translates perceptions into explicit pictures.

2.8 Conclusion

In this thesis complexity theory and systems thinking approaches are used to assess the land use change in the Eastern Cape to determine whether it can be seen as a regime shift. The suite of ecosystem services provided by these two potential regimes as well as the ecological and social impact, including human well-being, are identified. This is also important because existing work has not holistically integrated ecological assessments to socio-economic aspects. Although spatial change with regards to privately-owned land use trends has been acknowledged in the region, as well as documentation of studies linking such changes to climate change (Ramankutty & Coomes, 2016), these have not yet been assessed from a systems perspective. This study fills this research gap by studying the complex nature of the social-ecological system using systems thinking and regime shifts as an approach.

This research is an exemplary case based on application of systems thinking to understand how land use change over time can potentially configure and impact human well-being. A regime shift is depicted as a change in ecosystem structure and function with potential implications on ecosystem services linked to human well-being and livelihoods. Although game farming is seen as a lucrative form of land use among landowners, it is also stated as a problematic land use by others. In this literature review, different views and perceptions of land use change to game farming were highlighted. However, the missing link is whether this land use change can be seen as a regime shift, which was assessed in terms of ecosystem service provision and their implications to human well-being.

Chapter three: Research methodology

3.1 Introduction

This chapter provides a detailed description of the study area, and how data was collected, processed and analysed. Quantitative and qualitative methods adopted for this study are described in detail, including why they were proposed as the best strategies for this study and how they were applied to align with the aims and objectives of the study.

3.1.1 Layout of the study area: Amakhala Game reserve

Amakhala private game farm is located in the Eastern Cape province in South Africa, at $33^0$26`45.07``S and $26^0$7`24.05``E respectively (Vaudo *et al.*, 2012) (Figure 3). The ecosystems are characterised by a transition between two dominant biomes in the area, namely thicket and savannah biomes. The thicket biome consists of thorny scrub forests mixed with grasslands especially in high areas. Plant species characterising the thicket biome include; Cassine aethiopica, *Asparagus species*, *Plumbago auricuata*, *Dovyalis rotundifolis*, *Diospyros dichrophylla*, *Euphorbia triangularis* and *Euphorbia tetragona* (Cocks & Wiersum, 2016). These support commercial small stock grazing, game for eco-tourism and trophy hunting (Knight, 2007). Savannah biome on the other hand consists of grass and shrub-trees, mainly use for grazing of cattle and game (Hamann & Tuinder, 2012). The region also hosts a diversity of charismatic animal species including cheetah, buffalo, elephants and various bovines (Maciejewski & Kerley, 2014). The study area was spatially identified based on previous research, specifically research conducted by Maciejewski (2012), which explored linkages between biodiversity conservation and ecotourism in private protected areas in the Eastern Cape. Within the Amakhala Conservation centre, three sites/lodges were chosen as a representative sample: Woodburry, Leeuwenbosch and Carnarvon Dale sites, as outlined in Figure 3. This layout was digitised in ArcGIS 10.5.1 from a raster file of land ownership status in Amakhala game reserve.

Amakhala is one of the game farms where land was previously used for agricultural purposes. This game farm represents several livestock farms where landowners amalgamated their portions over time to form the game farm (Vaudo *et al.*, 2012). Amakhala was specifically used as a case study because the landowners of this now managed game farm represent the original landowners of the smaller agriculture and livestock farms. This provided the opportunity for a deep analysis/exploration of this social-ecological system, to understand the consequences and implications of this land use change

over time. This reserve also provided the opportunity to draw on different types of views, ranging from the landowners' to farm workers', to gain a holistic perspective of the functioning and the change in this social-ecological system.

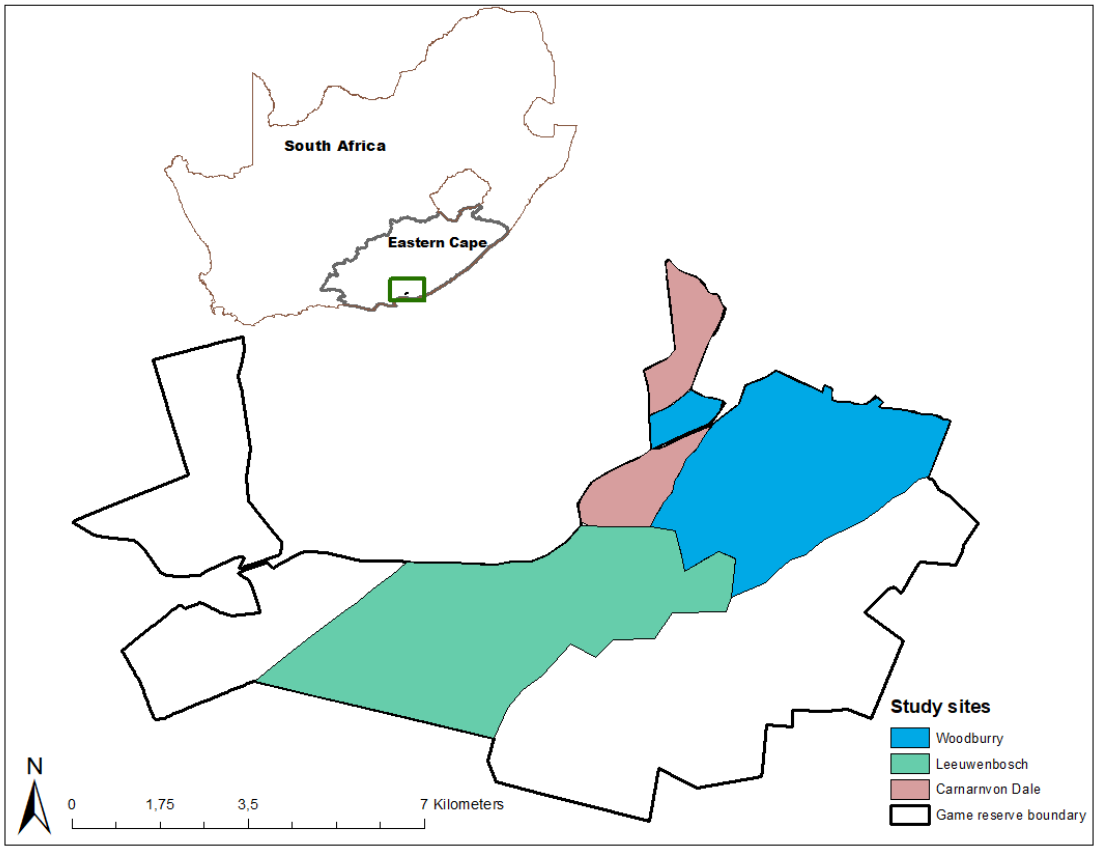

Figure 3: Layout of study sites in Amakhala game reserve, with the three study sites that were visited (ArcGIS 10.5.1)

3.2 Study methods: research design, methods and methodology

To address the research questions outlined in Chapter 1, this research integrated both qualitative and quantitative approaches. Qualitative methods consisted of open-ended interviews with landowners and farm workers, using participatory mapping, a comprehensive literature survey and qualitative understanding of complex interactions through causal loop modelling. Quantitative methods entailed change detection analysis using Geographic Information System and Remote Sensing (GIS/RS). Chronology of research methods, and specifics of choices of each of these methods or their aptness in contributing to study questions are discussed in this section (Figure 4).

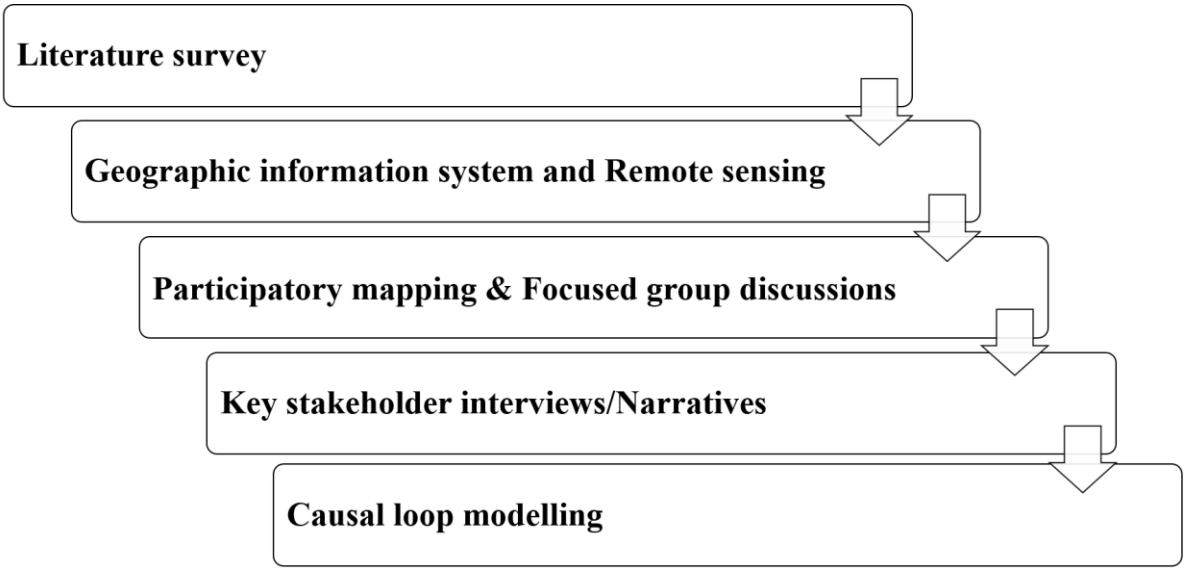

Figure 4: Chronology of research methods used to answer key research questions

3.2.1 Literature survey

A literature review was used to understand the study context in terms of the concept of regime shifts and land use change. This review cast light on key research questions and identified knowledge gaps. In this case, literature was critically reviewed to form an understanding of drivers of land use change in the Eastern Cape Province as well as social-ecological implications of such changes. The literature review provided a firm background of study context specifically to understand two research questions: (i) what are the main drivers responsible for this change? and (ii) what are some of the already discovered implications of the land use change over time? In addition, it offered a platform to discuss key concepts underpinning the concept of regime shifts and their linkages. Secondary materials used for this analysis included books, journal articles, PhD theses, reports, web pages, working papers and conference proceedings.

3.2.2 Geographic Information System and Remote Sensing (GIS/RS)

Geographic Information System and Remote Sensing (GIS/RS) are analysis tools used to measure changes in vegetation cover over time (Mapedza et al., 2003). This research mapped out temporal changes using GIS/RS technologies, using medium resolution images (Appendix C). High resolution images were not used due to financial constraint. Landsat 5-8 datasets were used, selected at a time range of eight to ten years, dating back to the time when such changes were realised (1980s), as indicated in the literature review. For the early periods of 1984 and 1992, Landsat 5 spectral bands were acquired. Landsat 7 spectral bands

were used for the year 2009, while Landsat 8 bands were acquired for the most recent year, 2017 (Earth explorer 2018). The years were also chosen because they had clear images. To ensure consistency and accuracy of temporal variations, all the images were acquired within the month of May of each year. May was chosen due to limited cloud cover in this month. This method specifically addressed the first research question of how the land use change occurred over time, through land cover change assessment. Output from this method consisted of land cover maps from 1984 to 2017, indicating temporal variations in land cover classes addressed in Chapter four as the first objective.

3.2.3 Participatory mapping

Participatory mapping is a social mapping tool effective in capturing perspectives of stakeholders. It is as an interactive process involving engagement with stakeholders through communication, listening, and consultation to establish and deliberate on areas of agreement and disagreements to help in decision-making (Okello *et al.,* 2012). Participatory mapping is used as a tool to understand historical and present relationships of people and the environment that they live in, and derive their livelihood sources from, and it helps to understand ways in which communities connect with their environment/landscapes (Belay, 2012). By reconnecting communities with their memories, it makes them appreciate their value as well as the value of their spaces (Belay, 2012). While land use change over time can be technically assessed through remote sensing techniques (Mapedza *et al.*, 2003), participatory mapping by social-ecological system stakeholders, referred to as actors in the social-ecological system functions (Mcginnis & Ostrom, 2014), effectively complements scientific findings from these technical methods within their limits to capture events and perceived causes of changes witnessed in land uses.

Participatory mapping was also proposed on the basis that it contextualises the perceptions of stakeholders and offers a platform for their visual impression (Belay, 2012). For this study, participatory mapping technique gave stakeholders a visual map of the change and potential drivers for such changes, contributing to understanding how the land use change has occurred over time through assessment of ecosystem service provision and its implications. In this process, farm workers were guided through a mapping exercise where they were asked to sketch the historical landscape as far as they could remember (Appendix A), and then draft a sketch of their current scenario. This process was followed by focus group discussions, with was done in Xhosa with the help of interpreters.

3.2.4 Focus group discussions

Discussions followed from the sketches, where participants were asked to list the ecosystem services that the landscapes previously provided, and what they now receive with respect to features sketched on the maps. They were also asked how they understood the implications of the land use change as well as drivers of the change (Appendix B). Responses were noted and recorded with participants' consent, to maintain accuracy of data capture or to avoid omission of data. As part of the participatory mapping, focus group discussions offered free spaces in which participants shared their emotions and memories linked to certain services lost or acquired over time.

