

The assessment of abandoned cultivated lands: A case study of Lower Tsitsana and Hlankomo villages in the Tsitsa River catchment, Eastern Cape, South Africa

By

Regina Nokufa Dakie

Supervisor: Dr Alta De Vos

Co-supervisors: Dr Sukhmani Mantel and Dr Bukho Gusha

A thesis submitted in the fulfilment of the requirements for the degree of

Master of Science in Environmental Science

October 2024

Table of Contents

List of Figures	3
List of tables.....	4
ACKNOWLEDGEMENTS	5
ABSTRACT.....	6
CHAPTER 1: INTRODUCTION	8
1.1 Drivers of cultivated land abandonment.....	8
1.2 Consequences of Cultivated Land Abandonment	11
1.3 Trade-offs of abandoned cultivated lands and exploring alternative land use following abandonment.	13
1.4 The interrelations of cultivated land abandonment and land degradation.	14
1.5 Abandoned cultivated lands as a complex social-ecological system.....	15
CHAPTER 2: CONCEPTUAL FRAMEWORK AND STUDY SITE	19
2.1. Conceptual Framework.....	19
2.2. Study Site.....	21
3.1 Data collection.....	31
3.2 Analysis.....	44
CHAPTER 4: RESULTS	46
4.1 Socio-demographic characteristics of the respondents	46
4.2 Thesis objective 1: To what extent has land abandonment emerged as a focal action situation in these two villages?	46
4.3 Thesis objective 2: What interactions shaped the emergence of current levels of land abandonment (focal action situation?	49
4.4 Thesis objective 3: What impacts resulted from the current action situation for people (actors), resource units and resource systems (grass, soil, biodiversity, and ecosystem health)?.....	51
4.5 Thesis objective 4: What future outcomes (future focal action situations) are desired with regards to abandoned cultivated lands, and how do current conditions in resource and governance systems constrain or enable that?.....	59
CHAPTER 5: DISCUSSION.....	65
5.1 The extent that land abandonment has emerged as a focal action situation in these two villages.	65
5.2 Interactions that shaped the emergence of current levels of land abandonment (focal action situation).....	68
5.3 Impacts resulting from the current action situation for people (actors), resource units and resource systems (grass, soil, biodiversity, and ecosystem health)	71
5.4 The future outcomes (future focal action situations) desired with regards to abandoned cultivated lands, and how do current conditions in resource and governance systems constrain or enable that? 82.....	74
CHAPTER 6: CONCLUSION	78

CITED LITERATURE.....	80
APPENDIX A.....	92

List of Figures

Figure 2.1: Conceptual framework of social-ecological systems, framework re-drawn from McGinnis and Ostrom’s framework 2014.....	19
Figure 2.2: McGinnis’ and Ostrom’s framework applied to Lower Tsitsana and Hlankomo showing examples of resource systems, actors, governance systems, resources units.....	20
Figure 2.3: The Tsitsa River catchment with the selected study sites shown in the quaternary catchment T35A.....	21
Figure 2.4: A close-up of the selected sites of Hlankomo and Lower Tsitsana in T35A.....	22
Figure 2.5: A timeline of Significant events in South Africa that could have contributed to the changes in land use/land cover.....	25
Figure 2.6: The local governance structure in the traditional villages of Hlankomo and Lower Tsitsana. The Figure is adapted from the Green Village Project report by Rowntree et al., 2018, p 42.....	28
Figure 3.1: Study area map showing T35A-E quaternary catchment.....	31
Figure 3.2: The polygons showing land that was under cultivation in 1966.....	36
Figure 3.3: The polygons showing land that was under cultivation in 2003.....	36
Figure 3.4: The polygons showing land that was under cultivation in 2015.....	37
Figure 3.5: Schematic diagram of the Rapid assessment and grass species data collection.....	44
Figure 4.1: Different periods the local people reported as the time they stopped cultivating in Hlankomo and Lower Tsitsana. This plot shows that more respondents stated that they had abandoned cultivation in the 1990s, followed by the 1980s, 2000s and 1970s, respectively.....	47
Figure 4.2: The total areas (Hectares) under cultivation in the different years 1966,2003 and 2015) for Hlankomo and Lower Tsitsana.....	48
Figure 4.3: The home gardens in the villages in 2033 after cultivated land abandonment.....	48
Figure 4.4: Percentage covers for the different vegetation types found in the abandoned fields of Hlankomo and Lower Tsitsana. The box plot shows that grasses (IQR=25) were the most dominant compared to other vegetation covers. Large shrubs (IQR=0), dwarf shrubs (IQR=0) and succulents (IQR=0) were the least appearing.....	51
Figure 4.5: Weeds, bush encroachment and alien invasive plants in abandoned lands of Hlankomo and Lower Tsitsana. The box plot shows that alien invasive plants (IQR=20) was the most dominant, followed by weeds (IQR=5) and bush encroachment (IQR=0), respectively.....	52
Figure 4.6: Degradation types detected using Rapid Assessment test in Hlankomo and Lower Tsitsana.....	53
Figure 4.7: The abundance values for the different grass grazing statuses. The box and whisker plot shows that increaser III species were the most dominant grass species, while Decreaser species were the least appearing In Hlankomo and Lower Tsitsana.....	54
Figure 4.8: Abundance representing the different grazing values for the grass species in abandoned lands of Hlankomo and Lower Tsitsana. The box and whisker plot shows more grass species with low grazing (IQR=17.2) values than those with average (IQR=0.9) and high (IQR=4.8) grazing values.....	55
Figure 4.9: Life forms presented as mean abundance for the different grass species in Hlankomo and Lower Tsitsana. The box and whisker plot shows that there were more perennial grass species (IQR=10) than weak perennials (IQR=6) and creeping (IQR=0) grass species.....	56
Figure 4.10: Plant successions presented as mean abundance values for grass species found in Hlankomo and Lower Tsitsana. The box and whisker plot shows more Climax grass species (IQR=10.8) followed by Sub-climax (IQR=10.5), Sub-climax and Climax (IQR=1.4), Pioneer (IQR = 0.8) and Common weed (IQR=0) grass species.....	57

List of tables

Table 3.1: Variables measured in the rapid assessment and how they were measured	39
Table 4.1: Identified themes, their proportions, and illustrative quotes emerging from the interview questions “drivers of cultivated land abandonment”	50
Table 4.2: Identified themes, their proportions, and illustrative quotes emerging from the interview questions “consequences of cultivated land abandonment”	58
Table 4.3: Identified themes, their proportions, and illustrative quotes emerging from the interview questions: “Do you have cultivated lands, and are you still ploughing those fields?	59
Table 4.4: Identified themes, their proportions, and illustrative quotes emerging from the interview questions “what, other possible land use.”	61
Table 4.5: Identify themes, their proportions, and illustrative quotes emerging from the interview questions “How many people are interested in recultivation, and what are the benefits of cultivating?”	62
Table 4.6: The social-ecological considerations according to the desired future actions of the locals.....	63

ACKNOWLEDGEMENTS

I am grateful to God for His guidance. Special thanks to my supervisors, Dr Alta De Vos, Dr Sukhmani Mantel, and Dr Bukho Gusha, for their continuous support from the beginning to the completion of my master's journey. I extend my appreciation to the National Research Fund and the Water Research Commission for their financial assistance. Thanks to Mr. Kamva Zenani for accompanying me to the field and aiding in data translation and to Ms. Thantazwa for transcribing my data. Heartfelt thanks to my family, my mom, Julia Malebatso, my aunt Ntombizanele Dakie, and my siblings, Kamohelo Malebatso and Lebohang Dakie for their unwavering support and belief in my dreams. Lastly, I want to express my gratitude to friends Papama Yose, Kwanele Siyengo, Philisa Dunyana, Seipati Kabura, Mannuku Moroane, and Bongile Nkolonzi for their unwavering support throughout this challenging journey. Special acknowledgement to Papama Yose for consistently walking me home during late departmental work, making the journey bearable. I genuinely appreciate your friendship; you've been a crucial part of my success.

ABSTRACT

Globally, agriculture is an essential part of people's livelihoods, contributing to rural economies and food security. However, cultivated land abandonment, the intentional or unintentional cessation of agricultural activities for takeover by other land uses, is becoming increasingly common. Although widely studied, the outcomes of cultivated land abandonment are highly context-dependent and varied. Understanding this phenomenon would thus benefit from placed-based social-ecological case study perspectives, particularly in more understudied contexts.

This study represents such a perspective, taking a social-ecological approach to understand how land abandonment has emerged and what its consequences are for the desired future outcomes in the Hlankomo and Lower Tsitsana villages in the Tsitsa River catchment. Drawing on McGinnis & Ostrom's (2009) framework, I framed cultivated land abandonment in my study area as a "focal action situation" informed by the interaction of natural resource systems, governance systems, actors, and resource units. To better understand the current state of the natural resource system and important ecological (resource) units (grass), I used two measures of ecological condition: a rapid assessment test that provided a broad, if superficial, understanding of degradation and land condition, and a veld condition assessment that provided an understanding of grassland composition and quality in abandoned fields. I also used aerial photographs to assess the extent of changes in abandoned cultivation in the catchment. To understand actors, governance systems, how they interacted with natural resource systems and units for land abandonment to emerge, and what implications these interactions may have for the future of these lands, I used semi-structured interviews. The Rapid Assessment Test tool showed that the abandoned cultivated fields were dominated by grasses (58.3%), while shrubs (11%) and succulents (11%) were the least prevalent. The veld assessment identified sixteen grass species in both villages, with *Aristida junciformis* (23%) and *Eragrostis plana* (22.2 %) being the most dominant. The grazing statuses of the grasses showed that there were more Increaser II species, followed by Increaser III, Exotic, Increaser I and Decreaser species, respectively. There were more grass species with low grazing and average grazing values than grass species with high grazing values. The Rapid Assessment tool and the Veld assessment showed that the fields were dominated by poor grass species that grow on degraded lands. The results thus showed that the abandoned cultivated lands are degraded and in poor condition, as they are covered mainly by poor grass species that are dominant in over-utilised and overgrazed areas. The aerial photographs showed a decline in cultivated lands from 1966 to 2015, with a significant decline between 1966 and 2003. The land under cultivation between 1966 and 2003

decreased by 95 %, resulting in an annual decline of 2.56 %. The land under cultivation from 2003 and 2015 decreased by 60 %, resulting in a decline of 4 % per year.

Local people corroborated the increase in cultivated land abandonment in the interviews, and this is why I attempt to understand why abandoned cultivated land happened (how the resource system and governance systems/actors interacted to shape cultivated land abandonment). As in other South African rural contexts, reasons people gave for land cultivation abandonment revealed the strongly intertwined nature of ecological and social systems, including no fence, livestock eating crops, no cattle, lack of labour, migration, lack of resources (money and equipment), parents passing on, expensive fertilizers, rainfall variability, dependency on grants, lack of interest and laziness. People had different views about the future of the abandoned cultivated lands, suggesting building homes, recreational parks, poultry farms, and recultivating and livestock protection camps, while others indicated that they didn't care what happens to the abandoned fields. Many people still value abandoned lands and would prefer for the land to be recultivated, but they are held back by factors beyond their control, such as no fencing and a lack of governmental support in the form of fertilisers and machinery for ploughing. Additionally, our ecological results suggest that, due to the degraded states of these lands, significant rehabilitation would be required to realize these desired outcomes. Overall, this study shows the social-ecological complexity that drives cultivated land abandonment in the Tsitsa River catchment, providing a context-specific understanding of the drivers and consequences of abandoned cultivated land, future options more specific to these villages, and the broader Tsitsa catchment. At the same time, my study also corroborates similar studies in rural African and other global South contexts, thus supporting generalizable knowledge that can be used in the development of agrarian, social and environmental policies in these regions.

Keywords: Cultivated lands, Grass species, Local perceptions, Aerial photographs

CHAPTER 1: INTRODUCTION

Many people in rural and urban areas depend on agriculture for income generation and food production (Kuntz et al., 2018; Prishchepov, 2020; Shackleton et al., 2013; Christian et al., 2020). However, agricultural activities are declining worldwide, as seen through increased cultivated land abandonment (Leal Filho et al., 2017; Kuntz et al., 2018; Prishchepov, 2020, Jewitt et al., 2015). The United Nations Food and Agriculture Organisation (FAO) defines land abandonment as the cessation of farming and giving away land for nature without signs of management for at least four years (Prishchepov, 2020), but other definitions include the possibility of cultivated land being replaced with land-use activities such as forestry, tourism, and land game reserve development (Cocuccioni., 2018).

Cultivated land abandonment is a land use change that encompasses complex and multifaceted processes (van der Zanden et al., 2017; Munroe et al., 2013; Masiza et al., 2023) and is observed in many parts of the world, especially in marginal and rural areas (Khanal and Watanabe, 2006; Prishchepov et al., 2012; Shackleton et al., 2013; Blair et al., 2018; Chaudhary et al., 2020; Jewitt et al., 2015). It is a phenomenon that affects both the environment and societies living in these environments through the interconnectedness of its social, technological, environmental, and economic factors (Prishchepov et al., 2012; Shackleton et al., 2013; Blair et al., 2018).

1.1 Drivers of cultivated land abandonment

Drivers of land abandonment vary within countries and from region to region (Khanal and Watanabe, 2006; Prishchepov et al., 2012; Shackleton et al., 2013; Blair et al., 2018; Chaudhary et al., 2020). Cultivated land abandonment drivers are often divided into ecological and socioeconomic drivers (Prishchepov, 2020; Shackleton et al., 2019; Ustaoglu & Collier, 2018; Zhou et al., 2020). The socioeconomic drivers may include factors such as market changes, population dynamics, land tenure systems, and industrialization (Prishchepov et al., 2020; Smaliychuk et al., 2016; Blair et al., 2018; Christian et al., 2020; Chen & Xie, 2021). Ecological drivers refer to factors related to biophysical factors which may limit agricultural activities. Ecological drivers include slope, aspect, elevation, soil fertility, soil erosion, and climate change, resulting in long dry spells, limited water availability, and prolonged droughts (Benayas et al., 2007; Chen & Xie, 2021; Cramer et al., 2008; Chaudhary et al., 2020).

In Eastern Europe, the collapse of the Soviet Union led to the government privatizing public agricultural land and giving it to people who did not have an interest and experience in managing

agricultural lands, and that, combined with decreased government subsidies for agriculture, led to many agricultural lands failing and ultimately being abandoned (Prishchepov, 2012, 2020). In China, the driving forces of cultivated land abandonment include policy changes (e.g. environmental protection that led to afforestation of previously cultivated areas), employment (migration of youth to urban centres for better work), land degradation (lost soil productivity), increase in construction for housing, agricultural structure adjustments (e.g. shifts away from grain-pig farming) and sea level rise (Cao et al., 2013; Li & Li., 2017). In Latin America, the forces driving change in cultivated lands were reported to be related to migration and land reform policies (Ramankutty & Coomes, 2016). The restitution of land back to owners who had relocated to cities and had limited interest in agriculture also led to the abandonment of the cultivated land in the Baltics, Europe (Prishchepov et al., 2012).

Although cultivated land is well-studied in Europe, Asia and America, there has been a growing interest in cultivated land abandonment in African countries (Blair et al., 2018; Bavorova, 2023; Olsen et al., 2021). The drivers of cultivated land abandonment vary in African countries and regions. For example, In Ghana, cultivated land abandonment was reported to be driven by the size of the farm and the distance to the nearest farmland (Bavorova, 2023). In South Sudan, cultivated land abandonment was driven by armed conflicts that caused the displacement of the population, leading to the abandonment of the cultivated lands (Olsen et al., 2021).

In South Africa, where this study is situated, political and socio-economic shifts greatly influenced the changes in cultivated lands nationally (Niedertscheider et al., 2012). The three most significant developments which influenced land use systems in South Africa are the Green Revolution, political shifts, and the opening of democracy (Niedertscheider et al., 2012). The Green Revolution is the period in which there was a significant increase in agricultural production using high-yielding variety crops (wheat and rice), increased area under cultivation, increased use of fertilisers and pesticides, double cropping, and improved irrigation techniques in developing countries (John & Babu, 2021). The first green revolution in the early 1960s allowed for expanding agricultural activities in marginal areas through governmental subsidies, resulting in increased agricultural activities (Niedertscheider et al., 2012). The modernization of farming activities increased, resulting in the increased use of agricultural machinery, replacing draft animals. The second influencer of changes in agricultural activities was the political and economic crisis of Apartheid. The Native Land Act of 1913, the Land and Trust Act of 1936 and the Group Area Act of 1950 of the apartheid era endorsed the uneven distribution of land in

South Africa which resulted in relocation of black people in overcrowded homelands and redistribution of their land to white commercial farmers through subsidies. The Native Land Act limited black ownership of land to 7 % and later 13 % through the Native Land and Trust Act of 1936. The political state of South Africa from 1979 to 1994 resulted in slow economic growth and stagnant agricultural development, resulting in decreased land use efficiency (Niedertscheider et al., 2012). Niedertscheider et al. (2012) report that from 1980 to 1995, the period of agricultural growth stopped, and this was linked to the increased population growth and the inability of South Africa to sustain itself during the two periods of significant droughts (1982 and 1992). The third influence was the opening of democracy in the early 1990s. From the early 1990s, agricultural activities increased again but were shortly outgrown by the rise in population, which meant food had to be imported, and the agricultural land kept declining (Lidzhegu et al., 2012; Niedertscheider et al., 2012). The decline in cropland was attributed to the aftermath of the apartheid crisis, which resulted in complex trading systems and insufficient programs to improve rural development (Lidzhegu et al., 2012; Niedertscheider et al., 2012). The different political shifts and socio-economic shifts were prevalent at different times, and they had different influences on cultivated land abandonment. The green revolution had a positive influence on cultivation through using high-yielding variety crops (wheat and rice), increased area under cultivation, increased use of fertilisers and pesticides. The apartheid era had a bad influence on small holder farmers due to promotion of labour migration (Lester, 2000). The opening up of democracy perpetuated cultivated land abandonment through the halt of governments agricultural support and increase social grants. The political history and land reform shift in South Africa resulted in socioeconomic factors greatly influencing the abandonment of cultivated land instead of environmental issues (Shackleton et al., 2013; Shackleton et al., 2019; Blair et al., 2018).

In South Africa's Eastern Cape, studies have shown that the complex drivers of cultivated land abandonment are primarily socioeconomic as opposed to ecological (Blair et al., 2018; Shackleton et al., 2013; Christian et al., 2020). These socioeconomic drivers include industrialization, insufficient governmental support, and land tenure changes (Lester, 2000; Simon and Ramutsindela, 2000). For example, democracy came with many changes, where people could now freely move from one area to the other without consequences, unlike in the past, leading to more people moving from rural areas to more developed towns in search of better job opportunities (Rowntree et al., 2018; Shackleton et al., 2013). Industrialization also led to more jobs outside the agricultural sector, resulting in limited labour for farming activities, hence

abandonment (Lester, 2000). Access to social grants might have also contributed to people leaving cultivation as they could now purchase food from supermarkets using their grants (Shackleton et al., 2019). The halt in the government's agricultural support also played a role in the abandonment of cultivated lands. For example, the loss of cattle was seen to have played a significant role in the abandonment of cultivated lands in Kwazulu Natal, Lebowa, Venda, Transkei, and the Wild Coast (Shackleton et al., 2013; Blair et al., 2018). The loss of cattle may be attributed to the withdrawal of government agricultural support services and veterinary assistance after democracy. Although there are similarities in the drivers of cultivated land abandonment across different regions, some authors mentioned drivers that were not mentioned by others, showing that the drivers of abandonment are context-specific and vary from region to region and often lead to consequences that may also vary between countries and from region to region (Blair et al., 2018; Shackleton et al., 2019; Shackleton et al., 2013).

1.2 Consequences of Cultivated Land Abandonment

Cultivated land abandonment affects the ecosystem goods and services and leads to land use changes, which may alter agricultural landscapes and livelihoods (Chen & Xie, 2021; Shackleton et al., 2013; Blair et al., 2018; Chaudhary et al., 2020). The consequences of cultivated land abandonment are context-specific and depend on the extent and type of agriculture the locals are involved in, including whether they were cultivating for selling or household consumption (Ojha et al., 2017; KC and Race., 2020). The impacts of cultivated land abandonment can be socioeconomic or environmental, depending on the history of agricultural activities in a particular area at a specific time (Chaudhary et al., 2020).

Socioeconomic consequences may include a decline in agricultural income, shortage of food, dependency on non-agricultural income, and increased poverty (Blair et al., 2018; Chaudhary et al., 2020; Shackleton et al., 2013; Masiza et al., 2023). The abandonment of cultivated land may also lead to heritage and cultural displacement depending on how people relate to the abandoned lands, which may lead to people feeling like they have lost a sense of belonging and their long-standing cultural practice of cultivating the land (Couccoccini, 2018; Chaudary et al., 2020; van der Zanden et al., 2017). Economically, abandoned land may jeopardize food security and increase the need for food imports (Yu & Lu, 2006). The decline in income from agricultural activities may lead to increased criminal activities as people may resort to crime in trying to put bread on the table (Shackleton et al., 2019). Another consequence of cultivated land abandonment is that

the urban areas can be under pressure and over-populated by people migrating from rural areas to urban areas for better job opportunities, resulting in overwhelmed resources and failing infrastructures in urban areas (Blair et al., 2018; Kuntz et al., 2018).

Ecological consequences depend strongly on the area's land use, land cover, context, and historical agricultural activities (Leal Filho et al., 2017). These consequences may include biodiversity change, changes in carbon sequestration, hydrological processes, and ecosystem services (Beyanas et al., 2007; Shackleton et al., 2013; Wilcox, 2010). The ecological consequences of cultivated land abandonment may be divided into negative and positive (Beyanas et al., 2007; Leal Filho et al., 2016). The negative consequences may include reduced biodiversity heterogeneity and vegetation homogenization, soil erosion and alteration of ecosystem processes, and promotion of invasive alien species (Beyanas et al., 2007; Leal Filho et al., 2016; Cramer et al., 2008). The positive consequences of cultivated land abandonment may include increased carbon sequestration, nutrient cycling of the soil, and reduced chemicals in places previously managed with chemicals (Beyanas et al., 2007; Munroe et al., 2013). Studies have shown that after abandonment, the land can be used for other purposes such as rewilding, rangelands, reforestation, or recultivation in areas with potential to still cultivate (Blair et al., 2018; Chen & Xie, 2021; Li & Li, 2017; Pointereau et al., 2008; Prishchepov et al., 2012; Shackleton et al., 2013; van der Zanden et al., 2017). Studies have shown that in most communal areas, when the land is abandoned, it is primarily used for livestock grazing (Bennett & Barrett, 2007; Bennett et al., 2007; Moyo and Ravhuhali., 2022). Unused arable land effectively becomes an extension of grazing land either formally or informally and this can be seen as land use change from cultivated land to rangelands. It is, therefore, important to note that what we may see as cultivated land abandonment may sometimes change from one land use to another. Andrew and Fox. (2004) also argues that the decrease in cultivated lands may not be a complete cessation of cropping but a shift towards intensification where farmers use home gardens to intercrop maize with other food crops, which could be interpreted as land use change from cultivated lands to home gardens.

What land may be used for after abandonment depends on the size and the ecological state of the abandoned land and the perspectives/wishes of the local people in the area (Smaliychuk et al., 2016; Blair et al., 2018; Couccoccini, 2020; Kuntz et al., 2018). Studies have shown that the abandonment of the land often changes how local people relate to the land, which has implications for their livelihoods (Munroe et al., 2013; Sibiya et al., 2023). When the land is

abandoned, it often leaves communities in despair as they can't get the ecosystem services they used to get from the cultivated lands (Shackleton et al., 2013; Blair et al., 2018). Sometimes, the communities are left in poverty and hunger, resulting in increased crime (Shackleton et al., 2013). Other consequences of cultivated land abandonment may be related to the ecological implications, such as the vulnerability of abandoned lands to invasive alien species and increased soil erosion (Scorer et al., 2019; Tarolli et al., 2014). In contrast, when the land is under cultivation, it could reduce species diversity, which may be seen as a negative by some communities as they may see rewilding as a form of nature restoration and a way of bringing back some wild animals into the ecosystem (Couccoccini et al., 2018; Beyanas et al., 2007).

1.3 Trade-offs of abandoned cultivated lands and exploring alternative land use following abandonment.

The impacts of cultivated land abandonment may be positive or negative, making it challenging to decide the best management practices that will benefit both the environment and the societies in a particular area at a specific time (Munroe et al., 2013; Beyanas et al., 2007; van der Zanden et al., 2017). For example, while cultivated land abandonment may reduce fire risk, it may also reduce soil organic carbon (Chen, 2022). Van der Zanden et al. (2017) and Munroe et al. (2013) showed that abandoned cultivated lands might increase carbon sequestration in one area and promote the growth of invasive alien species in another area when they investigated the impacts of abandonment in different areas. Munroe et al. (2013) also state that abandoned cultivated lands may promote the loss of traditional landscape and displacement of rural livelihoods. The different trade-offs of cultivated land abandonment show that this phenomenon is embedded with dynamic interactions, creating complicated feedback that may increase uncertainty on how the land should be used going forward and if the decisions on land management will be beneficial for both the local people and the ecosystem (van der Zanden et al., 2017). These uncertainties may, therefore, influence decisions made around land management. For example, there could be disagreements on whether the land should be recultivated or used for other land uses amongst communities; depending on different ecosystem services, the local communities may benefit from the environment, further increasing the complexity of abandoned cultivated lands. The decision of the local community on what the abandoned land should be used for in the future may also be greatly influenced by the current ecological state of the abandoned fields, further showing the social-ecological complexity of abandoned cultivated lands. If the land is degraded, this may hinder some of the desired prospective land use and lead to demotivation and hopelessness from the locals, increasing rural landscape dysfunctionality.

The positive and negative consequences of cultivated land abandonment also influence how the local communities relate to cultivated lands, influencing their decisions on what should be done with these abandoned lands in the future (van der Zanden et al., 2017; Scorer et al., 2019; Meyfroidt et al., 2016). Studies show that different farmers have differing views on whether these lands should be reused or left for natural vegetation succession (Kuntz et al., 2018; Cocuccioni, 2020). Kuntz et al. (2018) showed that some farmers were happy with the abandonment of cultivated lands as they felt it would allow nature to take its course and promote biodiversity and wildlife. In contrast, other farmers mentioned that they would be happy if the abandoned lands were recultivated as they represent a part of their culture and history, provide a living for them as they can sell agricultural goods and services, and bring pleasing aesthetics to the environment and promote good visuals attractive to outside tourists (Kuntz et al., 2018; Zhou et al., 2020). The trade-offs of the effects of cultivated land abandonment make the topic of land abandonment worth exploring to understand the interplay of drivers and how they create feedback which affects the area's biophysical and social context. Therefore, this phenomenon should be investigated using methods that allow for flexible and iterative management practices to explore different management trajectories which may promote the protection of livelihoods and the environment.

1.4 The interrelations of cultivated land abandonment and land degradation.

Land degradation decreases land productivity, making land less able to support livelihoods (Tarolli et al., 2014). Although agriculture plays a significant role in livelihoods, cultivated land abandonment has been observed all over the world, and this phenomenon seems to have negative implications on land (Tarolli et al., 2014; Scorer et al., 2019 and van der Waal et al., 2018).