3.2.5 Key stakeholder interviews/Narratives

In the experience of Belay (2012), narrative as a method can be fundamental in capturing and understanding people's deeper emotions and honest thoughts relating to their space, a place they consider, or at least used to consider, home. It also captures and contextualizes ideas, stories and reflections constituting a complex social-ecological system. To get a better understanding of interplays between and within the two land uses, key stakeholder interviews targeting landowners were conducted. These interviews with landowners aimed to cover certain aspects of their demographic, including age and gender, history of the farms, the provision of ecosystem services and aspects of human well-being. With this scope, fundamental dimensions of the land use change were assessed. This method was also carried out to understand the different perspectives of the change in land use, perceived drivers and implications of the change from the context of existing stakeholders.

3.2.6 Causal loop modelling

Causal loop modelling was used to address the question of whether this land use change can be considered a regime shift and help understand interactions within the system. Causal loop modelling is a method useful in indicating cause and effect relationships between variables (Maani & Cavana, 2007). This technique was used to identify the main drivers of change, as well as social and ecological impacts of the land use change. In linking variables and establishing causalities, it can help understand complex processes. Variables considered for this process emerged from perspectives from both landowners and farm workers. Causal loop modelling was also used to understand different feedbacks that maintained each regime from the perspective of farm workers and the landowners. The causal-loop diagram was created using Vensim PLE x32 modelling software.

3.3 Sampling framework and research strategy

3.3.1 Sample size and framework for landowners

Landowners who have converted their livestock farms to game farms, forming Amakhala, were the targeted primary respondents. Consent was sought from these landowners to provide contacts for their farm workers, which formed the sample size for farm workers of the respective converted farms. The initial target for the landowners was eight, which constituted all the landowners in Amakhala. However, only four landowners were available for interviews. All four landowners were interviewed at Woodburry lodge/Amakhala Conservation Centre (ACC), where they were asked to give a historical narrative of the whole game farm, followed by guiding questions. The interview sessions were recorded with their consent and also documented in field notes and reports to avoid omission of data.

3.3.2 Sample size and framework for farm workers

The number of farm workers that were interviewed varied per site and was based on farm worker contacts provided by landowners. Various categories of farm workers were considered and attributes that were recorded included gender, number of years working on the farm, duties and responsibilities, and relationships with landowner.

Within the Amakhala game farm there were three lodges where meetings with farm workers were organised. These included Woodburry (ACC), Leeuwenbosch, and Carnarvon Dale. Five farm workers, one man and four women, participated in the first participatory mapping and focus group discussions held at the ACC (Woodburry lodge). The second participatory mapping and focus group discussions were held at Leeuwenbosch lodge with two women participants. A third discussion followed at Carnarvon Dale with two women, and finally the last process of participatory mapping and a discussion was held with a man at Woodburry lodge. This sampling technique was chosen for this study due to unfamiliarity with the study area, with a starting point being previous contacts for landowners provided by knowledge from previous research (Maciejewski, 2012).

3.3.3 Research strategy

This research was preceded by a literature review and time series data analysis. Qualitative data generation through participatory mapping, focus group discussions, and key stakeholder interviews were used to provide a better understanding of the two regimes. This was done to understand the perceived causes of temporal changes and implications of such

trajectories. Qualitative representation of interacting variables emerging from perspectives of stakeholders was conducted through causal loop modelling. This was then followed by data analysis and thesis write up, as summarized in Figure 5.

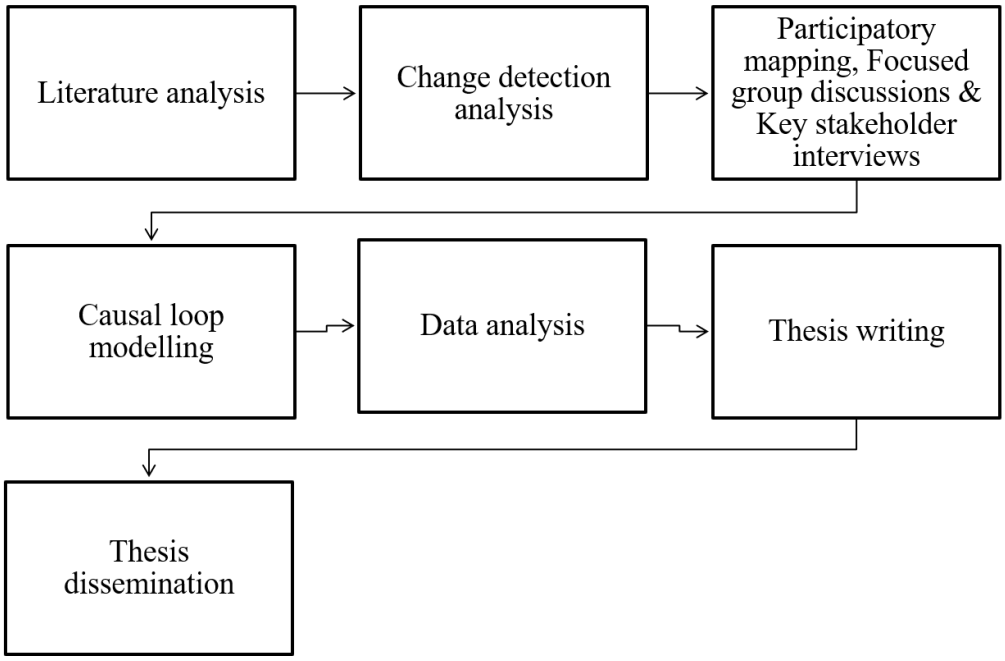

Figure 5: Research strategy used as a roadmap for the research process

3.4 Data processing and analysis

3.4.1 Qualitative data processing and structuring

Qualitative data acquired from the focus group discussions and interviews were coded and analysed using ATLAS.ti 8 qualitative data analysis software. Each objective was coded by category, sub-category, specific attributes and examples. The Millennium Ecosystem Assessment framework (MEA, 2010) was used as a reference and guideline to generate codes for categories of ecosystem services that emerged per site, and implications to human well-being. Impacts of the land use change on ecosystem services were assessed in terms of availability of the services, accessibility to these services with regard to distance, safety and accessibility, and both quality and quantity of the services. Data on participants' perceptions of these changes was disaggregated by gender, the number of years individuals worked on the farm, duties or responsibilities and relationships with landowners. The outcome is presented as network links, generated in ATLAS.ti 8.

Perceived drivers were also coded under attributes of farm workers and landowners. The categories for ecosystem services used for this case were narrowed down to provisioning ecosystem services and valued social and community features. This was due to the ease of understanding, identification and resonance by participants. As constructed in the literature, supportive and regulatory ecosystem services on the other hand were not possible to capture with participants in this context because these are biological or natural processes that they do not necessarily recognise or interact with, or easily identify. Part of the reason is that local constructs of these services do not correspond with those in the framework of ecosystem services highlighted in the literature. Although these services might exist in the narrative contexts, their interpretations differed from the framework used and hence were not possible to identify by local names in this research. Those values tied to the ecosystem (cultural), including aesthetic, recreation did not come up during discussions with participants, but instead participants mentioned valued social and community features. Output data was presented as networks, loops, tables and figures, and narrated to maintain data richness, preserve nuance and avoid generalisation of certain perspectives.

3.4.2 Quantitative data processing

Landsat datasets used for land cover change analysis were downloaded from earth explorer (Earth Explorer 2018). The image processing phases are summarised in Figure 6. Historical assessment required time series data and therefore both historical and current images were downloaded from Landsat 5 and 7&8 respectively. These were layer-stacked in ENVI 4.7 software to obtain specific bands for each year, study area masked/extracted from the layer-stacked scenes in Qgis 2.6, which were then segmented using MaDCAT 4.0 (Figure 7). With the segments generated, eight land cover classes were identified from the visual composites using Land Cover Classification System 1.8.3 (LCCS). These classes included rangeland/grassland, bare areas, thicket, cultivated/bare crop fields, riparian vegetation, wetland, juvenile growth forms (newly revegetated) and ‘others’. The ‘others’ category included those land cover classes that could not be categorised as the other eight classes. Juvenile growth forms (newly revegetated) in this case was referred to as land cover category observed as ‘carpets’ covering areas initially identified from previous Landsat images as bare areas.

Area coverage per image was 6939.54 ha calculated from a product of 30m by 30m pixel size except for 1992, which used 28m by 28m cell size, summing up to 6836.56 ha. The

segments and the generated land cover classes were used to perform supervised classification, by assigning land cover classes to segments and validated using google earth. Segments with similar classes were eventually merged and the area of the polygons calculated for each year in ArcGIS 10 to identify land cover change. Results of this change were presented as classified maps and proportional ecosystem type change over time.

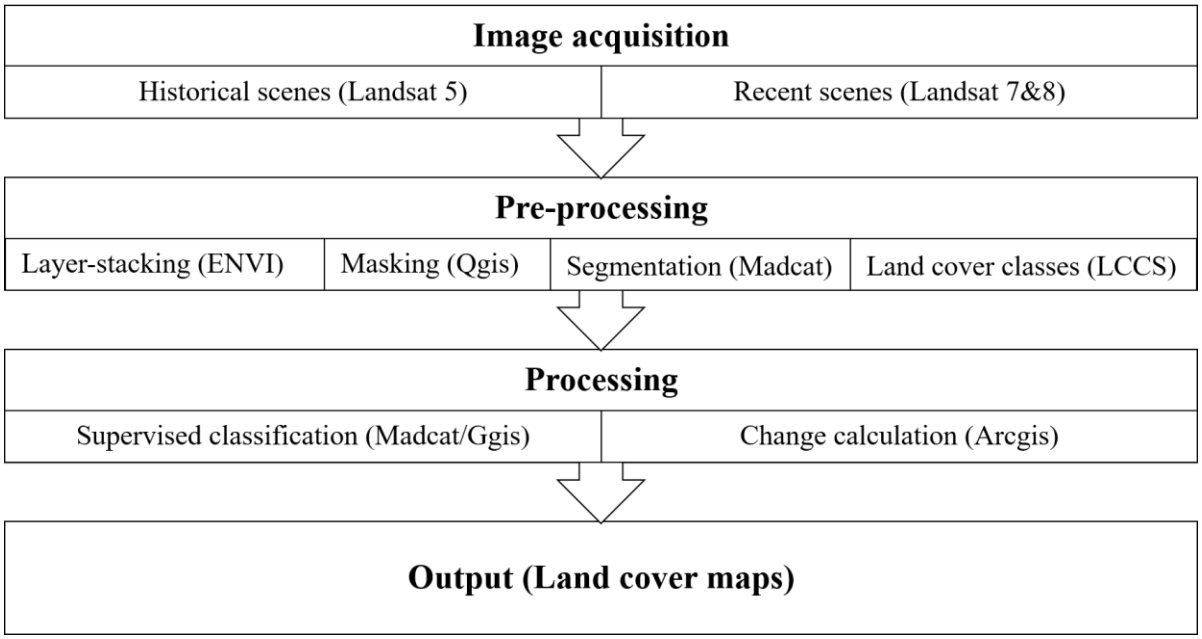

Figure 6: Landsat data processing phases used to perform land use land cover analysis over time

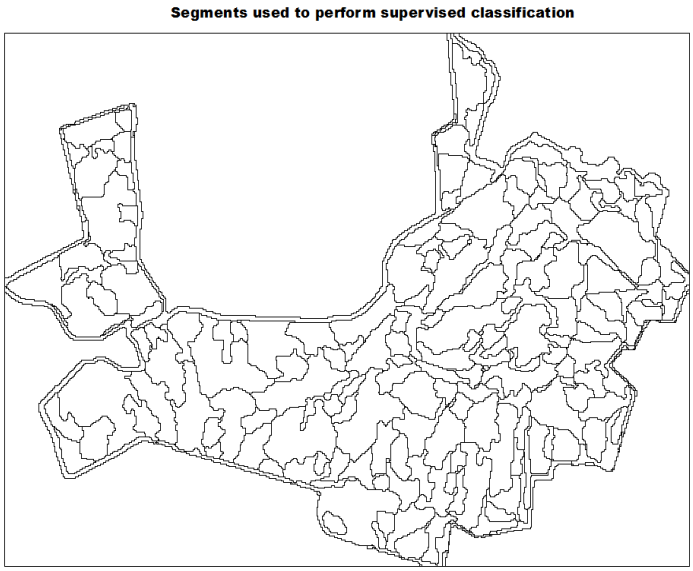

Figure 7: Segments used to perform supervised classification of land cover classes (generated from MaDCAT 4.0)

3.5 Conclusion

This chapter focused on the study context and elaborated on the sampling framework and methodologies that were relevant for this case study. Working in a social-ecological system where human decisions have significantly influenced land use change, it was important that both ecological and human (social) components were studied. To understand the richness of people's experiences in the change in land use, quantitative assessment was combined with interview-based qualitative assessment. This justified the specific choices of methods discussed in this chapter. Investigating social-ecological systems complexity requires a holistic approach and application of tools that helps to understand system structures and functions to identify key drivers of change as well as implications of such changes. This justified the use of a systems thinking approach to understand the land use change trajectories. The next chapter presents and discusses the research results.

Chapter four: Results and discussion

4.1 Introduction

In this chapter, the key research question of whether the land use change can be seen as a regime shift is addressed. Amakhala presents a context that is fairly representative of broader issues associated with livestock-game farming transition in the Eastern Cape. Results are presented descriptively and analytically: participant narratives are used to bring in their voices and the richness of their experiences of the changes; diagrams are used to visualise feedbacks and flows; maps and satellite images are used to show vegetation changes over time; and graphs are used to present the temporal changes. The discussion presented in this Chapter focuses on establishing and explaining causalities and linkages between variables that emerged from these results.

This chapter first sets the context by providing a descriptive narrative and layout of the study area, from the perspective of the landowners, describing the change from livestock farming to game farming and what this change means from a social-ecological perspective. This brief history is followed by change analysis of land cover over time before delving into perceptions of landowners and farm workers regarding the change. Interviews conducted with farm workers and landowners were drawn on to gain a better understanding of their contrasting understanding of the drivers of this land use change and how this impacted on the provision of the ecosystem services they use.

4.2 Descriptive narrative of the study context

Prior to converting into game farms, the initial land use was predominantly for agrarian purposes including chicory and maize farming, livestock farms and different forms of subsistence practices. Loosely defined, certain 'assets' were owned at individual level. Large portions of land were under commercial livestock farming and within the porous boundaries of livestock farms, farm workers and farm dwellers interacted in a way that was attributed to as a community; that is, shared residential areas, social and cultural activity spaces. However, these interactions changed when erection of fences around the game farms started to emerge, at around 1980s in the name of game farming with concomitant forms of spatialization. The nature of social relations also changed and the concept of a ‘community’ on the game farms took on very altered characteristics. This aspect of change to the social-ecological system is explored in the discussion below.

Histories of change with specific reference to land use in Amakhala are not unique from other locations within or outside the Eastern Cape province of South Africa. In this case, Amakhala, a private game farm, was selected to help unravel finer details of often overlooked, but critical aspects of how change is experienced. To put this into context, a historical description from the landowners is drawn on, to understand how the land area that is now the Amakhala game farm emerged.

Amakhala game farm is founded on amalgamation of neighbouring livestock farms into one conservation centre, known as the Amakhala Conservation Centre. Its total area coverage is 8500 hectares, shared in various sized plots among eight landowners. Prior to being recognised as a tourist destination and functioning as a game reserve, the now amalgamated farms were separate commercial livestock farms for dairy, sheep and goat farming. Four of the livestock farm owners signed their first constitution draft in October 1999 to convert their livestock farms into a game reserve. The draft outlined operation procedures; shortly after the draft, farmers began to sell their livestock portion by portion to purchase large game animals. This decision was primarily influenced by a six-year drought between 1989-1995, which dried livestock feeds and reduced water quality and quantity, making the livestock sector less economically viable.

When rainfall eventually returned in 1996, filling up the dried-up Bushman's river, the farmers' scepticism to continue investing in livestock farming remained due to concerns over whether there would be potential for-profit generation in the event of a more long-term drought. Additionally, a neighbouring game farm, Shamwari, which had started to experiment with game farming, was showing progress in terms of the number of foreign visitors it received. The example of Shamwari was seen as a success story by the neighbouring livestock farmers. They were further encouraged by a South African Veterinary specialist, Dr. William Fowlds, who had a passion for conservation across South Africa and played an advisory role to the undecided farmers to invest in game farming. With these situations playing out, farmers gradually sold portions of their livestock, bought game animals and erected game fences around their properties. This enabled them to convert from commercial livestock production to game farming, with very few traditional livestock farms left and only certain farmers keeping few a dairy cows for their own domestic use. It is against this backdrop that a regime shift lens is

used to explore what the land use change from livestock to game farming meant for both landowners and farms workers.

4.3 Land cover change analysis over time

The impact of the land use change from livestock to game farming on ecosystems was assessed through an analysis of land cover change between 1984, 1992, 2009 and 2017 (Figure 8).

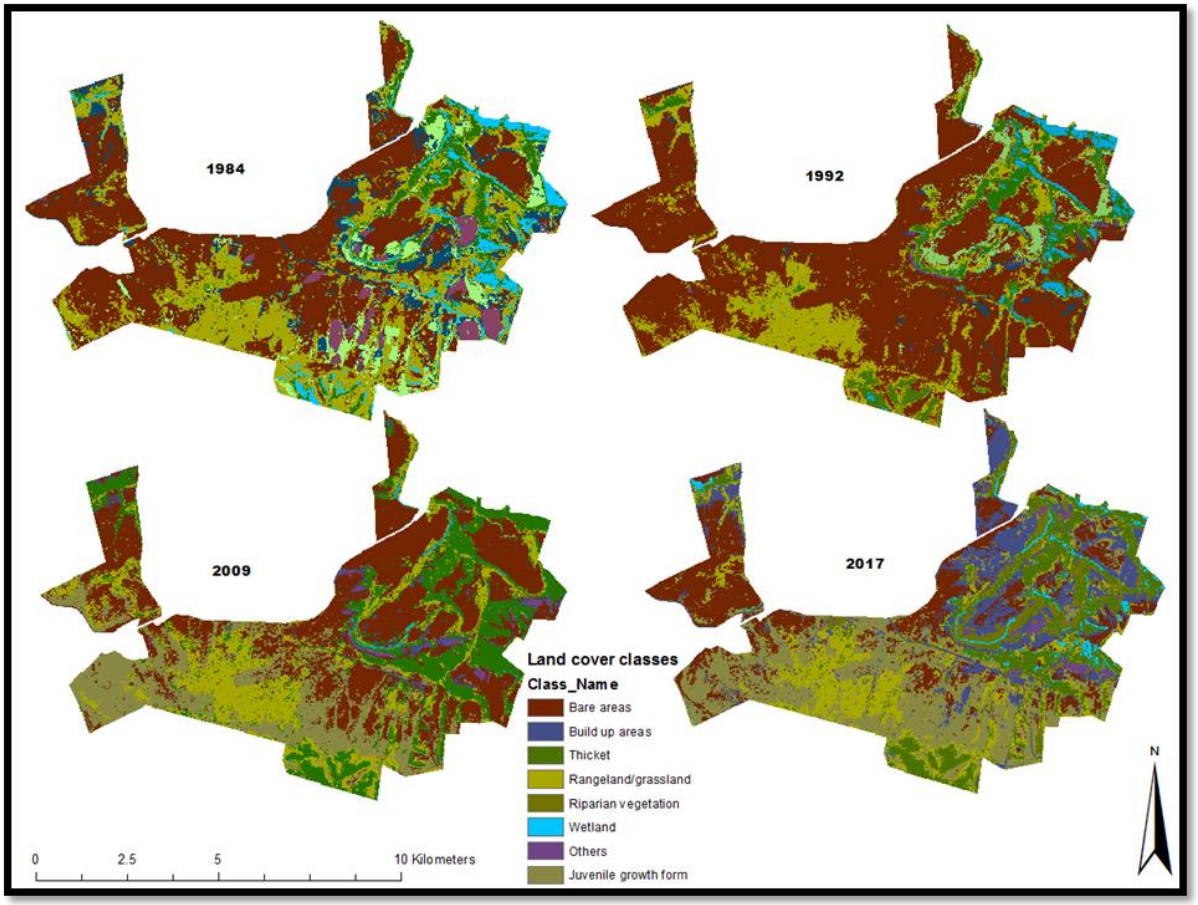

Figure 8: Land cover classes in Amakhala game reserve over four time series (ArcGIS 10.0).

In 1984, the majority of the land cover (41%) was comprised of bare areas, followed by rangeland/grassland at 27%. Riparian vegetation recorded lowest at 2%, while juvenile growth forms (newly revegetated) in this year were not identified (Table 1), (Figure 9).

In 1992, the area covered by bare areas increased to 62% of the total area, while that covered by rangeland/grassland decreased to 18%. The smallest percentage of land cover appeared under the 'others' category at 1% and juvenile growth forms were also unidentified for this year (Table 1), (Figure 9)

Area covered by bare areas and rangeland/grassland dropped to 37% and 17% respectively in 2009 from 1992. Thicket land cover recorded second highest class after bare areas at 21%. Juvenile growth forms recorded 20%, while crop fields were unidentified for this year (Table 1), (Figure 9).

In 2017, juvenile growth forms recorded highest area coverage of 26%, followed by bare areas at 20%. Built up areas emerged third, covering 16% of the total land area, closely followed by thicket and rangeland, which both covered 14% of the area. Crop fields were unidentified in the 2017 land cover classes (Table 1), (Figure 9).

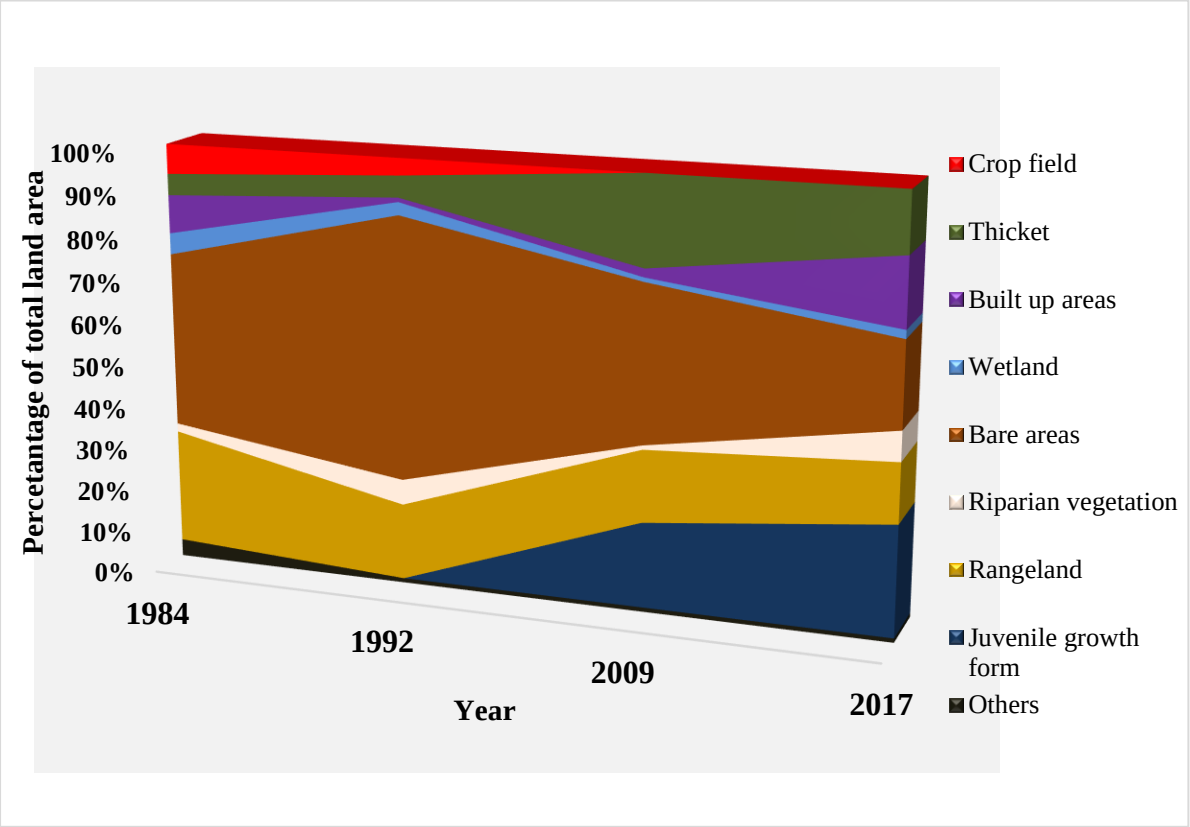

Figure 9:Percentage area coverage of land cover classes varied over four-year period

Table 1:Percentage area coverage of land cover classes varied over four-year period

Land cover	1984	1992	2009	2017
Riparian vegetation	2%	6%	1%	7%
Wetland	5%	3%	1%	2%
Built up areas	9%	1%	2%	16%
Thicket	5%	5%	21%	14%
Crop field	7%	4%	0%	0%
Rangeland	27%	18%	17%	14%
Others	4%	1%	1%	1%
Bare areas	41%	62%	37%	20%
Juvenile growth form	0%	0%	20%	26%

Between 1984 and 1992, the majority of the total area was comprised of bare areas, which then gradually declined from 2009-2017 (**Error! Reference source not found.**). At the same time, juvenile growth forms (revegetated areas) made up a substantive fraction of the total area. In the same year, there was also an increase in thicket and riparian vegetation, as well as built up areas (Figure 9). Rangeland slowly decreased in land cover between 1992 and 2017, and crop fields disappeared between 2009-2017.

The drought between 1989-1995, which dried up the Bushman's River, could explain the 62% increase in bare cover in Amakhala in 1992 because this year falls within the drought period. The increase in revegetated areas from 2009, 10 years after most farmers converted their land to game farms, may indicate a recovery in the vegetation cover, due to the return of rainfall in 1996. This rainfall would have increased soil moisture and facilitated regeneration, reducing disturbance of the soil from grazing and other livestock-related activities.

4.4 Stakeholders perception of the land use change

4.4.1 Demographic structure and background information of interviewed stakeholders

Data presented in this chapter reflects responses from a sample of farm employees and landowners from Amakhala game reserve. Farm worker participants included current employees of the game farm who had been employed on the livestock farms, as well and some who had only been employed since the conversion to game farming. Landowners were selected

for participation in the research only if they had owned the livestock farm and still owned it after it was converted to a game farm.

Farm workers

A total of 10 farm workers from three lodges in Amakhala game reserve were interviewed: two men and eight women between the ages of 20-70 years. The number of years each individual had worked on the farm was captured as indicated in Table 2, and ranged from 2.5 years to 31 years. The interviewees' duties and responsibilities on the game farms were noted as well as their relationship with their employers. This information was obtained from the focus group discussions, which were rated as good or poor based on their attitude and references made towards the employer by the employee. Table 2 shows characteristics of farm workers interviewed.