Although land degradation is a natural process, it is sometimes anthropogenically exacerbated by agricultural activities that lack conservation and overgrazing (van der Waal et al., 2018; Sibiya et al., 2023). Abandoned land can be a source of erosion and sedimentation. Croplands contribute to land degradation through soil erosion, which may vary according to whether the land is still under cultivation or abandoned (Sibiya et al., 2023). When the land is under cultivation, the soil may be disturbed by tillage, and the aftereffects of that may last up to until the land is no longer being cultivated and, therefore, increase sediment yield, which may increase gully formations (Tarolli et al., 2014). This high sedimentation may affect water availability and ecosystem health through high siltation.

Cultivated lands have been reported to be both the cause and the sign of land degradation (Sibiya et al., 2023; Tarolli et al., 2014). As gullies form on abandoned fields, the more likely the land would be permanently abandoned and act as a source of sediment, increasing the siltation of water bodies and therefore affecting the nearby water bodies, which may affect water availability and water quality in those areas (Tarolli et al., 2014; Sibiya et al., 2023). Cultivated land abandonment may be a sign of land degradation because as the land is degraded, it will be less productive and discourage planting as the local people may see cultivating as unable to generate income and sustain livelihoods. Consequently, this cycle of land abandonment may escalate due to discouragement stemming from diminished soil fertility and nutrients caused by land degradation (Tarolli et al., 2014). Overgrazing may also contribute to land degradation by decreasing the grass cover, further reducing soil nutrients and moisture content, resulting in topsoil loss, which may further increase land degradation. When the soil functionality is disturbed, the gullies will increase, increasing the potential for sedimentation (Tarolli et al., 2014; Sibiya et al., 2023). The disturbed soil structure may also promote the growth of invasive alien species as they grow on previously disturbed lands, which will further increase land degradation and reduce the ecosystem's functionality (Scorer et al., 2019). When the land is degraded, it cannot support agricultural activities, and inappropriate management of agricultural activities could reduce soil productivity and increase soil erosion (Sibiya et al., 2023; Rowntree et al., 2018; Alam et al., 2014).

Land degradation on abandoned cultivated lands is likely to be exacerbated by climate change (Pereira, 2017). Climate change may alter rainfall patterns, resulting in floods in some areas and droughts in others, and these will likely worsen water shortages in already water-stressed areas (Angelo & Plessis, 2017). Climate change will also increase global temperatures, further impacting water resources, affecting crop yields, and promoting the abandonment of cultivated lands (Pereira, 2017). The high rainfall events may wash off the topsoil, increasing soil erosion. At the same time, droughts will reduce water resources and directly impact ecosystem services and food security (Pereira, 2017). However, rehabilitated cultivated lands may support ecosystem functionality and ecosystem services by providing rangelands for livestock and habitat for diverse plants and animal species.

1.5 Abandoned cultivated lands as a complex social-ecological system.

As the discussion thus far suggests, crop abandonment is an emergent outcome of interactions between interacting social and ecological systems and processes. Thus, decisions about

managing abandoned cultivated land would do well to recognise these systems as social-ecological systems, complex adaptive systems where people and nature are intertwined (Biggs et al. 2022; Folke et al. 2016). Social-ecological systems are integrated systems characterized by strong connections and feedback between and within social and ecological components (Biggs et al., 2022). Social-ecological systems have many components that interact with each other and give rise to patterns that cannot be directly predicted from the individual components of the systems (Biggs et al., 2022). These patterns influence the interactions of the different components of the system, creating feedback that further influences how the system will change and adapt over time (Biggs et al., 2022; Folke et al., 2016). The interactions of social-ecological systems are non-linear, meaning small changes in the system may lead to significant consequences and vice versa (Preiser et al., 2018). These systems are also context-specific, and as the context changes, the components of the systems may change and take on different functions, resulting in the system taking on a different context (Levin et al., 2013).

A social-ecological lens allows us to recognise that land abandonment is inherently context-dependent, depending on the history of agricultural activities in a particular area (Chaudhary et al., 2020), as well as the ecosystems and governance systems that supported those activities (Kuntz et al., 2019 and Shackleton et al., 2013). Recognizing cultivated land abandonment as a social-ecological system is important to understand the complexity associated with the interconnections and interactions between social and ecological factors of cultivated land abandonment (Holden et al., 2021). As the people interact with the land by cultivating to produce food, they may interfere with the ecological processes of the land and ecosystem services that can be derived from these lands (Sibiya et al., 2023; Blair et al., 2018). For example, cultivated land abandonment may be viewed as an opportunity for rewilding and giving the environment a chance to recover, while this may be a disadvantage for communities that rely heavily on cultivated lands as a source of food and income (Shackleton et al., 2013; Scorer et al., 2019). For instance, cultivated land abandonment was an enabler for alien plant invasions and poverty (Scorer et al., 2019; Blair et al., 2018). In contrast, Beyanas et al. (2007) found cultivated land abandonment to be good for soil recovery, biodiversity increases and nutrient cycling.

The trade-offs associated with cultivated land abandonment further suggest a social-ecological system that calls for an adaptive system thinking approach (van der Zanden et al., 2017). Such an approach recognises the complex nature of systems. It encourages knowledge creation through transdisciplinary, participatory and multistakeholder processes that engage experts from

different fields and local people to work together towards the development of sustainable management strategies that can improve the ecological health of ecosystems so that they may provide goods and services to the local communities (Preiser et al., 2022; Itzkin et al., 2021).

The Tsitsa project, based in the Tsitsa River catchment, Eastern Cape, South Africa, is one example of a transdisciplinary monitoring and restoration project. The Tsitsa Project is a research praxis that has been going on since 2014 and has been looking at the sustainable restoration of degraded ecological infrastructure in the Tsitsa River Catchment (Itzkin et al., 2021). The project uses a transdisciplinary and complex social-ecological approach, which includes integrating community knowledge and ideas. This systems analysis approach used in the Tsitsa project has shown that land degradation problems result from interrelated biophysical challenges that arise because of the connectivity between social and biophysical factors of the catchment (Itzkin et al., 2021; Cockburn et al., 2018). Cultivated land abandonment was identified as one of the factors contributing to land degradation in the Tsitsa catchment due to increased soil erosion on abandoned lands and the vulnerability of abandoned lands to invasion by alien plant species (Rowntree et al., 2018). Exploring abandoned cultivated lands in the Tsitsa River catchment will help us understand the interactions contributing to cultivated land abandonment, their impacts on the locals and the environment, and future considerations for the abandoned fields. The Tsitsa project has laid a good foundation for this project to come and understand potential options for cultivated land more holistically for better functioning social-ecological systems that can provide goods and services to the communities in the area. This study will contribute to understanding the broader social-ecological system of abandoned cultivated lands, expand knowledge of abandoned cultivated land in South Africa, and add value to the lives of people affected by those abandoned cultivated lands.

Aims and objectives.

In this project, I take a place-based social-ecological systems approach to understanding land abandonment in a context-specific case study, but also a representative example of land abandonment in rural South Africa. My main aim is to understand how land abandonment has emerged and its consequences for the desired future outcomes in Hlankomo and Lower Tsitsana of the Tsitsa River catchment. The Tsitsa River catchment is characterized by land degradation seen through gully formations and high soil erosion. The Tsitsa River catchment also has high cultivated land abandonment, which presents an opportunity for understanding the broader social-ecological context of cultivated land abandonment in Hlankomo and Lower Tsitsana.

I use McGinnis' & Ostrom's 2014 social-ecological system SES framework as a lens through which to investigate this broader question and as a way to organize my study. This framework was developed to diagnose common-pool resource management problems (Biggs et al., 2022). The framework is a collection of social and ecological variables that are relevant for explaining when the resource users can sustainably manage their common resource by successfully self-organizing (Biggs et al., 2022). Through the lens of this framework (described in more detail in Chapter 2), I consider land abandonment (or use of once-cultivated land) an emergent focal action situation that emerged from interactions between resource systems, governance systems, resource units, and actors, as well as interactions with other systems at different scales. To achieve my aim, I ask the following questions:

1. To what extent has land abandonment emerged as a focal action situation in these two villages?
2. What interactions shaped the emergence of current levels of land abandonment (focal action situation)?
3. What impacts resulted from the current action situation for people (actors), resource units and resource systems (grass, soil, biodiversity and ecosystem health)
4. What future outcomes (future focal action situations) are desired with regard to abandoned cultivated lands, and how do current conditions in resource and governance systems constrain or enable that?

I approach these questions through a combination of GIS, interviews with local people and ecological surveys. I use GIS to help triangulate people's perceptions of change in the extent of abandoned cultivated land. I rely on interviews with local knowledge holders to understand the main drivers and interactions that led to current conditions. I investigate current conditions of the resource system through interviews and ecological surveys, particularly focusing on key resource units (soil, grass) and system conditions (degradation) in the case of the latter. I use interviews to understand people's future desires for the system and use the understanding that emerged from investigating my previous questions to comment on potential constraints and options for attaining these goals.

CHAPTER 2: CONCEPTUAL FRAMEWORK AND STUDY SITE

2.1. Conceptual Framework

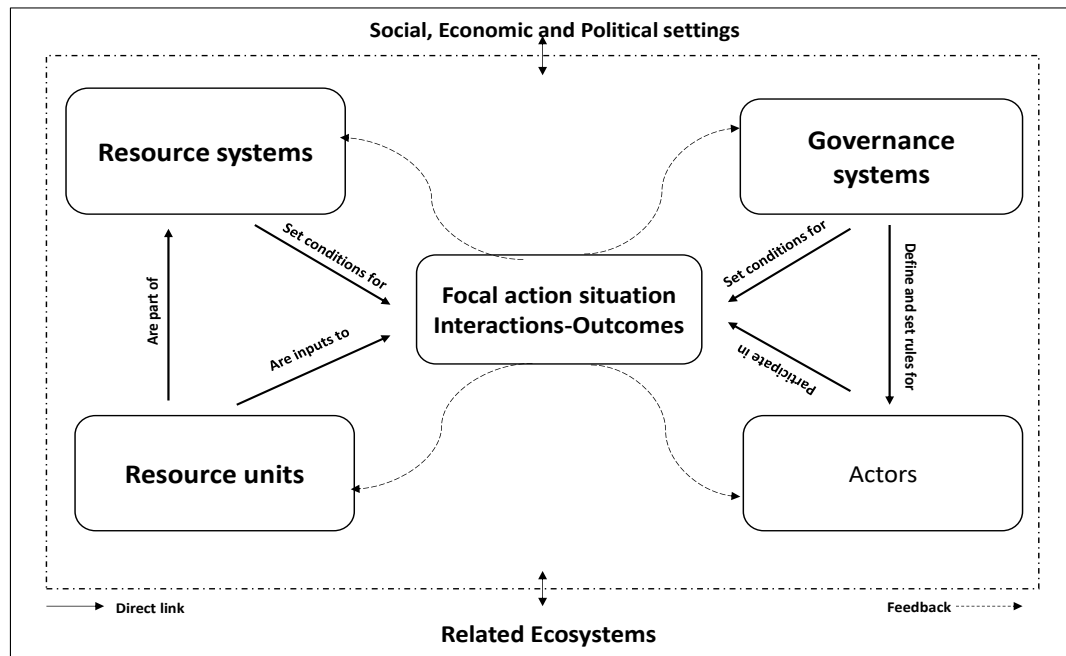


Figure 2.1: Conceptual framework of social-ecological systems, framework re-drawn from McGinnis and Ostrom's framework 2014.

McGinnis' and Ostrom's framework is a modified version of Ostrom's 2007 and 2009 social-ecological system framework. This framework was developed as an explanatory framework for diagnosing common-pool resource management problems (Biggs et al., 2022). The framework is a collection of social and ecological variables that are relevant for explaining when the resource users can sustainably manage their common resource by successfully self-organizing (Biggs et al., 2022). The variables in the framework are organized into four high-level tiers: the resource system, the resource unit, resource governance and resource users (Figure 2.1). The solid boxes in the diagram above denoted the highest tier variables (Resource system, Resource units, Governance systems and Actors) that contain multiple variables at the second and lower tiers (McGinnis & Ostrom, 2014). The centre part (Action situations) is where all the actions happen as the inputs are converted to outputs by the actions of the different actors (Figure 2.1). Feedback occurs from the action situation to each top-tier category (McGinnis & Ostrom, 2014). The focal social-ecological system can be viewed as a logical whole, but the external influences from related social, ecological, economic, and political systems can affect any component of the system (McGinnis & Ostrom, 2014). The external influences may come from the dynamic operation of the processes at a smaller or larger scale than that of the system. The resource

system may be composed of multiple types of resource units. Each governance system has authority over a set of defined actors, and its outcomes effectively define the actors involved and the options available to them (McGinnis & Ostrom, 2014). The framework will help with data collection and analysis by highlighting the variables that may be important for self-organizing.

The conceptual framework for abandoned fields in the Tsitsa River catchment shows that abandoned lands have different factors embedded in them. The resource actors include cultivators, livestock owners, local people, LIMA Rural Development Foundation, ward counsellors and Private landowners. LIMA is a non-governmental and non-profit organization established in 1989 that focuses on a wide range of rural development interventions around South Africa (LIMA Rural Development Foundation, 2022). Some of LIMA’s focus areas involve implementing projects in agriculture, civil engineering, land reform, housing, public health, food security and community-based training (LIMA Rural Development Foundation, 2022). LIMA also acts as a consultant providing administrative, project management and participatory research services (LIMA Rural Development Foundation, 2022). The resources governance system involves the local traditional authority, local municipality, Department of Agriculture and Department of Environmental Affairs. The governance system uses policies to manage cultivated lands, and how they are managed impacts the ecosystem services these cultivated lands and other resource units provide. The resource units involve rivers, rangelands, livestock, forested lands, and natural trees.

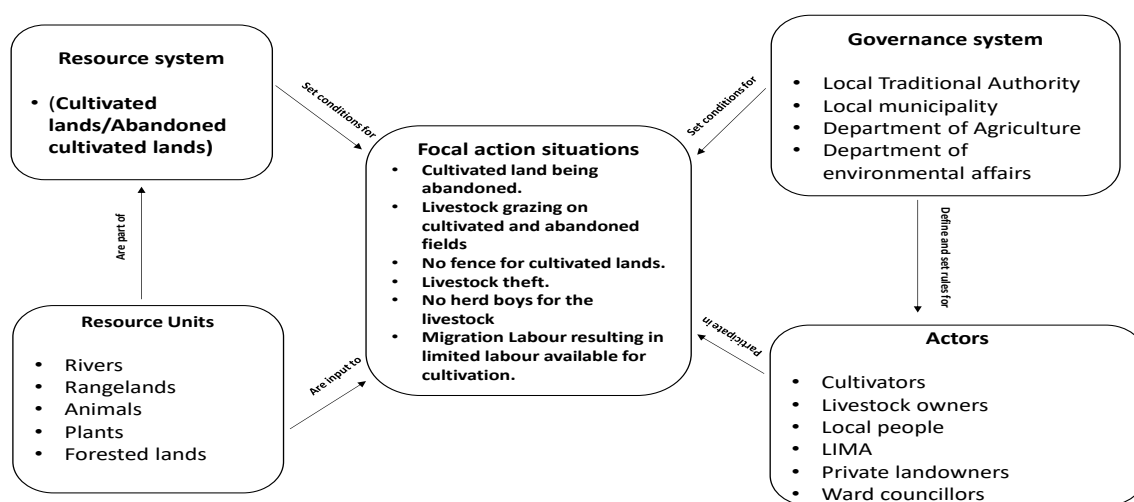


Figure 2.2: McGinnis ‘and Ostrom’s framework applied to Lower Tsitsana and Hlankomo showing examples of resource systems, actors, governance systems, resources units.

2.2. Study Site

Location (Context, Social-Ecological, Economic Settings)

The study was conducted in two villages under traditional leadership, namely, Hlankomo and Lower Tsitsana traditional areas near Maclear town in the Tsitsa River catchment within Elundini Local Municipality in the Joe Gqabi District Municipality of the Eastern Cape Province. Both Hlankomo and Lower Tsitsana lie in the Ntabelenga dam, which comprises five quaternary catchments (T35A-E); Hlankomo and Lower Tsitsana lie in the T35A. The land is owned communally under the Tribal Authority of Lower and Upper Tsitsana and Batlokwa. Hlankomo has an area of 8.24 km² and is located at an elevation of 1393 m asl (Geoview, 2021). Hlankomo has 199 households and a population of 1111 (Census 2011). Lower Tsitsana has an area of 2.64 km² and is located at an elevation of 1394 m asl (Geoview, 2021). Lower Tsitsana has 94 households and a population of 326 people (Census, 2011). The economy is based on commercial farming and urban areas, which employ most people in the agriculture, commercial, and service sectors (<https://www.elundini.org.za>). The communities rely on multiple livelihoods, including cropping and livestock, home gardens, natural products, remittances, and dependency on social grants. The employment rate in rural settlements is low because most people are involved in subsistence activities that produce a little surplus for economic profit.

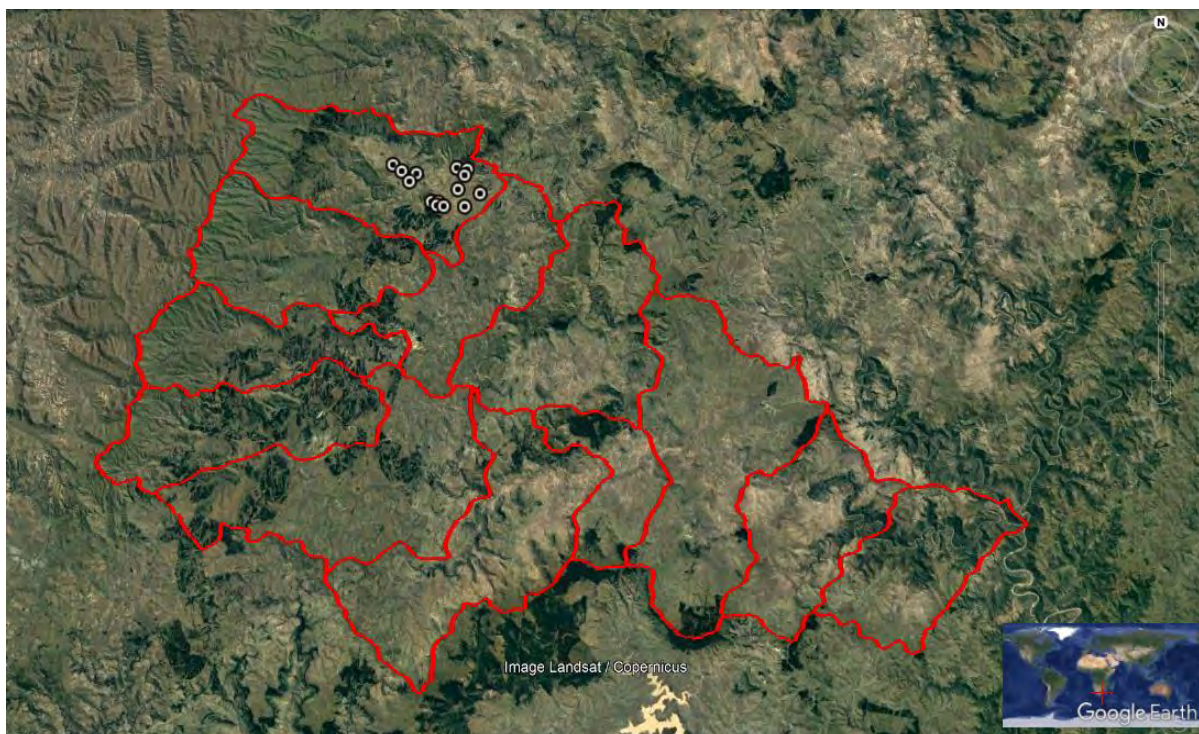


Figure 2.3: The Tsitsa River catchment with the selected study sites shown in the quaternary catchment T35A.



Figure 2.4: A close-up of the selected sites of Hlankomo and Lower Tsitsana in T35A

The biophysical context of the Tsitsa River catchment (Resource Systems and Resource Units) The Tsitsa River catchment covers 2000 km² and is centred around 31° 7' 35.9" S and 28° 40' 30.6" E. The catchment's elevation ranges from 950 m at the catchment outlet to approximately 3000 m at the Drakensberg Mountain (van da Waal et al., 2018). The Tsitsa River takes its source from the Drakensberg, and it's fed mainly by the Mooi, Pot, Tsitsana and upper Tsitsa rivers (van der Waal et al., 2018). The Tsitsa River flows into the Tina River, which flows into the Mzumvubu River. The terrain is complex, with steep mountain tops, gently undulating foot slopes, and almost valley-bottom slopes (van der Waal et al., 2018). The temperatures are warm, with daily winter temperatures of 4°C to 18°C and daily summer temperatures of 12°C to 26°C (Theron et al., 2021). The annual rainfall is about 749 mm, with the lowest (15 mm) average rainfall received in June and the highest (108 mm) in January (Parwada & Van Tol., 2017).

Basic/mafic lavas underlay the upper parts of the catchment, whereas the lower part is underlain by intercalated arenaceous and argillaceous strata (van der Waal et al., 2018). The lower sedimentary sequence consists of the Tarkastad, Molteno, Elliot and Clarens formations (van der Waal et al., 2018). Intrusions of pyroclastic rocks or dolorite dykes can be found through the

catchment. The soil in the catchment varies greatly, but the most dominant soils are poorly drained and shallow to moderately deep loams. Soils from the Molteno, Elliot and Tarkastad formations in the central part of the catchment are associated with duplex soils and are highly erodible with evident gully erosions (van der Waal et al.,2018). The duplex soils in the middle of the catchment are dispersive and easily lose aggregation because of the high absorption of sodium. The central part of the catchment is, therefore, affected by dense and deep gully formations. The land cover is dominated by natural vegetation composed of grasslands, forested lands, and cultivated lands (National Land Cover, 2020; van der Waal et al., 2018). The most dominant grasslands are the Lesotho Highland Basalt Grassland, Southern Drakensberg Highland Grassland, Mthatha Moist Grassland, East Griqualand Grassland, Drakensberg Foothill Moist Grassland and Eastern Valley Bushveld (Rowntree et al., 2018, van der Waal et al., 2018). The main land uses are livestock grazing and home gardens. Following the betterment planning, fields were established on the lower slopes, which have since been abandoned.

Land abandonment in the Tsitsa River catchment

Studies show that cultivation was once widespread in the Tsitsa River catchment but has almost entirely declined with increased home gardens (Rowntree et al., 2018). The main reasons reported for ceasing cultivation are drought, lack of draught power, soil erosion and reduced soil fertility, lack of workforce for ploughing, lack of fencing, lack of access to machinery and tractors and lack of interest in ploughing due to increased access to soil grants (Rowntree et al., 2018). The consequences of cultivated land abandonment in the catchment may include a decline in agricultural income, shortage of food, dependency on non-agricultural income, and eventually increased poverty, biodiversity change, changes in carbon sequestration, hydrological processes, and ecosystem services (Rowntree et al., 2018, Cockburn et al., 2018; Itzkin et al., 2021). The consequences and drivers of cultivated land abandonment show that it's embedded with complexity from how the biophysical factors are affecting the society and how the society is affecting the environment due to the decisions they make around land use and land cover changes, which are mainly influenced by the governance in place within the catchment (Itzkin et al., 2021; Cockburn et al., 2018).

Cultivated land abandonment in the Tsitsa River catchment is a social-ecological system with many components interacting at different spatial and temporal scales (Itzkin et al.,2021). The way these components interact with one another creates feedback processes. The feedbacks are not unidirectional, meaning it's not a simple cause-and-effect process (Biggs *et al.*, 2015).

For example, for some people, the fields offer cultural and traditional norms, so if the fields are no longer there, the local people cannot perform their cultural beliefs, which affects how they relate to the environment (Chaudhary et al., 2020). The local people also rely on cultivated lands for their primary food and fibre, and the fields also provide feed for their livestock (Chaudhary et al., 2020). The abandonment also interferes with knowledge dissemination of cultivation practices, as when they are no longer cultivated, there would be no knowledge passing from the older generation to the younger generation on cultivated land practices (Chaudhary et al., 2020). The lack of knowledge dissemination may further dismantle the functionality of the rural area as the younger generations will start to look for other opportunities outside the agricultural sector and move out of the rural areas, further increasing the rural-urban migration (Shackleton et al., 2019). The management of cultivated lands, which also pours into the overall functionality of the ecosystem, will cease to happen, and this may have negative impacts on the environment as it will not be under any management system, which may result in modification and degradation of rural landscapes, resulting in loss of traditional and cultural norms and loss of the unique identity of the area (Beyanas et al., 2007; Shackleton et al., 2019; Sibiya et al., 2023). Land abandonment should, therefore, be studied through interdisciplinarity and transdisciplinary approaches, which allow for multiple stakeholders, academic experts from different fields and local people to work together towards the development of sustainable management strategies that improve the ecological health of ecosystems so that they may provide goods and services to the local communities (Itzkin et al., 2021).

The social context of the Tsitsa River catchment (Governance Systems and Actors)

In this section, we look into historical political events in South Africa that could have affected the landscape, land use/land cover changes leading to the abandonment of cultivated lands in the Tsitsa River catchment. The drivers of abandoned cultivated lands include biophysical, social, and political drivers. Here, we consider some South African policy drivers that can be considered as the drivers of cultivated land abandonment.

Historical policies and actions under the apartheid regime, such as the separation of the former homeland of Transkei from the Republic of South Africa, restrictions of land ownership by black people and limited investment in education and social grants, impacted the social-ecological landscape of the Tsitsa River catchment, resulting in increased disempowerment, poverty, and changes in land use and landcover within the catchment (Itzkin et al., 2021).

Before democracy

For example, the earlier policies during the apartheid era, such as the Native Land Act of 1913 (Figure 2.5), the Black Authorities Act of 1951 and the Promotion of Black Self Government Act of 1959, greatly influenced the Tsitsa River catchment landscape (Rowntree et al., 2018; Simon and Ramutsindela, 2000; Beinart & Delius, 2014). These policies influenced cultivated lands by separating the Transkei from the Republic of South Africa, laws restricting black people from land ownership, labour migration, which resulted in men being taken to the mines to work, betterment planning, limited investment in education and social grants in the form of pension (Rowntree et al., 2018; Lester, 2000).

A timeline of events that took place in South Africa that could have played a role in the changes of cultivated lands.