Table 2: Demographic structure and description of interviewed farm workers in Amakhala game reserve

Respondent	Gender	Years worked on farm	Current duties and responsibilities	Relationship with employee
1.	Woman	2.5	Front of house	Good
2.	Man	3	Waitering	Good
3.	Woman	4	Catering	Good
4.	Woman	5	Cleaning	Poor
5.	Woman	10	Housekeeping	Poor
6.	Woman	16	Catering	Poor
7.	Woman	17	Front of house	Poor
8.	Woman	20	Housekeeping	Poor
9.	Woman	30	Housekeeping	Poor
10.	Man	31	Driving/maintenance	Good

Landowners

Four landowners and one reserve manager were interviewed: three men and one woman. Two of the landowners were a couple (husband and wife), owning one of the sites in partnership. For all these landowners, land acquisition was through inheritance from their fathers or close relatives. Before these lands were converted to game farms, their fathers or relatives who passed on these inheritances practiced livestock farming in partnerships between different landowners, which were terminated at inheritance. The respective years each owner acquired/inherited their portion of land to carry on livestock farming were indicated (Table 3), as well as the years these same livestock farms were converted into game farms. Hectarage owned by each individual landowner is also shown in Table 3.

Table 3: Characteristics of interviewed landowners from Amakhala game reserve

Respondent	Gender	Land acquisition mode	Year land was acquired	Year converted to game farm	Ha
1.	Man	Inheritance	1991	1999	1100
2.	Man	Inheritance	1980	1999	1200
3.	Man	Inheritance	1985	2000	1000
4.	Woman	Inheritance	1991	1999	1100
Reserve manager	Man	N/A	N/A	N/A	N/A

4.5 Ecosystem service provision by livestock and game farms: farm workers' perceptions

Table 4 summarises the ecosystem services and valued social and community features historically provided by livestock farms versus those provided by game farms. These findings are provided for each of the sites visited and were drawn from the participatory mapping and focus group discussions with farm workers. From the summary in Table 4, it is evident that in all three sites, there were more provisioning ecosystem services provided by livestock farms compared to valued social and community features. Both provisioning and social benefits provided by the livestock farms decreased when the land use was converted into game farms. There was a decrease in the provision of food from livestock and gardens, wood fuel, game meat, social and cultural practices. Spiritual spaces however remained consistent in both land

uses. A common finding in all three sites was that when the livestock farms were converted into game farms, the majority of farm workers, along with their families were relocated to surrounding locations such as Paterson and other nearby towns. This movement away from the farms where the villages were located, altered the social networks initially established among farm workers and erased intimate connections linked to the land as a place referred to as home. Concomitantly, the nature of ecosystem service provision changed in terms of quality and quantity, and accessibility and availability to the benefits associated with livestock farms. The responses that emerged from the participatory mapping exercise are addressed per site in the following section.

Table 4: Summary of provisioning ecosystem services and valued social and community features by both land uses, as perceived by farm workers in the three sites visited in Amakhala game reserve

Site	Provisioning services (Livestock regime)	Valued social and community features (Livestock regime)	Provisioning services (Game farm regime)	Valued social and community features (Game farm regime)
Woodburry	**1**. Food crops **2**. Vegetable gardens **3**. Wood **4**. Ration **5**. Tapped water **6**. Livestock (pigs, goats, & chickens) **7**. Plough for themselves	**1.** Community games **2**. Church **3**. Cultural sports	**1**. Only chicken **2**. Tapped water	**1**.Church moved closer **2**. End of residential community
Leeuwenbosch	**1**. Game meat **2**. Ration **3**. Wood **4**. River water **5**. Chicory and maize **6**.Livestock (pigs, cows & chicken)	**1**. Cemetery **2**. Church	**1**. Limited wood for fuel **2**. Limited water for vegetables **3**. Less livestock and poultry **4**. Piped water	**1**. Methodist church **2**. Gatherings for celebration **3**. Traditional celebrations

Carnarvon Dale	**1**. Wood **2**. Ration **3**. Livestock (chicken, goats, & cows) **4**. Dam water **5**. River water **6**. Game meat **7**. Beans, pumpkin & other vegetables	**1**. Cultural activities and ceremonies **2**. Methodist church **3**. Social interaction with other workers **4**. Community concerts and drama shows **5**. Bazaars	**1**. Water from 'jojo' tanks.	**1**. Church **2**. Limited social gatherings

4.5.1 Woodburry site

Of the farm workers that were interviewed in Woodbury, two women and one man had worked on both the livestock and game farms for a period of more than 10 years, and two women and a man had less than five years working experience on the game farm. The first three participants led the discussion around what ecosystem services the livestock farms provided them with, which was unknown amongst those participants who had only worked on the game farm.

Life on livestock farms in Woodburry site

Prior to the conversion to the game farm, only three participants were originally living on the livestock farm. They lived in clustered houses, forming a community, which they referred to as 'villages'. Within their homesteads, they had their own vegetable gardens where they could grow beans, pumpkins and other vegetables for their own consumption. They used piped water from the nearby Bushman's river to irrigate their gardens but had tapped water for drinking and domestic use. Piped water was occasionally supplied through pipes connected from the river by landowners to supply water for livestock, while tapped water was supplied by the municipality to the households. Churches and schools were within the farms and at a walking distance from these villages that their children could safely walk to. School playgrounds were occasionally used for local games or other social events that would bring local communities together.

People living in the villages used to collect firewood from the woodlands, which they used in communal 'braais' (barbeques) during celebrations or other social events. During collections, the firewood could be loaded onto the farmers' trucks and delivered to the villages. Firewood was harvested mostly because it was available, accessible and the cheapest source of energy.

Two women from Woodburry site narrated: *"We could fetch plenty of wood for cooking from these patches of woodlands or bushes because we did not use gas or electricity to cook. We did not have to buy wood; even during braai when would come together to celebrate, we had enough."* (Focus group discussion, May 13, 2018).

To the farm workers, the livestock fields or rangelands were seen as places of work, but also places to graze their own livestock. Payment for work on the farm was in form of a small amount of money and rations, which they refer to as a certain amount of food (flour, sugar, meat, milk, etc.) given to each farm worker by their employer in the form of a wage.

A woman from Woodburry site: *"The ration could sustain my family even though the money was little. I did not have to buy much food from the market; if anything, we had our own livestock which we mixed with the dairy cattle from the farms which could help us."* (Focus group discussion, May 13, 2018).

Life on game farms in Woodburry site

When the livestock farms were converted to game farms, the nature of the farm workers' lives and interaction with the farmland changed dramatically. Almost all the villages were demolished, and most farm dwellers were moved to nearby rental locations. As a result of the relocation, some farm workers stopped working on the farm while others maintained their jobs. Very few houses remained occupied by farm workers on the game farm. Participants indicated interactions with the game reserve, lodges and camps as strictly professional, where they simply report to work and deliver daily services. Some schools and churches had been relocated to further distances, but there were buses provided by the game farm, organized by landowners to help with transportation of school-going children. Participation in social events decreased among farm workers due to limited space and the relocation of villages to rental locations in Paterson town and other places. The few houses that remained inhabited on the game farm now have dwellers keeping their own chickens due to the lack of space to rear their own livestock. The provisioning services that the river used to provide them, in terms of freshwater, are no longer available as the river is now polluted and the water is of poor quality. The reasons for this are unknown to the few farm workers who stay in the remaining houses, but they have had to adapt, and now rely on tapped water from the municipality.

4.5.2 Leeuwenbosch site

Living on livestock farms

Provisioning services emerged as an important ecosystem service from two female participants in this site, both of whom were born and raised on the livestock farm and had been working on the game farm for more than 10 years. The majority of the services received were direct benefits, including game meat from occasional hunts in the open woodlands and wood fuel. The farm villages were home to farm workers who used to work on both dairy farms and chicory and maize farms where they kept their own livestock, such as pigs, cows and poultry. These villages were in close proximity to religious and educational facilities, which were important for local social gatherings and traditional celebrations. Within the villages there used to be graveyards, which held a social value of remembrance to family members and relatives they had lost.

A woman from Leeuwenbosch site responded: *"When I was growing up in Kraaibos farm village, people who stayed here used to work on the chicory and maize fields while some people also worked on dairy farms. They received ration and cash as a wage in return. Schools and churches were close by; even the graveyards where we often saw as a remembrance to the people we lost."* (Focus group discussion, May 13, 2018)

Living on game farms

With the change from livestock farms to game farms, schools, churches and the cemetery were moved to other locations to create space and more land for the game reserve. Only a few villages remained occupied on the farm, as most people were relocated to rental houses in Paterson and other surrounding towns. Relocation from these villages meant that farm workers could no longer tend to their own livestock and cultivate their vegetable gardens to consume fresh products. Participants also indicated that they no longer frequent traditional celebrations or community gatherings as often as they previously did. This was attributed to the sense of 'community', which is defined by shared residential areas, social practices and cultural celebration, being weakened or broken up, and a lot of the participants' time now being consumed with work duties on the game farm.

4.5.3 Carnarvon Dale site

Living on livestock farms

Two female participants, who were both born and raised on the farm and had been working for over 30 years on the same farm, were interviewed. During the participatory mapping exercise, when participants drew the map of the landscape, the cultural celebrations and social practices that brought local communities together were emphasised. These included cultural ceremonies, bazaars, community drama shows and concerts, and social interactions among workers from other farms. Schools, churches and market centres were used to host these events.

A woman from Carnarvon Dale site stated: *"We used to have bazaars where we could come together as a community and exchange our handmade products or do barter trade among ourselves. I could get what I did not have in the house from another member because we also trusted each other and felt oneness. We could talk, make fun of each other and laugh and this made us feel important to each other."* (Focus group discussion, May 14, 2018).

Besides the valued social significance connected to the previous land use, the participants recalled having their own vegetable gardens and livestock in these villages growing up. Vegetables, such as beans and pumpkins, were cultivated along with chickens and pigs, which supplemented the ration and money they obtained as payment for services delivered on the livestock and chicory farms. Water from the Bushman's river and dams was available, which could be used to water their vegetable gardens. Woodlands were used as sources of firewood and hunting for game meat without any form of restriction. These constituted provisioning ecosystem services.

Living on game farms

With the change to a game farm, both provisioning and valued social features had decreased to only water tanks ('jojo' tanks) where participants could obtain water on the farm and limited social gatherings that were rarely participated in due to limited time available. This decrease in both provisioning and valued social features was attributed to the fact that farm workers no longer live on the farms. The decrease was also due to changes in infrastructure, such as the establishment of lodges and erection of fences, which restricts access to certain services.

4.6 Perceived implications of the land use change by stakeholders

4.6.1 Farm workers

(a) Years worked on the farm

To establish a relationship between number of years of experience working on either farms and the impacts of the land use change, years worked on the farm were categorised into two groups: participants who had worked on the farm for more than 10 years; and those who had worked for a period less than 10 years. Those with 10 years' experience and above had worked and/or been raised on both farms (game and livestock), while those with less than 10 years only had working experience on the game farm. The participants in these two categories differed in their perceptions. Farm workers that had worked on the land in its previous land use or 'regime' felt that their community and family bonds have weakened; they have lost their vegetable gardens, trust in their employers, sense of security of place, and have observed or suffered from lifestyle diseases. Whereas farm workers that had only experienced the game farm felt that they have gained more skills on the job through trainings and took pride in their jobs and skills. This perception centred on the skills gained on game farms because staff delivering certain services to tourists must be trained on how to do so.

Those workers who had experienced both the livestock and the game farm regimes had a clear image and taste of both land uses, either as workers on the farms or as homes where they grew up. Positively, these workers indicated that the change to game farms had meant an increase in their wages, improved infrastructure and a sense of pride in their current jobs. In their opinion, washing and milking cows did not pay much (an activity they did on the livestock farms) and was not seen as an exemplary duty to take pride in. Wearing a uniform on the game farm however, formalised their roles as they perform duties now, a change positively attributed to the new land use. These findings are summarised in Figure 10.

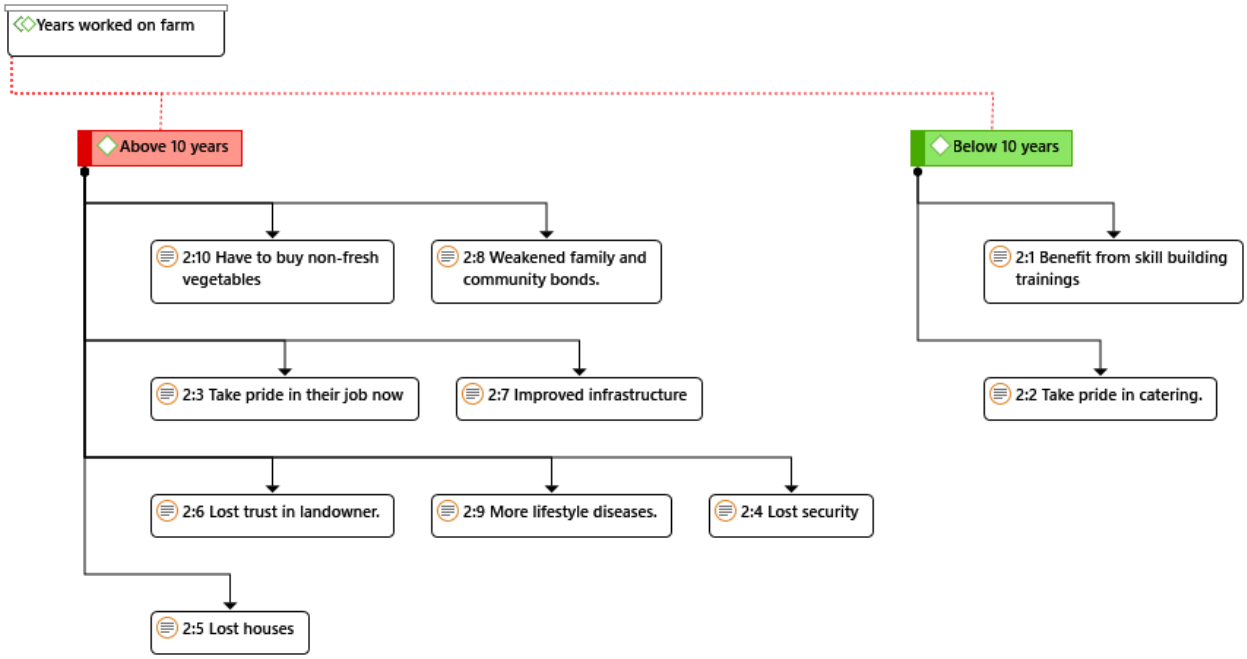

Figure 10: Perceived impacts of the land use change of farm workers in Amakhala game reserve disaggregated by the number of years of experience working on the farm (ATLAS.ti 8)

(b) Gender

Figure 11 indicates how farm workers' perceptions of the land use change differed by gender. There were some responses that were shared by men and women, which was grouped into its own category. Otherwise, there were strong differences in participant responses by gender. Women perceived more impacts of the land use change than men. To further understand why this could be the case, the gender aspect was further disaggregated by duties and responsibilities, as well as relationships, as shown in Figure 12 and Figure 13 respectively.