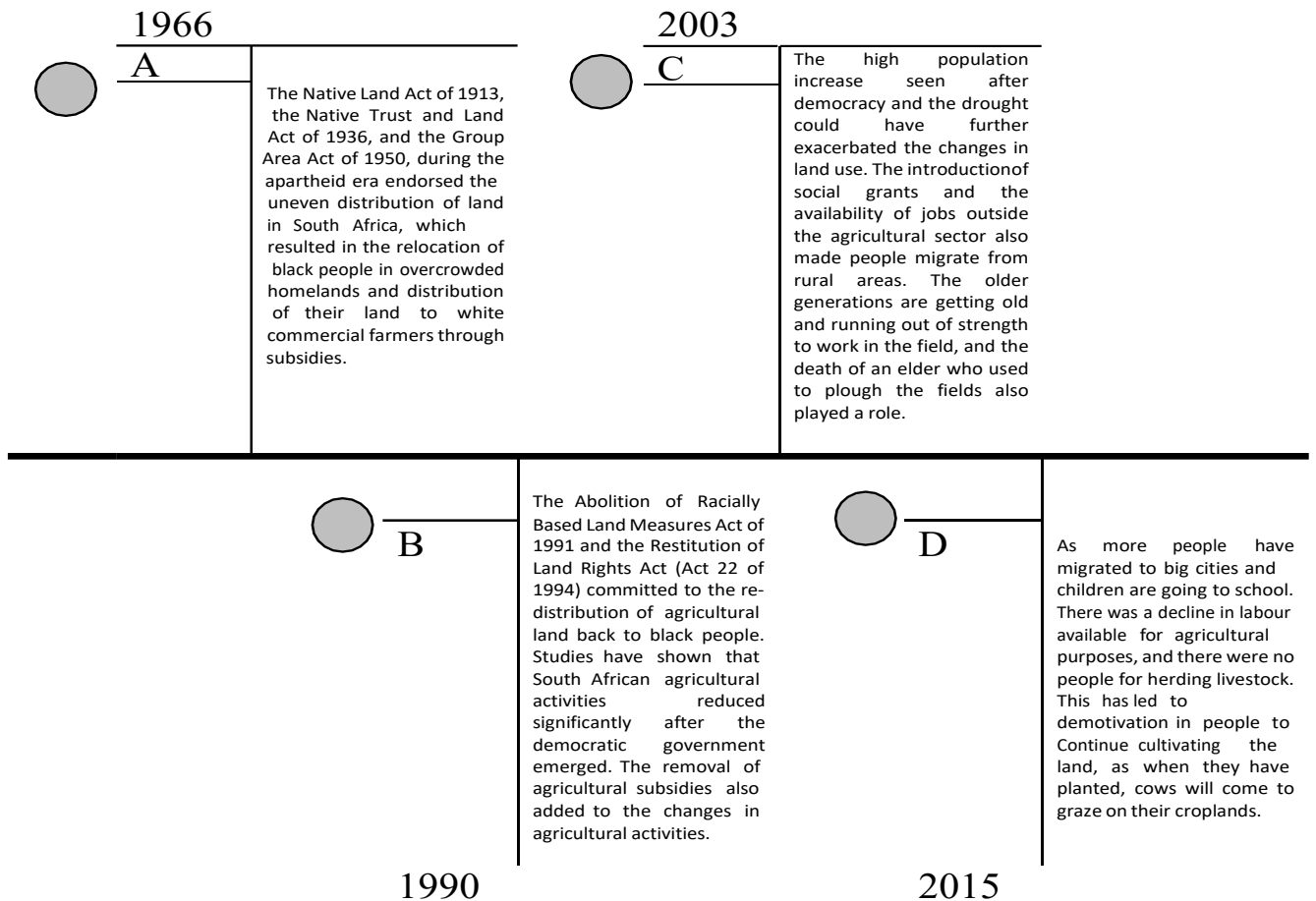


Figure 2.5: A timeline of significant events in South Africa that could have contributed to the changes in land use/land cover.

Urban labour

Men were taken from their villages to work in mines away from home, and influx control meant their wives could not join them (Figure 2.5) (Lester, 2000). The women were left to head the household and carry out farming activities. Men would come back home occasionally to help with farming activities. Cultivation was done with oxen, which required strength and skilled people. Fewer male availability in the villages resulted in fewer planted areas, affecting agricultural labour availability in the Tsitsa catchment (Rowntree et al., 2018; Lester, 2000).

Betterment plan

The betterment plan was introduced in the 1930s with the aim of establishing more sustainable land use patterns by resettling nuclear villages and delimiting land for cultivation and grazing (Rowntree et al., 2018). In Transkei and Ciskei, where the study areas are situated, betterment planning was introduced in the 1960s and in many villages where the betterment planning had happened, it resulted in increased distance between homelands and the new cultivated lands and reduced control over livestock (Letsoalo & Rogerson, 1982). These changes led to people having smaller fields and gardens and having to walk further to find resources such wood, water and thatching grass (De Wet et al., 1987).

Social grants

In 1954, social grants in the form of pensions were introduced for whites and were later extended to black South Africans (Rowntree et al., 2018; Kakembo & Rowntree, 2003). Although the pension provided some financial relief and increased household incomes for families, it reduced reliance on cultivating for food.

Post-democracy

Land tenure systems

The land tenure system in the Tsitsa River catchment hasn't changed despite the land reform policies initiated in the late 1990s. The former Transkei area is still under tribal authorities, while the former Republic of South Africa is still under commercial farmers under white ownership (Rowntree et al., 2018; Itzkin et al., 2021; Simon & Ramutsindela, 2000). The division into communal and private areas of production among black farmers was a significant aspect of land allocation during the colonial period. This system often aimed to control access to land and resources, creating disparities in agricultural productivity and economic opportunities. In the Tsitsa River catchment, these divisions would have likely reinforced

existing inequalities (Simon & Ramutsindela, 2000). The eastern part is more communal, and the western part is by private commercial farms. The communal side of the catchment is held under Tribal authorities, comprising traditional leaders, headmen, and sub-headmen, while the private commercial farms are under white ownership (Figure 2.6). Private commercial farms are characterized by plantations, forestry, and mixed agriculture, including livestock and crop cultivation (Cockburn et al., 2018). Tribal Authorities are generally responsible for determining who farms what land, how the stock is managed, who gets employed on externally funded projects, and the private farmers are self-governing.

Withdrawal of the farmers support programme

The farmer support programme was initiated in the mid-1980s by the Development Bank of South Africa (Deliwe, 1995). The intention was to finance agriculture in the homelands through a loan scheme to improve agricultural production and ultimately improve commercial farming (Deliwe, 1995). The withdrawal of the program led to significant challenges for these farmers. Many faced difficulties in obtaining financing, utilizing resources effectively, and marketing their produce, which contributed to a decline in agricultural activity and, in some cases, abandonment of their fields (Vink et al., 2021).

Freedom of movement

Since 1994, people have had freedom of movement. With this freedom of movement, the women can now join their husbands in cities, and men no longer see a need to return to the villages. The movement of men from the villages meant fewer people were available in the villages to carry out agricultural activities, further reducing areas under cultivation (Rowntree et al., 2018). With the freedom of movement, more learners can join their families in cities for education and access education-driven skills. This further drives the abandonment of cultivated lands as the youth are uninterested in agricultural activities and living in rural areas.

Local governance structures of the Lower Tsitsana and Hlankomo

The land is state-owned but administered through traditional authorities (Figure 2.6). The land is administered by chiefs, who each oversee several headmen who may be responsible for individual villages or a cluster of neighbouring villages (Rowntree et al., 2018). Each headman may have several sub-headmen, and the sub-headmen may represent each village not represented by the headmen (Figure 2.6). The two study sites fall under the Batlokwa (Hlankomo) and Lower and Upper Tsitsana (Lower Tsitsana) tribal authorities (Lunderstedt et al., 2017). The chief has land use and land management authority through a tribal council. The tribal council is made of headmen and several sub-headmen. The household can report their

concerns to the sub-headman, who can deal with them directly or take them higher up in the tribal council (Figure 2.6).

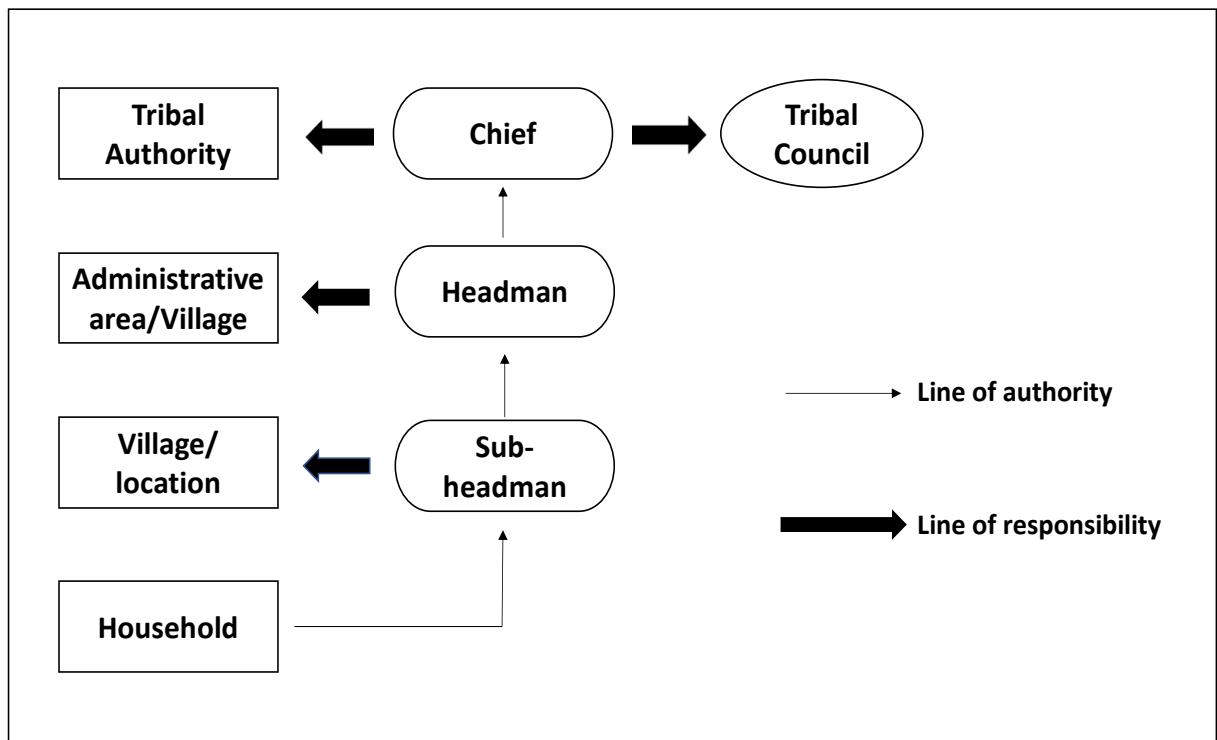


Figure 2.6: The local governance structure in the traditional villages of Hlankomo and Lower Tsitsana. The Figure is adapted from the Green Village Project report by Rowntree et al., 2018, p 42.

Social-ecological linkages in the Tsitsa River Catchment

Social and ecological system interactions in the Tsitsa River catchment are closely linked. Social and ecological functioning influence socio-economic activities, and socio-economic factors influence land use and land cover.

The Tsitsa River catchment is characterized by steep topography, variable rainfall, and high soil erodibility, reducing dependence on agriculture and fuelling poverty (Itzkin et al., 2021). The unreliable rainy seasons influence when people can plant and if their crops will mature (Theron et al., 2021). Heavy rainfall on land with low vegetation cover may increase soil erosion, and the high runoff may destroy agricultural development. Degraded soil and limited access to resources such as water and tractors make agriculture/cultivation difficult for subsistence farmers, further influencing their cash income (Rowntree et al., 2018). Land degradation in the form of encroachment by woody vegetation, invasion of wattle and reduced abundance of

palatable grass in the catchment also reduces grazing productivity of the land, resulting in reduced numbers of livestock, which may result in low cash income from livestock sales.

The shift to democracy has been perceived to break down the local governance structures, increasing theft of livestock and fences, leading to the discontinuation of cultivation in the Tsitsa River catchment (Rowntree et al., 2018). The breakdown of local government structures leads to a lack of control over resource use. Livestock is free to roam, and there are few controls on bush burning and over-harvesting of fuel wood, all of which may lead to vegetation cover degradation and increase soil erosion that will contribute to land degradation (Rowntree et al., 2018). With this landscape degradation, local communities may be vulnerable to poverty due to the inability to support themselves from the landscape.

The democratic era came with many changes, including freedom of movement, access to social grants and increased school attendance. The freedom of movement has increased rural-urban migration, reducing the population of communal lands as women could now join their husbands and young people could search for better employment and education opportunities in cities, further contributing to the abandonment of cultivated lands (Rowntree et al., 2018, Blair et al., et al., 2018). The movement between large and small cities increases young people's disinterest in agricultural activities, as they view city life and formal employment as more desirable than labour-intensive agricultural activities (Shackleton et al., 2013; Shackleton et al., 2019). Access to social grants and labour migration also played a role in abandonment by increasing dependence on wages/ remittances, which have reduced the dependence of local communities on farming, resulting in the abandonment of cultivated lands (Blair et al., 2018). The increase in school attendance took young men from livestock herding duties, reducing labour for agricultural activities, and further perpetuating cultivated land abandonment (Rowntree et al., 2018). The high unemployment rate and poverty in the catchment may reduce people's ability to buy agricultural input, which decreases agricultural viability and further increases the disuse of cultivated lands, promoting grazing on abandoned fields and decreasing vegetation cover. The decrease in vegetation will further impact livestock productivity through damaged stock quality, which may lead to livestock deaths (van der Waal et al., 2018; Rowntree et al., 2018) and thus affect livelihoods as livestock is seen as a source of food and income, as well as a safety net during hard (Shackleton et al., 2013).

With increasing cultivated land abandonment, the number of invasive alien plants growing in abandoned fields also increases, contributing to land degradation, reducing the viability of agriculture in the area, and further promoting the abandonment of cultivated lands (Scorer et al., 2019). The disuse of fields combined with poor grazing controls can lead to grazing on abandoned fields, reducing ground cover on abandoned fields and increasing soil erosion (Tarolli et al., 2014). The increase in abandonment in the Tsitsa River catchment increased the number of small gardens, which women can easily manage.

The previous land policies in the apartheid era greatly influenced rural agriculture by marginalizing small-scale black farmers through curtailed access to land, credit, and technical support (Hanekom, 1998; Rowntree et al., 2018; van der Waal et al., 2018). The policy changes and the social and ecological interactions of the Tsitsa River catchment show that the catchment is embedded with complexity. The interplay of the different catchment factors may result in undesirable feedback affecting ecosystem functionality and how people relate to the environment. For example, social grants and remittances may reduce people's interest in cultivation as they can afford to buy from supermarkets, resulting in increased abandonment of cultivated lands. The abandonment of cultivated lands may result in increased soil erosion and grazing of livestock on abandoned lands, contributing to land degradation. These changes will affect how people relate to the abandoned fields and change the ecosystem functions. The interplay of the different environmental, political, and social factors requires a good understanding of the drivers and consequences as complex processes dependent on each other that connect the ecosystems with society to suggest the best management strategies that will benefit the local communities whilst protecting the environment. Therefore, the social-ecological systems thinking approach is essential when working in complex environments embedded with complexity, such as the Tsitsa River catchment.

CHAPTER 3: DATA COLLECTION AND ANALYSIS

3.1 Data collection

Before data could be collected from the study sites, permission to conduct the study in the area was asked from the chief and his tribal council. Permission was granted in an official meeting with the tribal council. Fourteen sites previously under cultivation in both villages were pre-selected using Google Earth Pro (7.3.4.8642) in two selected villages. The sites were first selected using Google Earth Pro by dropping location pins. Selection of the sites was based on the visibility of contour lines showing that the sites were once under cultivation and were now abandoned. After the sites were selected on Google Earth, their GIS coordinates were noted. Following the site selection on Google Earth Pro, a field trip was taken to verify what was seen on Google Earth. If the sites selected were challenging to access due to the hilly terrain of the catchment, then a site close by with easy access was selected to replace the original site. The sites were then given names, and their GIS coordinates were recorded for future trips.

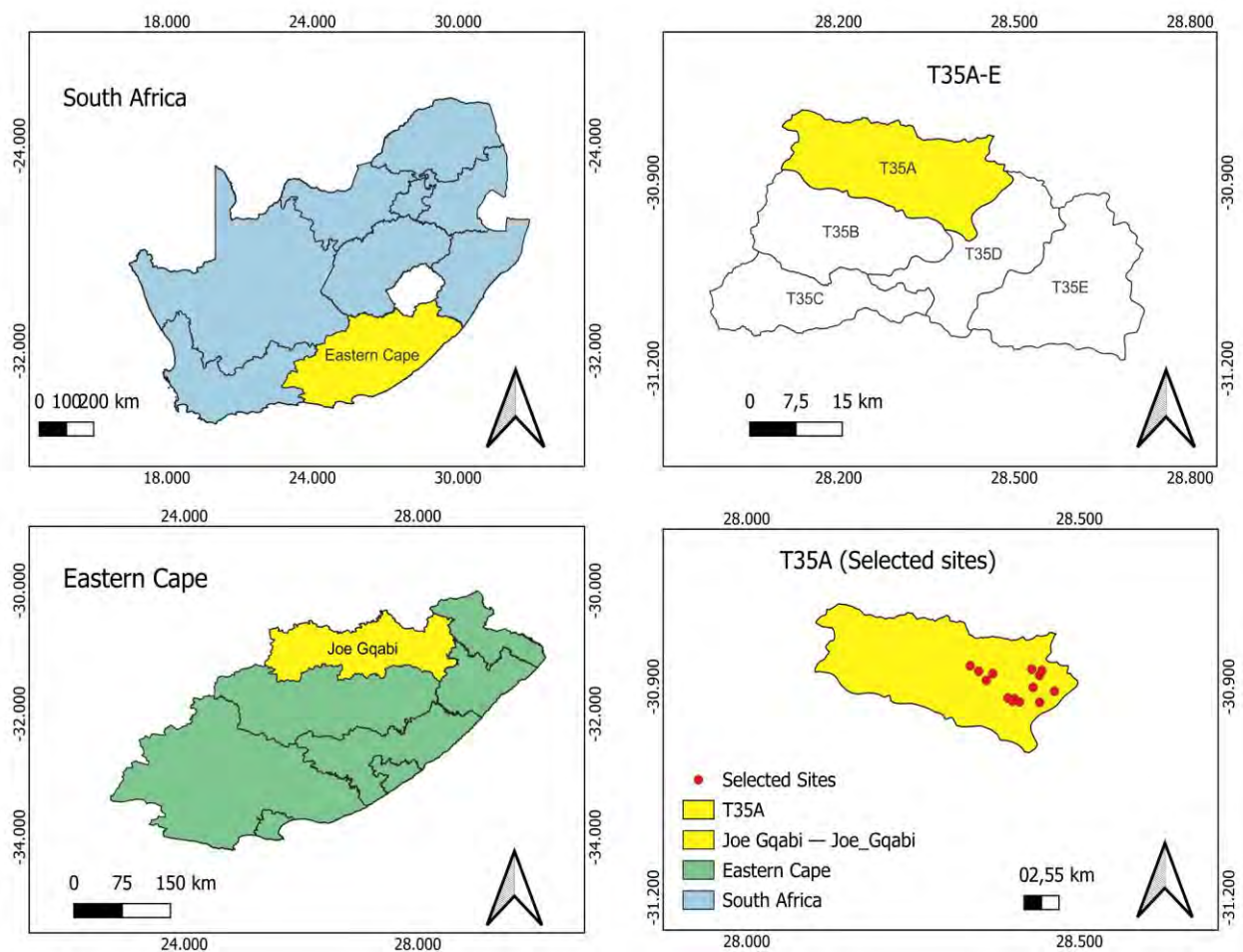


Figure 3.1: Study area map showing T35A-E quaternary catchment.

This study followed a mixed-method approach to assess long-term land-use changes using aerial photographs, field rapid and vegetation assessments, interviews on historical agricultural activities and changes, and perceptions of future agricultural engagements. The mixed-method approach includes both qualitative and quantitative methods. It is recommended for complex social-ecological systems as it incorporates multiple ways of seeing the world and can better understand complex systems than when individual methods are used alone (Biggs et al., 2022).

Interviews

The use of interviews to study the patterns of cultivated land abandonment has been widely used in the past four decades (Shackleton et al., 2013; Kuntz et al., 2018; Coucoccini, 2018; Shackleton et al., 2019). Interviews provide an opportunity to assess, and document cultivated land abandonment from the first-hand experience of people who have abandoned their land and are affected by it. This method allows for capturing the drivers, implications, and future trajectories of abandonment according to the local people's perceptions of how they relate to cultivated lands.

Interviews to assess land use changes have been successfully used over decades. It has been shown to provide a more holistic approach where stakeholders' views can be understood and explored for possible management practices that can be implemented to support local livelihoods and protect the environment. Blair et al. (2018) used a mixed-method approach, using a combination of interviews and aerial photography analysis to document the patterns of cultivated land changes from 1950 to 2010 in the former homelands of South Africa. Kuntz et al. (2018) used surveys to assess the perception of local farmers on abandoned cultivated lands in Allan County, New York, in the United States of America. Shackleton et al. (2013) used household questionnaires to interview current and former cultivators to understand how local people understand the changes in land use, what causes them, and how they relate to abandoned cultivated lands in a Biodiversity hotspot in the Wild Coast South Africa. Interviews can effectively capture land use changes and future perspectives on abandoned cultivated lands (Kuntz et al., 2018; Blair et al., 2018).

Interviews were conducted in the two villages of interest (Lower Tsitsana and Hlankomo). The villages were selected with the help of the Tsitsa project team at Rhodes University (Margaret Wolf and Nosiseko Mtayi). The Rhodes University Ethics Committee approved the study with the approval number (2021-5189-6416). We selected the villages because they have high

numbers of abandoned cultivated lands, with some evidence of land degradation seen through the gullies.

The households for interviews were selected with the help of the Tsitsa project community liaison officers. Forty-seven participants were interviewed; 23 were interviewed in Lower Tsitsana, and 24 were interviewed in Hlankomo village. The literature recommends a minimum of 25 to 50 participants for ground theory studies, and the numbers can increase or decrease depending on when data saturation is reached (Mthuli et al., 2021; Marshall et al., 2013). Data saturation is when different participants start saying the same thing repeatedly, and no new information is coming up (Mthuli et al., 2021; Marshall et al., 2013). The data saturation was reached. Of the 47 participants, 26 were males, and 21 were females. The interviews were conducted in participants' homes with notes taken, and the interviews were also recorded for further interpretation. The participants were opportunistically sampled and selected based on their availability and willingness to participate. The participants were spread around the two villages. We were interested in interviewing people aged 18 and above because the study is looking into understanding the changes in cultivated lands over time and the future perspectives. The older people would give insight into the changes in cultivated lands, and the youth would share some future perspectives and interests in the cultivated lands. The participants were interviewed using semi-structured questions in their local language (isiXhosa), using a translator. The participants were asked for consent to be interviewed, and the study's risks (which were low) were explained to them.

The interviews were recorded to capture the responses from the participants thoroughly. The recordings were then transcribed into English. In the first section of the interviews, we focused on understanding the demographic and socioeconomic dynamics of the participants. The second section of the interview focused on understanding the history, drivers, and consequences of cultivation, and the last section focused on future cultivation perspectives in the villages. In the demographics and socioeconomic section, we asked participants about their age, the number of years they have stayed in the area, their source of income and their level of education. In the drivers and consequences section, we asked participants why they abandoned their lands. What were the financial impacts of abandoning their fields? How have their livelihoods changed? What types of crops had they planted? Where do they get the food, they were previously getting from the cultivated lands that are now abandoned? To understand the future perspectives of local people about these abandoned lands, they were asked what they would like to do with these

abandoned lands. What other land uses would you prefer other than cultivation? How would those land uses change your lives and that of the community at large? The interviews lasted from 15 to 45 minutes per participant, depending on how the participant related to the questions and how they wanted to narrate the stories.

GIS analysis

Assessing the extent of cultivated land is essential for quantifying land use and land cover changes. The assessment of abandoned cultivated lands can be done using qualitative and quantitative methods (Baker et al., 1979; Puttick et al., 2014; Shackleton et al., 2013; Kuntz et al., 2018; Blair et al., 2018). Some studies only use quantitative methods such as aerial photographs and remote sensing tools to assess, monitor, and map the land use/land cover changes and understand environmental systems (Puttick et al., 2014). Aerial photographs are images taken from an aircraft or a helicopter using a precision camera. These images are used in topographical mapping and interpretation. Aerial photographs can be used for photogrammetry and photo interpretation (Imam, 2018). Photogrammetry is the science and technology of making reliable measurements from aerial images, and image interpretation is used to obtain qualitative information such as land cover/land use, soil types and topographical forms from aerial images (Imam., 2018). The changes in land use often have a severe effect on land cover changes and the overall functionality of the ecosystem.

Aerial photographs

Aerial photographs have been successfully used to map land use and land cover changes and have shown to be tools that can be dependent upon. Aerial photographs date far back in time and have data from as early as 1940. Therefore, one can use them to quantify land use and land cover changes over the years to see how the environment is affected by land use and changes over time. However, aerial images from the early years have some limitations regarding their quality and consistency (Baker et al., 1979). Another limitation of aerial photography is that the accuracy of the analysis depends on the experience of the person doing the analysis (Baker et al., 1979).

Puttick et al. (2014) used aerial photographs to monitor changes in the vegetation composition of rangeland over time in Fort Beaufort, Eastern Cape, South Africa. Aerial photographs were successfully used to assess land use and land cover changes over time (Puttick et al., 2014). The

time of the year the aerial image was taken can also pose constraints on the interpretation of the aerial images, which may reduce the accuracy of the interpretation (Baker et al., 1979). Blair et al. (2018) used repeated aerial photography analysis to assess land changes in the former South African homelands of Transkei, KwaZulu Natal, Lebowa and Venda. Shackleton et al. (2013) used aerial images from 1961 and 2009 to assess land use/land cover changes. The two images were compared to compare the land use/land cover changes over time.

Land use/land cover has been mapped using remote sensing tools (aerial photos and satellite imagery) (Puttick et al., 2014; Alcantara et al., 2013). Mapping from aerial photographs can be done manually or automatically. Mapping manually involves digitising recognisable features followed by reviewing and editing, while in automatic tools, features can be automatically recognised (Awwad., 2003). The aerial photographs of the two villages were obtained from the South African National Geo-Spatial Information (NGI) website (<http://www.cdngiportal.co.za/cdngiportal/>). The NGI is responsible for aerial photography in South Africa and has images dating back to the early 1930s. The images are taken from an aircraft and are available at varying scales. The images from the early 1930s to 2008 have a scale ranging from 1:30 000 to 1:50 000, and after that, the images were taken using a digital sensor (Aerial Photography (1926-2008) 2013). The aerial images show almost all the details on the ground, and the accuracy of the images depends on the user's interpretation of what may exist on the ground (Aerial Photography (1926-2008)2013).

I selected the images from 1966, 2003, and 2015 for this study because the time difference between the years was significant enough to show changes in abandoned lands over time. The images selected were of good quality compared to other images. The aerial images were loaded in QGIS 3.26.3 and georeferenced, and after that, the images were analysed to check for cultivated lands or land uses that resembled land under cultivation. Polygons were drawn around the land cover that resembled cultivated lands. Land under cultivation was defined as land that contained visible, linear man-made boundaries, with active contour lines indicating recent possible ploughing that might have happened (Blair et al., 2018). The same procedure was applied to all the selected images, and then the areas for all the polygons were calculated to give the total area of land under cultivation. The difference between the first image (reference image) and the following image was calculated as the change in percentage of the area under cultivation, giving the area abandoned from the previous or reference image.



Figure 3.2: The polygons showing land that was under cultivation in 1966.

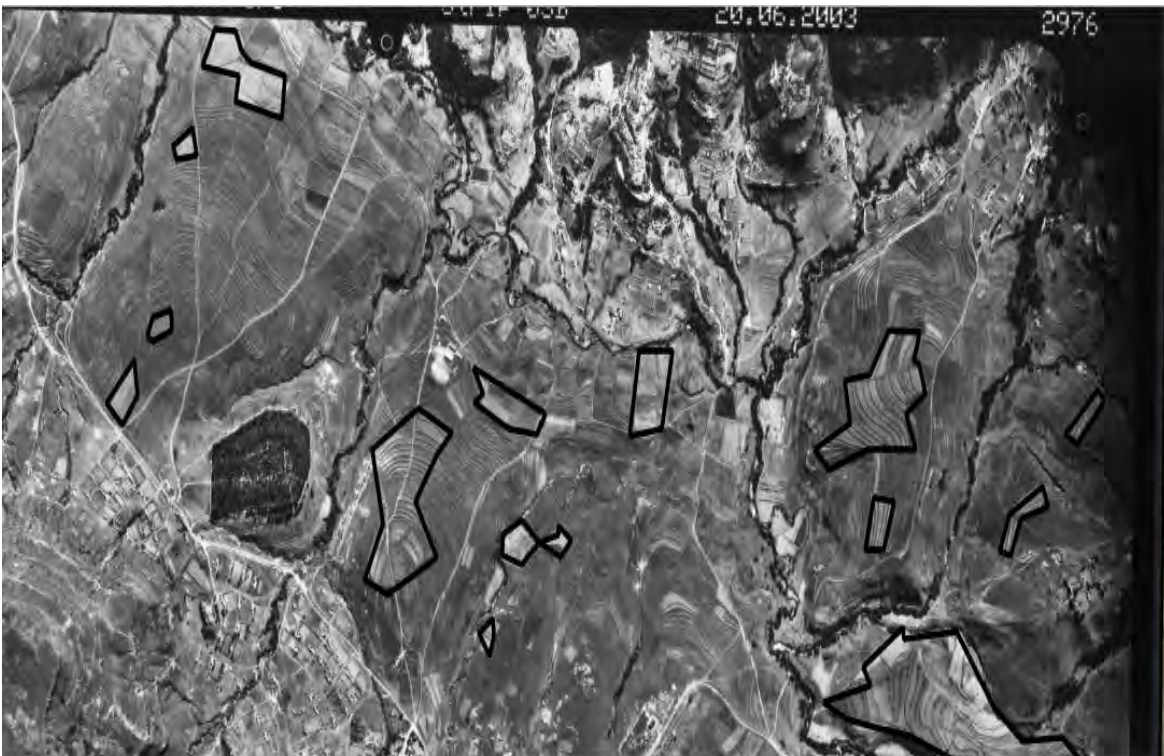


Figure 3.3: The polygons showing land that was under cultivation in 2003.



Figure 3.4: The polygons showing land that was under cultivation in 2015.

Ecological Surveys

Vegetation composition on abandoned cultivated lands.

The vegetation cover on the abandoned fields can indicate the previous land uses and the extent of damage caused by those land uses. An assessment of the vegetation composition and distribution of an area can help with understanding the ecological processes taking place in the area and the previous land use activities that have taken place in the area (Ngcaba & Maroyi, 2017; Swacha et al., 2018; Prévosto et al., 2011). After abandonment, vegetation succession can happen linearly in which the land can be first restored to grasslands, shrubs, and forested lands, but this may vary from one region to the other depending on the intensity of the disturbance, previous land use, and the period the land has been abandoned (An et al., 2019; Arévalo et al., 2016; Burdukovskii et al., 2020). Therefore, the vegetation composition of each area needs to be studied individually to understand the context of each area.

Cultivated land abandonment is a transition state leading to plant succession and vegetation recovery in abandoned areas (Prishchepov, 2020). A good understanding of the current conditions of abandoned cultivated lands, in terms of their vegetation composition, will help understand if the current ecological state of the abandoned lands can support the future perspective of the farmers (Ngcaba & Maroyi, 2017; Swacha et al., 2018; Prévosto et al., 2011).

After abandonment, various abiotic and biotic factors can determine the species composition, including soil properties (An et al., 2020) and land management practices (Swacha et al., 2018). The implications of the ecological composition and health of an area will vary by context, depending on the purpose of old fields in people's current and future lives (Ravhuhali et al., 2018 and Scorer et al., 2019) and viable, sustainable land management strategies (Ravhuhali et al., 2020; Mokgakane et al., 2021).

Rapid assessment test

A rapid assessment test is a method that was developed by SWEPE (Sustainable Wildlife Economy Project) to collect data on wildlife Ranches in South Africa (<https://www.wildeconomy.org>). This tool is an open data source in which data can easily be collected on any Android device. The form was developed to capture the ecological state of ranches. This test was first used in the Eastern Cape and has now been expanded to other parts of South Africa, such as Limpopo province (<https://www.wildeconomy.org>). This tool allows for rapid assessment of the landscape for possible identification of disturbances and degradation that may be happening in the area. It helps managers identify these disturbances to tell if any areas need attention. The tool may also help landscape managers monitor their rehabilitation intervention to know if their implemented management strategies are helping the environment or if different approaches should be explored.

The Open Data Kit app used in this project was adapted from the sustainable wildlife economy field verification survey. The SWEPE (Sustainable Wildlife Economy Project) sought to understand how wildlife-based land uses contribute to sustainable land management, socioeconomic development, and biodiversity conservation (<https://www.wildeconomy.org>). SWEPE was first used in the Eastern Cape in 2021, surveying wildlife ranches to understand how wildlife ranches contribute to sustainable land management. This rapid assessment method, which formed part of this baseline data collection, was developed by UNDP experts in sustainable land management assessments and designed to provide a broad, rapid, and repeatable assessment of the overall ecological state of an area, considering landscape characteristics, vegetation, and soils. The ODK form was downloaded from the Google App Store and stored on an Android phone. ODK is an open-source platform that allows for the collection of data using Android mobile devices and stores the data on a central server where the data can be aggregated for data analysis on one's computer (Anokwa et al., 2009) and can be used offline.

The first part of the rapid assessment reports on the site details by looking into terrain, landscape, aspect, and slope. The second part of the form investigated the vegetation types by assessing the plant covers such as tree cover, large shrubs, dwarf shrubs, succulent cover, herbaceous cover, grasses cover, and riparian cover. The severity of weeds, bush encroachment, and alien invasive plants were also investigated to assess which vegetation is most dominant in each abandoned land. The last part of the form covers the degradation type, which includes land and vegetation degradation. This part of the form seeks to report on abandoned land's most dominant/visible degradation. The types of vegetation found in the different fields may help infer the ecological health of the abandoned fields. For example, if more invasive plants are found in the fields, this may indicate that abandoned fields are prone to invasion by alien plants.

Table 3.1: Variables measured in the rapid assessment and how they were measured.

General details	Measured variables	How they were measured
Preliminaries	Location	GPS coordinates
	Assessment date	Day of data collection
	Property name	Unique names given to different sites
	Land Use	Choose from the given options: <ul style="list-style-type: none"> • Cultivated • Planted Pasture • Old Fields • Mixed Rangelands • Natural Water Bodies
Site details	Terrain	Choose from the given options: <ul style="list-style-type: none"> • Crest • Scarp • Midslopes • Footslope • Valley Bottom
	Landscape	Choose from the given options: <ul style="list-style-type: none"> • Undulating • Terrance • Flat • Concave • Convex
	Aspect	Choose from the given options: <ul style="list-style-type: none"> • North • South • East • West

Plant cover	Plant cover structure	Choose from the given options: <ul style="list-style-type: none"> • Very sparse with large bare soils • Cover is sparse with small bare areas. • Cover is moderate with bare patches. • Cover is good with only little soil exposure. • Cover is dense with no soil
	Tree cover	Tree cover percentage <ul style="list-style-type: none"> • >11% or 11-25% or 25-50% or 50-75% or >75% Number of tree species <ul style="list-style-type: none"> • Zero or 1-2 or 3-5 or 5-7 or >8
	Large shrubs	Large shrubs Percentage <ul style="list-style-type: none"> • >11% or 11-25% or 25-50% or 50-75% or >75% Number of large species <ul style="list-style-type: none"> • Zero or 1-2 or 3-5 or 5-7 or >8
	Dwarf shrubs	Dwarf shrubs percentage <ul style="list-style-type: none"> • >11% or 11-25% or 25-50% or 50-75% or >75% Number of tree species <ul style="list-style-type: none"> • Zero or 1-2 or 3-5 or 5-7 or >8
	Succulent cover	Succulent cover percentage <ul style="list-style-type: none"> • >11% or 11-25% or 25-50% or 50-75% or >75% Number of large species <ul style="list-style-type: none"> • Zero or 1-2 or 3-5 or 5-7 or >8
	Herbaceous Cover	Herbaceous cover percentage <ul style="list-style-type: none"> • >11% or 11-25% or 25-50% or 50-75% or 75% Number of tree species <ul style="list-style-type: none"> • Zero or 1-2 or 3-5 or 5-7 or >8
	Grasses	Grass cover percentage <ul style="list-style-type: none"> • >11% or 11-25% or 25-50% or 50-75% or >75% Number of large species <ul style="list-style-type: none"> • Zero or 1-2 or 3-5 or 5-7 or >8
	Riparian vegetation	Riparian cover percentage <ul style="list-style-type: none"> • >11% or 11-25% or 25-50% or 50-75% or >75% Number of tree species <ul style="list-style-type: none"> • Zero or 1-2 or 3-5 or 5-7 or >8
	Weeds, Bush encroachment and (Alien Invasive Plants) AIPs	Percentage scrubs <ul style="list-style-type: none"> • >11% or 11-25% or 25-50% or 50-75% or >75% Number of large species <ul style="list-style-type: none"> • Zero or 1-2 or 3-5 or 5-7 or >8
Soil Surface condition	Conditions of the soil	Choose from the given options: <ul style="list-style-type: none"> • Severe levels of topsoil loss • Moderate levels of topsoil loss • Slight levels of topsoil loss • Topsoil is not well covered but with visible soil loss. • The topsoil is well covered with no topsoil loss. • Rocky outcrop
Degradation type	Comments on the degradation you see	Severity of degradation

		<ul style="list-style-type: none">• Light• Moderate• Strong• Extreme
--	--	---

Veld condition assessment

Veld condition assessment is a method used to assess grassland health by identifying species composition. Grass species identification helps infer the landscape's ecological processes and biological diversity (Ravhuhali et al., 2020; Mokgakane et al., 2021). Studies have shown that through veld condition assessment, we can understand the state of the grassland and its functionality in terms of forage production and soil erosion (Ravhuhali et al., 2020). Knowing the health state of the grasslands will help know the potential of the grass in terms of what it can be used for.

Identifying the different grass species can inform on the state of the veld; for example, if Increaser species dominate the veld, this can indicate that the veld has undergone some disturbances, and the land is degrading. In contrast, if Decreaser species dominate the veld, this could be an indication that the grassland is healthy, and the land has the potential to produce good forage. Therefore, assessing the condition of the field can help managers and local people know the potential of their grasslands and, therefore, plan the future land use of the grasses with an informed perspective on whether the grassland will be viable to support their needs.

Grass species composition

While the rapid assessment tool test gives an overall indication of the ecological state of the area, it doesn't inform on the vegetation composition of the area. The 14 study sites were assessed to understand their vegetation composition after the abandonment of cultivation. Grass species were identified using the step-point method (Hardy & Tainton, 1993). Evans and Love developed this method in the 1950s to determine cover using point sampling. The step point method provides a rapid, objective, and accurate method for determining herbaceous vegetation composition and total cover (Evans & Love, 1957).

A 2 x 50 m transect was established on each randomly selected site to record grass species found along the transect. This method includes identifying grass species along the transect at every 1 m. Along the transect, if a pointer hits the ground, the nearest grass species to the pointer was identified, and the distance was measured to estimate cover. The grass species were identified in February-April 2022 when they still had inflorescence for easy identification.

The grass species of both study sites were added together to represent the grass species composition of the whole study area. The abundance for each grass species was calculated by getting the total number of each species in the study area. The grasses were then classified into

different categories, and they were classified according to their ecological status, grazing value, life form, and plant succession. The grass's ecological status indicates the landscape's state regarding forage quality and whether the veld is in good or bad condition (Van Oudtshoorn, 2012). If the veld is in bad condition, it will mostly be dominated by unpalatable species which grow in disturbed lands. Grazing value is the general acceptability of the grass for grazers and is influenced by nutritional value and digestibility. Plant succession is the progressive succession of plant communities. Plant succession happens when a disturbance occurs in an area, and a new, better-adapted plant community recolonises the area. Pioneer plants are hardened, annual plants that can grow in unfavourable conditions. Sub-climax plants are denser than pioneer plants and offer more protection to the soil, and these are mainly weak perennial grasses. Climax plants are strong perennial plants that grow in normal and optimal growth conditions and will grow in that area as long as the conditions prevail.

Grass species ecological statuses were defined as follows,

1. Decreaser species are grasses that are abundant in veld that are in good condition. However, Decreaser species decrease when the veld condition deteriorates. These grasses are palatable climax grasses mostly preferred by grazing animals (van Oudtshoorn, 2012).
2. Increaser I species are described as grasses that are abundant in the underutilised veld. These grasses are usually unpalatable (van Oudtshoorn, 2012).
3. Increaser II species are described as grasses that are abundant in the over-grazed veld. These grasses usually increase due to the disturbances of overgrazing (van Oudtshoorn, 2012).
4. Increaser III Species are described as grasses primarily found in overgrazed veld. These grasses are unpalatable and usually increase when palatable grasses are weakened due to overgrazing (van Oudtshoorn, 2012).

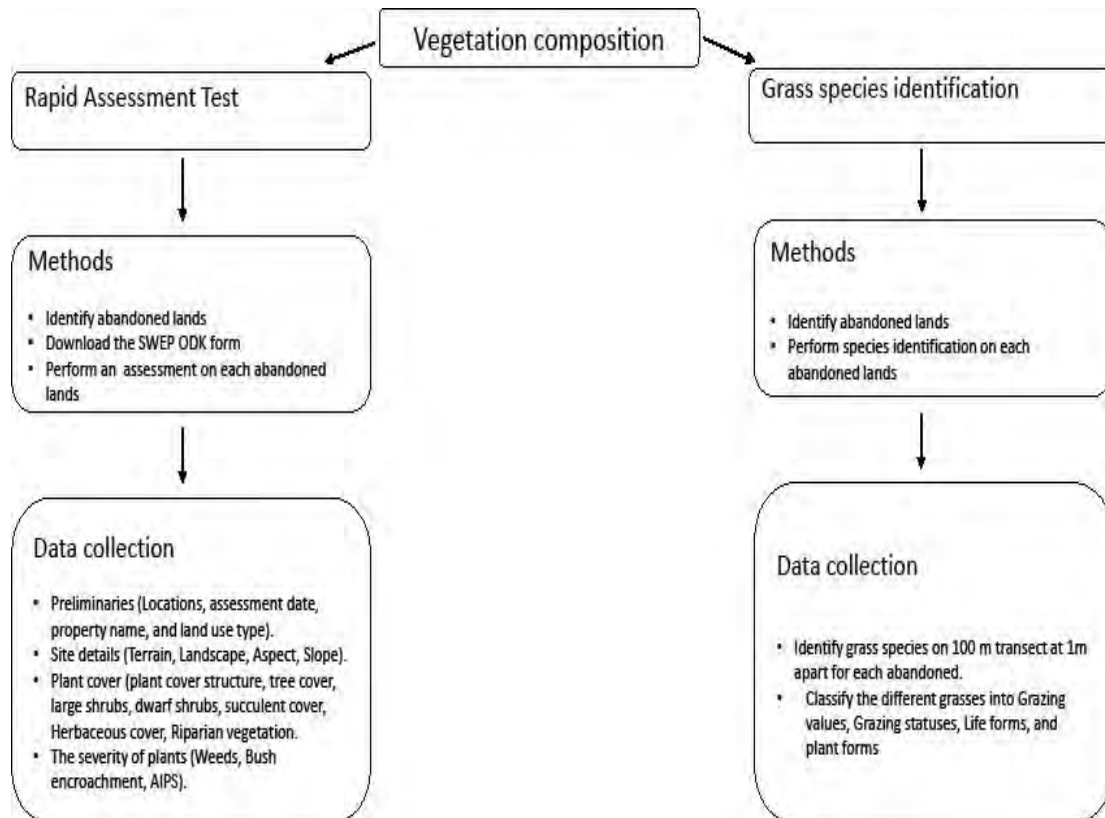


Figure 3.5: Schematic diagram of the rapid assessment test and grass species data collection.

3.2 Analysis

Qualitative analysis

The interviews were analysed using thematic coding. Thematic analysis is a qualitative process involving looking into a dataset to identify, analyse and report on repeated patterns (Preiser et al., 2022). It involves familiarising yourself with the data, which involves thorough and repeated reading (Braun & Clarke, 2006). The data was then coded, which involved selecting patterns of interest used to help answer the research questions. The coded data were then categorised into themes by analysing, comparing, and combining codes. The themes were then defined and named.

In this study, we used an inductive coding approach, in which the themes were identified using reflexive thematic analysis (Braun & Clarke, 2006). We identified codes around when the local people stopped cultivating, why they stopped, the impacts of stopping, and their future with these abandoned fields. The codes with similar meanings were grouped into themes and given

names. A Chi-Square test of independence was conducted in STATISTICA Version 14.0.0.15 (2016) to test if there was a significant difference between the most-mentioned and the least-mentioned driver of abandonment.

Quantitative analysis

The manual mapping of the extent of abandonment was performed in QGIS 3.26.3 software. The land cover change was reported as a total percentage change and annualised rates of change (% year⁻¹). The annualised rates of change (% year⁻¹) are relative to the starting date and divided by the years between periods.

Rapid Assessment Test tool

A Kruskal Wallis statistical analysis was conducted in STATISTICA Version 14.0.0.15 (2016) to assess whether there is a statistically significant difference in the mean estimated extents of the different vegetation (tree cover, large shrubs, dwarf shrubs, succulent cover, herbaceous cover, grass cover, riparian cover, severity of weeds, severity of bush encroachment, and severity of alien invasive plants).

Grass species composition

The mean abundances of the grass species for the different categories of ecological statuses, grazing values, life forms, and plant succession were calculated to indicate the difference in abundance. The grass's ecological status suggests the landscape's state in terms of forage quality and whether it is in good or bad condition (Van Oudtshoorn, 2012). Grazing value is the general acceptability of the grass for grazers and is influenced by nutritional value and digestibility. Plant succession is the progressive succession of plant communities. A Kruskal-Wallis test was conducted on STATISTICA Version (14.0.0.15) 2016 software to test if there is a significant difference in abundance for the varying categories of the ecological status, grazing values, plant succession, and life forms of the different grass species.

CHAPTER 4: RESULTS

4.1 Socio-demographic characteristics of the respondents

More males (n=26, 55%) participated in the study (n=47) than females (n=21, 45%). The age difference of participants varied from ≤ 30 to greater than ≥ 61 . The participants were grouped into four age groups, with more participants in the age ≥ 61 (n=18, 38%) followed by 45-60 (n=15, 31.9%), ≤ 30 (n=8, 17%), and 30-44 (n=5, 12.8%). There was a high unemployment rate in the area, with 68% (n=32) of participants dependent on social grants, 13% (n=6) on livestock farming, 13% (n=6) on a salary, 6% (n=3) on remittances and 4% (n=2) on business as a source of income. The education level varied from no education (n=6, 12.8 %) to tertiary (n=3, 6.5 %), with more people having a primary school education (n=24, 51 %) and only a limited number having matric (n=12, 25.5 %).

4.2 Thesis objective 1: To what extent has land abandonment emerged as a focal action situation in these two villages?

Interviews

Almost all (n=46, 97.9 %) participants once cultivated lands. However, only one (n=1, 2.13 %) of the participants who once had cultivated lands were still cultivating under projects or co-operatives (where locals come together to fence their fields so they can plant on them). The results showed a decline in abandoned cultivated land from the late 1970s, as reported by participants in the study. More decreases were reported to have occurred in the late 1980s to the early 1990s, with more prevalence in the 1990s (Figure 4.2). The participants mentioned that there was a significant change in the landscape over the years. The environment is no longer giving them the services they used to get in the past. One participant mentioned that they no longer have wild fruits and haven't seen some animals (Porcupine and rabbits) they used to see in the past.

Respondent 24: Things have changed; even the birds that used to be around when we used to plant are no longer there. Even animals that used to be around, like Porcupine, etc., that used to eat maize are no longer there. Even rabbits are scarce. Nature has changed, and the environment has changed a lot. We also no longer eat fresh food, and we buy beans. We used to plant and eat fresh potatoes and beans.

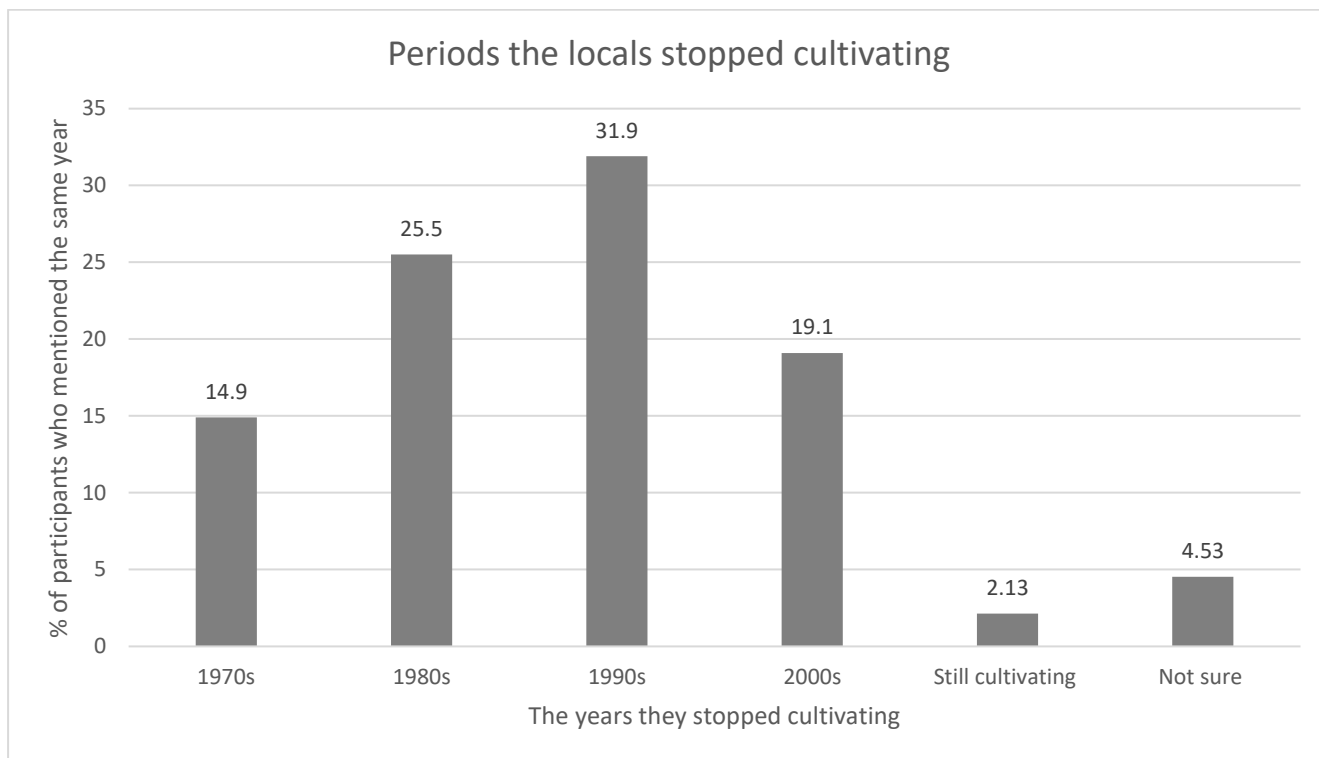


Figure 4.1: Different periods the local people reported as the time they stopped cultivating in Hlankomo and Lower Tsitsana. This plot shows that more respondents stated that they had abandoned cultivation in the 1990s, followed by the 1980s, 2000s and 1970s, respectively.

GIS Analysis

The extent of abandonment analysis showed a reduction in the proportion of land under cultivation (Figure 4.2). The aerial photographs showed a decline in cultivated lands from 1966 to 2015, with a significant decline between 1966 and 2003. The land under cultivation between 1966 and 2003 decreased by 95 % and decreased by 60 % from 2003 and 2015. The results indicated that as abandoned cultivated lands increased, there was a corresponding rise in home gardens, with each household having one (Figure 4.3).

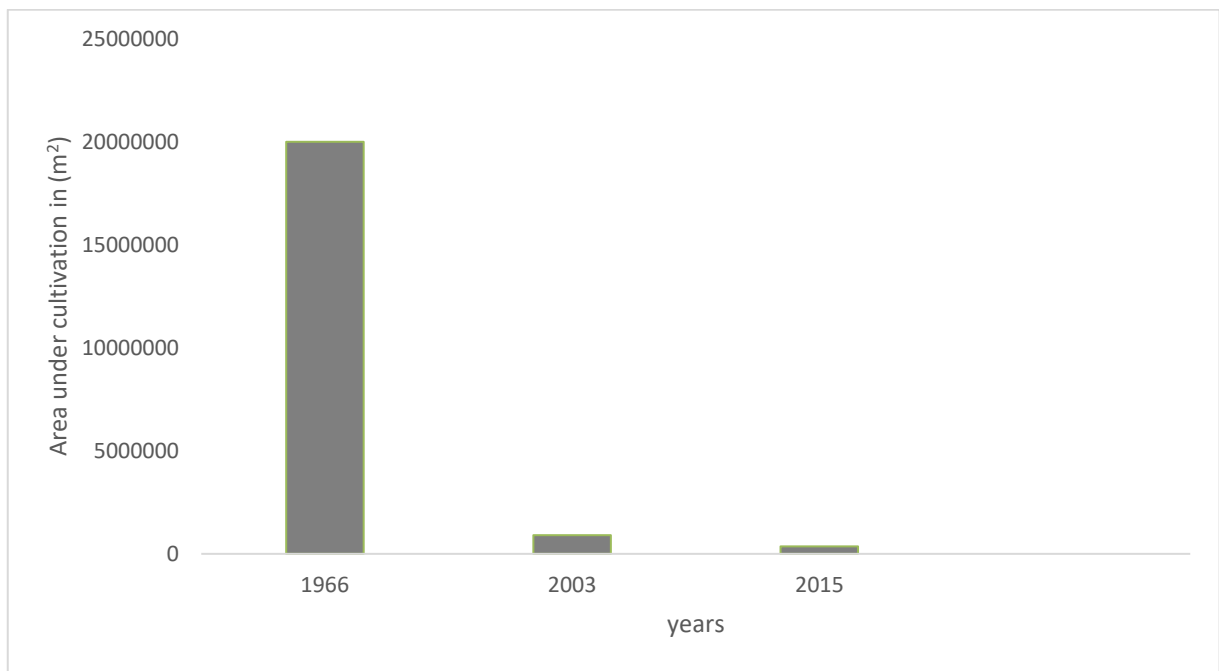


Figure 4.2: The total areas (Hectares) under cultivation in the different years 1966,2003 and 2015) for Hlankomo and Lower Tsitsana



Figure 4.3: The home gardens in the villages in 2033 after cultivated land abandonment.