While men felt that the shift from livestock to game farming resulted in a decrease in work or duties, they also acknowledged that this was countered with an increase in income, through tips from tourists. Women, on the other hand, felt overworked with barely enough time to bond with family members. A culturally gendered notion that taking care of children remains a sole responsibility of women has meant that these same women spend more hours at work due to increased workload, barely having enough time to spend with their children. Women also mentioned lost connections with their loved ones, loss of trust in the landowners and poor services or sub-standard services rendered to them by their employers. Despite this, women acknowledged that they appreciate the physical and professional looks associated with duties performed in their current jobs and have acquired more skills in terms of catering and

hospitality. The responses shared by men and women included an increase in wages, skill-building trainings, a sense of pride in what they do, and improved infrastructure.

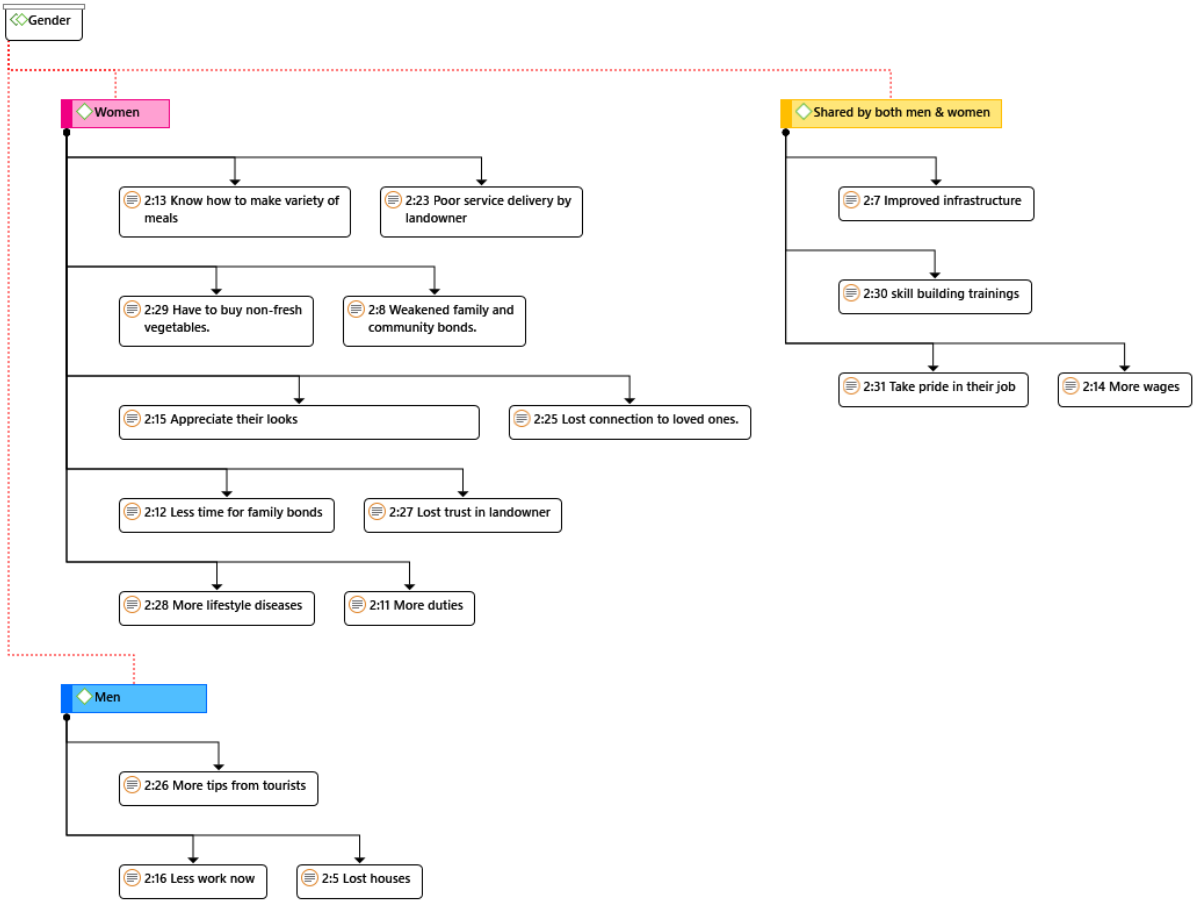

Figure 11: Perceived impacts of the land use change of farm workers in Amakhala game reserve segregated by gender (ATLAS.ti 8)

(i) Duties and responsibilities separated by gender

Impacts of the land use change was perceived differently by those working in hospitality and the maintenance sector. The hospitality sector was dominated by women, while maintenance responsibilities were mostly undertaken by men. Conventionally, technical duties have been associated with men and this was true in Amakhala where game rangers, security guards, drivers and those fixing fences were men. Women on the other hand were associated with working as house/lodge attendants, catering and waitering. These fit gendered divisions of labour generally in this cultural context.

Differences in workload and typical work hours also aligned with gendered divisions of labour in the wider social context. Work in lodges was akin to home duties usually undertaken by women, which included waitering, catering or cleaning. These duties required more hours

every day of the week compared to the maintenance sector. Longer working hours meant less available time to spend with family members or participate in social activities. Women associated these duties with more wages; whereas the duties in the home are unpaid. They also had to be in certain 'get-up' (clothing requirements) for the job, which required that women pay special attention to their physical looks. This was a more formalised outfit that professionalised their duties compared to previous casual outfits that were less specific when they worked on livestock farms.

Men on the other hand admitted to performing less duties on the game reserve in the maintenance sector compared to the heavy workload they experienced on the livestock farms. This was a result of there being few maintenance needs, which only included fixing broken fences and driving around the game reserve, compared to livestock farms, which included washing cows, milking and mowing cattle feed on the livestock farms. Men also acknowledged being tipped on the job by tourists at the end of guiding tours on the game reserve, which they did not receive when working on the livestock farms (Figure 12).

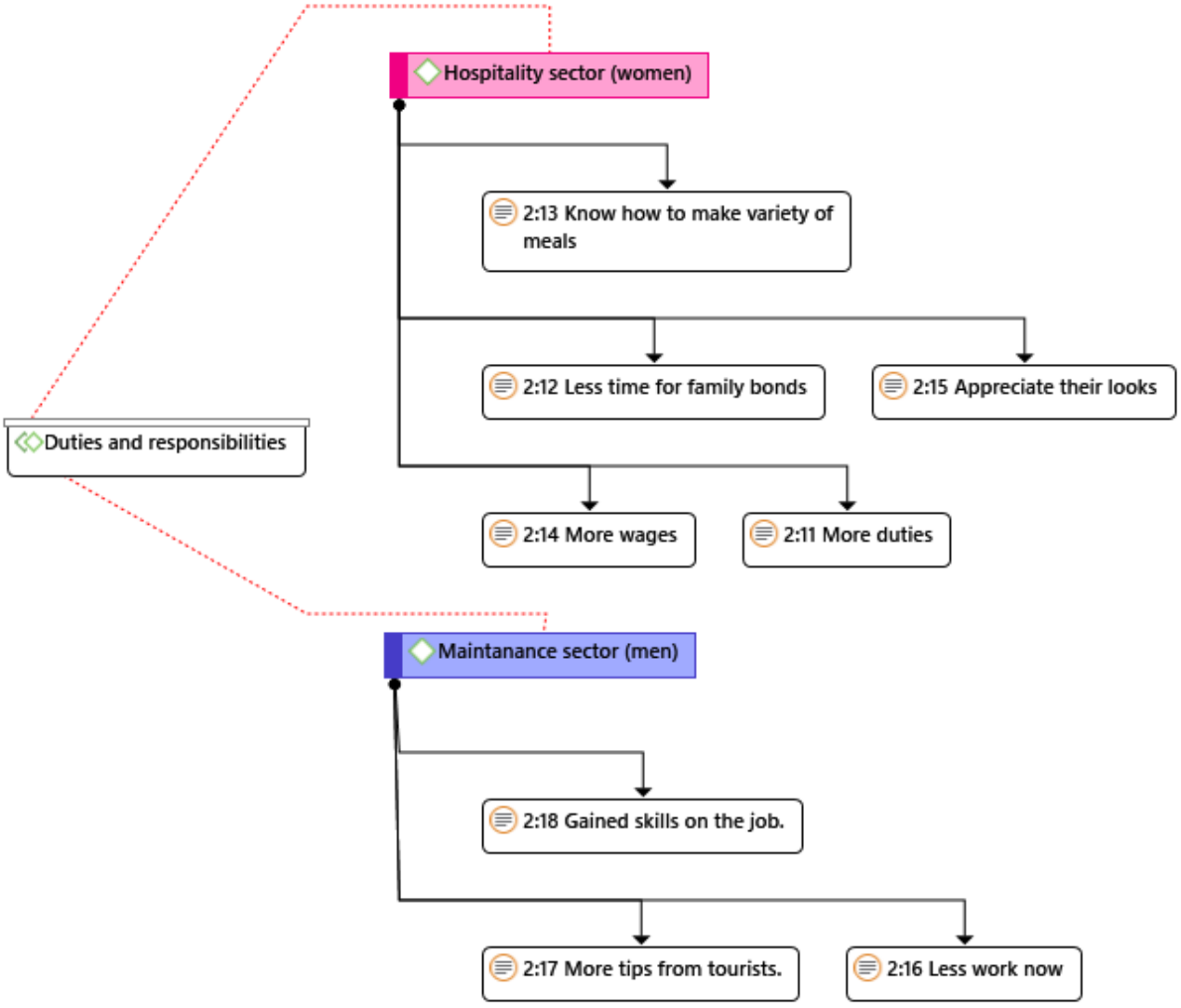

Figure 12: Perceived impacts of the land use change of farm workers in Amakhala game reserve segregated by duties and responsibilities with respect to gender (ATLAS.ti 8)

(ii) Relationships separated by gender

The farm workers' relationships with the landowners, which were rated as good or poor, also influenced their perceptions of the land use change (Figure 13). Farm workers in good relationships with their employers acknowledged getting promotions, gaining certain skills outside of work, running personal errands for the landowners, feeling connected with their employers and enjoying certain favours such as using their employers' trucks or vehicles to run their own errands. Farm workers with poor relationships with landowners on the other hand felt a sense of oppression, poor/substandard services offered to them by landowners and emphasized that they have lost connection with their loved ones.

There was a link between relationships and gender, where all the men reported good relationships with landowners. Responses from women on the other hand were mixed. This

variation could be linked to duties and responsibilities. In the maintenance sector dominated by men, they interact more often and closely with landowners in performing personal duties for their employers, which may help to establish good relationships. The hospitality sector on the other hand employed more women, with longer hours and larger workloads, which left little time to perform certain chores at their own homes, such as fetching water for their vegetable gardens. The salient point here about gender relations more generally is that the gendered division of labour outside work remained unchanged despite the changes and gendered differences in time commitments to paid jobs. Occasionally, when a request was made to the landowner to assist with trucks to deliver water, false promises were made. Examples mentioned by the farm workers indicated mistrust or poor relationships development due to employers failing to deliver on promises made. Female participants in good relationships with their employers justified the case on good wages and kindness from their employers.