4.3 Thesis objective 2: What interactions shaped the emergence of current levels of land abandonment (focal action situation?)

The respondents mentioned that they stopped cultivation because they did not have enough cattle, which were previously used to plough the fields (n=21, 44.7%) (Table 2), and their fields were not fenced (n=21, 44.7%) (Table 2). The respondents also mentioned that livestock would graze on their fields due to the lack of fencing, leaving them no choice but to abandon their fields as the plants could not grow up to harvest time.

Respondent 6: "The main reason was that livestock would graze on their fields because the fields are not fenced off. People stopped for that reason, even though they were still eager to plant. It is the unfenced fields".

"We also ran short of the cattle that we used as oxen, and they died of diseases. Stock theft also played a role. It was very painful; the only thing left was for them to steal us. Sheep, cattle, and chicken are stolen. When I was young, they used to say there are wolves".

In addition to lack of fencing and cattle, the people also mentioned lack of labour (n=13, 27.7%), lack of resources (money and equipment) (n=12, 25.5%), migration (n=6, 12.8%), youth laziness (n=5, 10.6%), death of an elder (n=5, 10.6%), expensive fertiliser (n=4, 8.5%), rainfall variability (n=2, 4.3%), dependency on grants (n=1, 2.1%), lack of knowledge (n=1, 2.1%) and lack of interest (n=1, 2.1%) as the reasons they had stopped cultivating (Table 2). A Chi-Square test was done to check if there is a significant difference between the most and the least-mentioned drivers of abandonment. The Chi-square test showed that there is a significant difference between the most mentioned (no fence) and the least mentioned (dependency on the grants) driver of cultivated land abandonment (n=22, df=1, $\chi^2=18.2$, p=0).

Respondent 28: "In 1980, but it worsened in 1994, and there were no longer kids who stayed at home. Kids went to schools in Cape Town. We don't even keep livestock anymore; this freedom has brought much damage."

Respondent 24: "I don't know. Most people live in Cape Town, and we planted with cattle, and people no longer have large herds of cattle. People depend on Government grants, which started after 1994 when people started receiving government grants and houses (RDP) in Cape Town and Gauteng. So, people stay in both the village and Cape Town/Gauteng. Most of the time, they stay in Cape Town and a few in the villages."

Table 4.1: Identified themes, their proportions, and illustrative quotes emerging from the interview questions “what are the drivers of cultivated land abandonment”.

Drivers of abandonment			
Themes	Number	Proportions (%)	Illustrative quotes
Fence	21	44.7	<i>“The reason could be that there was no yard/fence. Cattle would enter the planted fields”.</i> (Respondent 03)
No cattle	21	44.7	<i>“We also ran short of the cattle that were used as oxen, and they died of diseases. Stock theft also played a role. It was very painful. The only thing left was for them to steal us.”</i> (Respondent 29)
Lack of labour	13	27.7	<i>“Another thing that made us stop planting is because the head of the houses (men) died, then there are no children because they go and live in towns. Now tell me, if a person does not come home for two years, who will plant? That is what caused the situation we are in. The elders die, and a home is left closed with no one there. People are living happily in town.”</i> (Respondent 29)
Lack of resources (money and equipment)	12	25.5	<i>“They do not have money to plant. They want to cultivate on their fields, but they do not have money.”</i> (Respondent 33)
Migration	6	12.8	<i>“People are no longer staying in the village; some have relocated to cities, such as Cape Town and Gauteng; even kids don’t stay at home anymore; they go to schools now. And we also don’t keep livestock anymore.”</i> (Respondent 28)
Parents passed on	5	10.6	<i>“The reason that caused us to stop is that the elders passed on, and we were only children, so we did not have the strength.”</i> (Respondent 37)
Laziness of youth	5	10.6	<i>“I do not see a reason; the dedicated elders passed on, and the remaining youth are too lazy to work; that is all because the fields are still there.”</i> (Respondent 07)
Fertiliser is expensive	4	8.5	<i>“According to my understanding, I could say It’s because manure is expensive.”</i> (Respondent 04)
Rainfall variability	2	4.3	<i>“It is the rain. Sometimes it rained heavily, then sometimes we had a severe drought. Maize would get I think it is the rain. Back then, we had a severe drought in other years.”</i> (Respondent 38)
Dependency on grant	1	2.1	<i>“I don’t know, mostly people are living in Cape Town, and we planted with cattle, and people no longer have large herds of cattle, and people are dependent on Government grants; this started happening after 1994 when people started receiving government grants and houses (RDP) in Cape Town and Gauteng.”</i> (Respondent 24)
Lack of interest	1	2.1	<i>“No, they just stopped as if they are people who are no longer interested, starting from year 2000 we were no longer planting.”</i> (Respondent 19)

4.4 Thesis objective 3: What impacts resulted from the current action situation for people (actors), resource units and resource systems (grass, soil, biodiversity, and ecosystem health)?

Ecosystem Assessment

Rapid Assessment Test tool

The terrain of the study sites was found to be mid-slopes (n=5, %=35.7), foot slopes (n=4, %=28.6), crest (n=2, %=14.3) and valley bottom (n=3, %=21.4). The slopes of the sites varied from north-facing (n=4, %=28.6), south-facing (n=7, %=50), east-facing (n=1, %=7.1) and west-facing (n=2, %=14.3) slopes. The landscape varied from concave (n=3, %=21.4), convex (n=2, %=14.3), flat (n=8, %=57.1) and undulating (n=1, %=7.1). The abandoned lands were dominated mainly by grasses; the least appearing vegetation was succulents and shrubs. Grasses were the most dominant plant cover type in the studied sites, with a mean percentage and an Interquartile Range (IQR) of 58.9 % (IQR=25), followed by the herbaceous 25.3% (IQR=14), riparians 14.5% (IQR=0), trees 15.5 % (IQR =0), large shrubs 11 % (IQR =0), dwarf shrubs 11 % (IQR =0), succulents 11 % (IQR=0) (Figure 4.4). A Kruskal-Wallis test was done to check if there is a significant difference between the vegetation types in the abandoned fields. A Kruskal-Wallis test showed a significant difference between the mean values of the vegetation covers $H= 73.78, P= 0.000$.

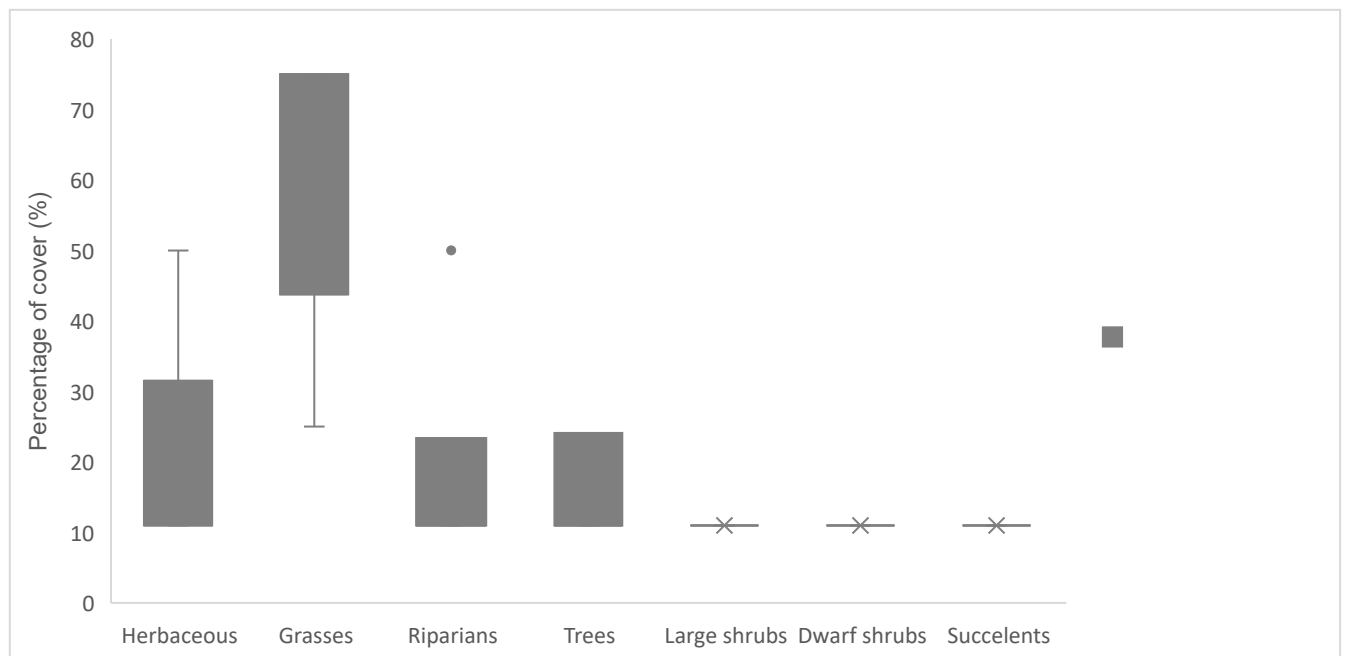


Figure 4.4: Percentage covers for the different vegetation types found in the abandoned fields of Hlankomo and Lower Tsitsana. The box plot shows that grasses (IQR=25) were the most dominant compared to other vegetation covers. Large shrubs (IQR=0), dwarf shrubs (IQR=0) and succulent (IQR=0) were the least appearing. n=14

The analysis of weeds, alien invasive plants, and bush encroachment showed that alien invasive plants were the most severe, with a mean percentage of 15 % (IQR= 20), followed by weeds at 11% (IQR=5) and bush encroachment at 6 % (IQR=0) (Figure 4.5). A Kruskal-Wallis test was done to check if there was a significant difference between different vegetation types. A Kruskal-Wallis test showed no significant difference in abundance between the weeds, alien invasive plants, and bush encroachment $H=9.31$ $p=0.095$

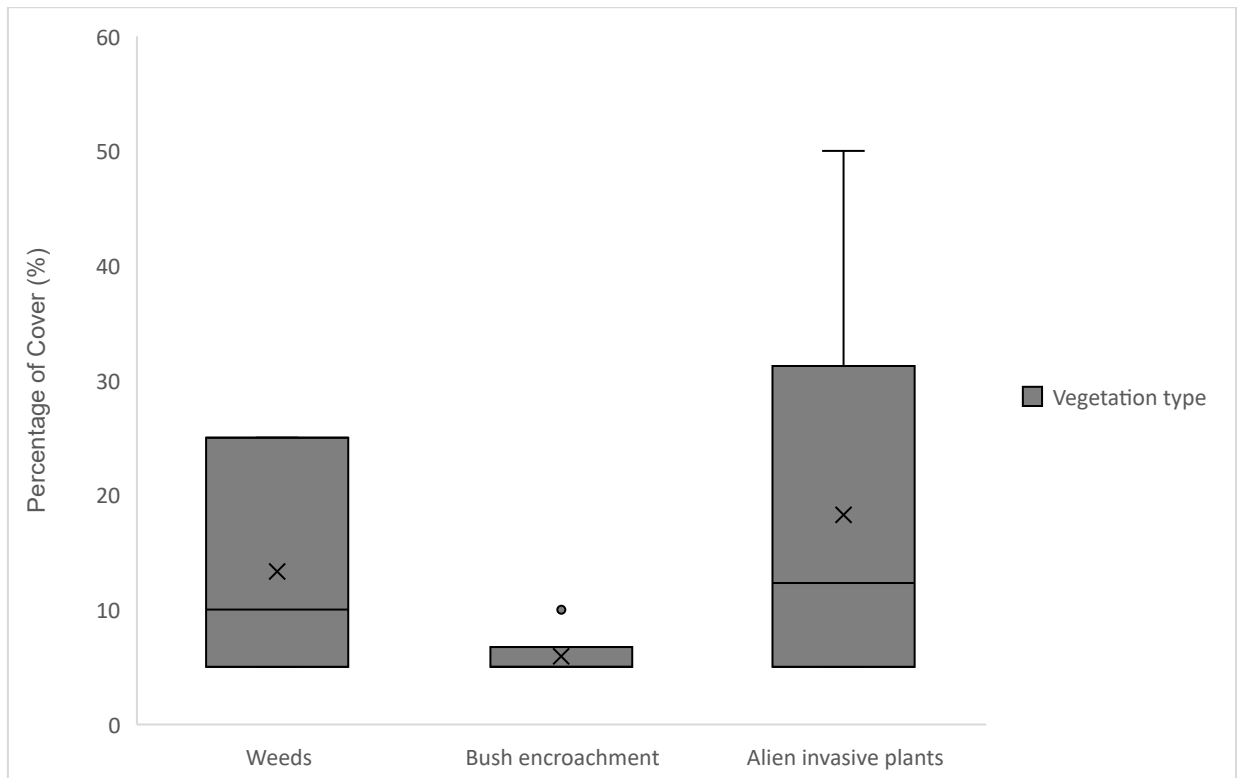


Figure 4.5: percentage of weeds, bush encroachment and alien invasive plants in abandoned lands of Hlankomo and Lower Tsitsana. The box plot shows that alien invasive plants (IQR=20) were the most dominant, followed by weeds (IQR=5) and bush encroachment (IQR=0), respectively. $n=14$.

An analysis of the different degradations found in the different abandoned sites showed more sites having land degradation as opposed to vegetation degradation (Figure 4.6). Bare grounds ($n=4$, 25 %) were dominant in more sites followed by gullies ($n=3$, 18.75 %), Trees and bare grounds ($n=2$, 12.5 %), slight dongas ($n=2$, 12,5 %), invasion by wattle ($n=2$, 12.5%), bare grounds and invasive alien plants species ($n=1$, 6.25 %), gullies and bare grounds ($n=1$, 6.25 %), bare grounds and dongas ($n=1$, 6.25 %). The extent of land degradation was evident in the prevalence of bare grounds, dongas, and gullies across multiple study sites (Figure 4.6). The graph shows that bare grounds were more severe, followed by invasion by Wattle, Gullies and bare grounds and bare grounds and dongas. The gullies, bare grounds and AIPs, trees and bare grounds and slight dongas were moderate throughout all the sites.

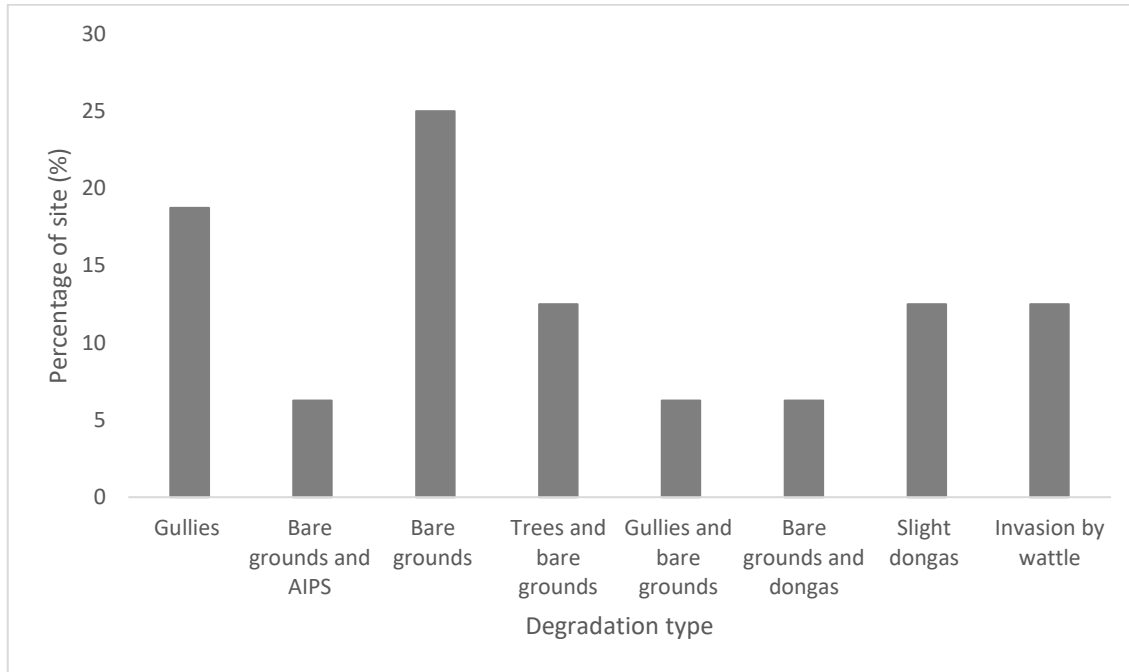


Figure 4.6: Degradation types detected using rapid assessment test in Hlankomo and Lower Tsitsana

Grass species composition

Sixteen (16) grass species were identified in the two study sites. The grass species were categorised into their grazing values, ecological status, life form, and plant succession. The results showed that the most abundant species were *Aristida junciformis* (23.8 %), *Eragrostis plana* (22.2 %), and *Sporobolus africanus* (15.5 %), and the least appearing species was *Eragrostis chloromelas* with an abundance percentage of 0.08 %. The grazing statuses of the grasses showed that most grasses were increaser II species (n=11, 69%) (IQR =1.7), followed by Increaser III (n=2, 13%) (IQR =3.9), Exotic (n=1, 6 %) (IQR=0), Increaser I (n=1, 6 %) (IQR=0), and Decreaser (n=1, 6 %) (IQR=0). Although there were more Increaser II species, Increaser III species had a high mean abundance value (Figure 4.7). A Kruskal-Wallis test was done to determine if there was a significant difference between the different grazing statuses. The test showed no significant difference in abundance between the different grazing status groups (H = 5.87, P=0.2091).

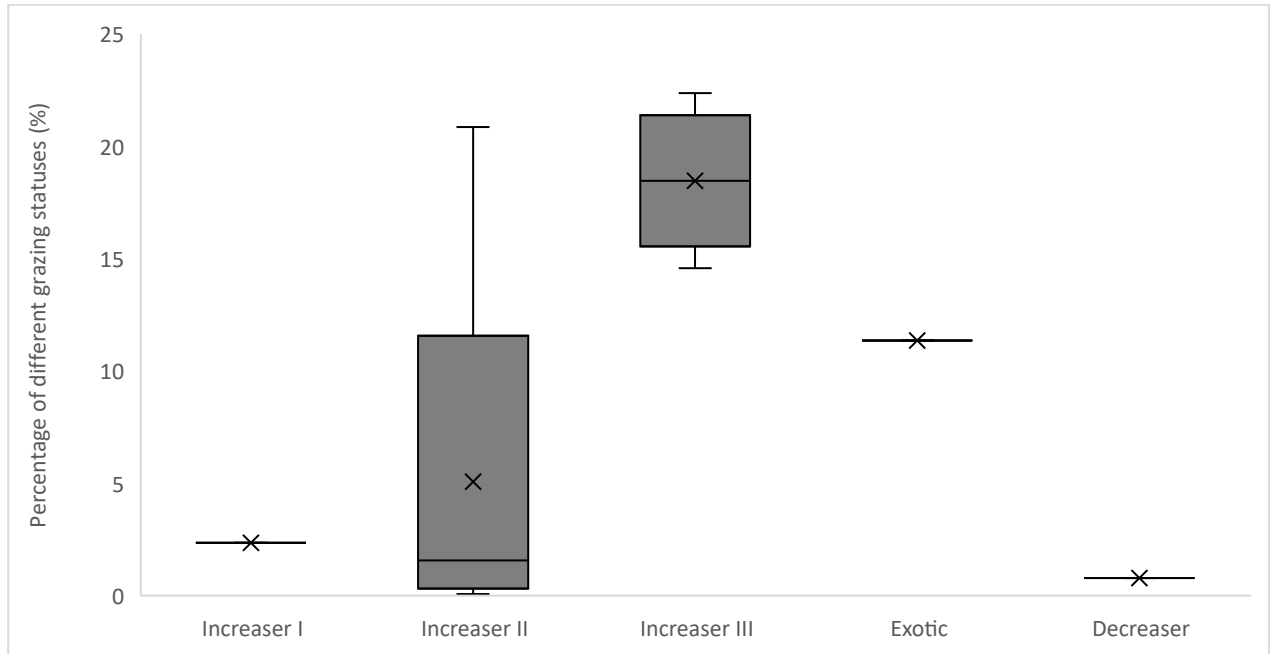


Figure 4.7: The abundance values for the different grass grazing statuses. The box and whisker plot shows that increaser III species were the most dominant grass species, while decreaser species were the least appearing in Hlankomo and Lower Tsitsana. $n=14$.

There were more species with low ($n=7$, 43.8 %) and average grazing values ($n=7$, 43.8 %) as compared to species with high grazing values ($n=2$, 12.5 %). However, when analysing the mean abundance according to the different grazing values, low grazing value species 8.8 % (IQR=17.2) were more abundant, followed by high 6.5 % (IQR=4.8) and average grazing values 2.7 % (IQR= 0.9), respectively (Figure 4.8). A Kruskal-Wallis test was done to determine if there was a significant difference between the different grazing values. The test showed no significant difference in the abundance of the different grazing value groups ($H=1.44$, $p=0.5643$).

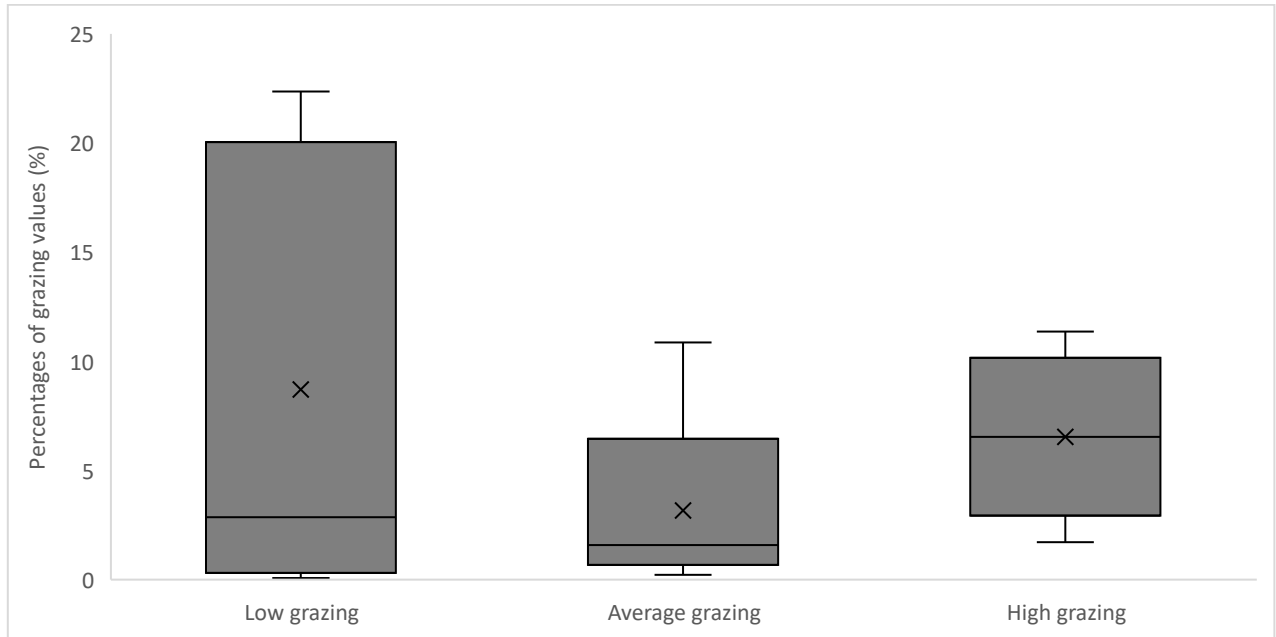


Figure 4.8: the abundance values representing the different grazing values for the grass species in abandoned lands of Hlankomo and Lower Tsitsana. The box and whisker plot shows more grass species with low grazing (IQR=17.2) values than those with average (IQR =0.9) and high (IQR=4.8) grazing values. n=14.

The life forms of the grass species showed that there were more perennials (n=13, 81 %), followed by weak perennials (n=2, 13 %) and creeping grass species (n=1, 6 %). The mean abundance of the grasses in the different life form groups showed that there were more perennials 6.2 % (IQR=10) followed by weak perennials 5.8 % (IQR=6) and creeping grasses 1.7 % (IQR=0), respectively (Figure 4.9). A Kruskal-Wallis test was done to test if there is a significant difference between the different life forms. The test showed no significant difference between the different groups of grass life forms (H=0.164, p=0.9214).

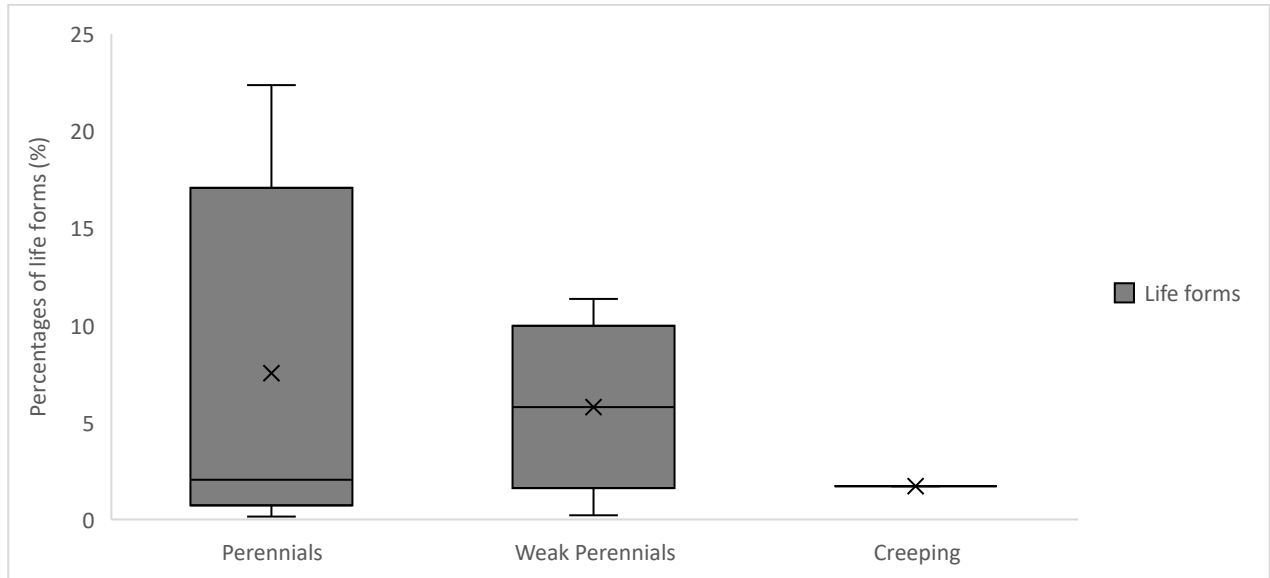


Figure 4.9: Life forms presented as mean abundance for the different grass species in Hlankomo and Lower Tsitsana. The box and whisker plot shows that there were more perennial grass species (IQR=10) than weak perennials (IQR=6) and creeping (IQR=0) grass species. n=14.

The plant succession stage results showed that most grass species were sub-climax grass species (n=8, 50 %), followed by sub-climax and climax (n=3, 18.8 %), climax (n=2, 12.5 %), pioneer (n=2, 12.5 %), and common weeds (n=1, 6.3 %). The abundance of the grasses in the different plant succession groups showed that there were more climax grasses 11.6 % (IQR=10.8) followed by common weeds 11.4 % (IQR=0), sub-climax 6.5 % (IQR=10.5), sub-climax and climax 1.8 % (IQR=1.4), and pioneer grasses 0.93 % (IQR=0.8), respectively (Figure 4.10). A Kruskal-Wallis test was done to check if there is a significant difference between the different life forms. The test showed no significant difference in the different groups of plant succession (H=2.325, p=0.6761).

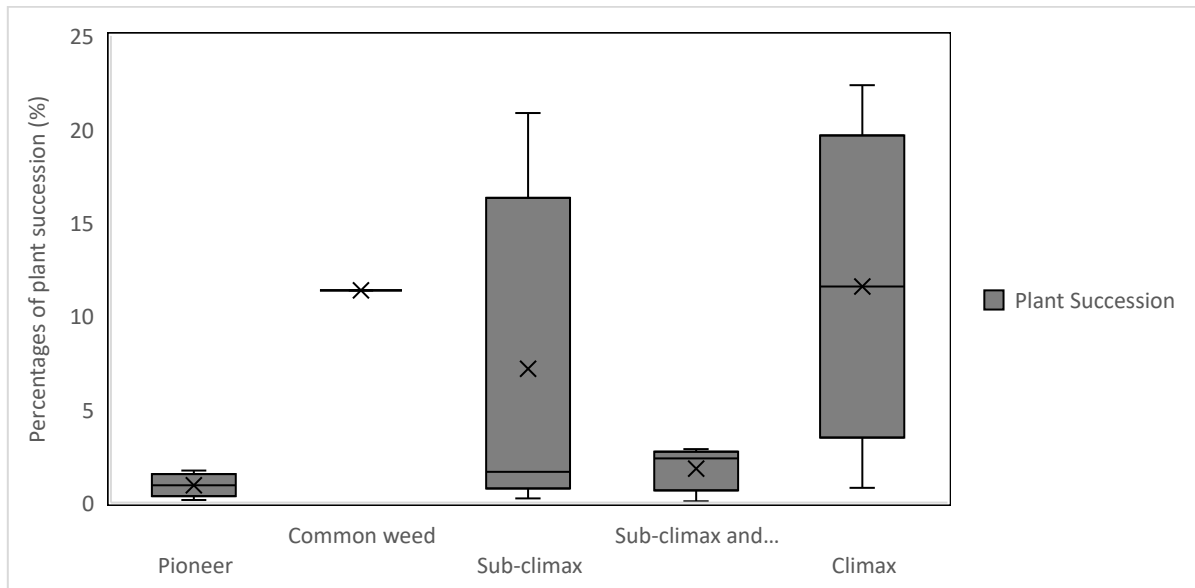


Figure 4.10: Plant successions presented as mean abundance values for grass species found in Hlankomo and Lower Tsitsana. The box and whisker plot shows more climax grass species (IQR=10.8) followed by sub-climax (IQR=10.5), sub-climax and climax (IQR=1.4), pioneer (IQR = 0.8) and common weed (IQR=0) grass species. n=14.

Interviews

The respondents mentioned increased poverty (n=24, 51.1 %), buying from supermarkets (n=32, 68 %), and dependence on home gardens (n=16, 34.0 %) as some of the impacts they have had to face since abandoning their cultivated lands.

Respondent 8: " Today, we are facing difficulties. If you do not have the money, you will never eat because your field is Spar. You are forced to have money now. "

In addition to the impacts mentioned above, the respondents also mentioned dependency on grants (n=9, 19.1 %), lack of food for livestock and chickens (n=7, 14.9 %), getting sick often (n=5, 10.6 %), lack of ubuntu (n=3, 6.4 %), increased crime (n=2, 4.3 %), lack of knowledge about planting (n=2, 4.3 %), change in environment (species diversity) (n=1, 2.1 %), and eating Genetically Modified Foods (GMFs) (n=1, 2.1 %) (Table 3). A Chi-square test was done to check if there is a significant difference between the most and the least appearing impact of cultivated land abandonment. A Chi-Square test showed a significant difference between the most and least appearing impact of cultivated land abandonment (n=33, df=1, $\chi^2=29.1$ and p=0).

Respondent 24: " We no longer eat fresh food, and the maize we buy is tasteless because this maize is genetically modified. It is not that original maize. Things have changed; even the birds that used to be around when we used to plant are no longer there. Even animals that used to be around, like Porcupine, etc., that used to eat maize are no longer there. Even rabbits are

scarce. Nature has changed, and the environment has changed a lot. We also no longer eat fresh food, and we buy beans. We used to plant and eat fresh potatoes and beans."

Table 4.2: Identified themes, their proportions, and illustrative quotes emerging from the interview questions "What are the consequences of cultivated land abandonment?".

Consequences			
Themes	%	Proportion (%)	Illustrative quotes
Buying from shops	32	68.1	<i>"It has done a great change because now we live off buying things, while back then we didn't buy, we didn't even buy maize back then." (Respondent 04)</i>
Poverty	24	51.1	<i>"In the village, people are struggling financially. Even the grant that they receive, you will have to buy maize and buy bran, but they could have been eating from the fields." (Respondent 10)</i>
Dependency on gardens	16	34.0	<i>"We buy everything and are more reliant on our gardens, which are too small." (Respondent 35)</i>
Dependency on grants	9	19.1	<i>"We are now living on our grant money and the salaries/wages we work for. The money we receive from these grants and salaries/wages is the money that helps us to buy the food we used to plant, we no longer plant for ourselves, we buy, or we plant in our gardens inside the homestead." (Respondent 22)</i>
No food for livestock and chickens	7	14.9	<i>"We buy from shops even for feeding pigs. At home, we have about 15 pigs. We are struggling. It has really changed, we are struggling, now that we are no longer planting, we are struggling." (Respondent 10)</i>
Sickness	5	10.6	<i>"Life has changed; many diseases started appearing when we started eating processed food. This is why we are so sick. Before, we ate sour porridge that was milled on a milling rock. We were healthy and happy. Then sicknesses surfaced once we started eating processed food." (Respondent 07)</i>
Lack of ubuntu	3	6.4	<i>"It has affected us hugely. Even if I have some small change, I cannot help them because I am looking after my household, that's all, my relatives and other community member. I do not care as to what they eat. Can you see it is a terrible life? We cannot share." (Respondent 14)</i>
Lack of knowledge about planting	2	4.3	<i>"Our livelihoods have changed because you will find that people are really struggling financially, and the crime rate is high because the arable fields are no longer planted, and people's knowledge is decreasing in knowing that the land is what produces food." (Respondent 32)</i>
Crime increases	2	4.3	<i>"Our livelihoods have changed because you will find that people are really struggling financially, and the crime rate is high because the arable fields are no longer planted." (Respondent 32)</i>
change in species diversity	1	2.1	<i>"Things have changed; even the birds that used to be around when we used to plant are no longer there. Even animals that used to be around, like Porcupine, etc., that</i>

used to eat maize, are no longer there. It is even rabbits are scarce. Nature has changed, and the environment has changed a lot.” (Respondent 24)

Genetically Modified Foods	1	2.1	<i>“We no longer eat fresh food, and the maize we buy is tasteless because this maize is genetically modified. It is not that original maize.”</i> (Respondent 24)
-----------------------------------	---	-----	--

4.5 Thesis objective 4: What future outcomes (future focal action situations) are desired with regards to abandoned cultivated lands, and how do current conditions in resource and governance systems constrain or enable that?

Of the 47 respondents, 46 had previously had land under cultivation, and only one had no land under cultivation (Table 4). However, only two participants are still ploughing or cultivating their fields. The participants mentioned that they used to plough using cattle and had planted them for household consumption. They had primarily planted maize and grew wheat, potatoes, beans, cabbage, and pumpkin.

Respondent 28: “I will still choose cultivation. What can be done is to bring people together to form a project, and they can be groups of 8 or 20 people. They would combine their fields, start cultivating there, and share the money they made there.”

Table 4.3: Identified themes, their proportions, and illustrative quotes emerging from the interview questions: “Do you have cultivated lands and are you still ploughing those fields.”

Farming practices			
Own cultivated lands			
Themes	Number	Proportion (%)	Illustrative quotes
Yes	46	97.9	<i>“ Yes, every household owned a field back then.”</i> (Respondent 04)
No	1	2.1	<i>“ No, I still don’t have arable lands.”</i> (Respondent 25)
Active farmers			
Themes	Number	Proportion (%)	Illustrative quotes
Yes	2	4.3	<i>“ We planted the whole field, even the one that is on that side, it is still planting in it. It is planted as a projected.”</i> (Respondent 6)
No	45	95.7	<i>“No, there is no one planting in the arable fields.”</i> (Respondent 2)

Although most participants mentioned that they would be happy if the fields could be recultivated, other participants mentioned that they would be pleased if the fields could be used for recreational purposes (n=2, 4.26 %), buildings (n=5, 10.6 %), livestock protection camps (n=2, 4.3 %), and poultry farms (n=1, 2.1%) (Table 5). In contrast, other participants said they did not care what the old fields could be used for as long as that would bring employment opportunities within the area (n=6, 12.8).

Respondent 08: "There are many things that could be done in those fields, a thing that could be done in one of these fields, with us being in poverty and our children being cruel, locking our mothers. It would be nice if these fields could have a police station built on them, or sports fields, for example, in the location, there be sports grounds, there would be people who can coach sports if kids could be taken to such facilities, I am certain that crime would go down by keeping these kids busy."

Table 4.4: Identified themes, their proportions, and illustrative quotes emerging from the interview questions "What are other possible land uses."

Other land uses			
Themes	number	proportion	Illustrative quotes
Recultivate	31	66	<i>" No, I do not even like the fact that cattle are grazing there. If there were to be fencing and we start planting again, it would look beautiful, and we would also be healthier." (Respondent 01)</i>
didn't care	6	12.8	<i>" No, for me, they can do anything I do not mind. They once said they would build houses, but people refused." (Respondent 44)</i>
Building	5	10.6	<i>" Yes, there is. We are cutting in those fields' resident places, or they could also build a mall."(Respondent 15)</i>
Livestock protection camps	2	4.3	<i>" It could also be turned into camps for livestock so they can be protected. So that when we have planted sorghum, we can bring the livestock from the rangelands to keep them in good health. These camps can be used as rotational grazing systems so that when they are grazing in one camp, they can be moved to another camp and not graze on one side all the time. When one camp is being utilised, the other camps are rested."(Respondent 29)</i>
Recreational purposes	2	4.26	<i>"I want to plant again because it will save money and the environment. Maybe they can also be used for building libraries or recreational purposes."</i>
Poultry farms	1	2.1	<i>" They can make projects in that way people can be motivated. Maybe they say people should come together, and they will make for them chicken structures, or they say they will make you plant a certain vegetable, then Spar can come buy from us." (Respondent 14)</i>

When asked about other land uses, most participants (n=38, 80.9 %) mentioned that they would be interested in re-cultivating the old fields. The participants who mentioned that they would be interested in recultivation said they would only go back if there were governmental support in the form of fertilisers and fencing. The participants also mentioned that re-cultivating the land will have many benefits, such as financial independence (n=23, 48.9 %), increased food availability for them (n=20, 42.6%), food available for livestock (n=7, 14.9 %), job creation (n=4, 8.5 %), less crime (n=1, 2.1 %) and reduced sicknesses (n=1, 2.1 %) (Table 6). The participants said eating highly processed foods from the supermarket resulted in frequent clinic visits because of diseases like diabetes and high blood pressure. The interviews showed that most

participants were still interested in re-using the land for planting crops, as opposed to other land uses, because they believed their lives used to be better when they were still cultivating the land.

Respondent 24: “Yes, for my health, to save money, and to save the environment. Because the environment benefits when we have planted, cattle will eat until they are satisfied, and we will eat until we are satisfied. After harvesting, cattle eat maize stover, and the cattle become fat. When we slaughter and eat the cattle, we eat cattle with fat meat, you see.”

Table 4.2: Identify themes, their proportions, and illustrative quotes emerging from the interview questions: “How many people are interested in recultivation, and what are the benefits of cultivating? ”.

Interest in recultivation			
Themes	Number	Proportions (%)	Illustrative quotes
Interested in recultivation	38	80.9	<i>" Yes, I do have an interest in planting, but a disadvantage is that we do not have fencing around our fields." (Respondent 25)</i>
Not interested	9	19.1	<i>" No- I don't have the strength, my waist is so sore!" (Respondent 36)</i>
Benefits of recultivation			
Themes	Number	Proportions (%)	Illustrative quotes
Financial independence	23	48.9	<i>" Interviewee: People are dependent on government grants because most people are unemployed; they depend on government grants. They would come out of debt because people have debts from shops just from taking food. So people wouldn't depend on shops for food. They could provide for themselves." (Respondent 24)</i>
More food available	20	42.6	<i>" Firstly, I would benefit because it will receive their vegetable close to home. Secondly, the community would benefit because they would receive fresh produce planted in front of them. After all, we do not know how long the vegetables in town have been sitting on the shelf." (Respondent 22)</i>
More food for livestock	7	14.9	<i>"It helps people and their livestock. People's cattle die from hunger in winter, but since I started planting, no cattle starved because when the grass is depleted in those areas, then these area grass would be opened for them to graze, and forage (stalks and cobs) will be available for the livestock to eat. So certain people benefit, those with livestock and those who don't have livestock as a community" (Respondent 32)</i>
More job creation	4	8.5	<i>" It will benefit because I would employ people, even if it is a few people, because many people are sitting at home and not being productive. Then others will start doing wrong things</i>

			<i>because they are non-productive due to a lack of work." (Respondent 22)</i>
Less crime	1	2.1	<i>" Our lives would change, and we would not even have thieves in the community, and everyone would have work or be employed because we have crime due to high energy levels that are not utilised productively." (Respondent 32)</i>
Less disease	1	2.1	<i>" We are sick. We are dying from this diabetes and high blood. They are sucking the life out of us. Planting will reduce diseases." (Respondent 10)</i>

As stipulated by respondents, the desired outcomes of the abandoned cultivated lands showed that locals have varying preferences for the abandoned fields. However, it is essential to recognise that the future desired outcomes depend on the abandoned fields' social-ecological state (Table 7). The table shows the social-ecological considerations of each desired outcome as derived from the current state of the fields. The results show that for each desired outcome, there will be social-ecological challenges that may need to be overcome.

Social-Ecological Consideration

Table 4.6: The social-ecological considerations according to the desired future actions of the locals

Desired Future Focal Action Situation	SES Consideration
Re-cultivation	<ul style="list-style-type: none"> The results showed that the abandoned fields are in poor conditions, dominated more by grass species that grow in poor veld conditions. Fertilisers and labour will have to be available, and there is already limited labour in these villages due to outmigration.
Building	<ul style="list-style-type: none"> Gullies formation and soil erosion will have to be considered.
Livestock protection camps	<ul style="list-style-type: none"> The ecological conditions of the fields are currently deteriorated, and the fields are dominated by poor grass species. The soil conditions will have to be considered. The fencing and livestock used for these camps might be targets for thieves, as respondents have reported.
Recreational parks	<ul style="list-style-type: none"> The ecological state of the fields is currently not good as they are covered by poor grasses.

	<ul style="list-style-type: none"> • The soil conditions are not in a good state, and the formation of gullies will have to be considered.
Poultry farms	<ul style="list-style-type: none"> • The ecological state of the field won't have much influence on this as the poultry won't necessarily depend on the ecological state of the fields. • Labour availability must be considered as more people have migrated to big cities.

CHAPTER 5: DISCUSSION

My results show that abandoned cultivated lands emerge from social-ecological interactions that also shape differing desires and constraints for the future of these lands. Both aerial photographs and interviews show a decline in cultivated lands from the late 1970s, worsening in the 1990s, similar to other studies (Blair et al., 2018; Shackleton et al., 2013; Andrew & Fox., 2004; Jewitt et al., 2013). It is important to note that with the high number of years between the analysed images, cultivation abandonment could have happened before 2003, and my analysis couldn't have picked that up. However, from the interviews, literature and google earth images I can speculate that the most abandonment happened in the late 1970s to 1990s. The interviews showed that the people started abandoning cultivation in the late 1970s to the early 1980s, with the highest abandonment in the 1990s. A superficial comparison with Google Earth imagery (1985, 2003 and 2016) also show that abandonment had already started occurring in the 1985 and continued to happen as the 2003 and 2016 images show increased cultivated land abandonment (Annexure B). The declines were more strongly driven by socio-economic factors (lack of fence and cattle) than biophysical factors (drought and rainfall variability), although the latter contributed significantly as a barrier to re-starting cultivation. My results further showed that abandoned fields are degraded and covered in poor grass species (Increaser II species usually have a low grazing value and grow on poor land) (Van Oudtshoorn., 2012). Whilst there were differing views on the future of the lands, many people valued re-cultivation, but it is clear, both from interviews and ecological results, that there are significant barriers to such future states. In this discussion, I attempt to synthesise the interactions that played a role in cultivated land abandonment in Hlankomo and Lower Tsitsana, shaping differing desired outcomes for these abandoned lands.

5.1 The extent that land abandonment has emerged as a focal action situation in these two villages.

The combination of interviews and aerial photograph analysis confirms that cultivated land abandonment has been going on in the catchment for the past four decades. The aerial photographs showed a decline in cultivated lands from 1966 to 2015, with a significant decline between 1966 and 2003. The land under cultivation between 1966 and 2003 decreased by 95 % and decreased by 60 % between from 2003 and 2015 decreased by 60 %. A superficial comparison with Google Earth imagery (1985, 2003 and 2016) supports the conclusions drawn from analysis of aerial photos and interviews as it indicates that abandonment had already started

occurring in the 1985 and continued to happen as the 2003 and 2015 images show increased cultivated land abandonment (Annexure B).

This finding correlates with other studies done in South Africa (Shackleton et al., 2013; Blair et al., 2018; Andrew and Fox, 2004). Andrew and Fox. (2004) showed a decrease of 49 % in cultivated land from 1962-1982. Blair et al., 2018 found widespread crop abandonment from the 1950s to 2010s, with cropland abandonment peaking in the 1970s and 1990s in their surveyed homelands (Kwa Zulu Natal: 0.08% year⁻¹, Transkei: 0.13% year⁻¹, Lebowa: 0.23% year⁻¹, Venda: 0.28% year⁻¹). Shackleton et al. (2013) also found an increase in the abandoned field cover from 1.5 % in 1961 to 6.9 % in 2009 on the wild coast of South Africa.

The high increase in abandonment correlates with changes in the historical political events of South Africa (Simon and Ramutsindela, 2000; Lester, 2000). The early decline was seen in the 1970s and 1980s, correlating with South Africa's betterment planning (Letsoalo & Rogerson, 1982). The betterment planning came into action in the 1930s and resulted in the segregation of black and white farmers (Lestoalo & Rogerson, 1982; Rowntree et al., 2018). The initial plan of the act was to protect the environment and reduce soil erosion. However, this act resulted in the segregation of black and white farmers. Black people were moved to small, congested homesteads that were far from their agricultural fields, resulting in a decline in agricultural activities in the black communities (Letsoalo & Rogerson, 1982). The early decline of cultivated lands could also be because of industrialisation, as men were taken to go work in mines leaving woman in the villages to carry out farming activities (Beinart & Delius, 2014; Lester, 2000). The Native Land Act of 1913 also resulted in white farmers being allocated more land, credits and subsidies, and horticulture and veterinary support, while black farmers were not catered for (Beinart & Delius, 2014). Although the government tried to reverse the damage done by the betterment plan through policy changes which speak to redistribution, restitution and land tenure, there is still an increase in the abandonment of cultivated lands in South Africa (Lidzhegu & Palamuleni; Blair et al., 2018, Shackleton et al., 2013, Shackleton et al., 2019).

When mapping the extent of abandonment within the two villages, it was recognised that the home gardens increased as the cultivated lands declined. Other authors also reported this finding (Andrew & Fox., 2004; Shackleton et al., 2019). Andrew and Fox. (2004) showed that the decrease in cultivated lands also showed an increase in home gardens, which could be interpreted as land use change from cultivated lands to home gardens. Shackleton et al. (2019) found

increased gardens as cultivated lands were abandoned. This finding also correlates with the interview results, as some participants mentioned that they had stopped cultivating because the fields were far away. They didn't have the strength to walk to the fields, so they resorted to home gardens. Although this trend seemed popular, the respondents were still unsatisfied with only planting in their home gardens and expressed their desire to return to cultivating.

Similarly, in this study, the respondents reported a decline in agricultural activities from the late 1970s and early 1980s, with a significant decline in the 1990s (Figure 4.1), which correlates well with the beginning of democracy, which came with many changes that may have further exacerbated the increase in cultivated land abandonment. When democracy came into play, people could move freely from where they were originally located in the apartheid era, resulting in increased out-migration from rural areas in search of better jobs outside their hometowns and ultimately reducing agricultural labour available in the rural areas (Rowntree et al., 2018). Democracy also came with the initiation of social grants, which afforded people the luxury of buying food from supermarkets, further perpetuating the abandonment of cultivated lands (Shackleton et al., 2013). Amongst the changes brought by democracy was the Children's rights in section 28 of the Bill of Rights, which advocated for children's right to basic education. This notion further resulted in a lack of people available to herd livestock, causing the livestock to roam free and graze on the cultivated fields as they were not fenced. The macro changes that happened because of the regime change from apartheid to democracy were also reported by respondents in this study and other studies (Lester, 2000; Shackleton et al., 2019; Lidzhegu and Palamuleni., 2012).

The political changes happening on a national scale also played a significant role in cultivated land abandonment (Lester, 2000; Letsoalo & Rogerson, 1982; Beinart & Delius, 2014). This was also seen in European countries, in which the collapse of the Soviet Union resulted in land being privatised, leading to agricultural land being given to people with no knowledge and experience in farming, resulting in the abandonment of cultivated lands (Smaliychuk et al. 2016; Prishchepov 2020). Lidzhegu and Palamuleni (2012) also attributed the decline in agricultural activities to land restitution policies, resulting in the shift of land ownership and management from experienced commercial farmers to the Makotopong community property association in Polokwane, Limpopo.

5.2 Interactions that shaped the emergence of current levels of land abandonment (focal action situation).

The local people indicated that they stopped cultivating in the late 1970s to the early 1980s, but this phenomenon worsened in the 1990s, corresponding with the dawn of democracy. When asked why they stopped cultivating, most respondents alluded to the loss of cattle and no fencing as the most predominant reasons they ceased farming (Table 2). This finding aligns with other literature that has also shown that the loss of cattle contributed to land abandonment as the cattle were previously used for ploughing the fields (Blair et al., 2018; Shackleton et al., 2013). For example, Blair et al. (2018) and Shackleton et al. (2013) reported that the loss of cattle was the predominant reason people left cultivation in the Eastern Cape, South Africa. Blair et al. (2018) found that 80% of farmers attributed cultivated land abandonment to the death of cattle, which came from the withdrawal of government agricultural support services and veterinary assistance after democracy in the former homelands of Transkei, KwaZulu-Natal, Venda, and Lebowa. The cattle decline meant no draught power was available to plough the fields. The lack of a fence resulted in livestock grazing on fields. In this study, the respondents mentioned that they lost their cattle to theft and the cessation of government's agricultural support. One respondent mentioned that the fence that used to separate the livestock from the villages was stolen by the locals to fence off their yards, which aligns with reasons in the literature given for the loss of fences (Shackleton et al., 2013; Blair et al., 2018). As education became more accessible, more children attended school, diminishing the number of cattle herders. Consequently, cattle roamed freely in villages, grazing on cultivated lands, prompting people to abandon farming (Ainslie, 2002).

In addition to fencing and no cattle, the respondents also mentioned lack of labour, lack of resources (machinery and monetary), migration, death of elders, lazy youth, expensive fertilisers, rainfall variability, lack of interest and dependency on grants as some of the reasons they stopped cultivating. Other studies also reported these drivers in other parts of the country (Shackleton et al., 2013; Blair et al., 2018). Labour migration played a significant role in cultivated land abandonment in the early years, as it resulted in decline of men in the villages (Beinart & Delius, 2014). The migration of men from their homes to cities to work in mines, left many rural households without a head and women were forced to become heads of the household (Lester, 2000). The movement of men from villages to cities resulted in the abandonment of cultivated lands as women could not carry out agricultural activities independently due to limited strength, as cultivation was done with oxen, which required strength and skilled handlers. The “youth

laziness” driver could have been because a lot of young people see professional jobs as more appealing and having more social status than farming, resulting in a further shortage of labour for working in the field as the elderly people who are still interested in farming don’t have the physical strength to work on the fields anymore (Shackleton et al., 2013). The high number of people getting grants in the area could have also created an overreliance on social grants as they could use the money to buy some groceries, and they didn’t see a need for cultivating anymore (Blair et al., 2018; Shackleton et al., 2019). The change in climate might have also perpetuated the abandonment of cultivated lands, as climate change is associated with high rainfall variability, which might have discouraged the locals from cultivating the land (Pereira, 2017). The introduction of social grants also created government-dependent communities, further encouraging people to stop cultivation as they could now use their grant money to buy food from supermarkets. The drivers of cultivated land reported by the respondents, shows that the drivers were prevalent at different times. For example, labour migration seems to have played role in the earlier years of cultivated land abandonment, while other drivers such as social grants, cattle losses could have played a role in cultivated land abandonment after democracy (Lester, 2000; Beinart & Delius, 2014).

Some of the drivers mentioned by respondents were also mentioned as consequences. For example, dependency on grants was mentioned as a driver and consequence. This could indicate that as people got exposed to social grants, they became more reliant on them and did not see the need to cultivate the land anymore as they could now afford to buy food from supermarkets, which further resulted in them being more and more vulnerable, and dependent on grants. Dependency on grants, also mentioned as a consequence, could mean that the participants realised that not cultivating the land has made them dependent on grants, further increasing their vulnerability. Although social grants were mentioned as both a driver and consequence in this study, other studies have only mentioned it as a driver of cultivated land abandonment (Shackleton et al., 2019; Hebinck et al., 2007; Blair et al., 2018; Hebinck et al., 2018).

In addition to the drivers reported in this study, other studies in South Africa have also mentioned lack of water, wild animals eating crops, and poor soils as drivers of abandonment, which were not mentioned in this study (Blair et al., 2018 and Shackleton et al., 2013). Only 4.3% of respondents mentioned biophysical drivers (lack of rainfall) as the reason they left cultivation. The mention of more socioeconomic than biophysical drivers suggests that the drivers of cultivated land abandonment in the Lower Tsitsana and Hlankomo of the Tsitsa River catchment

were more socioeconomic than biophysical. This phenomenon was also observed in other parts of the world and South Africa (Alcantara et al., 2013; Blair et al., 2018; Chaudhary et al., 2020). Although the participants mentioned drought as the reason for the death of their cattle, they didn't see this as a reason they had stopped cultivating the land.