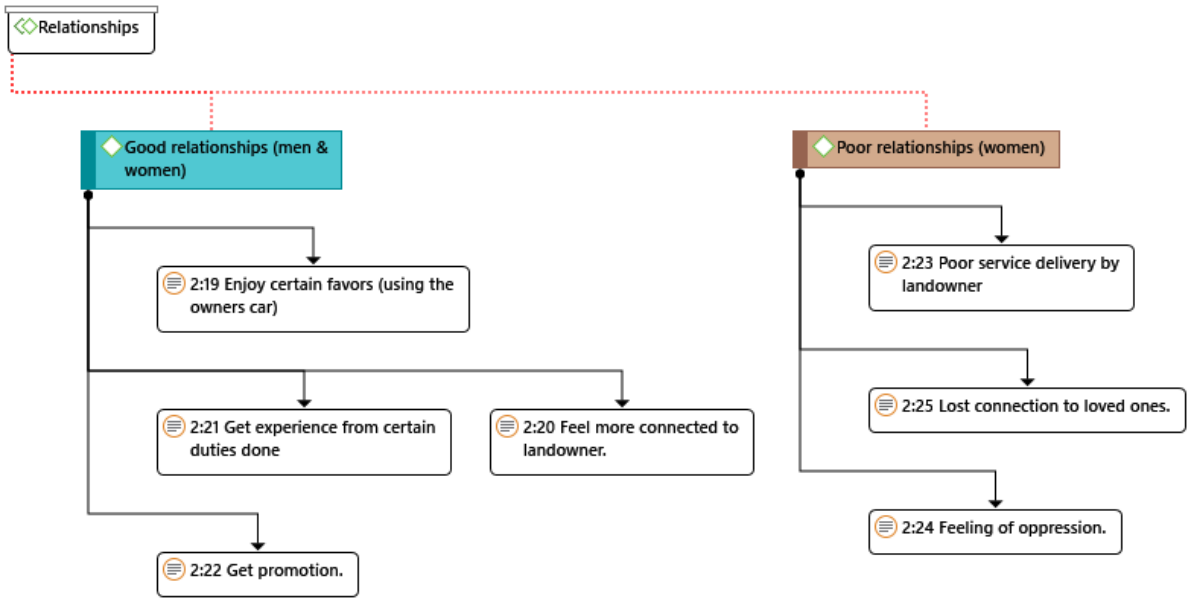

Figure 13: Perceived impacts of the land use change of farm workers in Amakhala game reserve linked to relationships with landowners, disaggregated by gender (ATLAS.ti 8)

4.6.2 Landowners

The landowners' perceived impacts of the land use change was divided into three categories: impacts on farm workers/or surrounding population; impacts to themselves as farmers; and impacts on beneficiaries, including the education program for children belonging to junior staff members, a charity fund (ISIPHO), and bursary foundations (Figure 14). Amakhala foundation is a non-profit organisation that generates its funds from a quarter percentage of accommodation paid by visitors per bed-night, known as a bed levy. This money is channelled

to a bursary meant to support school children belonging to farm workers and a charity fund known as ISIPHO in Paterson. This was perceived as one of the key contributions the game reserve was making to support farm workers and other local communities.

Landowners felt that since livestock farms have been converted into game farms, there has been an increase in job opportunities, especially for female employees. These are associated with increased wages, acquisition of skills and training, which often leads to job promotions. This context has enabled staff members to take pride in what they do and feel more professional and empowered. However, employing more women was directly related to culturally gendered divisions of labour, as women are usually responsible for household chores and cooking.

The landowners feel that the change to game farms has resulted in an increase in profit over the past 10 years, which has resulted in an improvement in infrastructure, including tourist facilities, schools, housing and roads. This land use change has also expanded their market networks, and they made reference to the fact that they are now living a much busier lifestyle, working every day of the week. Employing more staff enabled by profit they get from the reserve has helped with duties, and hence eased their personal responsibilities.

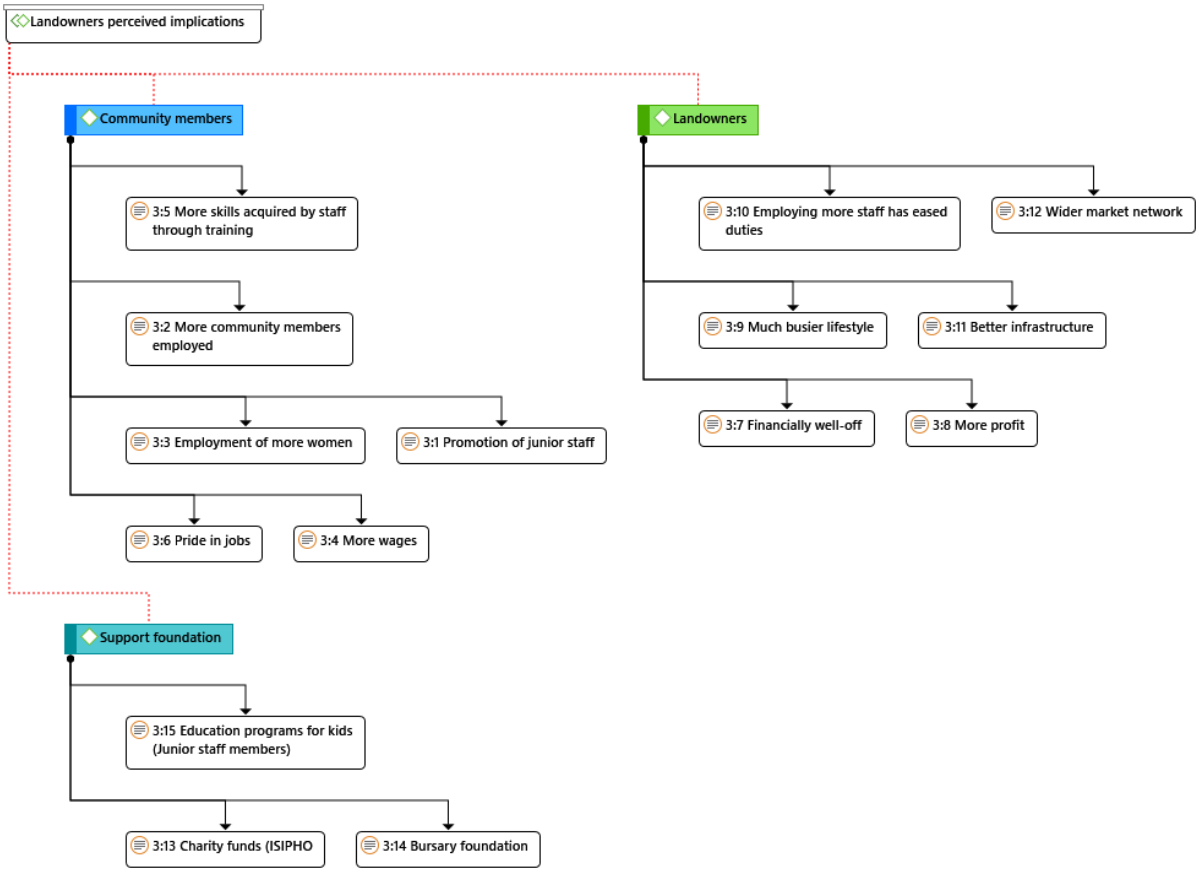

Figure 14: Perceived impacts of the land use change of landowners in Amakhala game reserve (ATLAS.ti 8)

4.7 Perceived drivers of the land use change by landowners and farm workers

Perceptions of the main drivers of the land use change differed between landowners and farm workers. This is visually represented in Figure 15. The figure reflects how the different stakeholders perceived the driving factors that influenced the shift from the livestock farming to the game farming regime in the case of Amakhala game reserve.

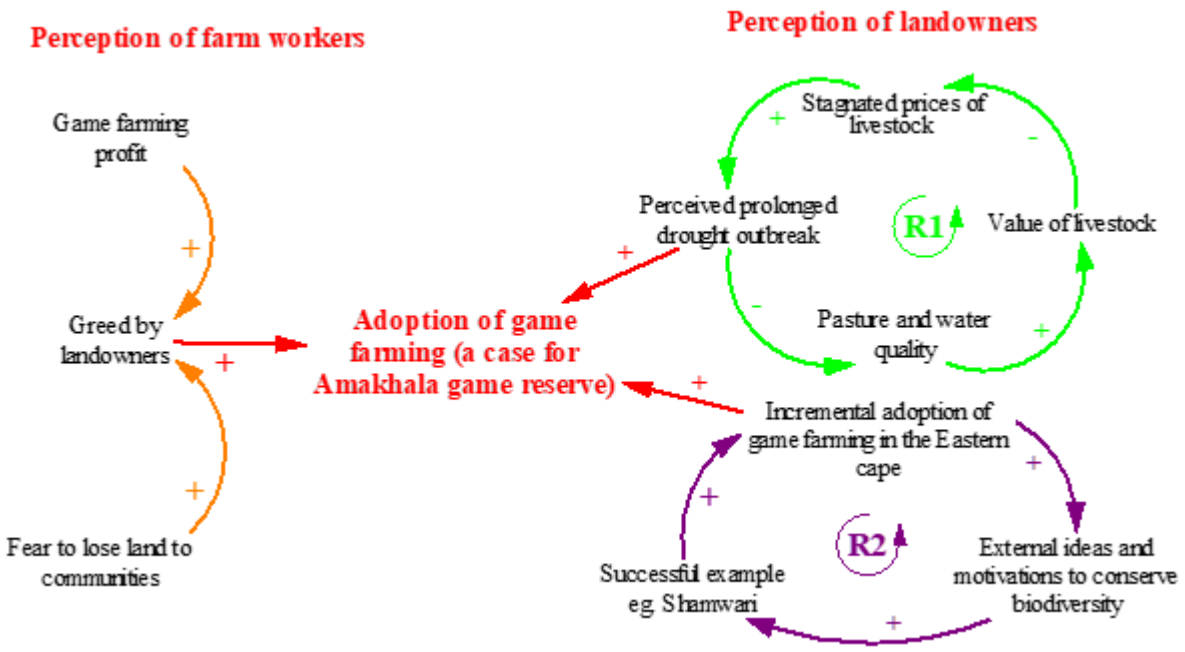

Figure 15: Perceptions of main drivers of land use change by farm workers versus landowners in Amakhala game reserve (Vensim PLE x32)

4.7.1 Perception of farm workers

The farm workers believe that the main deciding factor responsible for influencing farmers' decision to shift into game farming is profit driven and the fear of losing land to communities. It was largely felt that this land use change was a 'selfish' act, related to individual farmers' fear of sharing their land, or losing their land to expropriation. This was perceived as positively reinforcing their 'greed' and increasing their desire to adopt game farming (Figure 15).

4.7.2 Reinforcing loop (R1&R2): Perception of landowners

The landowners' decision to shift from livestock farming to game farming is reflected in two reinforcing loops, R1 and R2 (Figure 15). The farmers felt that incremental adoption of game farming in the Eastern Cape accredited game farming practice as a sustainable land use, which increases the protected area estate, contributing to the conservation of biodiversity. This catalysed the spread of ideas and motivations to conserve biodiversity and therefore farmers, including those from neighbouring farms such as Shamwari, welcomed these ideas and successfully started converting their pastoral land into game farms. With Shamwari's success story, which was perceived to be generating more profit, it increased farm owners' desire to generate profit they had been losing with livestock farming. This gradually spread among

livestock farmers close by, reinforcing the increased idea of tourism industry in the Eastern Cape. This interaction reinforced the decision of landowners to shift to game farming.

In R1, the prolonged drought between 1989-1995 led to the drying up of the Bushman's river, along with other water sources that provisionally sustained the livestock sector. With an increase in the drought period, the quality and quantity of cultivated and natural pasture and water reduced. As a result, the value of livestock declined with regard to quality and quantity of livestock products. With the quality of products declining, there was a decrease in value. The drought reinforced this cycle, which influenced the farmers decision to convert their pastoral land into game farms.

4.8 Discussion: Is the land use change a regime shift?

According to Biggs *et al*. (2018), for any change in a system to be considered a regime shift, it has to manifest certain attributes: (i) if there has been a reorganisation in the structure and functions of the system; (ii) if this reorganization has altered ecosystem service provision that differs from the previous regime and consequently impacts on human well-being; (iii) if the feedbacks interacting in the current regime locks the system in, which is often irreversible or costly to reverse. In addition to the temporal land use change evidenced at the onset of this chapter, the context of conversion of livestock farming to game farms in Amakhala game reserve was framed in this conceptualisation by Biggs *et al.* (2018).

4.8.1 Reorganisation of structure and functions of the social-ecological system

To reorganise in this case means to configure the system in a different way that changes its structure and function economically and ecologically. Unforeseen or stronger forces; natural, social, economic and political are potential leading factors in configuring spatial landscapes. In the event of this happening, social structures, cultural values, and provisioning services are at stake.

In the context of Amakhala game reserve, the land use change from livestock farming to game farming reorganised both ecological structures shown in land cover maps and social structures were perceived differently by stakeholders. The former is demonstrated by variations in area coverage, notably replacement of bare areas with revegetated category of the land cover over the four-year period, potentially due to the drought or change in land use. It is also demonstrated by gradual reduction in area covered by rangeland/grassland land cover class. This might

indicate a contribution to conservation of biodiversity, an increase which may also be linked to increase in functional diversity.

Perceived changes in the social system included personal connections with the land, social platforms of farm workers and broken connections with the past that had been maintained through the presence of cemeteries. This can be seen as the 'free' space changing into a 'caged' space. I use the terms 'cage' and 'free' to establish a structural contrast between livestock and game farms. 'Cage' in this case refers to the introduction of impermeable boundaries around the game farms, which has restricted the provision of ecosystem services previously gained from livestock farms. 'Free' space is used here to refer to the porous boundaries that existed on the livestock farms. It represents expression of free movements by farm workers during the livestock regime without fear of attack by wild animals, the assurance to harvest firewood from a woodland without restriction and a space to congregate as a community. Being' free' meant having one's own space to grow fresh vegetables while working on the farms to earn ration and fresh livestock products such as milk and meat. 'Free' space also meant being close to their loved ones who had passed on by staying close and visiting the on-site cemeteries. This configured the then geographical space in a manner described as 'intimate'. However, this intimacy wore down gradually as 'cages' were constructed.