The drivers mentioned in this project could be linked to the change in policies. For example, the earlier policies during the apartheid era, such as the Native Land Act of 1913, the Black Authorities Act of 1951 and the Promotion of Black Self Government Act of 1959, greatly influenced the Tsitsa River catchment landscape (Beinart & Delius, 2014; Rowntree et al., 2018). These policies influenced cultivated lands by separating the Transkei from the Republic of South Africa and laws restricting black people from land ownership. The farmer's support in direct and indirect subsidies, such as grants for soil conservation and low-cost irrigation water, was only provided to white farmers and not extended to black farmers, further perpetuating cultivation abandonment (Rowntree et al., 2018). The increase in the abandonment in the Tsitsa River catchment resulted in an increase in small gardens that could be managed and fenced by women. The removal of agricultural subsidies could have also exacerbated the changes in cultivated lands, as there was no more support, such as veterinary assistance and agriculture. Some changes that came with democracy were that people now had freedom of movement, which meant they could migrate from their villages to cities, further reducing agricultural labour available in the villages and leading to the abandonment of cultivated lands (Rowntree et al., 2018). The migration of people from rural to urban areas seems to have also played a significant role. People moving from rural areas could be influenced by people trying to search for better job opportunities in urban areas. This study has shown that political shifts greatly influenced the changes in land use and how people relate to cultivated land abandonment in the Hlankomo and Lower Tsitsana of the Tsitsa River catchment.

The drivers of cultivated land in the Tsitsa River catchment support the idea that it is a complex social-ecological system, as most of the drivers were driven by political changes over the years, and these changes, directly and indirectly, influenced land use in the Tsitsa catchment. As there was segregation of the former Transkei from the Republic of South Africa, this meant that the black people from the homelands of the Transkei were cut off from some agricultural support programs which could have helped the local community maintain their cultivated lands (Rowntree et al., 2018). The betterment plan also resulted in fields being situated far from the people's homes, leading to abandonment. The migration of men from their homes to cities to

work was also an indirect driver of abandonment, as when the men left, women were forced to become heads of the household and carry out agricultural activities, which were mostly done by men. This shows how political changes had an impact on land use changes, which may have an impact on the ecological state of the area and affect how people relate to the landscape. The high abandonment of cultivated lands being seen after democracy further shows that this is a complex social-ecological system. The introduction of land restitution programs may have also resulted in an increased decline in cultivation (Lidzhegu & Palamuleni, 2012). This shows that one change in the system could have devastating consequences, whether positive or negative. Democracy was seen as a positive change; however, it has resulted in more and more cultivated lands being abandoned, leaving some rural communities impoverished (Lidzhegu & Palamuleni, 2012).

5.3 Impacts resulting from the current action situation for people (actors), resource units and resource systems (grass, soil, biodiversity, and ecosystem health)

In the interviews, many respondents mentioned spending money on food from supermarkets (**n=32**) and **poverty (n=24)** as the most dominant impacts after abandoning cultivation. In addition, they also mentioned sickness, dependency on gardens, no food for livestock and chickens, crime increase, lack of ubuntu (unable to share with others out of fear of running short), lack of knowledge about planting, dependency on grants and change in species diversity as the impacts they faced after they had stopped cultivation. Other studies have also mentioned the same effects of cultivated land abandonment on livelihoods (Chen & Xie, 2021; Masiza et al., 2023). The abandonment of cultivated lands in Tyhume Valley was widely seen to be one of the major causes of poverty by 72.55% of the respondents and cited by 34.31% and 41.12% of the respondents as one of the major causes of high unemployment and increased purchasing and consumption of unhealthy food, respectively (Masiza et al., 2023).

Although the respondents mentioned more socio-economic impacts, they also mentioned changes in species diversity as there was a decline in wild fruit and animals that they used to see. Other studies also reported changes in species diversity (Beyanas et al., 2007; Shackleton et al., 2013; Blair et al., 2018). Shackleton 2013 showed a trend of increased woody biomass and species richness with the length of time since abandonment. Masunungure et al. (2018) found a decline in natural resources and woodland products as the diversity of wild fruits, wild animals, and grass species declined.

The respondents also mentioned that they were no longer getting the goods they used to get from the cultivated lands, and the lands were laying fallow and had now turned into rangelands. This phenomenon of abandoned lands being primarily used as rangelands was reported by other studies. Bennett & Barrett (2007) and Bennett et al. (2007) showed that in most communal areas, when the land is abandoned, it is primarily used for livestock grazing. Abandoned cultivated land formally or informally becomes an extension of grazing land and this can be seen as land use change from cultivated land to rangelands (Moyo and Ravhuhali., 2022). Andrew and Fox (2004) also argue that the decrease in cultivated lands may not be a complete cessation of cropping but a shift towards intensification where farmers use home gardens to intercrop maize with other food crops, which could be interpreted as land use change from cultivated lands to home gardens. It is, therefore, important to note that what we may see as cultivated land abandonment may sometimes be change from one land use to another. This change in land use from cultivated lands to rangelands may impact livelihoods and the community, as the local people can no longer harvest the same goods and services they used to get while cultivating and this will impact how local communities relate to cultivated lands. Although most respondents perceived this change negatively, the shift from cultivated lands to rangelands can have good outcomes as their livestock will now have enough land to graze/forage on. The consequences of cultivated land abandonment were just like the drivers; they were more socio-economic than biophysical, as mentioned by the participants, showing that the drivers might greatly influence the consequences of abandonment. These findings suggest that the impacts of cultivated land abandonment in the rural areas of the Tsitsa River catchment were also more socioeconomic than biophysical, corresponding with other findings globally (Benayas et al., 2007; Li and Li et al., 2016; Masunungure, 2018; Zhou et al., 2018; Chen & Xie, 2021). The different findings from various authors further show that cultivated land abandonment is a complex social-ecological system and is not unidirectional, as what happens in one region can be completely different to what happens in another area.

The consequences of cultivated land abandonment in the Tsitsa River catchment were greatly influenced by the drivers, which were influenced by political changes. The consequence mentioned by participants shows that how the land is used has a direct impact on their livelihoods and economic status. As people abandoned their fields due to the drivers mentioned above, this led to poverty and high dependency on social grants and remittances, resulting in rural landscape dysfunctionality. As people could no longer get the food they used to get from the fields, crime would increase and more outmigration from the villages as people would move to cities in search

of better employment and school opportunities, leading to limited labour in the rural areas for agricultural activities and therefore perpetuating cultivated land abandonment and the dysfunctionality of villages (Shackleton et al., 2013; Blair et al., 2018). The disuse of the fields also affected their ecological state, which may affect their future land uses.

My results suggest that abandoned cultivated land may lead to degradation. The Tsitsa catchment is located in the grassland biome (Mucina and Rutherford, 2006), and the fact that sites were dominated by grasses, as opposed to invasive trees or shrubs, is on the surface positive. However, the grass was of poor quality, there was a high number of increaser II grasses, and many sites were eroded. Since my study did not include comparisons with counterfactual land uses or ecological assessments over time, I cannot conclude a causal link between land abandonment and degradation. Nevertheless, land degradation and abandonment have been widely linked globally (Munroe et al., 2013; Khanal et al., 2006) and in the Eastern Cape specifically (Sibiya et al., 2022), thus there is good reason to believe that this may be the case here too. The results also showed a high cover of alien invasive plants within the catchment compared to weeds and bush encroachment. The high occurrence of alien invasive plants is similar to what was found in other studies (Scorer et al. (2019). The study compared the spread of *Acacia mearnsii* in undisturbed and disturbed grassland areas (previously cultivated areas), and the results showed that the spread of invasive alien plants was higher in disturbed areas than in undisturbed areas (Scorer et al., 2019). The authors suggest that abandoned cultivated lands are more vulnerable to invasion by alien plants than undisturbed lands.

Poor grass species on abandoned cultivated fields have been linked in other studies to overgrazing, as unmanaged livestock move into abandoned fields (Ravhuhali et al., 2020; Mokgakane et al., 2021). In interviews, many (n=42) respondents mentioned livestock freely roaming (n=21) and no fence (n=21), supporting the idea that overgrazing may have played a role in the prevalence of poor grass species in this area. The prevalence of poor grass species, resulting from the shift to rangelands without proper management, implies overuse and overgrazing, contributing to further land degradation. To counteract this, prolonged rest periods for abandoned lands may be necessary, allowing for grass species stabilisation and the regeneration of other plant populations (Sibiya et al., 2023). Furthermore, the high distribution of Increaser II species, such as *Eragrostis plana*, *Aristida junciformis*, and *Sporobolus africanus*, indicates degraded fields possibly subjected to disturbances like burning and overgrazing (Van Oudtshoorn, 2012; Fish et al., 2015; Huchzermeyer et al., 2019). The scarcity of Decreaser

species in the assessed fields supports the notion of poor field conditions prone to soil and environmental degradation (Ravhuhali et al., 2018; Ravhuhali et al., 2021; Mokgakane et al., 2021), which may negatively impact livestock productivity by reducing nutrient availability. Additionally, the assessment of grazing values reveals that most grass species exhibit low to moderate values, signifying unpalatability and low nutritional content. This aligns with the hypothesis that the soil conditions in the areas are suboptimal, potentially leading to the prevalence of low-grazing value species. The reliance on these abandoned fields as rangelands threatens livestock productivity, impacting both income and food sources for the local communities in Lower Tsitsana and Hlankomo. Therefore, the current ecological state of the fields poses significant challenges for local residents, limiting their ability to use the fields for cultivation and reducing their productivity even when utilised as rangelands. As discussed in the next section, poor grassland composition has significant implications for future options for abandoned cultivated land.

5.4 The future outcomes (future focal action situations) desired with regards to abandoned cultivated lands, and how do current conditions in resource and governance systems constrain or enable that?

Although there are conflicting views about the future of abandoned cultivated lands in the Tsitsa River catchment, it is evident that most people (66 % of respondents) would prefer for the fields to be re-cultivated. Although this is the desire of most participants, the ecological conditions of the abandoned lands showed that all the identified fields were covered by poor grasses when assessed through grass species composition, suggesting that the fields may be in poor conditions and degraded. These findings show that it is reasonable to suppose that the abandonment of cultivated lands has negative implications on the ecological state of the area and will, therefore, highly influence what fields can be used going forward. However, this finding may also be seen positively as the abandoned fields are still covered by grass and not encroached by bushes or invasive alien plants, which will usually be more costly to rehabilitate than when covered by only grass.

It is, therefore, important to check if the social-ecological state of these fields could support the desired future, as the current ecological state of the fields will greatly influence the desired outcomes for the fields. For example, the respondent mentioned recultivation, building, livestock protection camps, recreational parks, and poultry farms as their desired outcomes for

the abandoned fields. The diversity of the desired outcome for the abandoned fields shows how complex this phenomenon is, as the local people also have different preferences for the fields. The desire to recultivate could work as the fields are still only covered by grass and not tall trees, which might require more work to remove. However, the results show that the abandoned fields are in poor conditions as they are dominated more by grass species that grow in poor veld conditions. The fields might need to be given enough time to recover, and recultivation can then be considered.

Restoration/rehabilitation would be required before the fields can be cultivated. This rehabilitation or restoration would improve the quality of the abandoned fields by bringing back productivity and environmental sustainability so the lands may be in a good state to be able to support recultivation. Sakellariou et al. (2021) showed that the recultivation of abandoned land depends on the presence of resources and necessitates a closely integrated approach involving site-specific mapping, meteorological data analysis, soil profiling, and precise planning of agricultural activities and crop choices. They advocate for the implementation of land stewardship to address issues of land fragmentation and technological gaps, aiming to engage younger generations and overcome socioeconomic constraints that often result in land abandonment.

Restoration of abandoned fields would also be required to support any of the other desired future activities in the villages, such as livestock protection camps, recreational parks, or building developments. Livestock protection camps could be overnight shelters for animals, which wouldn't require significant ecological improvement, but if these lands were also to be used for grazing, they would require improvement of forage quality and soil condition, as well as sound management plans that support livestock rotation. Considering the current ecological conditions of the fields, they will have to be placed under some management strategies to restore their conditions and promote the growth of healthy grass species that would benefit livestock (Sibiya et al., 2023). Livestock grazing camps could also benefit the local communities' cultivated lands as the livestock won't graze on their unfenced croplands, improving livelihoods and contributing to all stakeholders as those who want to plant will be able to plant without worrying about the cows coming to graze their fields. However, there might be some theft of the fence and livestock in the villages, as has been reported by the locals. Some people might steal the fence to sell it or to fence off their home yards. Sibiya et al. (2023) used grazing management as an intervention to reduce land degradation on abandoned and partially abandoned lands and move towards

sustainable land management. The intervention included the establishment of grazing camps and promoting the rotational resting of camps. These practices allowed the community to control livestock grazing patterns by opening certain parts of the camp in one season while allowing the other parts to camp to the rest for the next season (Sibiya et al., 2023).

Recreational parks as a desired outcome could be pleasing as there are a few youth activities in the villages. The ecological state of the fields is currently not good as they are covered by poor grasses, and the soil is highly erodible. However, this park might mean the grass will get some rest as it is no longer grazed by livestock all the time, which may bring back some pleasing aesthetics. A poultry farm could be a pleasant initiative as it will create jobs in the villages that will shift the youth from the streets and potentially reduce some criminal activities in the villages. The ecological state of the field won't bear much influence on this as the poultry won't necessarily depend on the ecological state of the fields. However, this poultry will have to be well managed so that it does not further contribute to the deterioration of the abandoned fields in the area. The labour availability might be a constraint for the poultry as more people have migrated to cities; maybe this will be a way of bringing the people back to the village. Building, as a desired outcome, could work because there are no issues with the conditions of the fields except for the ecological state of the fields being in bad condition. However, this would also be influenced by whether the fields are not in an area dominated by high soil erosion and gully formation, as this may present hazardous conditions in the future. Other authors have also reported building on abandoned cultivated lands (Gradinaru et al., 2015; Fayet et al., 2022). Gradinaru et al., 2015 showed that abandoned cultivated lands were a valid precursor for built-up development in Bucharest, Romania. Whilst proposed future outcomes of the abandoned fields in the two villages have their different trade-offs and likely outcomes for people and ecosystems, achieving these outcomes requires that communities take account of social-ecological linkages.

Although the local people seem unhappy with the current land use (rangelands). This shift could benefit their livestock and ultimately benefit them as they could sell their livestock at reasonable markets. However, the rangelands are in degraded condition, threatening livestock productivity within these areas. Therefore, rangeland management strategies may need to be implemented to improve the quality of the grass in the catchment. Improving the health of abandoned lands could require that the land be placed under better sustainable management strategies, such as introducing camps for rotational grazing and regulating the number of animals that can graze an

area (Sibiya et al., 2023). Rotational resting is considered one of the simplest methods of stock management. This method involves setting aside an area for some time to allow vegetation to rest and recover (Sibiya et al., 2023; Van der Waal et al., 2018). The common way to do rotational resting is to separate areas for winter and summer; this encourages the pasture to be grazed short in summer and bulk forage to be saved for winter (van der Waal et al., 2018). The areas used for summer and winter need to be altered to allow recovery. In rotational grazing, animals are moved between grazing camps to reduce selective grazing of palatable species and increase stocking densities (van der Waal et al., 2018; Sibiya et al., 2023). The three camps system is commonly used in this method, where two camps are used in each of the dry and wet seasons allowed for grazing while the third camp is rested for a year (van der Waal et al., 2018). Resting systems have also proved to be effective in maintaining the productivity of palatable forage species (Vetter, 2013). Resting schemes are also favoured because they can provide feed during winter and drought periods (Vetter, 2013). These interventions may also help the abandoned lands recover to a state where they can support the future perspectives of the locals while also contributing to the rehabilitation and protection of the environment.

This study has shown that cultivated land abandonment in the Tsitsa River catchment forms a complex social-ecological system. Both socio-economic and ecological factors contribute to this abandonment phenomenon, with socio-economic and political changes appearing more pronounced than ecological influences. The drivers of cultivated land abandonment in Hlankomo and Lower Tsitsana encompass factors such as the loss of cattle, the absence of fencing, and labour shortage, among others. These drivers have led to adverse consequences, drastically affecting the lives of the local community members. Respondents expressed that they were living in poverty and relying on grants for survival.

The ecological assessment of the catchment reveals the degraded state of previously cultivated lands, dominated by unpalatable grass species thriving in overgrazed areas. This degraded state of abandoned lands suggests a shift towards using abandoned lands for grazing without implementing a structured rangeland management system. The cultivation-to-grazing transition in Hlankomo and Lower Tsitsana reflects the complex interplay of socio-economic factors, showcasing the complexity embedded in these areas. Understanding this complexity is crucial for formulating effective management strategies.

CHAPTER 6: CONCLUSION

Cultivated land abandonment is one of the biggest environmental issues facing the rural areas of South Africa. This phenomenon has implications on land vegetation cover, land productivity and livelihoods. This is seen in communal areas such as Lower Tsitsana and Hlankomo of the Tsitsa River catchment, where there has been an increase in the cultivated land abandonment. In this study a combination of interviews, aerial photograph analysis and vegetation assessment was used to understand the extent of cultivated land abandonment, the interactions that shaped the current extent of land abandonment, impacts resulting from the current action situation for people (actors), resource units and resource systems (grass, soil, biodiversity, and ecosystem health) and the future outcomes (future focal action situations) desired with regards to abandoned cultivated lands, and how do current conditions in resource and governance systems constrain or enable that. The study found that cultivated land abandonment has been going on in the catchment for the past four decades. The aerial photographs showed a decline in cultivated lands from 1966 to 2015, with a significant decline between 1966 and 2003. The increase in abandonment was attributed to a complex mix of social, economic and environmental drivers that are interconnected.

The abandonment of cultivated lands also proved to have consequences which were also social-ecological. This study has shown that the high decrease of cultivated lands in the Tsitsa River catchment has left many people in poverty, financial strains, and desperation. Although there is undeniable evidence that the cultivated lands are declining and not in a good ecological state, the locals still showed interest in recultivating the abandoned fields. This notion suggests that the locals still value cultivation and are very interested in re-cultivating the fields but are held back by factors such as no fencing, limited labour, and lack of governmental support in fertilisers and machinery for ploughing. However, the ecological state of these fields suggests that they may need some rehabilitation, such as introducing camps for rotational grazing and regulating the number of animals that can graze an area before they can be reused for cultivation. Alternatively, the abandoned lands may be used for other land uses, such as rangelands, buildings, livestock protection camps, poultry farms and recreational parks, as mentioned by the respondents.

From the results found in this study, we can conclude that cultivated land abandonment in Lower Tsitsana and Hlankomo of the Tsitsa River is a complex social-ecological system, as the

abandonment had consequences on both the livelihoods and the environment. This means that this phenomenon should be explored with systems thinking approaches, which allow for different stakeholders to work together in understanding the interactions at play and the consequences thereof, with the aim of understanding how the system can adapt and rearrange itself to perform optimally to contribute positively to livelihoods and the environment. The systems thinking approach in this study has helped show that various factors played a role in the abandonment of cultivation in Lower Tsitsana and Hlankomo. The drivers influenced the consequences, which influenced the locals' desired outcomes of the abandoned fields. Cultivated land abandonment in Hlankomo and Lower Tsitsana is a major threat to livelihoods and the environment, with people being vulnerable because of poverty, distorted land management, and the ecological state of the fields being degraded. Therefore, a social-ecological system is necessary for understanding the drivers and implications of cultivated land abandonment for sustainable land management on the Tsitsa River catchment. This study thus provides the foundation for planning land use changes and management that could benefit the ecological state of the abandoned lands while also improving livelihoods in the catchment.

Study limitations

In conducting my study, I found it challenging to distinguish between cultivated and fallow/abandoned lands, as cultivated fields are not individually fenced. While cultivated lands often display a more regular texture due to ploughing, and abandoned fields show a more irregular vegetative pattern, various factors such as the timing of the photographs, soil moisture levels, slope gradients, and shadows contribute to potential inaccuracies in classifying these fields.

CITED LITERATURE.

Alam, Md., Islam, Md., Salahin, N., & Hasanuzzaman, M. (2014). Effect of tillage practices on soil properties and crop productivity in wheat-mungbean-rice cropping system under subtropical climatic conditions. *The Scientific World Journal*, 2014, 1–15. doi:10.1155/2014/437283

Alcantara, C., Kuemmerle, T., Baumann, M., Bragina, E. v., Griffiths, P., Hostert, P., Knorn, J., Müller, D., Prishchepov, A. v., Schierhorn, F., Sieber, A., & Radeloff, V. C. (2013). Mapping the extent of abandoned farmland in Central and Eastern Europe using MODIS time series satellite data. *Environmental Research Letters*, 8(3). <https://doi.org/10.1088/1748-9326/8/3/035035>

Andrew, M. and Fox 1, R.C. (2004) “undercultivation” and intensification in the transkei: A case study of historical changes in the use of arable land in Nompá, Shixini’, *Development Southern Africa*, 21(4), pp. 687–706. doi:10.1080/0376835042000288851.

An, H., Zhang, B., Thomas, B. W., Beck, R., Willms, W. D., Li, Y., & Hao, X. (2019). Short-term recovery of vegetation and soil after abandoning cultivated mixedgrass prairies in Alberta, Canada. *Catena*, 173.

Angelo, M.J., & Plessis, D.A. (2017) in *Research handbook on climate change and agricultural law*. Cheltenham, UK: Edward Elgar Publishing.

Anokwa, Y., Hartung, C., Brunette, W., Borriello, G., & Lerer, A. (2009). Open source data collection in the developing world. *Computer*, 42(10), 97–99. <https://doi.org/10.1109/mc.2009.328>

Ainslie, A. Cattle ownership and production in the communal areas of the Eastern Cape, South Africa. Programme for Land and Agrarian Studies, University of the Western Cape, 2002. Research report no. 10. Available online: <http://www.plaas.org.za/sites/default/files/publications-pdf/RR10.pdf> (accessed on 29 August 2018).

Arévalo, J. R., Tejedor, M., Jiménez, C., Reyes-Betancort, J. A., & Díaz, F. J. (2016). Plant species composition and richness in abandoned agricultural terraces vs. natural soils on Lanzarote (Canary Islands). *Journal of Arid Environments*, 124. <https://doi.org/10.1016/j.jaridenv.2015.08.012>

Awwad, W.A. (2003). *Land cover mapping: A comparison between manual digitizing and automated classification of black and white historical aerial photography*. dissertation. University of Florida.

Baker, R.D., De Stieguer, J.E., Grant, D.E., & Newton M.J. (1979). Land-Use/land-Cover Mapping from Aerial Photographs, *Photogrammetric: Engineering and Remote Sensing*, 45(5), pp. 661–668.

Bavorová, M., Ullah, A., Nyendu, D., & Prishchepov, A. V. (2023). Determinants of farmland abandonment in the urban–rural fringe of Ghana. *Regional Environmental Change*, 23(4). <https://doi.org/10.1007/s10113-023-02117-z>

Beinart, W., & Delius, P. (2014). The historical context and legacy of the natives land act of 1913. *Journal of Southern African Studies*, 40(4), 667–688. doi:10.1080/03057070.2014.930623

Benayas, J., Martins, A., Nicolau, J.M., & Schulz, J.J. (2007). Abandonment of agricultural land: an overview of drivers and consequences. *Cab Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, 2, 205714.

Biggs, R. O., Rhode, C., Archibald, S., Kunene, L. M., Mutanga, S. S., Nkuna, N., Ocholla, P. O., & Phadima, L. J. (2015). Strategies for managing complex social-ecological systems in the face of uncertainty: Examples from South Africa and beyond. *Ecology and Society*, 20(1). <https://doi.org/10.5751/ES-07380-200152>

Biggs, R., Clements, H., De Vos, A., Folke, C., Manyani, A., Maciejewski, K., Martin-Lopez, B., Preiser, R., Selomane, O., & Schluter, M. (2022). What are social- ecological systems and social- ecological systems research?, in *Routledge Handbook of Research Methods for Social Ecological Systems*. S.l., London and New York: ROUTLEDGE, pp. 3–18.

Blair, D., Shackleton, C., & Mograbi, P. (2018). Cropland abandonment in South African smallholder communal lands: Land cover change (1950–2010) and farmer perceptions of contributing factors. *Land*, 7(4), 121. <https://doi.org/10.3390/land7040121>

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>

Burdukovskii, M. L., Perepelkina, P. A., & Kiseleva, I. v. (2020). Dynamics of vegetation and soil properties of fallow ecosystems. *Theoretical and Applied Ecology*, 2020(3).

Cao, Y., Bai, Z., Zhou, W., & Wang, J. (2013). Forces driving changes in cultivated land and management countermeasures in the Three Gorges Reservoir area, China. *Journal of Mountain Science*, 10(1), 149–162. <https://doi.org/10.1007/s11629-013-2240-5>

Chaudhary, S., Wang, Y., Dixit, A. M., Khanal, N. R., Xu, P., Fu, B., Yan, K., Liu, Q., Lu, Y., & Li, M. (2020). A synopsis of farmland abandonment and its driving factors in Nepal. *Land*, 9(3). <https://doi.org/10.3390/land9030084>

Chen, Q., & Xie, H. (2021). Research progress and discoveries related to cultivated land abandonment. *Journal of Resources and Ecology*, 12(2). <https://doi.org/10.5814/j.issn.1674-764x.2021.02.004>

Chen, Q. (2022). Analyzing farmers' cultivated-land-abandonment behavior: Integrating the theory of planned behavior and a structural equation model. *Land*, 11(10), 1777. <https://doi.org/10.3390/land11101777>

Christian, M., Jiba, P., & Lelethu, M. (2020). Factors Influencing Rain-Fed Agricultural Land Abandonment in Mquma and Mbashe Municipalities, Eastern Cape. *International Journal of Recent Technology and Engineering*, 9(2), 1213–1219. <https://doi.org/10.35940/ijrte.b3896.079220>

Cocuccioni, S., (2018). *The land abandonment process: Locals' perspectives from Western Iberia*. MSc. Wageningen University and Research.

Cockburn, J., Palmer, C. (Tally) G., Biggs, H., & Rosenberg, E. (2018). Navigating multiple tensions for engaged praxis in a complex social-ecological system. *Land*, 7(4), 1–24. <https://doi.org/10.3390/land7040129>

Cramer, V., Hobbs, R., & Standish, R. (2008). What's new about Old fields? land abandonment and ecosystem assembly. *Trends in Ecology & Evolution*, 23(2), 104–112. <https://doi.org/10.1016/j.tree.2007.10.005>

Deliwe, D. (1995). The farmer support programme in Chatha village, Keiskammahoek district. *Development Southern Africa*, 12(4): 519-533

Department of Environment, Forestry and Fisheries: Environmental Programmes – Natural Resource Management Programmes (NMR), Directorate – Operational Support and Planning, (2019). *BIOPHYSICAL MONITORING: REPORT 1 OF THE UPPER TSITSARIVER CATCHMENT (T35 A-E)*. Report 1. pp.44-47.

Elundini Local Municipality. Available at: <https://www.elundini.org.za/> [Accessed August 25, 2021].

Estel, S., Kuemmerle, T., Alcántara, C., Levers, C., Prishchepov, A., & Hostert, P. (2015). Mapping farmland abandonment and recultivation across Europe using Modis Ndvi Time series. *Remote Sensing of Environment*, 163, 312–325. <https://doi.org/10.1016/j.rse.2015.03.028>

Evans, R. A., & Love, R. M. (1957). The step-point method of sampling: A practical tool in Range Research. *Journal of Range Management*, 10(5), 208. <https://doi.org/10.2307/3894015>

Fayet, C. M. J., Reilly, K. H., Van Ham, C., & Verburg, P. H. (2022). What is the future of abandoned agricultural lands? A systematic review of alternative trajectories in Europe. *Land Use Policy*, 112, 105833. <https://doi.org/10.1016/j.landusepol.2021.105833>

Fish, L., Mashau, A. C., Moeaha, M. J., & Nembudani, M. T. (2015). Identification guide to southern African grasses: an identification manual with keys, descriptions and distributions.

Folke, C. (2016). Resilience (republished). *Ecology and Society*, 21(4). <https://doi.org/10.5751/es-09088-210444>

Grădinaru, S. R., Iojă, C. I., Onose, D. A., Gavrilidis, A. A., Pătru-Stupariu, I., Kienast, F., & Hersperger, A. M. (2015). Land abandonment as a precursor of built-up development at the sprawling periphery of former socialist cities. *Ecological Indicators*, 57, 305–313. <https://doi.org/10.1016/j.ecolind.2015.05.009>

Hardy, M. B., & Tainton, N. M. (1993). Towards a technique for determining basal cover in tufted grasslands. *African Journal of Range & Forage Science*, 10(2), 77–81. <https://doi.org/10.1080/10220119.1993.9638327>

Hanekom, D. (1998). *Agricultural policy in South Africa: Discussion document, South African Government*. Available at: <https://www.gov.za/documents/agricultural-policy-south-africa-discussion-document> (Accessed: March 17, 2023).

Hebinck, P. (2007). 1 investigating rural livelihoods and landscapes in Guquka and Koloni: An introduction. *Livelihoods and Landscapes*, 1–31. <https://doi.org/10.1163/ej.9789004161696.i-394.10>

Hebinck, P., Mtati, N., & Shackleton, C. (2018). More than just fields: Reframing deagrarianisation in landscapes and livelihoods. *Journal of Rural Studies*, 61, 323–334. <https://doi.org/10.1016/j.jrurstud.2018.01.004>

Holden, P. B., Ziervogel, G., Hoffman, M. T., & New, M. G. (2021). Transition from subsistence grazing to nature-based recreation: A nuanced view of land abandonment in a mountain social-ecological system, southwestern Cape, South Africa. *Land Use Policy*, 105, 105429. <https://doi.org/10.1016/j.landusepol.2021.105429>

Huchzermeyer, N., Schlegel, P., & van de Waal, B. (2019). *Biophysical Monitoring Methods in the Upper Tsitsa River Catchment (T35 A-E)*. rep., pp. 44–47.

Imam, E. (2018). Aerial Photography and Photogrammetry. *Remote Sensing and GIS*.

Itzkin, A., Scholes, M. C., Clifford-Holmes, J. K., Rowntree, K., van der Waal, B., & Coetzer, K. (2021). A social-ecological systems understanding of drivers of degradation in the tsitsa river catchment to inform sustainable land management. *Sustainability (Switzerland)*, 13(2), 1–28. <https://doi.org/10.3390/su13020516>

Jewitt D, Goodman PS, Erasmus BFN, O'Connor TG, Witkowski ETF 2015. Systematic land-cover change in KwaZulu-Natal, South Africa: Implications for biodiversity. *S Afr J Sci*. 2015;111(9/10), Art. #2015-0019, 9 pages. <http://dx.doi.org/10.17159/sajs.2015/20150019>

John, D. A., & Babu, G. R. (2021). Lessons from the aftermaths of Green Revolution on food system and health. *Frontiers in Sustainable Food Systems*, 5. <https://doi.org/10.3389/fsufs.2021.644559>

Kakembo V., & Rowntree K.M. (2003). The relationship between land use and soil erosion in the communal lands of Peddie District, Eastern Cape, South Africa. *Land Degradation and Development*. 14(1): 39-49

KC, B., & Race, D. (2019). Outmigration and land-use change: A case study from the Middle Hills of Nepal. *Land*, 9(1), 2. <https://doi.org/10.3390/land9010002>

Khanal, N. R., & Watanabe, T. (2006). Abandonment of agricultural land and its consequences: A case study in the Sikles Area, Gandaki Basin, Nepal Himalaya. *Mountain Research and Development*, 26(1), 32–40. [https://doi.org/10.1659/0276-4741\(2006\)026\[0032:AOALAI\]2.0.CO;2](https://doi.org/10.1659/0276-4741(2006)026[0032:AOALAI]2.0.CO;2)

Kuntz, K. A., Beaudry, F., & Porter, K. L. (2018). Farmers' perceptions of agricultural land abandonment in rural western New York state. *Land*, 7(4), 1–11. <https://doi.org/10.3390/land7040128>

C J de Wet (1987) Land tenure and rural development: Some issues relating to the Ciskei/Transkei region , *Development Southern Africa*, 4:3, 459-478,
DOI:10.1080/03768358708439335

Leal Filho, W., Mandel, M., Al-Amin, A. Q., Feher, A., & Chiappetta Jabbour, C. J. (2017). An assessment of the causes and consequences of agricultural land abandonment in Europe. *International Journal of Sustainable Development and World Ecology*, 24(6), 554–560. <https://doi.org/10.1080/13504509.2016.1240113>

Lester A. (2000). Historical geography. In RC Fox and KM Rowntree (eds) *The Geography of South Africa in a Changing World*. Cape Town: Oxford University Press. pp. 60-86

Letsoalo, E.M., & Rogerson, C.M. (1982) 'Rural "development" planning under Apartheid: Betterment Planning in Lebowa, South Africa', *Geoforum*, 13(4), pp. 301–314. doi:10.1016/0016-7185(82)90028-8.

Levin, S., Xepapadeas, T., Crépin, S.A., Norberg, J., de Zeeuw, A., Folke, C., Hughes, T., Arrow, K., Barrett, S., Daily, G., Ehrlich, P., Kautsky, N., Mäler, K.G., Polasky, S., Troell, M., Vincent, J.R., & Walker, B. (2013). Social-ecological systems as complex adaptive systems: modeling and policy implications. *Environment and Development Economics*, 18, pp 111132 doi:10.1017/S1355770X12000460

Lidzhegu, Z., & Palamuleni, L.G. (2012) "Land use and land cover change as a consequence of the South African land reform program: A remote sensing approach," *Journal of Food, Agriculture & Environment Vol.10 (3&4): 1441-1447. 2012* [Preprint].

Li, S., & Li, X. (2017). Global understanding of farmland abandonment: A review and prospects. *Journal of Geographical Sciences*, 27(9), 1123–1150.

Lunderstedt, K., Mtati, N., Ntsudu, M., & Powell, M., (2017). Participatory Mapping for the restoration and SLM Plan for T35 A-E. Tsitsa Project.

Marshall, B., Cardon, P., Poddar, A., & Fontenot, R. (2013). Does sample size matter in qualitative research?: A review of qualitative interviews in is research. *Journal of Computer Information Systems*, 54(1), 11–22. <https://doi.org/10.1080/08874417.2013.11645667>

Masunungure, C., & Shackleton, S. E. (2018). Exploring long-term livelihood and landscape change in two semi-arid sites in Southern Africa: Drivers and consequences for social-ecological vulnerability. *Land*, 7(2), 8–16. <https://doi.org/10.3390/land7020050>

Masiza W, Hamandawana H, Chirima JG, Khoboko P and Parkies N 2023. The extent, perceived causes and impacts of land use and land cover change in Tyhume Valley, South Africa. *Frontiers in Conservation Science* 4:1205750. <https://www.frontiersin.org/articles/10.3389/fcosc.2023.1205750/full>

Meyfroidt, P., Schierhorn, F., Prishchepov, A. v., Müller, D., & Kuemmerle, T. (2016).

Drivers, constraints and trade-offs associated with recultivating abandoned cropland in Russia, Ukraine and Kazakhstan. *Global Environmental Change*, 37, 1–15.

<https://doi.org/10.1016/j.gloenvcha.2016.01.003>

McGinnis, M. D., & Ostrom, E. (2014). Social-ecological system framework: Initial changes and continuing challenges. *Ecology and Society*, 19(2). <https://doi.org/10.5751/es-06387-190230>

Mokgakane, T. J., Mlambo, V., Ravhuhali, K. E., & Magoro, N. (2021). Contribution of soil type to quantity and nutritional value of grass species on the south african highveld.

Resources, 10(10). <https://doi.org/10.3390/resources10100106>

Mthuli, S.A., Ruffin, F., & Singh, N. (2021) “‘define, explain, justify, apply’ (DEJA): An analytic tool for guiding qualitative research sample size,” *International Journal of Social Research Methodology*, 25(6), pp. 809–821. Available at: <https://doi.org/10.1080/13645579.2021.1941646>.

Mucina, L., & Rutherford, M.C. (2006). The Vegetation of South Africa, Lesotho and Swaziland; South African National Biodiversity Institute: Pretoria, South Africa.

Munroe, D. K., van Berkel, D. B., Verburg, P. H., & Olson, J. L. (2013). Alternative trajectories of land abandonment: Causes, consequences and research challenges. *Current Opinion in Environmental Sustainability*, 5(5), 471–476.

<https://doi.org/10.1016/j.cosust.2013.06.010>

National Aerial photography and Imagery Programme (2013). *Cdngi Geospatial Portal*. Department of Rural Development and Land Reform. Available at: <http://www.cdngiportal.co.za/cdngiportal/> (Accessed: January 16, 2023).

Ngcaba, P., & Maroyi, A. (2017). Floristic composition and diversity in tsitsa river catchment area, the eastern cape province, South Africa. *Journal of Biological Sciences*, 17(6), 288–297.

<https://doi.org/10.3923/jbs.2017.288.297>

Niedertscheider, M., Gingrich, S., & Erb, K. H. (2012). Changes in land use in South Africa between 1961 and 2006: An integrated socio-ecological analysis based on the human appropriation of net primary production framework. *Regional Environmental Change*, 12(4), 715–727. <https://doi.org/10.1007/s10113-012-0285-6>

Ojha, H. R., Shrestha, K. K., Subedi, Y. R., Shah, R., Nuberg, I., Heyojoo, B., Cedamon, E., Rigg, J., Tamang, S., Paudel, K. P., Malla, Y., & McManus, P. (2017). Agricultural land underutilisation in the hills of Nepal: Investigating socio-environmental pathways of Change. *Journal of Rural Studies*, 53, 156–172. <https://doi.org/10.1016/j.jrurstud.2017.05.012>

Olsen, V. M., Fensholt, R., Olofsson, P., Bonifacio, R., Butsic, V., Druce, D., Ray, D., & Prishchepov, A. V. (2021). The impact of conflict-driven cropland abandonment on food insecurity in South Sudan revealed using Satellite Remote Sensing. *Nature Food*, 2(12), 990–996. <https://doi.org/10.1038/s43016-021-00417-3>

Pereira, L. (2017). Climate change impacts on agriculture across Africa. *Oxford Research Encyclopedia of Environmental Science*. doi:10.1093/acrefore/9780199389414.013.292

Pointereau, P., Coulon, F., Girard, P., Lambotte, M., Stuczynski, T., Sanchez Ortega, V., & Del Rio, A. (2008). *Analysis of Farmland Abandonment and the Extent and Location of Agricultural Areas that are Actually Abandoned or are in Risk to be Abandoned*. rep. European Commission, pp. 10–19.

Parwada, C., & Van Tol, J. (2016). Soil properties influencing erodibility of soils in the Ntabelanga area, Eastern Cape Province, South Africa. *Acta Agriculturae Scandinavica, Section B — Soil & Plant Science*, 67(1), 67–76. <https://doi.org/10.1080/09064710.2016.1220614>

Preiser, R., Hill, L., & Klein, L. (2022) “Qualitative content analysis,” in M.M. Garcia (ed.) *The Routledge handbook of Research Methods and for Social-Ecological Systems*. First. Milton Park, Abingdon: Routledge, pp. 270–281.

Prévosto, B., Kuiters, L., Bernhardt-Römermann, M., Dölle, M., Schmidt, W., Hoffmann, M., Van Uytvanck, J., Bohner, A., Kreiner, D., Stadler, J., Klotz, S., & Brandl, R. (2011). Impacts of Land Abandonment on Vegetation: Successional Pathways in European Habitats. *Folia Geobotanica*, 46(4), pp.303-325.

Prishchepov, A. v. (2020). Agricultural Land Abandonment. *Environmental Science, September*. <https://doi.org/10.1093/obo/9780199363445-0129>

Prishchepov, A. v., Radeloff, V. C., Baumann, M., Kuemmerle, T., & Müller, D. (2012).

Effects of institutional changes on land use: Agricultural land abandonment during the transition from state-command to market-driven economies in post-Soviet Eastern Europe. *Environmental Research Letters*, 7(2). <https://doi.org/10.1088/1748-9326/7/2/024021>

Puttick, J. R., Hoffman, M. T., & Gambiza, J. (2014). The influence of South Africa's post-apartheid land reform policies on Bush encroachment and range condition: A case study of Fort Beaufort's municipal commonage. *African Journal of Range & Forage Science*, 31(2), 135–145.

<https://doi.org/10.2989/10220119.2014.880943>

Ramankutty, N., & Coomes, O. T. (2016). Land-use regime shifts: An analytical framework and agenda for future landuse research. *Ecology and Society*, 21(2).

<https://doi.org/10.5751/ES-08370-210201>

Ravhuhali, K.E. (2018) Spatial Variation in Density, Species Composition and Nutritive Value of Vegetation in Selected Communal Areas. Ph.D. Thesis, Department of Animal Science, North-West University, Mmabatho, South Africa.

Ravhuhali, K. E., Mlambo, V., Beyene, T. S., & Palamuleni, L. G. (2020). Effects of soil type on density of trees and nutritive value of tree leaves in selected communal areas of South Africa. *South African Journal of Animal Science*, 50(1), 88–98. <https://doi.org/10.4314/sajas.v50i1.10>

Rowntree, K., Conder-Aller, L., Fox, H., Duma, M., & Ntsundu, M. (2018) *THE GREEN VILLAGE PROJECT Improving socio-economic conditions of the Tsitsa River catchment and Okhombe communities through landscape greening and integrated green innovations*. 1st edn. rep. Pretoria, Gautentg: Water Research Commission, pp. 28–46.

Rural Development Foundation (2022). Lima. Available at: <https://lima.org.za/> (Accessed: March 14, 2023).

Sakellariou, M., Psiloglou, B. E., Giannakopoulos, C., & Mylona, P. V. (2021). Integration of abandoned lands in sustainable agriculture: The case of terraced landscape re-cultivation in Mediterranean island conditions. *Land*, 10(5), 457. <https://doi.org/10.3390/land10050457>

SANBI (2021). *Sustainable Wildlife Economies Project*. Available at: <https://www.wildeconomy.org/> (Accessed: January 16, 2023).

Scorer, C., Mantel, S. K., & Palmer, A. R. (2019). Do abandoned farmlands promote spread of invasive alien plants? Change detection analysis of black wattle in montane grasslands of the Eastern Cape. *South African Geographical Journal*, 101(1), 36–50.

<https://doi.org/10.1080/03736245.2018.1541018>

Sibiya, S., Clifford-Holmes, J. K., & Gambiza, J. (2023). Drivers of degradation of croplands and abandoned lands: A case study of Macubeni communal land in the Eastern Cape, South Africa. *Land*, 12(3), 606. <https://doi.org/10.3390/land12030606>

Simon D., & Ramutsindela M. (2000). Political geographies of change in southern Africa In *The Geography of South Africa in a Changing World*. Cape Town: Oxford University Press. pp. 89-113

Swacha, G., Botta-Dukát, Z., Kački, Z., Pruchniewicz, D., & Zołnierz, L. (2018). The effect of abandonment on vegetation composition and soil properties in Molinion meadows (SW Poland). *PLoS ONE*, 13(5), 1–15.

Shackleton, C. M., Mograbi, P. J., Drimie, S., Fay, D., Hebinck, P., Hoffman, M. T., Maciejewski, K., & Twine, W. (2019). Deactivation of field cultivation in communal areas of South Africa: Patterns, drivers and socio-economic and ecological consequences. *Land Use Policy*, 82(October 2018), 686–699. <https://doi.org/10.1016/j.landusepol.2019.01.009>

Shackleton, R., Shackleton, C., Shackleton, S., & Gambiza, J. (2013). Deagrarianisation and Forest Revegetation in a Biodiversity Hotspot on the Wild Coast, South Africa. *PLoS ONE*, 8(10), 1–12. <https://doi.org/10.1371/journal.pone.0076939>

Statistics South Africa. (2022). *The South Africa I Know, The Home I Understand*. [online] Statssa.gov.za. Available at: <<https://www.statssa.gov.za/>> [Accessed 29 August 2022].

Smaliychuk, A., Müller, D., Prishchepov, A. v., Levers, C., Kruhlov, I., & Kuemmerle, T. (2016). Recultivation of abandoned agricultural lands in Ukraine: Patterns and drivers. *Global Environmental Change*, 38, 70–81. <https://doi.org/10.1016/j.gloenvcha.2016.02.009>

Tarolli, P., Preti, F., & Romano, N. (2014). Terraced landscapes: From an old best practice to a potential hazard for soil degradation due to land abandonment. *Anthropocene*, 6, 10–25. <https://doi.org/10.1016/j.ancene.2014.03.002>

Theron, S. N., Weepener, H. L., Le Roux, J. J., & Engelbrecht, C. J. (2021). Modelling potential climate change impacts on sediment yield in the Tsitsa River catchment, South Africa. *Water SA*, 47(1 January). <https://doi.org/10.17159/wsa/2021.v47.i1.9446>

Ustaoglu, E., & Collier, M. J. (2018). Farmland abandonment in Europe: An overview of drivers, consequences, and assessment of the sustainability implications. In *Environmental Reviews* (Vol. 26, Issue 4, pp. 396–416). Canadian Science Publishing.
<https://doi.org/10.1139/er-2018-0001>

van der Waal, B.B., Rowntree, K., Le Roux, J., Buckle, J., Biggs, H., Braack, M., Kawa, M., Wolff, M., Palmer, T., Sisitka, L., Powell, M., & Clark, R. (2018) *The Tsitsa Project: Integrated Restoration and Sustainable Land Management Plan; Working Together Adaptively to Manage and Restore Ecological Infrastructure for Improved Livelihoods and Futures*. rep., pp. 37–66.

van der Zanden, E. H., Verburg, P. H., Schulp, C. J. E., & Verkerk, P. J. (2017). Trade-offs of European agricultural abandonment. *Land Use Policy*, 62, 290–301. <https://doi.org/10.1016/j.landusepol.2017.01.003>

Van Oudtshoorn, F.P. (2012). *Guide to Grasses of Southern Africa*; Briza Publication: Pretoria, SouthAfrica.

Vetter, S. (2013). Development and Sustainable Management of Rangeland Commons – aligning policy with the realities of South Africa’s Rural Landscape. *African Journal of Range & Forage Science*, 30(1–2), 1–9. <https://doi.org/10.2989/10220119.2012.750628>

Wilcox, B. P. (2010). Ecohydrology Bearing - Invited Commentary Transformation ecosystem change and ecohydrology: ushering in a new era for watershed management. *Ecohydrology*, 130(February), 126–130. <https://doi.org/10.1002/eco>

Yu, B., & Lu, C. (2006). Change of cultivated land and its implications on food security in China. *Chinese Geographical Science*, 16(4), 299–305. <https://doi.org/10.1007/s11769-006-0299-4>

Za.geoview.info. (2022). *Hlankomo farmstead, Eastern Cape, South Africa*. [online] Available at: <<https://za.geoview.info/hlankomo,996335>> [Accessed 19 October 2022].

Za.geoview.info. (2022). *Lower Tsitsana populated place, Eastern Cape, South Africa*. [online] Available at: <https://za.geoview.info/lower_tsitsana,981651> [Accessed 19 October 2022].

Zhang, L., Wang, Z., E, S., Du, G., & Chen, Z. (2022). Analysis of climatic basis for the change of cultivated land area in Sanjiang Plain of China. *Frontiers in Earth Science*, *10*. doi:10.3389/feart.2022.862141

Zhou, T., Koomen, E., & Ke, X. (2020). Determinants of Farmland Abandonment on the Urban–Rural Fringe. *Environmental Management*, *65*(3), 369–384.
<https://doi.org/10.1007/s00267-020-01258-9>

APPENDIX A (INTERVIEW QUESTIONS)

The title of the study: Assessment of cultivated land abandonment: A case study of Lower Tsitsana and Hlankomo in the Tsitsa River catchment.

INTERVIEW QUESTIONS

Section 1: Demographical information

Gender	Female		Male	
Age	≤30	31-45	45-60	≥61
Number of people in the household				
Head of the household	Yes		No	
Level of education	Tertiary education	National senior certificate	Primary education	No education
Source of income	Salary/ wage	Government Grant	Livestock sales	Other
Number of years in the village				

Section 2: History of cultivation

Can you tell me the history of cultivation in this area? How were you cultivating? Who was working the land and how you were doing it?				
Do you own any abandoned cultivated land/ have you owned cultivated before?	Yes		No	
How big is/was your field in hectares/meters				
Are you still ploughing the fields?	Yes		No	
How much of your total field are you ploughing?				
Which crops are you or were you cultivating?				
When last did you plough?				
How long have you been ploughing?				
If not ploughing, how long in years have you stopped ploughing?				

Section 3: Drivers and Consequences of abandonment.

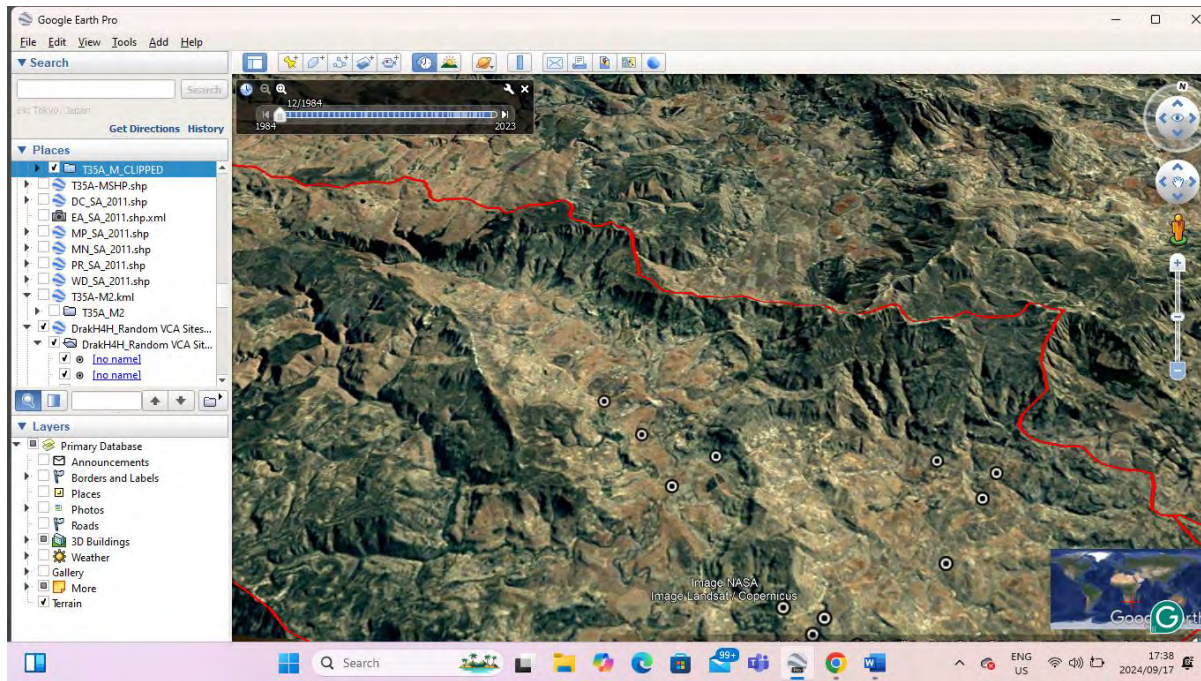
What are the reasons for your household stopping cultivation?				
What are some of the reasons have stopped cultivation?				
How do you get access to foods/ or things you used from the fields?				
How much do you spend on buying the things you used to plough?	300-600	600-900	900-1200	≥1200
How have your livelihoods changed since you have stopped cultivation?				
How has you and your family's lives changed since stopping cultivation?				
How has the abandoning of cultivated land changed the community?				
How is cultivating the land impacting your livelihoods?				
What are the benefits of cultivating the lands for you currently?				

Section 4: Future perspectives

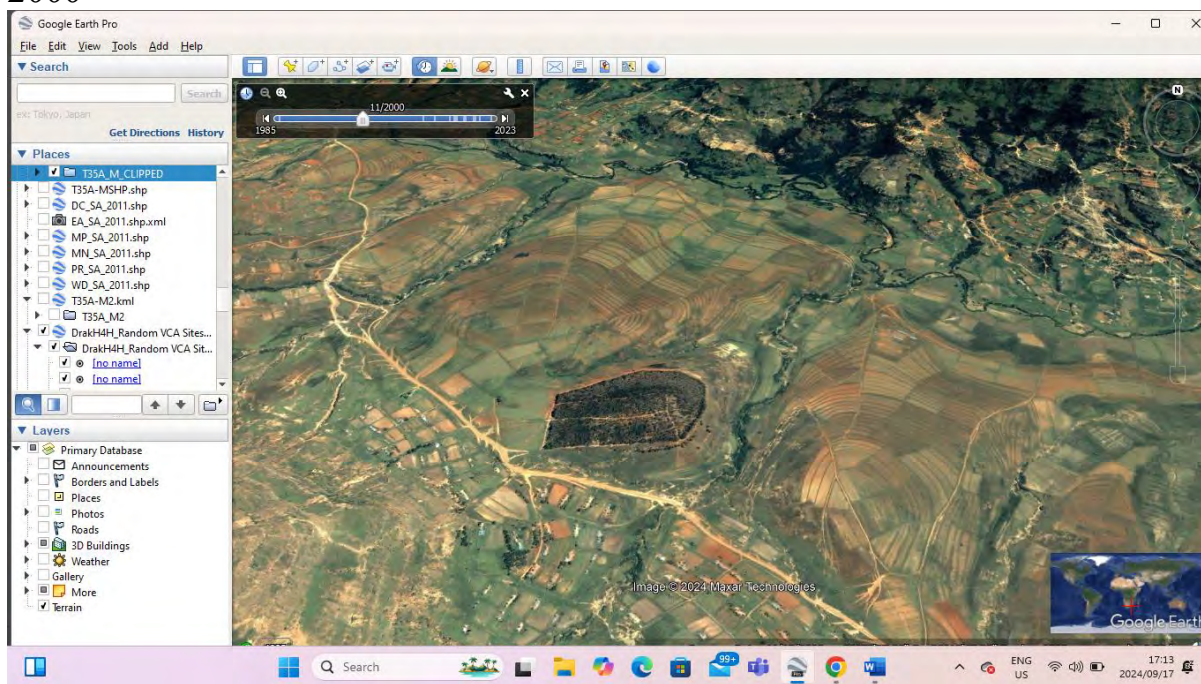
If you have abandoned your land, would you be interested in re-using the fields	Yes	No		
Why? Why not?				
If yes to the above, what would you use it for?				
If you would prefer to recultivate, which crops would you cultivate?				
How would recultivating help your household or the community at large?				
Have you considered other land-uses besides cultivation? If so, what have you considered?	Livestock grazing	Wildlife conservation	forestry	other
If other, specify				
How do you think these land-uses would contribute to your livelihoods?				
How would these land-uses contribute to your village?				

Annexure B (Google images from Google Earth Pro for the years (1985, 2003 and 2016).

1985



2000



2016