4.8.2 Changes in ecosystem service provision and implications for human well-being

The land use change from livestock farming to game farming altered valued social and community features and provisioning ecosystem services and had consequent implications for human well-being. Connection to the livestock regime was linked to a deeper connection with nature through a sense of place. The place provided intrinsic and intimate values, including connection with loved ones, both living and those that had been lost, and felt connected to by visiting the cemeteries.

A woman from Leeuwenbosch site recalled: *"I cried when the cemetery was fenced as part of a reserve. I had just lost a close family member and even though there was another cemetery started near the village where we lived, the bodies still remained buried in the soil and we could not get them out. We had to stop visiting the graves because we were no longer allowed in."* (Focus group discussion, May 13, 2018).

Connecting to the space was also realised through day-to-day livelihood activities that revolved around working in the livestock farms and forming social groups with fellow workers and their families, which led to social gatherings, cultural events and community micro-level economic

activities. These social networks provided platforms for cognitive developments and personal acknowledgements; a space to reconcile internal conflicts and share experiences with one another.

The land use change into a game farm impacted on people's sense of security as they no longer felt free to move around to obtain certain direct benefits they used to get from the livestock farms. Suddenly, there was a fear of being attacked by wild animals while hunting for game meat or harvesting wood in the woodlands.

A man from Woodburry site narrated: *"We used hunt for game meat (kudu, imbabala, ihodi, incanda etc) freely to supplement food sources which was mostly from the farm and our little vegetable gardens. We also fetched firewood from the bushes used for cooking at home and during braai or community get together. There is no more hunting because there are lions, cheetahs, elephant and other dangerous ones. There are imbabala (impalas), but we cannot hunt because it is restricted. We also have to buy wood now if we want to braai or cook with wood."* (Focus group discussion, May 13, 2018).

With the new land use, social networks and relationships between farm workers have changed in certain ways to fit into the game farming regime. Spaces that have emerged through game farming are those seen as economic nodes where everything revolves around economic values and interactions that maintain and sustain their livelihoods. Economic incentives, especially increased wages, drives stakeholders specifically because of the responsibility to support their families.

A man from Woodburry site made the following statement: "*The money I used to get paid when I was milking cows was something like R295 because I did not need to buy much, but I still needed to take care of my children. So, it was not enough, but now, I get enough money to fully support my family."* (Focus group discussion, May 13, 2018).

With better infrastructure, education and health facilities, mobility is easier; while the existence of child care facilities ensures their young ones are taken care of while they are at work. However, this conformity has altered the social relationships valued in the previous land use.

A woman from Leeuwenbosch gave the following response: "*There is a creche nearby where we take our kids before coming to work, that helps because we do not need to employ a house help. But we spend very less time with them because we are always working. We also don't get to meet as a community as we used to in the farms*." (Focus group discussion, May 13, 2018).

Erection of game fences that demarcate boundaries, and most importantly, secure the wild animals in the game reserve brought in impermeable boundaries. The difference between fences around livestock farms and those around game farms is in terms of accessibility. The livestock farms were more accessible despite the fences compared to game farms, which have more impermeable fencing boundaries. In this case, caging through inaccessible fencing gives rise to a 'metaphoric caging' where day-to-day relationships, social circles and family bonds revolve around the game farm as a privatised industry. While the animals were caged in, the community of people previously resident were caged out.

The livestock farms were more about people on the inside, that is, farm workers, farm owners and farm dwellers compared to game farms centred around people on the outside (domestic and international visitors). On the livestock farms, there were meaningful social and cultural interactions among farm workers, farm dwellers and farmers attributed to the shared residences, which built social networks forming a community. Social structures observable on the game farms significantly differ from previous land use. Game farm workers' and people using the farms' (tourists) social relationships are not definable as a community because they are about 'temporary' people whose needs are temporary; that is, time-bound game viewing and exquisite serenity of the game reserve. Decision-making processes align to the needs of visitors for optimal satisfaction.

Trade-offs in ecosystem services and implications for human well-being

The increase in profit generated from the game farm sector contributes to the GDP of the province (Maciejewski, 2012), a benefit that extends beyond the scale of the reserve and may be encountered at a national scale. The 'free' to 'cage' transition had trade-offs at play, which are summarised in Figure 16. While the livestock regime was associated with unrestricted connections through security, more space, social bonds and low wages to mostly men employed, the game farming regime is identified with more economic impacts and less about people and their intimate space considered a 'community'. It is mostly identified by economic relationships; offering more wages, good infrastructure, skill building among staff, which comes with a sense of pride and more women being employed, benefits which were not present in the previous land use. The economic gains are important to both landowners and farm workers at varied levels and contributes to their financial well-being. Although it can be said superficially at this front that it all cancels out, what has been lost as a result of the social-ecological regime shift cannot be quantified because it is beyond this investigation. However,

it may appear that the system has somehow balanced off and it is indeed a social-ecological regime shift characterised by trade-offs.

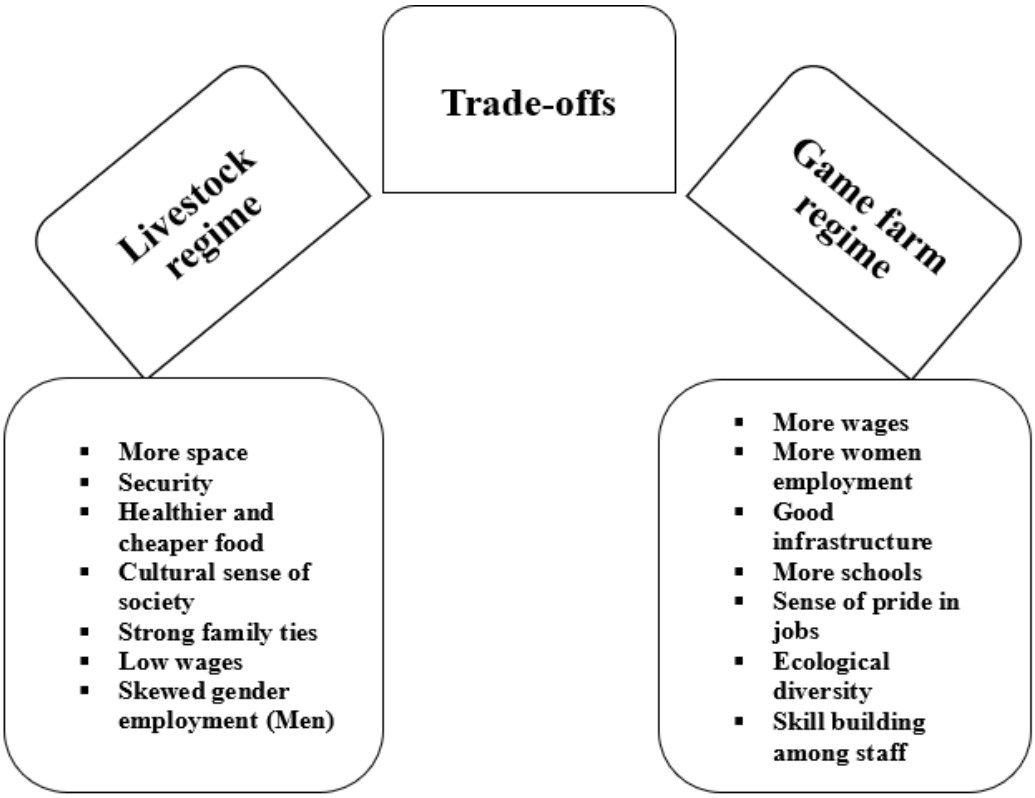

Figure 16: An illustration of trade-offs involved in the social-ecological regime shift from livestock to game farming in Amakhala game reserve

4.8.3 Feedbacks maintaining the game farm sector

The decision to shift land-use practices from livestock farming to that of game farming was a slow, gradual process for some livestock farmers, and abrupt for others. At the initial phase, farmers reported that it was tougher to a point where there was doubt among those farmers who had gradually started converting their portions, as to whether there would be potential for optimal profit with this new land use. As a result, they stayed halfway between livestock farming and game farming before fully converting to game farming afterwards.

A landowner of Carnarvon Dale site responded as follow: "*Game driving was tough at the beginning, yooh! My brother and myself used to do the driving, taking visitors around. At that time, we only had seven zebras and two giraffes. We could drive for hours without spotting any of these game animals. Profit was minimal and so I turned my house into a lodge to host visitors and moved to a smaller house nearby. My farm workers relocated to Paterson in government subsidised houses where they could pay rent for R1000, which was not a lot of money. We*

bought a bus to pick them from their homes to work and drop back in the evening to cut on transport cost, which they could channel to paying rent. By 2008, I was able to build a proper lodge, something related to what tourists would want. This was only possible because I was half into both practices, running both dairy farming and game farming at the same time. But my brother got fully going after 1995. He sold all his livestock at once and built a lodge." (Key stakeholder interview, May 14, 2018).

After the conversion from livestock farming to game farming, game farming was seen by landowners as a unique land use involving the establishment of fences and water sources for purchased wild animals. Presence of these animals attract tourists hosted in lodges and other facilities. This locks this regime in place, maintained through profit: employment for farm workers, and salary for landowners (Figure 17), a state that may be difficult to reverse. Such state may include a new management structure, which has started since the farm was inherited where restrictions are imposed to align to the land use, economic reputation of the game farming sector in the province and the mind-shift of individual farmers.

Figure 17: An illustration of perceived feedbacks sustaining the game farm regime in Amakhala game reserve according to landowners

4.9 Conclusion

This chapter focused on the land use change from livestock to game farming, identifying impacts and drivers of the change. The livestock to game transition has significantly altered social structures and functioning, provisioning of services and affected personal connections with the land. The transition has varied impacts on different stakeholders. A systems approach was useful as it provided a holistic view to unpack complexities of these interactions.

Chapter five: Conclusion

5.1 Introduction

The aim of this research was to investigate whether land use change from livestock farming to game farming in Amakhala, Eastern Cape can be seen as a regime shift. I explored this understanding using a systems lens, and a regime shift approach, to uncover changes in ecosystem service provision by both land uses, understand what this change means to different stakeholders of the ecosystem and what these stakeholders perceived as the key driving factors of the land use change.

To answer the key research question, I analysed landcover change in the area and interpreted the narratives that emerged from interviewed stakeholders and established linkages and relationships. This approach was appropriate for the research due to implications that regime shifts have on human economies, societies and human well-being. I drew on the historical and contemporary interactions to understand the social-ecological system. Below, the key findings from the study are summarised.

5.2 Key Findings

In summary, a change in land use is clearly illustrated in the land cover maps. Over the four-year period, the bare areas have been replaced with vegetation, and there has been a decrease in total area covered by rangeland/grassland. This could indicate an increase in biodiversity as well as the provisioning of ecosystem services. Livestock farms provided more provisioning ecosystem services and valued social and community features compared to the game farms. These provisioning services included the provision and consumption of fresh food products, which meant that less food was bought in markets. Valued social aspects that created social cohesions referred to the intimate spaces of deeper social connections and community formation with the social-ecological system stakeholders. Both land uses were profit driven and it is the profit motivation that maintained each regime.

The land use change however, had trade-offs in ecosystem service provision where both land uses had negative and positive outcomes. From the farm workers' perspectives, the livestock farms were seen as their intimate space, a place that allowed social networks to establish, which became their community. Game farms on the other hand were seen as land uses with more economic activities and gains generated from tourist activities. The economic benefits

contributed to the financial well-being of the farm employees (especially women) and employers and was even reported to extend beyond the reserve.

The livestock regime not only allowed individuals to connect with one another and with the space, but also connected them to their loved ones through valued social and community features such as the cemeteries. The conversion into a game farm therefore represents a loss in this social connection which only surfaced through interactions with stakeholders at an individual level. Perceptions of the land use change, however, varied across different stakeholders depending on gender, duties and responsibilities of farm workers, their relationships with the landowners, and also number of years they worked on the farm. All stakeholders however, benefited from 'good for everybody' financial benefits associated with game farming.

Farm workers perceptions to this land use change differed across gender. Women's socially prescribed roles as family carers and household managers did not change even though their work duties in the game farm regime increased. The provisioning and valued social and community features provided by the livestock regime that supported their roles were greatly reduced. Enclosures therefore radically altered the networks of social relations embedded in more than higher profit or higher income, but social relationships attached to these places. New types of social relationships and sense of community are inevitable with the changes. The workers now living in rental housing in towns and nearby centres have different communities compared to what previously existed in the villages on the livestock farms. Investigating these new forms of communities in these spaces was beyond the scope of this study. While this study can show what has changed in the form of a community from livestock farms, what has been lost or gained cannot be discussed without investigating the types of communities that are happening under the game farm regime. Based on the significant and sustained impacts that the change has had on the functioning of the ecosystems and the local community, this research concludes that the shift is indeed a social-ecological regime shift.

5.3 Reflections on the research approach

Regime shifts often referred to as ecological changes in the landscape (Biggs *et al.*, 2013), but this study used a social as well as ecological approach to not only look at how the land use changed, but also how this change impacted on individuals. Interviewing various stakeholders embedded in the system provided a holistic view of social perceptions of change, and how they were aligned with the vegetation changes measured using Geographic Information System and

Remote Sensing. Understanding this reality at different levels shows that it is a conflicted land use that may be wallpapered as a 'green' practice.

In this case study, the concept of ecosystem services, specifically supportive and regulatory, was challenging to capture in the local narratives. Quite often, the stakeholders seldom recognise these biological and natural processes as those that underpin ecosystems they rely on for the direct benefits (provisioning services) that are easily recognisable. Cultural services on the other hand are intangible and were mistaken for valued social and community features. This lack of resonance limits the knowledge when it comes to how ecosystem users value social-ecological systems. A regime shift approach can potentially bridge this knowledge gap with social-ecological system users to create local and common understanding.

This study highlighted the important role that relationships and social networks play in social-ecological systems. Although the sense of community between people observed on the livestock farms has decreased with the current land use, new forms of social narratives can be constructed for a socially functioning society. For instance, in good and transparent relationships between farm workers and landowners, individuals are likely to be on the same level of understanding when it comes to major decisions of operations, especially those that significantly alter their living conditions. The fact that farm workers had no clue about what was going on when the livestock farms were converted to game farms might impact the system. Thus, the role of social networks in social-ecological systems needs to be focused on due to its potential impacts on the system's resilience.

5.4 Limitations

The study context was in a predominantly Xhosa-speaking region mixed with Afrikaans and English population. As a researcher from Kenya, with linguistic knowledge in Luo, Swahili and English, in its unique space and culture, this meant that Xhosa-speaking interpreters had to be used to lead the participatory process and focus group discussions with farm workers. Although a small sample of farm worker and landowners participated in this study, they gave an indication of the diversity of perspectives regarding the land use change.

High resolution imagery was not used in this case due to financial constraints. This made it a hurdle for precision assessments with regard to temporal grassland transition in the region, with risks of generalising land cover classes. This constraint was however intercepted by a GIS data validation technique using Google Earth and iterative image classification.

5.5 Ethics

The research involved human participants in research methodologies, including behavioural observation, interviews and group discussions. Ethical clearance for the research was approved by the Research Ethics Committee: Human Research (Humanities), Stellenbosch University as project number: SPLSID-2018-6523. At all times the research team respected the rights, integrity and privacy of research participants and their fellow researchers.

All participants were volunteers, with every effort made to ensure full knowledge and disclosure of research goals, outputs and use of results prior to participation. Before participation, information was given specifying the aims, methods and implications of the research, the nature of the participation and any benefits, risks or discomfort that might ensue. Recruitment of eligible participants for research took place through identifying individuals and groups of relevance to the research topic. No participants were excluded on the basis of gender, culture, religion, ethnic origin or social class. All potential participants were informed that refusal to participate would have no consequences and would not involve any penalty or loss of benefits to which the person was otherwise entitled. All participants were made fully aware that they may discontinue participation and withdraw any data they had provided at any time without penalty or loss of such benefits. Research did not take place with children (under 18 years of age), patients, incompetent/incapacitated persons, immigrants or other sensitive groups (e.g., prisoners).

Audio recordings of various discussion groups or interviews were taken to facilitate later analysis. Audios have been kept by the researcher in her private storage systems and will be destroyed after the analysis has been completed. Participants were informed in advance of the recording and were asked to sign an informed consent prior to participation in the sessions, which contented the objectives and methodology of the project.

Identified risks included potential risk to participants of their opinions or responses on topics sensitive or controversial within their context being known. The research project addressed and minimized this risk by: participation at participants' discretion; information revealed at participants' discretion; confidentiality during data collection; and anonymisation of any research materials. Participants' identity will not be disclosed in publications or at meetings. No names or other personal data will be maintained or disclosed by the researchers. Participants' confidentiality will be respected at all times as detailed in the informed consent form in order to prevent possible identification of individuals' opinions or ideas in any sharing,

through publication or otherwise, of research results. As an ethical imperative, related to meaningful use of participants' time and knowledge, the research will generate meaningful, high-quality data and ensure timely publication, communication and dissemination of results.

5.6 Conclusion

From a social-ecological systems perspective, a systems approach provides a holistic understanding of the system. In this case, it provided a holistic view of both livestock and game farm regimes. It unpacked often overlooked, but crucial aspects of the two systems that support the well-being of social-ecological system stakeholders, that is, the role of social linkages. Through the comparison of changes in ecosystem service provision of both land uses and how individuals perceived these changes, it indicated trade-offs of the social-ecological regime shift. Although it all seems to cancel out and one can argue that the system has somehow balanced off, the amount of loss or gain that has been incurred as a result of the social-ecological regime shift is beyond this investigation. A key highlight however is how the structures and functions of the previous system changed significantly to accommodate the current system with its unique structures and functions.

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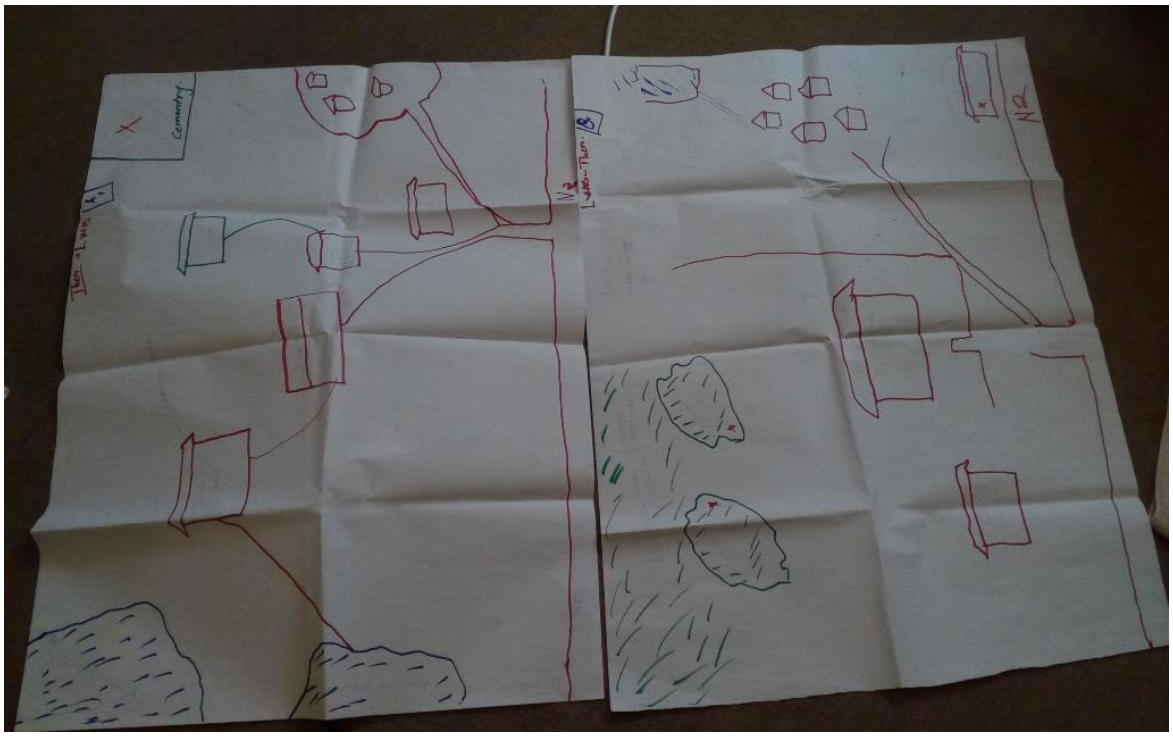
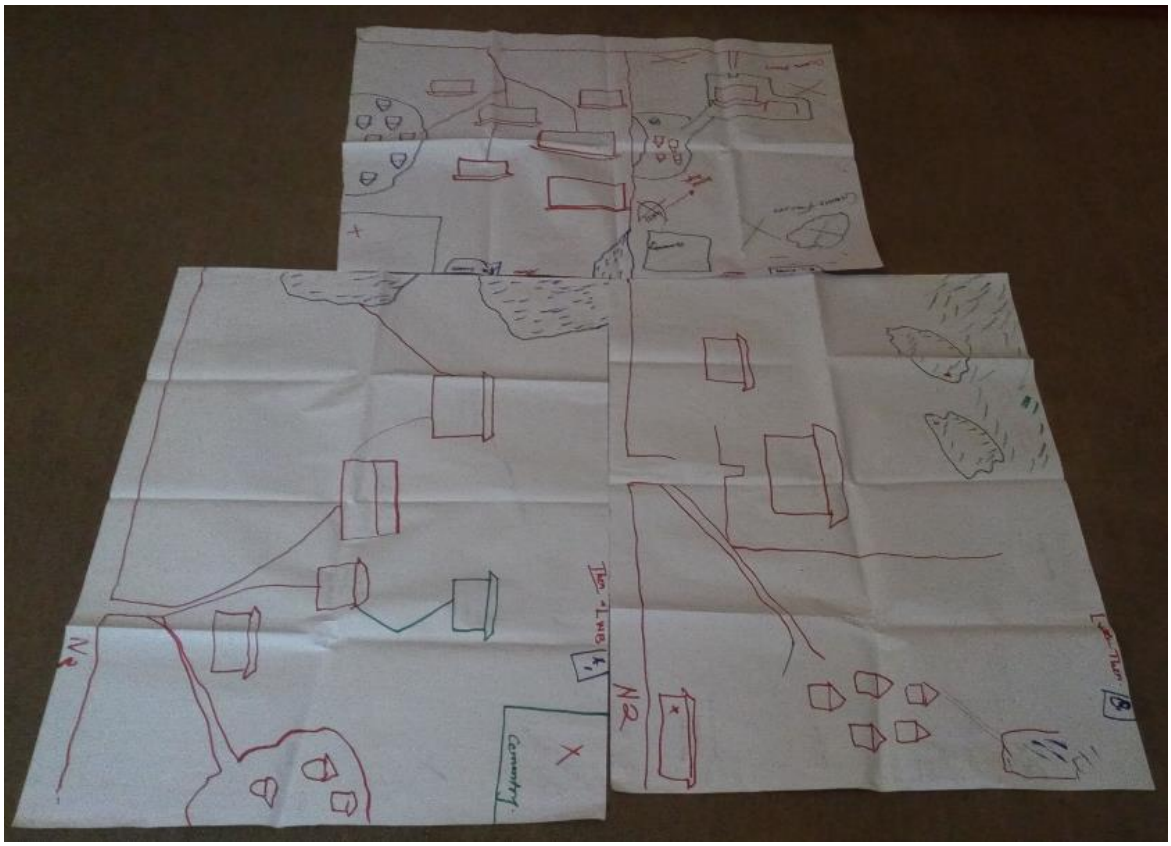
Appendices

Appendix A: Participatory maps sketched by stakeholders from Woodburry and Leeuwenbosch sites.





Appendix B: A study guide for participatory and focus group discussions with farm workers of Amakhala game reserve.

This research work intends to investigate whether land use change can be seen as regime. (A regime shift can be seen as changes in structure and functions of systems, which might come as a shock or occur gradually). Such changes have implications to ecosystems service provision, including direct and indirect services that people rely on for their day to day livelihood options, ranging from firewood, water, food, shelter, education etc. It intends to assess such changes in structure and functions through assessment of ecosystem services, that is, provisioning, cultural and regulatory services, looking at how such changes in the social-ecological system have implications for social, political, economic, cultural and ecological dimensions.

Key guide to this approach

Demographics and introductory information

1. Note number and gender of farm workers
2. How long they have worked in the farm for
3. How many were workers before
4. How many are worker now
5. Note their duties and responsibilities
6. Do they all live in the area? Or where do they live?
7. How did they come to live there?

Mapping the change with farm workers

To understand the change better and have clear map, participants are requested to collectively take part in giving a sketch of the landscape, indicating how it looked like before and then now. In this exercise, mark on the sketch where schools, market centres or stores, churches, roads, rivers, forests/bushlands, farmlands, livestock fields and game areas were located originally. And then on the other sketch, indicate where these facilities are located now. Then from these sketches, pop questions, including;

1. Where did you get the ecosystem services before?
2. How much of these services did you used to get?

Ecosystem service	Example	Where before	Qnty/Qlty
Provisioning	○ Food crops ○ Wood fuel ○ Fodder ○ Livestock ○ Timber ○ Wild animals and wild plant products ○ Freshwater		
Cultural	○ Cultural identity ○ Aesthetics ○ Trophy hunting ○ Knowledge and Education ○ Ecotourism ○ Recreation ○ Spiritual and religious values ○ Others (specify)		
Regulatory	○ Air quality regulation ○ Climate regulation ○ Water purification ○ Regulation of soil erosion ○ Pest & disease regulation ○ Pollination ○ Natural hazard regulation		

3. Where do you get them now?
4. How much do you get now?

Ecosystem service	Example	Where now	Qnty/Qlty
Provisioning	○ Food crops ○ Wood fuel ○ Fodder		

	○ Livestock ○ Timber ○ Wild animals and wild plant products ○ Freshwater		
Cultural	○ Cultural identity ○ Aesthetics ○ Trophy hunting ○ Knowledge and Education ○ Ecotourism ○ Recreation ○ Spiritual and religious values ○ Others (specify)		
Regulatory	○ Air quality regulation ○ Climate regulation ○ Water purification ○ Regulation of soil erosion ○ Pest & disease regulation ○ Pollination ○ Natural hazard regulation		

5. What are the drivers of the changes in ecosystem services witnessed? (could be perceived driver and actual drivers)
6. How has these changes impacted you/your human well-being? (probe using the guide list)

Aspects of well-being	**Increased**	**Neutral**	**Decreased**
Food & nutrition			
Health			
Livelihood & economic activities			
Security of housing			
Job security			

Household income			
Cultural identity			
Social conflicts			
Family life/family ties			
Land tenure security			
Household property ownership			
Life style			
Religion/spiritual values			
Others (specify)			

7. What do you think can be done to make the situation better or improve your well-being? (participants are encouraged to be open as possible and give a range of interventions strategies they think might work for them).

Appendix C: Landsat images used to generate vegetation classes